

2015
CITY OF PHOENIX SUPPLEMENT
TO THE

2015 EDITION
MARICOPA ASSOCIATION
OF GOVERNMENTS
UNIFORM STANDARD
SPECIFICATIONS FOR PUBLIC
WORKS CONSTRUCTION



City of Phoenix



**2015 CITY OF PHOENIX SUPPLEMENT
TO THE
2015 EDITION MARICOPA ASSOCIATION OF GOVERNMENTS
UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION**

Binder Spine Insert, trim as necessary.

2015 Changes to the Supplements

New Specification Sections Supplemented:

Section 310 PLACEMENT AND CONSTRUCTION OF AGGREGATE BASE COURSE – Added Supplements for COMPACTION; and THICKNESS AND/OR PLASTICITY DEFICIENCY.

Section 324 PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) – Added Supplements for CONSTRUCTION METHODS.

Section 325 PLACEMENT AND CONSTRUCTION OF ASPHALT-RUBBER ASPHALT CONCRETE – Added Supplements for QUALITY CONTROL; ACCEPTANCE; and REFEREE.

Section 345 ADJUSTING FRAMES, VALVE BOXES, METER BOXES AND PULL BOXES – Added Supplement for complete Section.

Section 701 AGGREGATE – Added Supplements for RECLAIMED CONCRETE MATERIAL; and RECLAIMED ASPHALT MATERIAL.

Section 717 ASPHALT-RUBBER ASPHALT CONCRETE – Added Supplements for MATERIALS; and MIX DESIGN REQUIREMENT.

Section 736 NON-REINFORCED CONCRETE PIPE – Added Supplement to delete complete Section.

Section 740 POLYETHYLENE PIPE AND FITTINGS FOR STORM DRAIN, IRRIGATION AND SANITARY SEWER – Added Supplement to delete complete Section.

Section 742 PRECAST MANHOLES – Added Supplements for GENERAL; MATERIALS; MANHOLE PENETRATIONS; GASKETS; and LIFTING POINTS.

Section 744 ABS TRUSS PIPE AND FITTINGS – Added Supplement to delete complete Section.

Section 745 PVC SEWER PIPE AND FITTINGS – Added Supplement to delete complete Section.

Section 753 GALVANIZED PIPE AND FITTINGS – Added Supplement to delete complete Section.

Section 755 POLYETHYLENE PIPE FOR WATER DISTRIBUTION – Added Supplement to delete complete Section.

Section 775 BRICK AND CONCRETE MASONRY UNITS (BLOCK) – Added Supplement for BRICK.

Existing Supplemented Sections with major updates:

Section 321 PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT – Added Supplements for MIX DESIGN; PLACEMENT; ACCEPTANCE; and REFEREE.

Section 401 TRAFFIC CONTROL – Updated Supplement for complete Section.

Section 404 TRAFFIC SIGNALS – Updated Supplement for complete Section.

Section 610 WATERLINE CONSTRUCTION – Updated Supplements for CONSTRUCTION METHODS; CONNECTION TO EXISTING MAINS; and METER SERVICE CONNECTIONS.

Added Supplement for POLYETHYLENE CORROSION PROTECTION.

2015 Changes to the Supplements

Deleted Supplement for TESTING.

Section 611 WATER, SEWER AND STORM DRAIN TESTING – Added Supplements for HYDROSTATIC TESTING; DISINFECTING WATER MAINS; SEWER LINE TESTING; POST INSTALLATION INSPECTION OF NEW MAINLINE STORM DRAINS; and PAYMENT.

Section 615 SEWER LINE CONSTRUCTION – Added Supplements for MATERIALS; and MEASUREMENT AND PAYMENT.

Updated Supplements for TRENCHING; SEPARATION; JOINTING; SANITARY SEWER TAPS; and BACKFILLING.

Deleted Supplements for LAYING PIPE; TESTING; and MEASUREMENT AND PAYMENT.

Section 618 STORM DRAIN CONSTRUCTION WITH CONCRETE PIPE – Updated Supplements for DESCRIPTION; MATERIALS; CONSTRUCTION METHODS; MEASUREMENT; and PAYMENT.

Deleted Supplement for VIDEO INSPECTION OF NEW MAINLINE STORM DRAINS.

Section 620 CAST-IN-PLACE CONCRETE PIPE – Deleted Supplement for complete Section.

Added Supplements for GENERAL; MATERIALS; CONSTRUCTION METHODS; METHODS AND TESTS; and PAYMENTS.

Section 710 ASPHALT CONCRETE – Updated Supplement for complete Section.

Existing Supplemented Sections with minor changes:

Section 301 SUBGRADE PREPARATION – Updated the Supplement for RELATIVE COMPACTION.

Section 336 PAVEMENT MATCHING AND SURFACE REPLACEMENT – Updated the Supplement for MEASUREMENT.

Added Supplement for PAYMENT.

Section 340 CONCRETE CURB, GUTTER, SIDEWALK, DRIVEWAY AND ALLEY ENTRANCE – Added Supplements for CONSTRUCTION METHODS.

Section 343 EXPOSED AGGREGATE PAVING – Added Supplements for CONSTRUCTION PROCEDURE.

Updated Supplement for MEASUREMENT AND PAYMENT.

Section 350 REMOVALS OF EXISTING IMPROVEMENTS – Updated Supplements for CONSTRUCTION METHODS; and MISCELLANEOUS REMOVAL AND OTHER WORK.

Section 601 TRENCH EXCAVATING, BACKFILLING AND COMPACTION – Updated Supplement for complete Section.

Section 621 CORRUGATED METAL PIPE AND ARCHES – Updated Supplement for INSTALLATION.

Section 625 MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS – Updated Supplements for CONSTRUCTION METHODS.

Added Supplements for CONSTRUCTION METHODS.

2015 Changes to the Supplements

Section 626 CORROSION COATING OF SANITARY SEWER MANHOLES – Updated Supplement for complete Section.

Section 702 BASE MATERIALS – Updated Supplement for complete Section.

Section 735 REINFORCED CONCRETE PIPE – Updated Supplements for GENERAL; and MATERIALS.

Section 750 IRON WATER PIPE AND FITTINGS – Updated Supplement for JOINT REQUIREMENTS.

Section 757 SPRINKLER IRRIGATION SYSTEM – Updated Supplement for GENERAL; and PIPE AND FITTINGS.

Section 760 COATING CORRUGATED METAL PIPE AND ARCHES – Updated Supplements for MATERIALS; and BASE METAL, SOLDER AND FABRICATION.

This Page Reserve for Future Use

2015
CITY OF PHOENIX SUPPLEMENT
TO THE

2015 EDITION
MARICOPA ASSOCIATION
OF GOVERNMENTS
UNIFORM STANDARD
SPECIFICATIONS FOR PUBLIC
WORKS CONSTRUCTION



City of Phoenix

**2015 CITY OF PHOENIX SUPPLEMENT TO THE 2015 MAG
UNIFORM STANDARD, SPECIFICATIONS AND DETAILS FOR PUBLIC WORKS CONSTRUCTION**

The **2015 edition** of the City of Phoenix Supplement to the 2015 Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction is effective **July 1, 2015**. The **2015 edition** supersedes all previous editions.

All public works construction contracts advertised and all permits issued on or after **July 1, 2015** shall be governed by the **2015 edition**.

A copy of the **2015 edition** is available for review and download on the City of Phoenix Website at the following address:

<https://www.phoenix.gov/streets/reference-material/2015maguniformstd>

For more information, or a copy of this publication in an alternate format, contact Street Transportation Department at 602-262-6284 (Voice) and 602-256-4286 (TTY).

FOREWARD

Forward: Delete the FORWARD in its entirety and replace with the following:

The City of Phoenix Standard Specifications and Details for Public Works Construction (Specifications) provides an integrated document that utilizes a specific City adopted edition of the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction, and the corresponding adopted edition of the City of Phoenix Supplement, to provide a clear compilation of the information within a single document. In the interest of maintaining consistency of established procedures, standards, specifications, and other documents used, the City has elected to adopt a complete, specific, edition of the Specifications periodically. In the interest of promoting county-wide standardization to the greatest extent possible, the City has established a standing Specifications Committee to periodically develop each edition of the Specifications utilizing that year's Maricopa Association of Governments Uniform Standard Specifications for Public Works Construction and Standard Details as its basis. The Delegates to the Committee represent interested City departments, the consulting engineering community, the engineering contracting community, the home building community and the Design Advisory Board.

A complete, integrated Specifications, in continual review, with periodically issued editions, will enhance this document's usability by engineers, architects, contractors, inspectors and others. The integrated format will reduce misinterpretations, conflicting language, and provide improved clarity of the construction documents.

These Specifications are developed for public works construction within the City of Phoenix and include construction of improvements that will be owned and/or maintained by the City of Phoenix. These improvements may be located on City owned property, public right-of-way, public right-of-way easements, or any other type of easement dedicated to the City of Phoenix. These Specifications are not intended to supersede the City of Phoenix Construction Code, or any other applicable law, or ordinance.

The Specifications should be thoroughly reviewed by the professional engineers and architects in responsible charge prior to incorporating them into project plans and specifications. The Specifications are not a substitute for good engineering judgment. Unique conditions will arise that are outside of the scope of this document. Professional engineers and architects are required to use their judgment to develop special provisions to properly adjust the Specifications to best meet site-specific needs. Professional engineers and architects are required to provide professional services in accordance with the statutes of the State of Arizona and the rules of the Arizona State Board of Technical Registration. Not all specifications contained herein will apply to all projects.

The City of Phoenix Standard Specifications and Details for Public Works Construction (Specifications) are revised periodically to allow for current trends in the construction industry and to promote county-wide standardization to the greatest extent possible. For more information on the standing Specifications Committee, or the process for submitting a *Request for Change of the Specifications*, please contact:

City of Phoenix, Street Transportation Department
City Engineer
200 West Washington Street, 5th Floor
Phoenix, Arizona, 85003
(602) 262-6136

A copy of the currently adopted City of Phoenix Standard Specifications and Details for Public Works Construction is available for review and download on the City of Phoenix Website at the following address:

<https://www.phoenix.gov/streets/reference-material/2015maguniformstd>

Kini L.E. Knudson, P.E.
City Engineer

This Page Reserve for Future Use

TABLE OF CONTENTS

FORWARD

PART 100 - GENERAL CONDITIONS

101	ABBREVIATIONS AND DEFINITIONS	2
102	BIDDING REQUIREMENTS AND CONDITIONS	3
106	CONTROL OF MATERIALS	4
107	LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC	5
110	NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION	6

PART 200 - EARTHWORK

206	STRUCTURE EXCAVATION AND BACKFILL	8
-----	---	---

PART 300 - STREETS AND RELATED WORK

301	SUBGRADE PREPARATION	10
310	PLACEMENT AND CONSTRUCTION OF AGGREGATE BASE COURSE	11
312	CEMENT TREATED BASE	12
321	PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT	13
324	PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)	19
325	PLACEMENT AND CONSTRUCTION OF ASPHALT-RUBBER ASPHALT CONCRETE	20
329	TACK COAT	25
336	PAVEMENT MATCHING AND SURFACING REPLACEMENT	26
340	CONCRETE CURB, GUTTER, SIDEWALK, CURB RAMPS, DRIVEWAY AND ALLEY ENTRANCE AND ALLEY ENTRANCE	29
342	DECORATIVE PAVEMENT CONCRETE PAVING STONE	31
343	EXPOSED AGGREGATE PAVING	32
345	ADJUSTING FRAMES, COVERS, VALVE BOXES, METER BOXES AND PULL BOXES	33
350	REMOVAL OF EXISTING IMPROVEMENTS	37

PART 400 - RIGHT OF WAY AND TRAFFIC CONTROL

401	TRAFFIC CONTROL	42
404	TRAFFIC SIGNALS	51
424	PARKWAY GRADING	55
429	TRAILS	56
430	LANDSCAPING AND PLANTING	60
431	PALM TREE TRANSPLANTING	69
440	SPRINKLER IRRIGATION SYSTEM INSTALLATION	73

PART 500 - STRUCTURES

505	CONCRETE STRUCTURES	84
515	STEEL STRUCTURES	85
520	STEEL AND ALUMINUM HANDRAILS	86

TABLE OF CONTENTS

PART 600 - UNDERGROUND WORK FOR UTILITIES AND UNDERGROUND FACILITIES

601	<u>TRENCH EXCAVATING, BACKFILLING AND COMPACTION</u>	88
603	<u>INSTALLATION FOR HIGH DENSITY POLYETHYLENE PIPE</u>	95
604	<u>PLACEMENT OF CONTROLLED LOW STRENGTH MATERIAL</u>	96
610	<u>WATERLINE CONSTRUCTION</u>	97
611	<u>WATER, SEWER AND STORM DRAIN TESTING</u>	102
615	<u>SEWER LINE CONSTRUCTION</u>	106
618	<u>STORM DRAIN CONSTRUCTION WITH CONCRETE PIPE</u>	107
620	<u>CAST-IN-PLACE CONCRETE PIPE</u>	111
621	<u>CORRUGATED METAL PIPE AND ARCHES</u>	115
625	<u>MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS</u>	118
626	<u>CORROSION COATING OF SANITARY SEWER MANHOLES</u>	120
627	<u>PAINTING SANITARY SEWER MANHOLES WITH INSECTICIDE</u>	125
630	<u>TAPPING SLEEVES, VALVES AND VALVE BOXES ON WATER LINES</u>	120

PART 700 - MATERIALS

701	<u>AGGREGATE</u>	128
702	<u>BASE MATERIALS</u>	129
710	<u>ASPHALT CONCRETE</u>	131
717	<u>ASPHALT-RUBBER ASPHALT CONCRETE</u>	136
725	<u>PORTLAND CEMENT CONCRETE</u>	138
728	<u>CONTROLLED LOW STRENGTH MATERIAL</u>	139
735	<u>REINFORCED CONCRETE PIPE</u>	140
736	<u>NON-REINFORCED CONCRETE PIPE</u>	141
738	<u>HIGH DENSITY POLYETHYLENE PIPE & FITTINGS FOR STORM DRAIN AND SANITARY SEWER</u>	142
739	<u>STEEL REINFORCED POLYETHYLENE PIPE & FITTINGS FOR STORM DRAIN, IRRIGATION AND SANITARY SEWER</u>	145
740	<u>POLYETHYLENE PIPE AND FITTINGS FOR STORM DRAIN, IRRIGATION AND SANITARY SEWER</u>	148
741	<u>LINING FOR REINFORCED CONCRETE SANITARY SEWER PIPE</u>	149
742	<u>PRECAST MANHOLES</u>	154
744	<u>ABS TRUSS PIPE AND FITTINGS</u>	155
745	<u>PVC SEWER PIPE AND FITTINGS</u>	156
750	<u>IRON WATER PIPE AND FITTINGS</u>	157
752	<u>ASBESTOS-CEMENT WATER PIPE AND FITTINGS</u>	164
753	<u>GALVANIZED PIPE AND FITTINGS</u>	165
755	<u>POLYETHYLENE PIPE FOR WATER DISTRIBUTION</u>	166
756	<u>DRY BARREL FIRE HYDRANTS</u>	167
757	<u>SPRINKLER IRRIGATION SYSTEM</u>	168
758	<u>CONCRETE PRESSURE PIPE - STEEL CYLINDER TYPE</u>	171
760	<u>COATING CORRUGATED METAL PIPE AND ARCHES</u>	177
775	<u>BRICK AND CONCRETE MASONRY UNITS (BLOCKS)</u>	178
787	<u>GRAY IRON CASTING</u>	179
795	<u>LANDSCAPE MATERIAL</u>	180

PART 100
GENERAL CONDITIONS

SECTION 101

ABBREVIATIONS AND DEFINITIONS

Subsection 101.1 ABBREVIATIONS: Add the following to this subsection:

COP City of Phoenix

Subsection 101.2 DEFINITIONS AND TERMS: Delete the definition for “Haunching” in its entirety and replace with the following:

The material placed in a trench from the bottom of the pipe or conduit to the springline of the pipe or conduit.

Subsection 101.2 DEFINITIONS AND TERMS: Delete the definition for “Initial Backfill” in its entirety and replace with the following:

The material placed in a trench above the springline of the pipe or conduit and the bottom of the Final Backfill. The height above the crown of the pipe or conduit is dependent on the pipe material and the type of facility.

Subsection 101.2 DEFINITIONS AND TERMS: Delete the definition for “Superpave” in its entirety:

SECTION 102

BIDDING REQUIREMENTS AND CONDITIONS

Subsection 102.10 WITHDRAWAL OR REVISION OF PROPOSAL: Add the following paragraph to the end of this Subsection:

Pursuant to the provisions of Section 2-188 of the City Code, the low bidder may file a request to withdraw his or her bid with the City Clerk.

SECTION 106

CONTROL OF MATERIALS

Subsection 106.2 SAMPLES AND TESTS OF MATERIALS: Delete the third paragraph in its entirety and replace with the following:

The procedures and methods used to sample and test materials will be determined by the Engineer. Unless otherwise specified, samples and tests will be made in accordance with the following: The City of Phoenix Minimum Sampling Frequency Guide, The City of Phoenix Materials Testing Manual, and the standard methods of AASHTO or ASTM, which were in effect and published at the time of advertising for bids.

Subsection 106.5 STORAGE OF MATERIALS: Add the following paragraph to the end of this Subsection:

No placement or storage of construction materials or storage bins, trash bins or trash receptacles on final surface pavement of Arterial and Collector streets.

Subsection 106.7 UNACCEPTABLE MATERIALS: Add the following paragraphs to the end of this Subsection:

Materials containing asbestos and/or lead in any form are unacceptable to incorporate into the project unless formally accepted in writing by the City of Phoenix. This written approval shall take place prior to the material being incorporated into the project and/or brought to the site.

Repair kits or touch-up materials, materials that include asbestos and/or lead introduced into the product at the factory or applied at the assembly plant are all unacceptable. Any and all field-applied products that are comprised of asbestos and/or lead containing materials are also unacceptable.

If asbestos and/or lead are installed without written approval by the City of Phoenix, the Contractor will remove these materials at his expense and dispose of these materials in accordance with all state and federal laws and pay for the supervision and reporting costs in addition to the cost to properly remove them.

SECTION 107

LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

Subsection 107.5 SAFETY, HEALTH AND SANITATION PROVISIONS: Add the following Subsection:

107.5.3 Hoist Certification: Prior to the final acceptance (MAG Section 105), the Contractor shall schedule a hoist, crane acceptance inspection through the Engineer. This inspection and load test will be performed by an agency approved by the Engineer. This inspection and acceptance will not relieve the Contractor from his contractual responsibility nor from his warranty for this installation.

Subsection 107.6 PUBLIC CONVENIENCE AND SAFETY: Delete Subsection 107.6.1 Contractor's Marshalling Yard in its entirety:

Subsection 107.6 PUBLIC CONVENIENCE AND SAFETY: Delete Subsection 107.6.1.1 Contractor's Marshaling Yard when the Agency is the Contracting Party in its entirety:

Subsection 107.6 PUBLIC CONVENIENCE AND SAFETY: Add the following Subsection to this Subsection:

107.6.1 Contractor's Marshaling Yard: Contractors shall obtain approval of the City Engineer when using vacant property to park and service equipment and store material for use on City construction contracts.

- (A) The Contractor shall notify adjacent property owners/residents of this proposed use.
- (B) Any use of vacant property adjacent to or near the project for parking or servicing equipment and/or storing of material will require the Contractor to obtain written approval from the property owner. This approval shall contain any requirements which are a condition of this approval.
- (C) A copy of the property owner's approval shall be submitted along with the Contractor's request to the City Engineer for approval for the use of the marshaling yard in connection with the project. An appropriate distance from adjacent property will be set by the City Engineer on a case by case basis on the size and type of equipment to be used on the project.
- (D) The yard shall be fenced and adequately dust-proofed in a manner such as to preclude tracking of mud onto paved City streets.
- (E) Work in the yard shall be scheduled so as to comply with the City Noise Ordinance.
- (F) Equipment, materials, etc., shall be located so as to minimize impact on adjacent properties. A sound barrier may be required if deemed necessary by the City Engineer.
- (G) The Contractor shall clean up property promptly upon completion of use.

Subsection 107.6.1.2 Contractor's Marshaling Yard when the Agency is not the Contracting Party (Private Development, Utility Work, Subdivision Construction, Etc.): Delete the Subsection number and replace with the following:

107.6.2

Subsection 107.6 PUBLIC CONVENIENCE AND SAFETY: Delete Subsection 107.6.2 in its entirety:

Subsection 107.6 PUBLIC CONVENIENCE AND SAFETY: Add the following Subsection to this Subsection:

107.6.3 City Code Section 23-14 (h): The Contractor shall comply with the City Code concerning work hours and noise level during construction.

SECTION 110

NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION

Subsection 110.3.3 Process: Delete Subsection (B) Dispute Review Board/Arbitration in its entirety and replace with the following:

(B) Dispute Review Board: The decision of the Level III Representative in relation to the claim shall be final. The Contractor reserves the right to initiate litigation pursuant to Section 12-821 et. seg. of the Arizona Revised Statutes, or if mutually agreed upon, the parties may choose to resolve the controversy utilizing the Dispute Review Board as prescribed in subsection 110.4.

Subsection 110.3 ADMINISTRATIVE PROCESS FOR DISPUTE RESOLUTION: Delete Subsection 110.3.4 Amount of Dispute in its entirety.

SECTION 110 NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION: Subsection 110.4 ARBITRATION: Delete Subsection 110.4 ARBITRATION in its entirety.

SECTION 110 NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION: Add the following Subsection to this SECTION:

110.4 DISPUTE REVIEW BOARD:

If the Dispute Review Board is utilized as prescribed in Subsection 110.3.3(B), the Engineer shall be notified within thirty days after the Level III Representative decision. The Dispute Review Board is a three member board independent of the parties involved in the issue. The Agency and Contractor shall each select a member for this board. The third member shall be mutually agreed upon independent member. This Review Board must be selected within fourteen calendar days after notice to the Level III Representative. Each member shall agree to impartially serve the Agency and the Contractor. The Dispute Review Board shall meet within thirty days of the selection of the board, unless, by mutual agreement, another date is selected. The scope of the Dispute Review Board shall be restricted and limited to the matters originally presented to the Level III Representative for decision or determination and shall include no other matters. The Board shall consider and evaluate the dispute and render a written decision that assigns responsibilities and allocates adjustments in the contract time, if applicable, within seven calendar days after the meeting.

SECTION 110 NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION: Delete Subsection 110.5 DISPUTE REVIEW BOARD in its entirety.

Subsection 110.6 FINAL DOCUMENTATION AND PAYMENT: Delete the Subsection number and replace with the following:

110.5

PART 200
EARTHWORK

SECTION 206

STRUCTURE EXCAVATION AND BACKFILL

Subsection 206.1 DESCRIPTION: Delete the word “manholes” in the first sentence of the first paragraph.

Subsection 206.4.2 Structure Backfill for Earth Retaining Structures: Delete the word “concrete” from the first paragraph.

Subsection 206.4.2 Structure Backfill for Earth Retaining Structures: Delete subparagraph (A) in its entirety and replace with the following:

(A) Shall conform to the material and the gradation requirements for Select Material, Type A, Type B, or Aggregate Base Course in Table 702-1 unless otherwise approved by the Engineer.

Subsection 206.4.2 Structure Backfill for Earth Retaining Structures: Delete last paragraph in its entirety.

Subsection 206.4.4 Structure Backfill for Structures within Paved Areas: Delete this Subsection in its entirety and replace with the following:

Where a structure is located within an existing street, proposed street or paved area:

(A) Backfill within 2 feet of the surface shall be compacted to the minimum density specified in Section 601, for Type I compaction or shall be filled with controlled low strength material as specified in Sections 604 and 728.

(B) All other structure backfill shall be compacted to the minimum density specified in Section 601, for Type III compaction or shall be filled with controlled low strength material as specified in Sections 604 and 728.

PART 300
STREETS AND RELATED WORK

SUBGRADE PREPARATION

SECTION 310

PLACEMENT AND CONSTRUCTION OF AGGREGATE BASE COURSE

Subsection 310.3 COMPACTION: Delete the second paragraph in its entirety and replace with the following:

The laboratory maximum dry density and optimum moisture content for the aggregate base course material shall be determined in accordance with Arizona Test Method 225, method "A". Field 'one-point' maximum dry density and optimum moisture procedures shall only be allowed as a measure of quality control until a laboratory maximum dry density and optimum moisture content is provided.

Subsection 310.3 COMPACTION: Delete the first sentence of the fourth paragraph in its entirety and replace with the following:

A rock correction, to compensate for rock content larger than the #4 sieve, shall be performed in accordance with Arizona Test Method 227.

Subsection 310.3 COMPACTION: Delete the sixth paragraph in its entirety and replace with the following:

Unless otherwise noted in the project plans or project specifications, the moisture content of the aggregate base course at the time of compaction shall be the optimum moisture content +/- 2%.

Subsection 310.3 COMPACTION: Delete subparagraph (C) in its entirety and replace with the following:

(C) All other areas not subject to vehicular traffic 95%

Subsection 310.4 THICKNESS AND/OR PLASTICITY DEFICIENCY: Delete Type IV in Table 310-1 in its entirety and replace with the following:

IV	A plasticity index of 6 to 7 inclusive or gradation deficiency	(1) The Contractor may choose to reprocess or treat the existing material to bring it within specification limits or remove deficient material from affected area and replace with material complying with the specifications. (2) If grades allow, the Contractor may increase the thickness of asphalt concrete by ½-inch minimum at no additional cost to the Owner. The thickness must be approved by the Engineer prior to the placement of asphalt concrete.
----	--	---

SECTION 312

CEMENT TREATED BASE

Subsection 312.5 INVERTED SECTION: Delete this Subsection in its entirety and replace with the following:

Where the cement treated base is to be covered with an aggregate base material, the minimum thickness of the aggregate base shall be 5 inches, unless otherwise specified in the special provision. In order to provide for free internal drainage of the aggregate base course overlaying the cement treated material, it shall be ABC, reference Section 725. The cement treatment shall be held back approximately 1 foot from each curb line.

Subsection 312.6 CURING: Delete the first two paragraphs in their entirety:

Subsection 312.6 CURING: Delete the first sentence in the third paragraph entirely and replace with the following:

Keep the surface of the compacted cement treated base course continuously moist until overlaid with the aggregate base course.

SECTION 321

PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

Subsection 321.3 WEATHER AND MOISTURE CONDITIONS: Delete this Subsection in its entirety and replace with the following:

Asphalt concrete shall be placed only when the surface is dry. No asphalt concrete shall be placed when the weather is foggy or rainy, or when the base or sub base on which the material is to be placed is unstable. Asphalt concrete shall be placed only when the Engineer determines that weather conditions are suitable.

For any pavement courses two inches thick or greater the atmospheric temperature shall be a minimum of 40 degrees Fahrenheit and rising.

For all pavement surface courses less than two inches thick, the surface temperature on which the course is to be placed shall be a minimum of 50 degrees Fahrenheit and rising.

Subsection 321.5 MIX DESIGN: Delete the first three sentences of the first paragraph in their entirety and replace with the following:

Should a Contractor wish to utilize a City of Phoenix mix design from a non-approved source, the mix design(s) shall be submitted to the City of Phoenix Materials Lab 15 working days prior to the start of the project. Included with the mix design, the Contractor shall also submit the appropriate asphalt concrete for mix verification and laboratory calibrations as specified by the City of Phoenix Materials Lab. These samples will not include standard City of Phoenix mix designs approved through annual asphalt concrete supplier calibrations. Mix designs provided by the agency may be utilized on projects at the Engineer's discretion. The Engineer will review and approve the mix design to assure it contains all of the required information as outlined in Section 710.

Subsection 321.6 MIX PRODUCTION: Delete the last paragraph in its entirety and replace with the following:

The temperature of the asphalt concrete, upon discharge from the mixer shall be per Table 321-1.1. The discharge temperature may be increased on the recommendation of the binder supplier, when approved by the Engineer. If the asphalt concrete is discharged from the mixer into a hopper, the hopper shall be constructed so that segregation of the asphalt concrete will be minimized.

Subsection 321.6 MIX PRODUCTION: Add the following Table 321-2 to the end of this Subsection:

TABLE 321-1.1 Asphalt Concrete Mix Temperatures at Production Plant		
Type of Asphalt Mix	Minimum Temperature °F	Maximum Temperature °F
Conventional Asphalt Mix (1/2", 3/4" & 1 1/2")	285	325
Rubberized Asphalt Mix	290	350

Subsection 321.8.1 Placing: Add the following paragraphs after the third paragraph:

“Ski-type device or string line as described in (a) or (b) above shall be used as directed by the Engineer.”

In conditions where the curb and/or gutter is not even and true to grade, the Engineer may require the Contractor to use a ski-type device or string line as described in C above to establish the grade of the asphalt concrete surface adjacent to the curb or gutter.

Subsection 321.8.6 Asphalt Concrete Overlay: Add the following sentence to the first paragraph:

SECTION 321

Asphalt concrete mix aggregate gradation and percentage of asphalt binder shall be in accordance with Table 321-3 using a D1/2" Marshall High or Low Volume mix designation for overlays.

Subsection 321.10.1 Acceptance Criteria: Delete this Subsection in its entirety and replace with the following:

A City of Phoenix representative will be present at the asphalt supplier plant during production and will facilitate the inspections and sampling of the asphalt concrete. The sampling frequency for hot asphalt concrete at the asphalt plant shall be 1 sample per 350 tons, with a minimum of 1 sample per day, sampled randomly. In lieu of a City of Phoenix representative at the plant, asphalt concrete may be sampled at the same frequency taken from the project by a City of Phoenix designated representative or from the list of approved materials testing labs. The approved list is available through the City of Phoenix Materials Lab. The samples will be transported to the City of Phoenix Materials Lab or other designated laboratory for acceptance testing. All samples will be obtained according to the procedures of Arizona Test Method 104 or AASHTO T-168.

Each obtained sample will be taken to the City of Phoenix Materials Lab or other designated laboratories for acceptance testing. Each sample obtained for that day's production shall be tested for oil content utilizing a calibrated Nuclear Oil Content Gauge, according to AASHTO T287. If all the samples are within oil content tolerances, a random sample will be taken and further testing will be performed, this includes oil content with a calibrated ignition oven, gradation, marshall, maximum theoretical density, and air voids. However, if there is a sample outside of the tolerances for oil content, each specific failing Nuclear Oil Content sample will be tested. The selected sample(s) will be tested for oil content, utilizing an ignition oven, and gradation. Testing for marshall, maximum theoretical density, and air voids will be performed on each sample tested utilizing an ignition oven.

The required density shall be obtained using a rolling pattern established by the Contractor and approved by the Engineer. Compaction efforts should continue until the specific gravity of the compacted mixture is not less than 95.0% of the Marshall density, from the specimens composed of the same mixture, and compacted in the laboratory by the 75-blow method of AASHTO T-245.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

Subsection 321.10.2 Gradation, Binder Content and Air Voids: Delete this Subsection in its entirety, including Tables 321-3A, 321-3B, 321-4, and 321-5, and replace with the following:

The acceptance laboratory will take a sample of the asphalt concrete in accordance with the requirements of Section 2 or 4 of Arizona Test Methods 104 or AASHTO T-168. The minimum weight of the sample shall be of sufficient amount to provide enough material to meet all the testing requirements as determined by the Engineer. Asphalt binder content and gradation shall be determined in accordance with AASHTO T-308 using the ignition furnace. The acceptance laboratory is responsible for obtaining the necessary materials and performing an ignition furnace calibration as outlined in AASHTO T-308 for each asphalt concrete mixture utilized on the project. The correction factor used for each test shall be clearly indicated on the report. The bulk density for Marshall Mix designs shall be tested in accordance with AASHTO T-245. The bulk density for Gyratory mix designs shall be determined in accordance with AASHTO T312. The maximum theoretical density shall be determined in accordance with the requirements of AASHTO T-209. Effective voids of the laboratory compacted specimens will be determined at a minimum of once per day in accordance with the requirements of AASHTO T-269. Acceptance testing results will

SECTION 321

be furnished to those who request test results within five working days of receipt of samples by the acceptance laboratory.

During production, deviation from the specified mix design will not be allowed without prior approval from the City of Phoenix Materials Lab or their representatives.

TABLE 321-3						
ACCEPTANCE LIMITS FOR STANDARD COP MARSHALL MIX DESIGNS						
LOW AND HIGH VOLUME						
	A 1-1/2"		C3/4"		D 1/2"	
Sieve Size	Target	Tolerance	Target	Tolerance	Target	Tolerance
1 1/2"	100	---	100	---	100	---
1"	93	+/-7%	100	---	100	---
3/4"	90	+/-7%	95	88-100	97-100	---
1/2"	---	---	85	+/-7%	88	+/-7%
3/8"	63	+/-7%	75	+/-7%	78	+/-7%
No. 4	45	+/-7%	58	+/-7%	58	+/-7%
No. 8	35	+/-5%	44	+/-5%	45	+/-5%
No. 30	20	+/-5%	24	+/-5%	25	+/-5%
No. 200	5	+/-2%	4	+/-2%	5	+/-2%
	High Volume	Low Volume	High Volume	Low Volume	High Volume	Low Volume
Oil Content %	4.3 +/- .4	---	5.0 +/- .4	5.5 +/- .4	5.1 +/- .4	5.6 +/- .4
Air Voids % (Recommended)	5.0 +/- 1.0	---	4.5 +/- 1.0	4.0 +/- 1.0	4.5 +/- 1.0	4.0 +/- 1.0
Density (On Grade)	95% Minimum of 75-Blow Marshall Density (For All COP Mix Designs)					

If the results from a single acceptance sample fall outside of the acceptance limits in Table 321-3(Excluding Air Voids), a second sample shall be taken and if the second acceptance sample is also outside of the acceptance limits the Contractor shall cease production of asphalt concrete. Production shall not begin again until calibration test results verify that adjustments made to materials or proportions yield a gradation that falls within acceptance limits in Table 321.3.

If the asphalt binder content is within $\pm 0.40\%$ of the mix design target value, the asphalt concrete will be paid for at the contract unit price. If the asphalt binder content deviates by more than $\pm 0.40\%$ from the mix design target value, the deficient area will be evaluated by coring at maximum intervals of 50 feet of either side from the deficient sample. The asphalt content of the original deficient sample will be averaged with the asphalt binder content of the cores taken for re-evaluation to determine compliance with the acceptance requirements. If the resulting average of the asphalt binder content deviates by more than $\pm 0.40\%$ from the mix design target value, then Table 321-4 shall apply to the deficiency, if any. Additional cores may be required to define the limits of the deficient area, and shall not be used for re-evaluating acceptance.

SECTION 321

TABLE 321-4		
ASPHALT BINDER CONTENT PAYMENT REDUCTION (AC)		
Deviation from that permitted (Acceptance to the tenth of a percent)	When Contracting Agency is Owner: Payment Reduction (Percent dollar per ton asphalt concrete)	When Contracting Agency is Not Owner (Permit Work): Payment Reduction (Percent dollar per ton asphalt concrete) *See note Below
Over/Under 0.0 to 0.1%	10%	Extended Warranty for two years with posted bond for the value of the taper mill and overlay
Over/Under 0.1 to 0.2%	25%	Extended Warranty for five years with posted bond for the value of the taper mill and overlay
Over/Under 0.2%	Removal of Non-Compliant Lift	Removal of Non-Compliant Lift

*Additional permit and fee required for extended warranty.

If an agency or Engineer is purchasing asphalt concrete directly from a commercial material supplier, the agency or Engineer will use Section 321.10, and specifically Table 321-3 as applicable, and Table 321-4 from Section 321.10, when determining the acceptance of the asphalt concrete with the material supplier.

Subsection 321.10.4 Asphalt Pavement Thickness: Delete the first paragraph in its entirety and replace with the following:

The method of acceptance for pavement thickness will be determined by the Engineer at any time. Coring may be required at the request of the Engineer by accepted methods based on inspection practices. If the thickness is determined to deviate from the specified thickness by more than ¼ inch, four inch cores will be obtained, at random as determined by the Engineer, for verification of the deficiency. Such cores will be taken and measured by the Asphalt Concrete Coring Method. This method can be found at in Section 321.14. Each core location will be patched by the party responsible for the coring.

Subsection 321.10.4 Asphalt Pavement Thickness: Delete the last three sentences of subparagraph (2) in their entirety and replace with the following:

This corrective action will consist of application of a Type II Slurry Seal or Micro Seal coat, as determined by the Engineer. The Contractor may present proposed remedial measures in writing for the consideration of the Engineer. The Engineer will review and decide within 30 working days whether to accept the proposed remedial measures.

Subsection 321.10.4 Asphalt Pavement Thickness: Delete the last three sentences of subparagraph (3) in their entirety and replace with the following:

The Contractor may present other proposed remedial measures for the Engineer's consideration. The Engineer will review and decide within 30 working days whether to accept the proposed remedial measures. If the Engineer chooses to reject the proposed remedial measures, the indicated overlay will be constructed by the Contractor at no additional cost to the Owner.

Subsection 321.10.4 Asphalt Pavement Thickness: Delete the fourth paragraph in its entirety and replace with the following:

If the pavement thickness deficiency is greater than 0.25 inches, but less the 0.50 inches, Table 321-6 will apply.

SECTION 321

Subsection 321.10.4 Asphalt Pavement Thickness: Delete Table 321-6 in its entirety and replace with the following Table 321-6:

TABLE 321-6		
ASPHALT PAVEMENT THICKNESS PAYMENT REDUCTION		
For Thickness Deficiency of More Than 0.25 inches and less than 0.50 inches		
Specified Pavement Thickness	When Contracting Agency is Owner: Reduction in Payment	When Contracting Agency is Not Owner (Permitted Work): Reduction in Payment
		*See note below
2.00 inches to 2.49 inches	25%	Extended Warranty for two years with posted bond for the value of the taper mill and overlay
2.50 inches to 2.99 inches	33%	Extended Warranty for three years with posted bond for the value of the taper mill and overlay
3.00 inches and over	50%	Extended Warranty for five years with posted bond for the value of the taper mill and overlay

*Additional permit and fee required for extended warranty.

Subsection 321.10.5.1 Pavement 1-1/2 Inches or Less in Nominal Thickness: Delete this Subsection in its entirety, including Table 321-7, and replace with the following:

Achieving the required compaction is the responsibility of the Contractor. The number and types of rollers is the Contractor's responsibility and shall be sufficient to meet these requirements.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

Subsection 321.10.5.2 Pavement Greater than 1-1/2 Inches in Nominal Thickness: Delete this Subsection in its entirety, including Table 321-8, and replace with the following:

Achieving the required compaction is the responsibility of the Contractor. The number and types of rollers is the Contractor's responsibility and shall be sufficient to meet these requirements.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the

SECTION 321

deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

The Contractor will provide the traffic control to facilitate any coring operations necessary for compaction acceptance.

The Contractor shall repair all of the core holes using high strength, no shrink grout. Sample cores shall follow the procedures outlined in Section 321.14. The frequency of testing will be determined by the City of Phoenix Materials Lab current minimum testing schedule, maintained by the City of Phoenix Materials Lab and available upon request.

Table 321-8		
PAVEMENT DENSITY PAYMENT REDUCTION		
Deviation Below Specification	When Contracting Agency Owner: Reduction in Payment (Percent dollar per ton of asphalt concrete)	When Contracting Agency Not Owner (Permitted Work): *See note below
94.0% to 94.9%	15%	Extended Warranty for three years with posted bond for the value of the taper mill and overlay
93.0% to 93.9%	20%	Extended Warranty for five years with posted bond for the value of the taper mill and overlay
Below 93.0%	Removal of Non-Compliant Lift	Removal of Non-Compliant Lift

*Additional permit and fee required for extended warranty.

Subsection 321.10.6 Engineering Analysis (EA): Delete this Subsection in its entirety, including Table 321-9:

Subsection 321.11 REFEREE: Delete the first paragraph in its entirety and replace with the following:

In the event the Contractor elects to question the acceptance test results for either asphalt binder content, thickness and density or a combination thereof for a deficient sample, the Contractor may make a written request for additional testing of that deficiency. The Engineer will select an independent and accredited materials lab from the City of Phoenix Contract Lab and Approved Laboratory List (referee lab) to perform the additional testing. The Contractor will pay for the cost of all referee testing as a lump sum. Included with the set of samples, the appropriate calibration samples will also be submitted to the referee lab. Only one set of samples for referee testing will be considered for the deficient sample. The results of these determinations will be binding on both the Contractor and the agency.

Subsection 321.11 REFEREE: Delete “in place air voids” in the first sentence of the second paragraph and replace with the following:

density

SECTION 324

PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

Subsection 324.3.3 Subgrade and Base Preparation: Delete “of Section 601” in the first sentence of the first paragraph.

Subsection 324.3.3 Subgrade and Base Preparation: Delete “extraneous” in the first sentence of the first paragraph and replace with the following:

deleterious

SECTION 325

PLACEMENT AND CONSTRUCTION OF ASPHALT-RUBBER ASPHALT CONCRETE

Subsection 325.8 QUALITY CONTROL: Add the following paragraphs after the first paragraph:

During production of the ARAC, the Contractor shall sample and test the mineral aggregate every 500 tons, with a minimum of one sample per day and shall test a calibration cold feed sample prior to the start-up on the first day of production. A calibrated nuclear oil content gauge will be furnished by the Contractor and 1 sample will be tested for each 350 tons produced, with a minimum of once per day. If at any time the oil content falls outside of the specified range, further testing will be performed until satisfactory results are obtained. An asphalt content test using an ignition furnace will be required once per each 500 tons of ARAC produced. A Marshall, maximum theoretical density and air voids of the laboratory compacted specimens will be determined once per shift.

Viscosities will be performed on the asphalt rubber blend, either at the asphalt production plant or rubber-blend plant, by plant quality control personnel for each blend prior to delivery or introduction to the final product. All viscosities shall be performed with a City Of Phoenix Materials Lab representative present.

Subsection 325.9.1 Acceptance Criteria: Delete this Subsection in its entirety and replace with the following:

During production, deviation from the specified mix design will not be allowed without prior approval from the City of Phoenix Materials Lab or their representatives.

TABLE 325-1		
ACCEPTANCE LIMITS FOR CITY OF PHOENIX ARAC		
MARSHALL MIX DESIGNS		
LOW AND HIGH VOLUME		
Modified D 1/2" ARAC		
Sieve Size	Target	Tolerance
3/4"	100	+/-0%
1/2"	97-100	+/-0%
3/8"	85	+/-7%
No. 4	35	+/-7%
No. 8	18	+/-5%
No. 30	8	+/-5%
No. 200	4	+/-2%
	High Volume	Low Volume
Oil Content %	8.0+/- .4	8.5+/- .4
Air Voids % (Recommended)	5.0+/-1.0	3.5+/-1.0
Density (On Grade)	95% Minimum (For All COP Mix Designs)	

Subsection 325.9.2 Gradation and Binder Content: Delete the title of this Subsection in its entirety and replace with the following:

Sampling and Testing

Subsection 325.9.2 Gradation and Binder Content: Delete the first and second paragraphs in their entirety, including Table 325-1, and replace with the following:

A City of Phoenix Materials Lab representative will be present at the asphalt supplier plant during production and will facilitate the inspections and sampling of the ARAC. Sampling for hot ARAC at the asphalt plant shall be 1 sample per 350 tons, with a minimum of 1 sample per day, sampled randomly. In lieu of a City of Phoenix Materials Lab representative at the plant, ARAC shall be sampled on grade at a frequency of 1 sample per 350 tons, with a minimum of 1 sample per day, sampled randomly. Tests used to determine acceptance will be performed by the City

SECTION 325

of Phoenix Materials Lab or other lab designated by the Engineer. In either case the laboratory shall be accredited by the AASHTO Accreditation Program (AAP), for the tests being performed. Acceptance testing results will be furnished, by the City of Phoenix Materials Lab, to those who request test results within five working days of receipt of samples by the acceptance laboratory.

Each obtained sample will be taken to the City of Phoenix Materials Lab or other designated laboratories for acceptance testing. Each sample obtained for that day's production shall be tested for oil content utilizing a calibrated Nuclear Oil Content Gauge, according to AASHTO T287. If all the samples are within oil content tolerances, a random sample will be taken and further testing will be performed, this includes oil content with a calibrated ignition oven, gradation, Marshall, maximum theoretical density, and air voids. However, if there is a sample outside of the tolerances for oil content, each specific failing Nuclear Oil Content sample will be tested. The selected sample(s) will be tested for oil content, utilizing an ignition oven, and gradation. Testing for Marshall, maximum theoretical density, and air voids will be performed on each sample tested utilizing an ignition oven.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

Subsection 325.9.2.1 Plant Based Sampling and Testing: Delete the Subsection number and Subsection title of this Subsection:

Subsection 325.9.2.1.1 Mineral Aggregate Gradation: Delete the Subsection number and replace it with the following:

325.9.2.1

Subsection 325.9.2.1.1 Mineral Aggregate Gradation: Delete the first sentence of the first paragraph in its entirety and replace with the following:

For each shift of ARAC production, at least one sample of mineral aggregate will be taken.

Subsection 325.9.2.1.1 Mineral Aggregate Gradation: Delete the last sentence of the first paragraph in its entirety:

Subsection 325.9.2.1.2 Binder Content: Delete the Subsection number and replace it with the following:

325.9.2.2

Subsection 325.9.2.1.2 Binder Content: Delete this Subsection in its entirety and replace with the following:

During production of ARAC, the Contractor shall maintain at the plant site a nuclear asphalt content gauge calibrated and operated in accordance with Arizona Test Method 421. The Contractor will utilize the same calibration samples that are provided to the City of Phoenix Materials Lab prior to the start of production. The City of Phoenix Materials Lab will store the nuclear oil content gauge calibration samples until the completion of the project. These samples may be utilized for recalibration if needed. Under the observation of the City of Phoenix Materials Lab or designated representatives, the Contractor shall determine the ARB content by means of the nuclear asphalt content gauge for each 350 tons, sampled randomly. The City of Phoenix Materials Lab or designated representative shall determine the time that the samples are taken. The Contractor's technicians performing the testing, including the calibration of

SECTION 325

the nuclear gauge, shall meet the technician requirements given in the Arizona Department of Transportation (ADOT) System for the Evaluation of Testing Laboratories. The requirements may be obtained from ADOT Materials Group, 1221 North 21st Avenue, Phoenix, AZ 85009.

Production of ARAC shall cease immediately and the plant and/or the nuclear asphalt content gauges re-calibrated if any single test result varies by an amount greater than $\pm 0.40\%$, or the average of three consecutive test results varies by an amount greater than $\pm 0.40\%$, from the mix design target. Material that has already been produced may be used on the project if the single test value representative of that material varies by an amount from $\pm 0.40\%$ to $\pm 0.60\%$, inclusive, from the mix design target. Material that has already been produced may not be used on the project if the single test value representative of that material varies by an amount greater than $\pm 0.61\%$ from the mix design target unless, by retesting, the material is found to be acceptable.

Subsection 325.9.2.1.2 Binder Content: Add Table 325-2 to the end of this Subsection:

TABLE 325-2		
ASPHALT RUBBER BINDER CONTENT PAYMENT REDUCTION (ARAC)		
Deviation from that permitted (Acceptance to the tenth of a percent)	When Contracting Agency is Owner: Payment Reduction (Percent dollar per ton asphalt concrete)	When Contracting Agency is Not Owner (Permit Work): Payment Reduction (Percent dollar per ton asphalt concrete) *See note below
Over/Under 0.0 to 0.1%	10%	Extended Warranty for two years with posted bond for the value of the taper mill and overlay
Over/Under 0.1 to 0.2%	25%	Extended Warranty for five years with posted bond for the value of the taper mill and overlay
Over/Under 0.2%	Removal of Non-Compliant Lift	Removal of Non-Compliant Lift

*Additional permit and fee required for extended warranty

Subsection 325.9.2 Gradation and Binder Content: Delete Subsection 325.9.2.2 End Product Sampling and Testing in its entirety, including Table 325-2.

Subsection 325.9 ACCEPTANCE: Delete Subsection 325.9.3 Marshall Air Voids in its entirety, including Table 325-3.

Subsection 325.9 ACCEPTANCE: Delete Subsection 325.9.4 Requests for Referee Testing in its entirety.

Subsection 325.9.5 Density: Delete the Subsection number and replace with the following:

325.9.3

Subsection 325.9.5 Density: Add the following paragraphs after the first paragraph:

The required density shall be obtained using a rolling pattern established by the Contractor and approved by the Engineer. Compaction efforts should continue until the specific gravity of the compacted mixture is not less than 95.0% of the Marshall density, from the specimens composed of the same mixture, and compacted in the laboratory by the 75-blow method of AASHTO T-245.

SECTION 325

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

Subsection 325.9.5.1 Equipment: Delete the Subsection number and replace with the following:

325.9.3.1

Subsection 325.9.5.2 Compaction Procedures: Delete the Subsection number and replace with the following:

325.9.3.2

Subsection 325.9.5.2.1 Pavement Lift Thickness 1 1/2 Inches or Less: Delete the Subsection number and replace with the following:

325.9.3.2.1

Subsection 325.9.5.2.1 Pavement Lift Thickness 1 1/2 Inches or Less: Delete this Subsection in its entirety and replace with the following:

Achieving the required compaction is the responsibility of the Contractor. The number and types of rollers is the Contractor's responsibility and shall be sufficient to meet these requirements.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

Subsection 325.9.5.2.2 Pavement Lift Thickness Greater than 1 1/2 Inches: Delete the Subsection number and replace with the following:

325.9.3.2.2

Subsection 325.9.5.2.2 Pavement Lift Thickness Greater than 1 1/2 Inches: Delete this Subsection in its entirety and replace with the following:

Achieving the required compaction is the responsibility of the Contractor. The number and types of rollers is the Contractor's responsibility and shall be sufficient to meet these requirements. Initial breakdown rollers shall follow as closely behind the paving machine as practical. The roller(s) for final compaction shall follow as closely behind the initial breakdown as practical, such that a uniformly smooth surface is achieved.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A four inch core will be

SECTION 325

obtained at a minimum of 4 locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufactures procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

Table 325-3		
PAVEMENT DENSITY PAYMENT REDUCTION		
Deviation Below Specification	When Contracting Agency Owner: Reduction in Payment (Percent dollar per ton of asphalt concrete)	When Contracting Agency Not Owner (Permitted Work): *See note below
94.0% to 94.9%	15%	Extended Warranty for three years with posted bond for the value of the taper mill and overlay
93.0% to 93.9%	20%	Extended Warranty for five years with posted bond for the value of the taper mill and overlay
Below 93.0%	Removal of Non-Compliant Lift	Removal of Non-Compliant Lift

*Additional permit and fee required for extended warranty.

Subsection 325.9.5.3 Compacting Miscellaneous Items and Surfaces: Delete the Subsection number and replace with the following:

325.9.3.3

Subsection 325.9 ACCEPTANCE: Delete Subsection 325.9.6 Engineering Analysis (EA) in its entirety, including Table 325-4:

Subsection 325.10 REFEREE: Delete the first paragraph in its entirety and replace with the following:

In the event the Contractor elects to question the acceptance test results for either asphalt binder content, thickness and density or a combination thereof for a deficient sample, the Contractor may make a written request for additional testing of that deficiency. The Engineer will select an independent and accredited materials lab from the City of Phoenix Contract Lab and Approved Laboratory List (referee lab) to perform the additional testing. The Contractor will pay for the cost of all referee testing as a lump sum. Included with the set of samples, the appropriate calibration samples will also be submitted to the referee lab. Only one set of samples for referee testing will be considered for the deficient sample. The results of these determinations will be binding on both the Contractor and the agency.

SECTION 329

TACK COAT

Subsection 329.1 DESCRIPTION: Add the following sentence to the end of this Subsection:

Tack coat shall be Type SS-1h per Section 713.

SECTION 336

PAVEMENT MATCHING AND SURFACING REPLACEMENT

Subsection 336.2.3 Temporary Pavement Replacement: Delete this Subsection in its entirety and replace with the following:

Temporary pavement replacement as required in Section 601 may be made using cold mix asphalt concrete. The cold mix shall be MC-70 or MC-250 liquid asphalt (6.0 +/- 0.4 percent) combined with the aggregate gradation shown below. Paving asphalt AC 2.5 (5.5 percent) may be substituted for the liquid asphalt. AC 2.5 must be heated for mixing.

TABLE 336-1

SIEVE SIZE	% PASSING	TOLERANCE
3/4"	97-100	+/- 7%
1/2"	88	+/- 7%
3/8"	78	+/- 7%
#4	60	+/- 7%
#8	47	+/- 5%
#30	25	+/- 5%
#200	.5	+/- 2%

Temporary pavement shall be used in lieu of immediate placement of single course permanent replacement or the first course of two course pavement replacement only on transverse lines such as spur connections to inlets, driveways, road crossings, etc., when required by the Engineer, by utilities or others who subcontract their permanent pavement replacement, under special prior arrangement; or for emergency conditions where it may be required by the Engineer. Temporary pavement replacement shall be placed during the same shift in which the backfill to be covered is completed.

The cold mix shall be placed in two inch increments and compacted with a roller that has not less than 60 psi. contact pressure. Each layer shall be compacted to 96 percent of the laboratory compacted density for like materials. On small areas where the use of the equipment specified above is impractical, the Engineer will approve the use of small vibrating rollers or vibrating plate type compactors provided comparable compaction is obtained. The surface of the temporary pavement shall be flush with the adjacent pavement.

Subsection 336.2.4.2 Adjustments: Delete the first and second paragraphs in their entirety and replace with the following:

The Contractor shall be responsible for adjusting to grade all new and existing manholes, valves, survey monuments, clean outs, etc., as directed by the Engineer. The Contractor shall remove all asphalt material and aggregate from this or prior work from all metal lids and covers encountered using a method approved by the Engineer. Debris will not be allowed to enter sanitary or storm drains. All loose material shall be removed from the excavation site and the interiors of structures prior to resetting the frames.

The Contractor shall coordinate with the various utility companies regarding the adjustment and inspection of their facilities. Each utility company's specifications shall be adhered to during the adjustment. The Contractor shall be responsible for meeting any additional requirements of the utility companies.

Manhole frames shall be adjusted according to the MAG Standard Detail 422, except that the concrete collar shall extend up to the finished grade. Water valve, survey monument, and sewer clean out frames shall be adjusted in accordance with the COP Standard Details P1270 and P1391.

Subsection 336.3 TYPES AND LOCATIONS OF PAVEMENT AND SURFACING REPLACEMENT: Delete the title of this Subsection in its entirety and replace with the following:

TYPES AND LOCATION OF BACKFILL AND SURFACING REPLACEMENT

SECTION 336

Subsection 336.3 TYPES AND LOCATIONS OF PAVEMENT AND SURFACING REPLACEMENT: Delete this Subsection in its entirety and replace with the following:

Normally, the type of pavement replacement and backfill required for the trench excavation will be noted on the plans or specified in the special provisions and construction will be in accordance with COP Standard Detail P-1200.

- (A) Unless otherwise specified, the "T" top as shown in COP Standard Detail P-1200 will not be required within the City of Phoenix. If the project extends into another municipality/county the "T" top may be required for that portion of the project.
- (B) When the trench excavation is not being accomplished in conjunction with a paving project, the following final backfill and pavement replacement requirements apply:
 - (1) When the trench is transverse (45 to 90 degrees to street centerline) the final backfill material required by COP Standard Detail P-1200 for Type B shall be used. Permanent trench pavement replacement is required.
 - (2) When the trench is parallel or less than 45 degrees to the street centerline, the final backfill material required by COP Standard Detail P-1200 for Type A shall be used. Permanent trench pavement replacement is required.
 - (3) When the trench crosses a major street, collector street, or any other signalized intersection, the final backfill materials required by COP Standard Detail P-1200 for Type B shall be used. Permanent trench pavement replacement is required.
- (C) When the trench excavation is being accomplished in conjunction with a paving project the following final backfill and pavement replacement requirements apply:
 - (1) When the trench is transverse (45 to 90 degrees to street centerline) the final backfill material required by COP Standard Detail P-1200 for Type B will be used. Permanent pavement replacement is not required.
 - (2) When the trench is parallel or less than 45 degrees to the street centerline, the final backfill material required by COP Standard Detail P-1200 for Type A shall be used. Permanent trench pavement replacement is not required.
 - (3) When the trench crosses a major street, collector street, or any other signalized intersection, the final backfill material required by COP Standard Detail P-1200 for Type B shall be used. Permanent trench pavement replacement is not required.
 - (4) Temporary pavement replacement (Subsection 336.2.3) will be required at intersections for traffic control and at existing partial paved areas when the total pavement is not scheduled for immediate removal and replacement. In addition to the above, the Engineer may require temporary pavement at any area where public safety and welfare warrants. This will be a non-pay item considered incidental to the project.
 - (5) If the excavation extends beyond the limits of the paving project, the Contractor shall provide permanent trench pavement replacement in accordance with paragraph (B) for this extension.
- (D) When the trench excavation is made in Portland cement concrete pavement, COP Standard Detail P-1200 Type C final backfill and pavement replacement applies.
- (E) When the condition of the existing pavement does not justify the use of COP Standard Detail P-1200, Type A or Type B final backfill, Type D final backfill and pavement replacement shall apply. Written approval from the Engineer shall be required.

SECTION 336

- (F) When the trench excavation is made in ABC or decomposed granite pavement, COP Standard Detail P-1200 Type E final backfill and pavement replacement shall apply.
- (G) When the trench excavation is made in asphalt concrete pavement which has a soil cement base course, concrete treated base course or bituminous treated base course, the Contractor has the option of matching the existing pavement structure, including all courses, or replacing the pavement structure with equivalent full depth asphalt concrete pavement. For computing the equivalent asphalt concrete pavement required, 1 inch of asphalt concrete is equivalent to 3.25 inches of ABC or 1.4 inches of soil cement, cement treated base or bituminous treated base. After computations are completed, the equivalent depth will be rounded off to the next higher 1/2 inch, i.e., 6.15 inches computed would be rounded to 6.5 inches.

Subsection 336.4 MEASUREMENT: Delete the first paragraph in its entirety and replace with the following:

Measurement and payment for permanent pavement replacement will be by the square yard, for the thickness specified. In computing the pay quantity, the field measurement along the centerline of the trench and the trench pay width as listed in COP Supplement 601 shall be used. When the longitudinal trench is only partially in the pavement, adjustments in the pay width will be made by the Engineer.

There will be no separate measurement for pipe bedding, haunching, initial backfill, final backfill and compaction. The cost of the pipe bedding, haunching, initial backfill, final backfill and compaction shall be considered incidental to the cost of the pipe.

Unless otherwise included in a separate pay item in the proposal, removal of obstructions shown on the plans shall be considered incidental to the cost of the pipe.

There will be no separate measurement for subgrade preparation or asphalt pavement removal. Subgrade preparation and asphalt pavement removal shall be considered incidental to the cost of the permanent pavement and surface replacement.

Subsection 336.4 MEASUREMENT: Delete subparagraphs (A) and (B) in their entirety and replace with the following:

(A) In computing pay quantities for replacement Types A, B, C and E, pay widths will be based on the actual field measured width; however the boundaries of the measurement will not extend further than ½ the distance, either side, from the centerline of the pipe as depicted on Table [601-1](#), Maximum Width At Top of Pipe Greater Than O.D. of Barrel.

(B) In computing pay quantities for replacement Types B-“T” Top, and D, pay widths will be based on the actual field measured width, however the boundaries of the measurement will not extend further than ½ the distance plus 12 inches, either side, from the centerline of the pipe as depicted on Table [601-1](#), Maximum Width At Top of Pipe Greater Than O.D. of Barrel. In all cases, the minimum pay width for replacement Types B-“T” Top and D shall be 48 inches.

Subsection 336.5 PAYMENT: Add the following paragraphs after the first paragraph:

Payment for bedding, haunching, initial backfill, final backfill and compaction shall be included in the cost of the pipe.

Payment for removal of obstructions shown on the plans, and not otherwise included in a separate pay item in the proposal, shall be included in the cost of the pipe.

Payment for subgrade preparation and asphalt pavement removal shall be included in the cost of the permanent pavement and surface replacement

SECTION 340

CONCRETE CURB, GUTTER, SIDEWALK, CURB RAMPS, DRIVEWAY AND ALLEY ENTRANCE

Subsection 340.2 MATERIALS: Delete the first paragraph in its entirety and replace with the following:

Concrete class shall be as specified on the plans, special provisions, and standard details. Concrete shall conform to the requirements of Section 725.

Subsection 340.2.1 Detectable Warnings: Delete this Subsection in its entirety and replace with the following:

Truncated dome dimensions and spacing for detectable warnings are defined by the Americans with Disabilities Act Accessibilities Guidelines (ADAAG) and, upon its adoption, the Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG) for optimal detect-ability and public safety.

Detectable warnings shall consist of raised truncated domes aligned in a square grid pattern in conformity to the ADAAG and, upon its adoption, the PROWAG. Detectable warning edges shall be sized and installed so that dome spacing is maintained across adjoining edges. Each dome shall have a minimum static friction of coefficient of 0.8 as tested per ASTM C1028.

Subsection 340.2.1.3 Attachment System: Delete this Subsection in its entirety and replace with the following:

Detectable warning tiles shall be back buttered with an approved, commercial-source, 5000 psi non-metallic non-shrink grout, and wet-set in freshly placed concrete to assure complete and continuous contact of the detectable warning tile bottom surface with the concrete as it cures, thus rendering the ramp a single monolithic structure.

Repair and replacement of existing detectable warning tiles shall conform to a method recommended by the manufacturer and approved by the Engineer.

Subsection 340.3.4 Joints: Delete the last sentence in the fourth paragraph.

Subsection 340.3.4.1 Expansion Joints: Add the following to the end of the first sentence in the third paragraph:

, between intersecting sidewalks and at adjacent portland cement concrete slabs and driveways

Subsection 340.3.4.2 Contraction Joints: Delete this Subsection in its entirety and replace with the following:

Unless otherwise specified, the large aggregate in contraction joints shall be separated to either side of the joint for a minimum depth equal to 25% of the concrete thickness; the minimum finished depth of contraction joints shall be 3/4 inch.

Unless an expansion joint is required, a contraction joint shall coincide with each form joint.

Sidewalk score marks shall not exceed 1/2 inch width, be at least 1/2 inch deep and shall be placed midway between contraction joints.

Subsection 340.5 MEASUREMENT: Delete the fourth paragraph in its entirety and replace with the following:

Detectable warnings shall be measured by the square foot.

Subsection 340.5 MEASUREMENT: Delete the last sentence in the fifth paragraph and replace with the following:

The surface area of the curb ramps shall be included in the measured quantity for sidewalk.

Subsection 340.6 PAYMENT: Delete this Subsection in its entirety and replace with the following:

SECTION 340

Payment for the above named items will be made at the unit price bid in the proposal. Such payment shall include full compensation for the necessary removal of asphalt pavement, subgrade preparation and for furnishing all labor, material, tools and equipment and accomplishing all work in conformance with the contract documents.

Payment for detectable warnings will be made at the unit price bid in the proposal for detectable warning strip. Such payment shall include full compensation for furnishing all labor, material, tools and equipment and accomplishing all work in conformance with the contract documents.

SECTION 342

DECORATIVE PAVEMENT CONCRETE PAVING STONE

Subsection 342.3.2 Aggregate Base Course: Delete this Subsection in its entirety and replace with the following:

The base course for decorative pavement shall consist of CLSM of a thickness specified in the plans or special provisions. 1-Sack CLSM shall be installed over subgrade soil compacted to a minimum of 95% density. The surface elevation of the CLSM shall be set to bring the 1-inch sand laying course, plus the thickness of the paving stones or bricks to the desired finished elevation of decorative pavement. The surface of the 1-Sack CLSM shall not vary more than +1/8 inch in 10 feet.

Subsection 342.4 MEASUREMENT AND PAYMENT: Delete this Subsection in its entirety and replace with the following:

Measurement for deco pavement shall be by the square foot. Payment for deco pavement shall be made at the unit bid price per square foot including subgrade preparation, 1-Sack CLSM, and sand base. This payment shall be full compensation for all labor, materials, tools and equipment required to complete the work.

SECTION 343

EXPOSED AGGREGATE PAVING

Subsection 343.3 CONSTRUCTION PROCEDURE: Add the following paragraph after the first paragraph:

Unless specified otherwise, the exposed aggregate may be seeded onto the surface of the finished slab and worked into the slab, or the exposed aggregate may be integral with the concrete mix.

Subsection 343.3 CONSTRUCTION PROCEDURE: Delete the second paragraph and replace with the following:

If the exposed aggregate is to be seeded, the slab surface shall be screeded and darbied; the aggregate placed onto the surface to the desired pattern; and the surface reworked to embed the aggregate into the slab and bring the cement paste over the aggregate. Cement paste shall completely surround the aggregate, leaving no holes or voids.

Subsection 343.3 CONSTRUCTION PROCEDURE: Delete the first sentence of the third paragraph and replace with the following:

A non-staining surface retarder shall be applied per the manufacturer's recommendations to provide an aggregate exposure of approximately 1/8".

Subsection 343.3 CONSTRUCTION PROCEDURE: Add the following paragraph to the end of this Subsection:

The Contractor shall utilize a method that will collect and contain the waste water, and shall properly dispose the waste water and concrete by-products generated by exposing the aggregate. The Contractor shall submit the proposed method in writing to the Engineer for review prior to start of the exposed aggregate paving.

Subsection 343.4 MEASUREMENT AND PAYMENT: Delete this Subsection in its entirety and replace with the following:

Measurement will be by the square foot. Payment will be made at the unit bid price in the proposal. This price shall include subgrade preparation, construction and disposal of the sample panel, waste water collection and disposal, concrete by-product collection and disposal and be full compensation for all labor, material, tools, and equipment required to complete the work.

SECTION 345

ADJUSTING FRAMES, COVERS, VALVE BOXES, METER BOXES AND PULL BOXES

Delete the title of this SECTION in its entirety and replace with the following:

ADJUSTING MANHOLE FRAMES AND UTILITY BOXES

Delete SECTION 345 in its entirety and replace with the following:

345.1 GENERAL:

This specification covers the work required to adjust manhole frames and utility boxes to established grades including new and existing sewer manholes, storm drain manholes, other utility manholes, valve boxes, survey monument boxes, cleanout boxes, meter boxes and other utility boxes.

The Contractor shall furnish all labor, materials, and equipment necessary to adjust all frames and boxes as indicated on the plans or as designated by the Engineer.

The Contractor may elect to remove old frames, covers, and boxes and then install new frames and/or boxes in accordance with standard detail drawings at no additional cost to the Contracting Agency.

The Contractor shall be responsible for maintaining an accurate description and location of all items to be adjusted. The locations shall be referenced with map documentation by the use of swing ties or GPS locations. This information shall be supplied to the Engineer and utility owner(s) prior to taking any action that would hide or restrict access to the items to be adjusted.

Missing or defective frames, covers and boxes shall be reported to the Engineer in writing during the initial locating process to allow for timely replacement. The Engineer shall furnish replacements for missing or defective items, reported by the Contractor, at no cost. Replacements for missing or defective items not reported to the Engineer during the initial locating process shall be furnished by the Contractor at no additional cost to the Contracting Agency.

The Contractor shall submit a written adjustment plan and schedule to the Engineer for approval prior to commencing the work. The adjustment plan will specify the locations of the adjustments to be completed each day and specify the expected timeframes for the work.

The Contractor shall submit a written method for cleaning manhole covers and box lids to the Engineer for approval prior to commencing the work. Cleaning shall be completed prior to starting the adjustment work.

Adjustment of existing manhole frames and existing utility boxes within asphalt concrete paved areas shall commence AFTER the placement of the asphalt concrete pavement surface course.

Adjustment of new manhole frames and new utility boxes within asphalt concrete paved areas shall commence AFTER the placement of the asphalt concrete pavement surface course, slurry seal materials and/or microsurfacing materials.

The Contractor shall attempt to locate all unexposed water valve boxes within the project's limits shown on the quarter section maps and shall excavate to a maximum depth of 18 inches in the attempt. Unexposed water valve boxes found, shall be adjusted to grade. Excavations for water valve boxes not found shall be backfilled and compacted with base material conforming to Section 702.

345.1.1 Quarter Section Maps for Water and Sewer Lines: For City projects, the Contractor may obtain up to three sets of water line and sewer line quarter section maps for the project area, at no cost, after the contract is awarded and issued. The Contractor shall bring proof of contract award and a signed Service Request Form (SERF). For permit projects, the Contractor may purchase sets of water line and sewer line quarter section maps for the project area. Maps can be obtained from the Water Services Department Infrastructure Record Services counter on the 8th floor of City Hall, 200 West Washington Street.

SECTION 345

345.1.2 Water Valve As-Built Drawings: Upon completion of the water valve box adjustments, the Contractor shall provide one complete, accurate and clearly legible set of marked-up as-built waterline quarter section maps to the Engineer. The Contractor shall mark the set with symbols consistent to those that appear on the quarter section maps. The Contractor shall color code all water valves on the maps as follows:

- Blue - All valves shown on the Q.S. map found and adjusted.
- Yellow - All valves shown on the Q.S. map but not found in the field.
- Red - All valves not shown on the Q.S. maps but discovered in the field and adjusted. (Draw the valve symbol at the appropriate location on the map and provide the offset and location dimensions for these valves.)

345.2 LOWERING PROCEDURE:

If required, manholes and boxes located within the paved areas to be milled or reconstructed shall be lowered to an elevation that will allow required work to be accomplished without damaging these facilities. Care shall be taken to prevent entrance of any debris into these facilities.

All manhole frames, boxes and related items removed by the Contractor during the lowering process shall be maintained in a secure area, and the Contractor shall bear full responsibility for the material. Sewer manhole frames and covers shall be matched, kept together, and replaced onto their original manholes. Any hardware items lost or damaged by the Contractor shall be replaced in kind, at no additional cost to the Contracting Agency.

Preparation for Milling: Compacted asphalt concrete shall be temporarily placed over the steel plate, filling the excavated area. Excavated areas that will be subjected to traffic prior to placement of the Portland cement concrete collar ring shall be temporarily filled with Type D-1/2 asphalt concrete pavement and roller-compacted flush with the adjacent pavement. No separate measurement or payment shall be made for furnishing, placing and removing the temporary Type D-1/2 asphalt concrete pavement and the cost shall be incidental to the adjustment.

345.3 ADJUSTING MANHOLE FRAMES:

Manhole frames shall be adjusted to the elevations indicated on the plans, or established by the Engineer.

The Contractor shall loosen manhole frames in such a manner that existing facilities will not be disturbed or damaged. Debris shields shall be used to prevent debris from entering sanitary sewers or storm drains. All loose material and debris shall be removed from the excavation and the interiors of structures prior to resetting frames. If dirt or debris enters the sewer system the Contractor shall be responsible for cleaning the sewer system for a minimum of one reach (the next downstream structure from the contamination point.)

Frames shall be set to match finished grade or the elevations and slopes established by the Engineer. Manhole frames shall be firmly blocked and grouted (or mortared) in place with masonry or metal supports per MAG Standard Detail 422. Spaces between the frame and the facility shall be sealed to prevent any concrete from entering the manhole. A Portland cement concrete collar shall be placed around the frame at the required elevation and slope.

Adjustments of 24 inches or more shall require a top-of-manhole rebuild. For existing precast concrete manholes, the cone shall be removed, the manhole shaft extended with the necessary precast concrete manhole sections and the existing precast concrete cone re-installed. The Engineer shall review the condition of each exposed precast concrete cone and approve its reuse. Existing brick manholes shall be reconstructed with brick as necessary.

Existing sanitary sewer manholes adjusted to grade shall have corrosion coating or liner applied to the new portion to match the existing corrosion system in the manhole. No separate measurement or payment shall be made for the corrosion coating or liner and the cost shall be incidental to the adjustment.

SECTION 345

Existing sanitary sewer manholes adjusted to grade shall be painted with insecticide, on the new portion, when applicable per Section 627. No separate measurement or payment shall be made for painting with insecticide and the cost shall be incidental to the adjustment.

All areas of pavement removed for adjustments that will be subjected to traffic prior to placement of the Portland cement concrete collar ring shall be temporarily filled with Type D-1/2 asphalt concrete pavement and roller-compacted flush with the adjacent pavement. No separate measurement or payment shall be made for furnishing, placing and removing the temporary Type D-1/2 asphalt concrete pavement and the cost shall be incidental to the adjustment.

345.4 ADJUSTING BOXES:

Boxes shall be adjusted to the elevations indicated on the plans, or established by the Engineer.

Boxes shall be adjusted per COP Standard Detail P1270. The top of the valve riser pipe shall be extended or shortened to conform to the dimension in COP Standard Detail P1270.

All areas of pavement removed for adjustments that will be subjected to traffic prior to placement of the Portland cement concrete collar ring shall be temporarily filled with Type D-1/2 asphalt concrete pavement and roller-compacted flush with the adjacent pavement. No separate measurement or payment shall be made for furnishing, placing and removing the temporary Type D-1/2 asphalt concrete pavement and the cost shall be incidental to the adjustment.

A debris cap with locating coil shall be installed in water valve boxes adjusted to grade in conformance with COP Standard Detail P1165. Prior to installation of the debris cap, valve risers shall be thoroughly cleaned to fully expose the operating nut. Undamaged existing debris caps with locating coils may be reinstalled. For permit projects, the Contractor shall furnish and install debris caps with locating coils. For City projects, the Contractor shall install City furnished debris caps with locating coils.

345.5 PORTLAND CEMENT CONCRETE COLLARS:

The Portland cement concrete collar around the frame or box shall be circular, and shall be a minimum of eight (8) inches thick, placed flush with the adjacent new pavement surface per COP Standard Detail P1270 and MAG Standard Detail 422. Concrete shall be a minimum of Class AA. All concrete shall be obtained from plants approved by the Engineer.

A single No. 4 rebar hoop shall be placed in each concrete collar. The hoop diameter shall be such that its placement is centered between the edge of the manhole frame or valve box, and the outer edge of the concrete collar, the depth of the hoop shall be centered in the thickness of the collar. Each concrete ring shall be scored radially at quarter-circle points. Score lines shall be ¼ -inch wide by ½ - inch deep. The concrete collar surface shall be medium broom finished.

Traffic shall not be allowed on the concrete collars until the concrete had reached a minimum compressive strength of 2500 psi on residential and 3000 psi on collector and major streets. On major streets the Contractor shall use "high-early" in the concrete mix, approved by the Engineer, to minimize delay in reopening the street(s) to traffic.

345.6 MEASUREMENT:

The quantities measured will be the actual number of existing frames adjusted and accepted.

The quantities measured will be the actual number of existing boxes of each type adjusted and accepted.

The quantities measured will be the actual number of attempts made to locate water valve boxes that are ultimately not found.

The quantities measured for rebuilding manhole tops will be the actual number of existing manhole tops rebuilt regardless of the utility served or the type of manhole construction.

SECTION 345

No separate measurement will be made for adjusting frames of new manholes, adjusting new boxes or for adjusting frames of manholes requiring the rebuilding of the manhole top.

345.7 PAYMENT:

Payment for adjusting existing frames will be made at the contract unit price for each. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work.

Payment for adjusting existing boxes will be made at the contract unit price for each type. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work.

Payment for attempts to locate water valve boxes that are ultimately not found shall be made at the contingent contract unit price. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work, including excavation, backfill, compaction and permanent surface replacement.

Payment for top-of-manhole rebuilds will be made at the contract unit price for each. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work, including adjusting the frame to grade.

No separate payment will be made for adjusting frames of new manholes, or adjusting new boxes. The cost shall be considered incidental to the respective new manhole or box and shall be included in the contract unit price for the new manhole or box.

SECTION 350

REMOVAL OF EXISTING IMPROVEMENTS

Subsection 350.2 CONSTRUCTION METHODS: Delete the title of this Subsection in its entirety and replace with the following:

REMOVALS

Subsection 350.2.1 Utilities: Delete the title of this Subsection in its entirety and replace with the following:

General

Subsection 350.2.1 Utilities: Delete this Subsection in its entirety and replace with the following:

The removal of existing improvements shall be conducted in such a manner as not to injure active utilities or any portion of the improvement that is to remain in place.

Unless otherwise designated on the plans, sidewalks shall be removed to a distance required to maintain a 5% (1:20) maximum running slope for the replaced portion of sidewalk. All driveways shall be removed to a distance designated on the plans or as required by standard details.

Plans shall specify existing sidewalk removals for a distance that would provide a 5% (1:20) maximum running slope for the replaced portion of sidewalk unless the site's grade at that location makes it impractical to provide. All driveways shall be removed to a distance designated on the plans or as required by standard details.

Portland cement concrete pavements, driveways, driveway entrances, curbs and gutters and sidewalks designated on the plans for removal, or as necessary for other work, shall be saw-cut at specified match lines or the nearest existing construction joint, and removed.

Removal of trees, stumps, roots, rubbish, and other objectionable materials in the right-of-way shall be done in accordance with Section 201 or as a miscellaneous removal item when not included otherwise in the proposal.

The Engineer shall be notified when utilities are encountered that are not shown on the plans.

Subsection 350.2.2 Others: Delete the title of this Subsection in its entirety and replace with the following:

Disposal of Surplus Materials

Subsection 350.2.2 Others: Delete this Subsection in its entirety and replace with the following:

350.2.2.1 Inert Materials: Surplus and/or waste material not containing asbestos or lead may be incorporated into the project when permitted by the construction documents and the Engineer.

The location for off-site disposal shall be at the Contractor's option, subject to the following conditions:

1. When the City landfills are used, the Contractor shall pay the normal fee.
2. When private property within the City of Phoenix City Limits is used, the Contractor shall obtain written agreement from the property owner and submit a copy of the agreement to the Engineer prior to hauling and dumping. If the property is not a licensed disposal facility, the agreement shall specifically state that the property owner accepting the material shall be responsible for the cost and maintenance of all air quality and storm water requirements as may be necessary by laws and ordinances. All disposal and grading shall be in strict conformance with the City of Phoenix Grading and Drainage Ordinance and all other applicable regulations, laws and ordinances. The Contractor shall obtain and pay for the necessary permits. The Contracting Agency is hereby held harmless by the Contractor of all liability when private property is used for disposal.

SECTION 350

3. When private property outside the City of Phoenix City Limits is used, the Contractor shall obtain written agreement from the property owner and submit a copy of the agreement to the Engineer prior to hauling and dumping. If the property is not a licensed disposal facility, the agreement shall specifically state that the property owner accepting the material shall be responsible for the cost and maintenance of all air quality and storm water requirements as may be necessary by laws and ordinances. All disposal and grading shall be in strict conformance with the jurisdiction's laws and ordinances and all other applicable regulations, laws and ordinances. The Contractor shall obtain and pay for the necessary permits. The Contracting Agency is hereby held harmless by the Contractor of all liability when private property is used for disposal.

No separate measurement or payment will be made for hauling and disposal. The cost shall be incidental to the work in the proposal.

350.2.2.2 Non-Inert Materials: Surplus and/or waste material containing asbestos and/or lead in any form shall not be incorporated into the project unless formally accepted in writing by the Engineer prior to its incorporation.

Disposal of materials containing asbestos and/or lead shall be in conformance with all regulations, laws and ordinances.

No separate measurement or payment will be made for hauling and disposal of material containing asbestos and/or lead. The cost shall be incidental to the work in the proposal.

Subsection 350.2.3 Backfill and Disposal: Delete the title of this Subsection in its entirety and replace with the following:

Removal of Pipe

Subsection 350.2.3 Backfill and Disposal: Delete this Subsection in its entirety and replace with the following:

Pipe designated on the plans for removal shall include excavation; removal and disposal of paving, obstructions and encasement; removal, preparation and proper disposal of pipe and debris; and backfill and compaction per Section 336 and Section 601. Measurement and payment shall be by the linear foot.

Subsection 350.2 CONSTRUCTION METHODS: Add the following Subsections:

350.2.4 Removal of Structures:

Structures designated on the plans for removal shall include the removal of irrigation structures and any other structures noted on the plans and not included otherwise in the proposal. Removal of structures shall include excavation; removal and disposal of paving, obstructions and controlled low strength material fill; removal, preparation and proper disposal of the structure and debris; and backfill and compaction per Section 336 and Section 601. Measurement and payment shall be by the lump sum.

350.2.5 Removal of Structural Concrete:

Structural concrete designated on the plans for removal shall include the removal of sidewalk scuppers and any other reinforced concrete and masonry noted on the plans and not included otherwise in the proposal. Removal of structural concrete shall include excavation; removal and disposal of paving, obstructions and controlled low strength material fill; removal, preparation and proper disposal of the structural concrete and debris; and backfill and compaction per Section 336 and Section 601.

Measurement and payment shall be by the cubic yard of structural concrete removed.

SECTION 350

350.2.6 Removal of Asphalt Outside of the Roadway Prism:

Roadway prism is defined as the area within a roadway between the lip-of-gutter and the opposing lip-of-gutter or edge of pavement where gutters are not present.

Asphalt removal, in areas to be covered by new sidewalk, driveway, driveway entrance, curb and gutter and other improvements that include subgrade preparation, shall be incidental to those improvements. Other asphalt areas shall be included as miscellaneous removal, except where otherwise specified as incidental to an item by its specifications.

350.2.7 Removal, Salvage and Disposal of Street Lights:

Street lights designated on the plans for removal shall include the removal of the light pole, arm and luminaire; removal and disposal of the junction box and conduit; removal and proper disposal of landscaping, paving, obstructions, concrete or other foundation fill material; necessary excavation; removal and proper disposal of concrete, or other foundation material, attached to the street light; proper disposal of other debris; backfill and compaction; and any restoration necessary and not included otherwise in the proposal with other work.

Payment shall be made for each light pole removed.

350.2.8 Abandonment and Removal of Utilities:

The removal of existing improvements shall be conducted in such a manner as not to injure active utilities or any portion of the improvement that is to remain in place.

A utility may be abandoned in place below a new major structure that is part of the work only if approved by the City and solidly filled with approved grout using methods approved by the City. All abandoned utilities to remain and the approved abandonment method shall be noted on the record drawings.

Utilities to be removed by the Contractor shall be disconnected and taken out in accordance with the requirements of the utility owner to the limits shown on the plans. Utility removal shall not be performed until a release has been obtained from the utility stating that their respective service connection and appurtenant equipment have been disconnected, removed or sealed and plugged in a safe manner.

The Engineer shall be notified when utilities are encountered that are not shown on the plans.

Subsection 350.3 MISCELLANEOUS REMOVAL AND OTHER WORK: Delete the first paragraph in its entirety and replace with the following:

Miscellaneous removal and other work shall include, but not limited to, the following and as designated on the plans and not otherwise included in the proposal with other work. Existing improvements shown on the plans that may need removal, but are not specifically designated on the plans for removal, and are not included otherwise in the proposal with other work, shall be removed and restored as miscellaneous removal. Payment shall be by the lump sum.

Subsection 350.3 MISCELLANEOUS REMOVAL AND OTHER WORK: Add the following paragraphs to this Subsection:

- (I) Landscape Irrigation System Removal and Restoration: The Contractor shall remove the conflicting portion of all underground landscape irrigation systems that are within the right of way and/or easements that conflict with new work or any portion which may remain under proposed curb, gutter or sidewalk regardless of whether shown or not shown on the plans.

The Contractor shall restore all affected landscape irrigation systems to an operational condition at least as good as existed prior to removal. Bubbler and/or sprinkler heads shall be installed behind the new sidewalk in areas where watering was accomplished by landscape irrigation heads which were removed. Specifically, all areas

SECTION 350

behind the new sidewalk which were watered by the existing irrigation system before relocation shall be watered after relocation without any accumulation of water on the sidewalk or pavement.

The Contractor shall have the option of either providing all new materials or salvaging and reusing existing materials. Either new or salvaged irrigation heads shall be installed in a new location, as close as practical to the existing location. Either new or salvaged pipe shall be installed and all the necessary connections made to put the system back into operation.

In the event it is not feasible to reinstall removed irrigation heads, the Contractor shall then make all the necessary connections to make the remaining portion of the system operational. Irrigation heads and pipe not reinstalled shall be given to the owner.

The Contractor shall furnish all new irrigation heads, new pipe and fittings, and pipe compound necessary to supplement salvaged materials.

The Contractor shall notify the affected property owners, at least fourteen days prior to removing and replacing underground landscape irrigation systems because some of the owners may desire to do this work themselves.

- (J) Lawn Restoration: When any construction by the Contractor encroaches into an improved yard, in or outside the right-of-way, the Contractor shall level any disturbed ground, resod all grass covered areas, and restore rock-covered areas with material to match existing in type and quality.
- (K) Precast Safety Curbs Inside Right-of-Way: Existing precast concrete safety curbs inside the right-of-way and approximately parallel to the new curb line shall be reset by the Contractor directly opposite their existing location, with the back edge on the right-of-way line.

All other precast concrete safety cubs inside the right-of-way shall be salvaged and stockpiled by the Contractor at a location on the adjacent property agreeable to the property owner.

- (L) Encroachments Inside the Right-of-Way: The Contractor shall notify property owners, who have encroaching walls, fences, planters, plants, bushes, small diameter trees, and other improvements in the right-of-way that interfere with construction, at least fourteen days before clearing is necessary.

Any encroaching items, not timely removed by the owner, shall be removed and disposed of by the Contractor in accordance with the Contract Documents.

- (M) Restoration of Temporary Construction Easements: The Contractor shall leave the easements in as good a condition or better after work is completed. Special care must be taken to replace any asphalt, trees, sprinklers, lights, walls, fences, etc., which were disturbed as a result of construction. Where grass is located within the easement such as a lawn, the Contractor shall remove the sod which would be in the path of any construction, store it, keep it moist, and replace it immediately after construction is complete.
- (N) Any removals called for on the Traffic Signal Plans and not otherwise included in a separate pay item.
- (O) Any and all items not specifically set forth as a separate pay item.

Subsection 350.4 PAYMENT: Add the following to the end of the sentence in this Subsection:

to the satisfaction of the Engineer.

PART 400
RIGHT-OF-WAY AND TRAFFIC CONTROL

SECTION 401

TRAFFIC CONTROL

Delete the title of this SECTION in its entirety and replace with the following:

TEMPORARY TRAFFIC CONTROL

Delete SECTION 401 in its entirety and replace with the following:

401.1 DESCRIPTION:

Temporary traffic control shall consist of traffic control devices and flagger or pilot cars deployed to protect and guide all modes of traffic (motor vehicle, bicycle, and pedestrian) within the construction work zone areas.

The Manual on Uniform Traffic Control Devices 2009 (MUTCD) with Arizona Supplements, and the City of Phoenix 2007 Traffic Barricade Manual (TBM), or the most recent adopted editions, take precedence over Section 401.

401.2 TRAFFIC CONTROL DEVICES:

The Contractor may be required to submit a temporary traffic control plan to the Engineer to obtain a Temporary Restriction and Closure System permit (TRACS) as specified in Chapter 2 of the TBM.

The Contractor shall furnish, erect and maintain all temporary traffic control in conformance with the TRACS permit and as approved by the Engineer.

Traffic control devices shall consist of providing, erecting, and maintaining the necessary and adequate devices for the protection of the work, the workers and the public.

- (A) Temporary traffic control devices shall be used to guide all traffic modes through the construction area. They include, but are not limited to, traffic cones to channelize traffic, portable barricades for warning, water-filled barriers for pedestrian separation, vertical panel channelizing devices to divert traffic, concrete barriers to protect traffic from hazards, and lighting devices between the hours of sunset and sunrise.
- (B) Advance warning devices shall be used to alert all modes of traffic to the construction area. They include diamond-shaped signs, flags, and flasher-type high level warning devices mounted 8 feet above the roadway.

401.3 FLAGGERS AND PILOT CARS:

Flagging of traffic or pilot cars shall consist of providing a sufficient number of properly trained flaggers (with proper signing), uniformed off-duty law enforcement officers or pilot cars to expedite the safe passage of traffic. Off-duty law enforcement officers shall be used at signalized intersections when one through lane is maintained in any direction.

401.4 TRAFFIC CONTROL MEASURES:

The application of all traffic control measures shall be based primarily upon the conditions existing at the time that such measures are deemed necessary. Prior to the start of any work that would interrupt the normal flow of traffic; sufficient and adequate devices and measures shall be provided and erected in compliance with the TRACS permit. The Engineer reserves the right to require additional traffic control measures in any specific instance. These devices shall be immediately removed when no longer needed.

401.5 GENERAL TRAFFIC REGULATION:

Requests for a TRACS permit shall be submitted to the Right of Way Management Agent (RMP Agent) through the Engineer or the Permit Inspector on permit work. Unless directed otherwise by the Engineer or RMP office, an advance

SECTION 401

notice of 72 hours for complete closures on major and collector streets; 48 hours for partial closures on major and collector streets; and 24 hours for complete or partial closures on local streets and alleys is required.

A minimum 11 foot clear traffic lane shall be required for a safe motor vehicle operating speed of 35 miles per hour.

For the purpose of temporary traffic control, an intersection is defined as all of the area within the right-of-way of the intersecting streets plus 300 feet beyond the prolongation of the intersecting right-of-way line on each street.

Except during emergency conditions, or otherwise provided for in the special provisions or permit, or approved by the RMP Agent, the following are minimum traffic control requirements for all traffic restrictions:

- (A) During WEEKDAY PEAK TRAFFIC HOURS between 6:00 a.m. and 8:30 a.m., and between 4:00 p.m. and 7:00 p.m., TRAFFIC RESTRICTIONS ARE NOT PERMITTED on Major or Collector streets.
- (B) During WEEKDAY PEAK TRAFFIC HOURS between 6:00 a.m. and 9:00 a.m., and between 4:00 p.m. and 7:00 p.m., TRAFFIC RESTRICTIONS ARE NOT PERMITTED on streets with reversible lanes.
- (C) During WEEKDAY OFF PEAK TRAFFIC HOURS, when one traffic lane is restricted at a multiple lane signalized intersection with left-turn lanes, the left-turn lanes may be used to provide a minimum of four through traffic lanes (two lanes for each direction).
- (D) Except as provided for in items A and C above, a minimum of two traffic lanes (one for each direction) shall be maintained on all Major and Collector streets through the week nights and through the weekends.
- (E) A minimum of two traffic lanes in the same direction shall be maintained on "one way" streets at all times.
- (F) A traffic lane shall not be considered as satisfactorily open to traffic unless it is paved with hot mix or cold mix asphalt.
- (G) The Contractor, utility or other agency shall provide a City of Phoenix approved uniformed off-duty police officer during OFF PEAK traffic hours to assist with traffic control at multiple lane signalized intersections whenever traffic is reduced to one through lane in any one direction. This requirement may be waived by the Engineer when conditions, in his opinion, do not require it.
- (H) Local streets may be closed except for local access, when construction or maintenance requires.
- (I) Local access shall be maintained to all properties on all streets (Major, Collector and Local) at all possible times. When local access cannot be maintained, the Contractor, utility or other agency shall notify the affected property owner, resident, or tenant, a minimum of 72 hours in advance and restore access as soon as possible. Unless specifically authorized by the Engineer, access to businesses will not be closed during business hours.
- (J) All Contractors doing work in the right-of-way shall promptly remove all traffic control devices when the closure or lane restrictions are no longer in effect. When no construction work is being done, all advance warning signs shall be turned so that they are not readable by drivers. All traffic control devices may be temporarily stored in cluster method behind the sidewalk for short periods of time. All temporary traffic control devices shall be collected and removed from the right of way within 24 hours of the expiration of the TRACS permit.
- (K) Special Events: If there are special events scheduled to take place during the construction of any project, the Contractor shall coordinate the construction schedule with these events.

401.6 EXISTING TRAFFIC CONTROL DEVICES:

SECTION 401

During construction and maintenance operations it is important that all existing traffic control devices be kept compatible with the traffic restrictions imposed. This includes existing signs, parking meters, traffic signals and pavement markings. Some devices will remain applicable to traffic and must be maintained. Other devices must be covered, relocated or removed. Requirements for each group of devices are detailed in this section.

(A) Traffic Signs:

The Contractor, utility or other agency shall maintain all existing STOP, YIELD and street name signs, verifying they are erect, clean and in full view of the intended traffic at all times. If these signs interfere with construction, the Contractor, utility or other agency shall temporarily relocate the signs to permit construction, but the devices must be kept in full view of the intended traffic. Portable signs shall be used to supplement the relocated permanent signs.

Other signs still applicable shall also be maintained erect, clean and in full view of the intended traffic by the Contractor, utility or other agency at all times. Existing signs, not applicable, shall be removed by the Contractor, utility or other agency without damage, and salvaged on the adjacent property lines. The Streets Transportation Department shall be notified of all removals.

(B) Traffic Signals:

The Contractor, utility or other agency shall maintain all existing traffic signal equipment except in-pavement vehicle detector sensing devices, fully operational in the existing locations and in full view of the intended traffic at all times unless otherwise specified in the City of Phoenix Traffic Barricade Manual or in the Project or Permit Plans or specifications. All traffic signal work performed by a Contractor shall be in accordance with Section 404.

The Contractor, utility or other agency shall notify the Traffic Signal Shop (602-262- 6021) 48 hours prior to the start of construction in the vicinity of signalized intersections. The Traffic Signal Shop will, in accordance with the Arizona Blue Stake regulations, provide the approximate locations of all underground traffic signal equipment (conduits, junction boxes, vehicle detector sensing devices, etc.). The exact location of this underground equipment shall be determined by the Contractor, utility or other agency prior to any excavating operations.

The Contractor, utility or other agency shall exercise care to prevent damage to all existing traffic signal equipment. Should damage occur, The Traffic Signal Shop will make the necessary temporary repairs to immediately restore traffic signal operation.

Responsibility for permanent repair or replacement of damaged equipment shall be as follows:

The cost for the permanent repair or replacement shall be at the Contractor's, utilities', or other agency's expense, when the approximate location of the damaged equipment has been made known to them. They will also be charged by the Traffic Signal Shop for any temporary or permanent repairs made by City of Phoenix forces. Permanent repairs or replacements made by a Contractor shall be approved in advance by the Traffic Signal Shop Supervisor or his or her designee and constructed in accordance with Section 404.

All permanent repairs or replacement shall be at the City's expense, when the approximate location of the damaged equipment has not been made known to the Contractor, utility or other agency; provided they have complied with the notification requirements of this section and requested underground locations.

When the existing traffic signal equipment cannot be maintained as provided for in the Arizona Supplemented MUTCD or in the Project or Permit Plans or specifications, the Contractor, utility or other agency shall, at their expense, have the Traffic Signal Shop or a qualified Contractor (as specified in Section 404) relocate said equipment to a temporary location and/or provide additional temporary equipment, such that all functions and indications of the existing signal equipment, except in-pavement

SECTION 401

vehicle detector sensing devices, are operational and in full view of the intended traffic at all times. The location and type of all temporary signal equipment shall be approved by the Streets Transportation Dept. All signal equipment relocations and/or installations of temporary signal equipment shall be coordinated by the Contractor, utility or other agency with the approval of the Traffic Signal Engineer. 72 hours advance notice is required.

When temporary equipment or new equipment is installed to replace existing equipment, the temporary or new equipment shall be fully operational before the existing equipment is removed.

The Contractor, utility or other agency shall restore all traffic signal control equipment to the original locations or new locations, if so specified, as soon as possible after all work in the immediate area is completed.

(C) Signalized Intersection Requirements:

The Contractor shall notify the Engineer and the Traffic Signal Shop (262-6021) at least 72 hours prior to the start of any construction in the vicinity of a signalized intersection where traffic signals may be affected.

The Contractor shall provide the Engineer and the Traffic Signal Shop a written schedule indicating days, times and specific locations where traffic signals will be interrupted or modified. **When work has been completed, the Contractor shall immediately notify the Traffic Signal Shop.**

The Contractor shall maintain the “cone of vision” for traffic signal heads in accordance with the Arizona Supplemented 2009 MUTCD Part 4 Section 4D.13 (see figure 4D-4 on page 463) or most current version at all signalized intersections for full view of intended traffic and signal indication. Motorists driving through signalized intersections in a construction zone must always be able to see at least two (2) traffic signal heads within the “cone of vision”. If the traffic control setup cannot provide the required “cone of vision”, the Contractor shall contact the Engineer and the Traffic Signal Shop at (602) 262- 6021 for instructions.

(D) Pavement Markings:

Existing pavement markings that conflict with the vehicle path indicated by barricades and channelization and cause driver confusion shall be removed or obliterated by the Contractor, utility or other agency as directed by the Streets Transportation Dept.

Generally, pavement marking removal or obliteration is only required on long term construction projects such as detours for bridge construction or similar fixed location projects. However, removal or obliteration of existing pavement markings may be required at any location when visual inspection and/or accident history shows driver confusion caused by existing pavement markings.

Proper pavement marking removal or obliteration leaves a minimum of pavement scars and completely removes existing markings. Painting over existing markings with black paint or asphalt material is not satisfactory except in emergency conditions awaiting more permanent removal to follow immediately.

Final Signing and Striping of Roadway: The Contractor, through the City project inspector, shall notify the Street Transportation Department, Traffic Operations Division (602) 262-6456, at least thirty (30) days prior to desired completion of final roadway signing and lane striping.

(E) Parking Meters:

The Contractor, utility or other agency shall maintain all metered parking spaces open for parking at all possible times. When parking meters must be hooded or removed, the Contractor, utility or other agency shall notify the Streets Transportation Dept. two business days in advance.

SECTION 401

All parking meter post removals, relocations or installations shall be done by the Contractor, utility or other agency as provided for in the plans, or as directed by the Parking Meter Supervisor. The Street Transportation Department will provide the parking meter posts.

(F) Coordination with Other Agency Projects:

The Contractor shall coordinate and schedule work to minimize disruption or conflicts with any other Agency projects.

Any work that may affect the project shall be coordinated with the appropriate Agency contact at least fourteen (14) days in advance.

(G) Pedestrian Access Requirements:

The Contractor shall ensure that all sidewalks on this project remain in compliance with the Americans with Disabilities Accessibilities Guidelines (ADAAG) and, upon its adoption, the Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG). All open pedestrian walkway areas, paved or unpaved, shall be maintained and safely usable at all times. Such measures as backfilling or ramping to existing sidewalks or providing alternate sidewalk areas adjacent to existing sidewalks may be used. In high pedestrian use areas, the Engineer may request temporary hard-surface walkways, such as compacted stabilized decomposed granite, compacted cold-mix asphalt, CSLM or hot-mix asphalt.

In addition, diversions shall conform to Figure 401-1.

SECTION 401



City of Phoenix STREET TRANSPORTATION DEPARTMENT

June 25, 2013

Dear City of Phoenix **Traffic Barricade Manual (TBM)** User:

RE: POLICY PERTAINING TO SIDEWALK BYPASS DESIGN AND IMPLEMENTATION OF 2009 MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) RULES

Effective July 1, 2013, updated regulations specific to pedestrian diversions in Part 6 of the 2009 MUTCD will be phased into general use by the City of Phoenix, Street Transportation Department. These regulations change the required devices utilized for pedestrian diversions as well as how diversions are installed and maintained.

This addendum specifically addresses two portions of the existing TBM in Chapter 3 pertaining to pedestrian safety and Chapter 6 pertaining to traffic control devices.

In Chapter 3, "Pedestrian Safety and Service Considerations" on page 22 (Figure 1) of the existing TBM, both "In-Street" and "Out of Street" diagrams, shall be modified as follows:

IN-STREET DIVERSIONS

- 1) A continuous barrier shall be installed on the outside portion of the temporary pathway nearest traffic. Vertical panels with caution tape, pedestrian fencing, cones, and any other devices will no longer be accepted, except in cases where a designated spotter is utilized (SEE EXCEPTION BELOW). "Devices used to channelize pedestrians shall be detectable to users of long canes and visible to persons having low vision. The bottom of the bottom surface shall be no higher than 2" above the ground, and the top of the top surface shall be no lower than 32" above the ground. (Refer to Section 6F.63.04 and .05, 2009 MUTCD)
- 2) The inner barrier of the constructed pathway may consist of any channelizing device accepted by the City of Phoenix.
- 3) Where pedestrians with visual disabilities normally use the closed sidewalk, a barrier shall be placed across the full width of the closed sidewalk; this barrier shall have the same dimensions and detectability as stated above. (Refer to 6D.02.03, 2009 MUTCD)
- 4) EXCEPTION: If maintaining an alternate pedestrian route is NOT feasible during the project, a spotter may be assigned the responsibility to assist pedestrians with disabilities through the project limits. (6D.01.05, 2009 MUTCD)
- 5) When crosswalks or other pedestrian facilities are closed or relocated, temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility. (Refer to 6H.28.01, 2009 MUTCD)

OUT-OF-STREET DIVERSIONS

- 1) A continuous detectable barrier shall be provided throughout the length of the affected facility. "Devices used to channelize pedestrians shall be detectable to users of long canes and visible to persons having low vision. The bottom of the bottom surface shall be no higher than 2" above the ground, and the top of the top surface shall be no lower than 32" above the ground. (Refer to Section 6F.63.04 and .05, 2009 MUTCD)
- 2) Where pedestrians with visual disabilities normally use the closed sidewalk, a barrier shall be placed across the full width of the closed sidewalk; this barrier shall have the same dimensions and detectability as stated above. (Refer to 6D.02.03, 2009 MUTCD)

FIGURE 401-1 ADDENDUM TO 2009 TRAFFIC BARRICADE MANUAL

SECTION 401

- 3) EXCEPTION: If maintaining an alternate pedestrian route is NOT feasible during the project, a spotter may be assigned the responsibility to assist pedestrians with disabilities through the project limits. (6D.01.05, 2009 MUTCD)
- 4) The detectable barrier should be placed nearest to the work zone.

WHAT THIS MEANS TO CONTRACTORS, CITY CREWS, BARRICADE COMPANIES AND OTHER RIGHT-OF-WAY USERS

Contractors will have the option of selecting from a number of new products that will fulfill the specifications for the creation of detectable pathways. **When a spotter is not utilized, the outer barrier closest to traffic must have detectable edging.** The inner barrier of an on-street pathway does not have to comply with this rule at this time. There are no current changes to ramps, ramp elevation ratios, or signage.

When selecting an out-of-street pathway, the barrier nearest the work area should have the detectable edge, while the other side of the pathway can be constructed of acceptable devices.

Thank you again for your partnership with the City in maintaining mobility safety for all work activities in Phoenix right-of-way. If you have any questions, please contact John Morgan at 602-262-4483 or Luiz Moreno at 602-262-6565.

Sincerely,



Thomas L. Godbee, P.E.
Deputy Street Transportation Director

P: RMP Working Documents\TBM Addendums\Sidewalk Bypass Addendum 6-25-2013

C: Luiz Moreno
John Morgan
Lorena Hall
Rick Florian

FIGURE 401-1 ADDENDUM TO 2009 TRAFFIC BARRICADE MANUAL, CONT

SECTION 401

401.7 HOLIDAY SEASON TRAFFIC:

During the holiday season from Thanksgiving Day through the 1st of January, it is imperative that traffic restrictions be minimized or eliminated to the greatest extent possible.

On all major streets, adjacent to, or serving as primary access to large regional shopping centers, work that restricts traffic should be minimized. In addition, work within the entire Central Phoenix area should be curtailed.

Careful planning of work schedules to avoid operations that restrict traffic flow can do much to benefit the traveling public and decrease traffic accidents.

401.8 FAILURE TO PROVIDE ADEQUATE MAINTENANCE OF TRAFFIC:

If the Contractor fails to provide adequate temporary traffic control, the Engineer will have the work performed by other sources. The cost of having this work performed by other sources will be computed in accordance with Subsection 401.11. The total cost will be deducted from monies due to the Contractor.

401.9 TRAFFIC BARRICADE MANUAL - VIOLATIONS; CIVIL SANCTIONS:

401.9.1 Authority and administration: The City Manager and the Director of the Police Department are authorized to issue notices for violating the Traffic Barricade Manual and may take those measures necessary to promote, preserve and protect public health, safety and welfare within the public right-of-way.

401.9.2 Violations of Traffic Barricade Manual, Civil Sanctions: The following violations of the Traffic Barricade Manual may result in a Civil Sanction. The amount of the Civil Sanction listed is the minimum amount per day for a violation prior to the commencement of a Civil Action.”

SUMMARY OF VIOLATIONS AND PENALTIES:

VIOLATION	DESCRIPTION	CIVIL SANCTION
#1	Creates imminent risk of injury to the public within ROW.	\$1,500
#2	Restricting ROW without proper certification or TRACS Permit.	\$1,000
#3	Restricting traffic during peak hours as described in the TBM without authorization.	\$1,000
#4	Failing to correct a violation, as listed, within the time period stated on the warning notice.	\$1,000
#5	Restricting traffic at signal with no work occurring.	\$1,000
#6	Closing sidewalk improperly, or without proper certification, or TRACS permit.	\$500
#7	Violating the restrictions, limits, times, and locations of the TRACS permit.	\$500
#8	Missing or improper use of advance warning signs.	\$500

SECTION 401

#9	Missing or improper use barricades/channelizing devices.	\$500
#10	Leaving advance warning signs facing traffic after restriction has been removed – per one traffic direction.	\$250
#11	Leaving TTC devices in the ROW 24-hours after TRACS permit expires, unless a request for a permit extension is received prior to the expiration of permit.	\$250
#12	Use of “unacceptable” quality traffic control devices as described in the TBM.	\$250
#13	Rendering a bus stop inaccessible without relocating it or making other accommodations.	\$250

401.10 MEASUREMENT:

Off-duty law enforcement officers will be measured by the hour for each individual, including vehicle and equipment, required to perform traffic control. Minimum payment shall be three hours on any separate call out.

401.11 PAYMENT:

Payment for complete temporary traffic control will be made at the unit bid price in the proposal item TRAFFIC CONTROL DEVICES.

Payment for uniformed off-duty law enforcement officer will be made at the unit bid price in the proposal item ALLOWANCE FOR UNIFORMED, OFF-DUTY LAW ENFORCEMENT OFFICER. If the officer is utilized in excess of 8 hours in any calendar day or in excess of 40 hours in any calendar work week, payment shall be at the rate of 1-1/2 times the proposal price for all hours worked in excess in either of the above time periods.

SECTION 404

TRAFFIC SIGNALS

Add SECTION 404 in its entirety:

SECTION 404

TRAFFIC SIGNALS

404.1 GENERAL:

The following specifications will outline the obligations of the private developer and /or private contractor constructing or relocating City of Phoenix traffic signal equipment. This includes private contractors working for ADOT, other agencies, or other departments within the City of Phoenix. **Any deviations to these work responsibilities will need to be discussed with the City of Phoenix Traffic Engineering Supervisor (602) 262-4690 or authorized designee.** The term Engineer for this section shall mean Traffic Engineering Supervisor or any of his or her authorized designees.

These specifications and approved, signed traffic signal plans are in addition to other applicable specifications and policies of the City of Phoenix, Maricopa Association of Governments and the Arizona Department of Transportation.

The Contractor shall notify the City of Phoenix, Traffic Signal Shop (602) 262-6021 a minimum of fourteen (14) calendar days prior to beginning any traffic signal work.

404.2 PREPARATION:

Before starting any traffic signal work under the project, **read and review** all project documents and general notes to make certain understanding and agreement is clear with all conditions stated.

Be sure that the traffic signal plans are the final approved plans. Final approved plans shall have the signatures of City of Phoenix, Street Transportation Department officials. An approved set of plan documents shall be present on the job site during construction.

Work to be done shall mean all labor, materials, equipment and other incidentals necessary to complete the work in accordance with the project plans. In the event an error or omission is discovered, it should be brought to the attention of the Engineer immediately. The Engineer shall make such corrections and interpretations as may be deemed necessary.

The Engineer also has the authority to suspend traffic signal work to correct conditions unsafe for the workers or the general public, for failure to carry out provisions of the contract and/or to carry out orders.

The Contractor shall note that approval from the Engineer is required before ordering or installing any material that is to be used on the project. A list of materials and equipment shall be submitted that contains all items to be supplied on the project by the Contractor. The City of Phoenix reserves the right to reject an incomplete or unclear submittal. Contractor supplied materials will be listed on the signal plans. The Engineer reserves the right to accept a partial list prior to full submission. This approval also includes the paint color for traffic signal equipment. The Engineer shall answer all questions that may arise as to quality and acceptability of materials furnished and work performed, interpretation of plans and specifications, and all questions related to acceptable completion of work. It is recommended that the Contractor invite the Engineer to a pre-construction meeting to discuss any traffic signal related questions and/or concerns. This meeting can be held in conjunction with other disciplines.

404.3 MAINTENANCE OF TRAFFIC:

Traffic shall be protected in accordance with The City of Phoenix, Traffic Barricade Manual, the Manual on Uniform Traffic Control Devices and Section 401.

404.4 MATERIALS AND WORKMANSHIP:

SECTION 404

Materials and construction details shall conform to the latest City of Phoenix Standard Traffic Signal Drawings, the Arizona Department of Transportation, Highways Division, Supplemental Specifications to Standard Specifications for Road and Bridge Construction, latest edition, the latest edition of the Arizona Highway Department Traffic Signal and Highway Lighting Systems Standard Drawings and the current National Electrical Code Standards unless otherwise specified herein or on the plans.

All electrical materials and workmanship shall conform to the requirements of the current National Electric Code (NEC).

Contractor shall be responsible for all work and materials as shown on the signal plans, the project specific specifications and/or general provisions.

The Contractor shall call the Blue Stake Center at least 48 hours prior to excavation for information relative to the location of buried utilities. The Contractor shall also contact the City of Phoenix Traffic Signals Department at (602) 262-6204 for traffic signal locates.

All underground conduits shall be schedule 40 rigid polyvinyl chloride (PVC) installed 24 inches to 30 inches below finished grade with the exception of loop lead-in conduits which shall be schedule 40 rigid PVC installed in accordance with the latest City of Phoenix Standards. All conduits shall be installed in straight lines (unless otherwise shown on the plans) junction box to junction box or junction box to signal equipment foundation with one 90 degree sweep on each end as specified in the plans. All conduits entering junction boxes shall be vertical, with the top of the conduit six inches below the bottom of the cover.

Foundations shall conform in size, type, and location as shown on the plans. The foundation anchor bolts shall be supplied by the Contractor unless otherwise noted on the plans and installed square with the intersection. The top of the pole foundation shall be set at the finished grade and at the back of sidewalk for each location unless otherwise shown on the plans. Concrete for foundations shall be Class A, 3000 psi concrete with a 6" slump per Section 725. Minimum pole foundation curing times are: A-Poles five (5) days, M-poles seven (7) days, Special M-poles (SM) and Special R-poles (SR) ten (10) days, NO EXCEPTIONS. With approval of the Engineer, high-early strength concrete may be used at no additional cost to the City. Testing is required to verify high-early strength concrete has attained a 3000 psi compressive strength per ASTM C39 and shall be performed at the Contractor's sole expense.

The Contractor shall have a Level II IMSA certified Technician/ Electrician on site at all times during construction/maintenance of traffic signal equipment. Conductor splices and terminations shall be made by a qualified Journeyman Electrician, who has successfully completed a recognized four (4) year apprenticeship program or equivalent training, or by a person enrolled in a recognized four (4) year apprenticeship program under the direct supervision of a Journeyman Electrician.

A separate loop lead-in circuit shall be supplied for each inductive loop. Inductive loop lead-in cable shall be continuous without splices from the loop stub-out junction box to the controller cabinet. A minimum of five (5) feet of slack shall be provided in the controller cabinet and a minimum of three (3) feet of slack shall be provided in each junction box.

Detector loops shall be installed and tested ONLY in the presence of an authorized representative of the City of Phoenix Traffic Signal Shop. Detectors installed without said representative in attendance, for any reason, shall be removed from the pavement and new conductors installed, all at the Contractors expense. Each detector shall be installed according to the latest Traffic Signal Standard Drawing. Installations shall be made permanent with approved sealant after successful testing. The loop conductor shall be temporarily spliced to the lead-in cables, as directed by the Inspector, and tested at the controller cabinet. Loop sealant shall be injected into all cuts and, before setting, surplus sealant shall be struck off flush with and removed from the roadway surface.

All traffic signal heads shall be covered until activation except for 12" mast arm heads, which will not be installed until the day of the activation. These coverings must be maintained in good repair.

SECTION 404

The Contractor shall maintain work and work site in an acceptable manner during the course of the project. Upon completion of the work all surplus earth, construction debris including abandoned foundations, and/or remnant equipment shall be removed and properly discarded by the Contractor and the work area shall be restored to a neat, orderly condition.

404.5 INSPECTION:

The City of Phoenix Traffic Signal Foreman or his designee shall inspect all work performed including these critical components: all trenches and conduit runs including splices before being covered, wiring, junction box installations, loop layout, saw cuts, loop installation, and traffic signal pole foundations before being poured. The Contractor shall contact the appropriate Traffic Signal Foreman forty-eight (48) hours in advance to request inspection or call (602) 262-6733.

Inspections are typically at no cost to the Contractor. However, if the Contractor's performance results in the need for additional inspections or excessive inspection time for the Traffic Signal Foreman or his designee the Contractor will be put on notice and subsequent inspection costs shall become the Contractor's responsibility.

The Traffic Signal Foreman, or his designee, are authorized to inspect and reject work and materials; and shall refer rejected work not resolved in the field to the Traffic Signal Engineer for resolution.

In the event the Traffic Signal Engineer determines that the materials furnished, work performed, or the finished product not in conformance with the plans and specifications, the non-conforming improvements shall be removed and replaced or otherwise brought into conformity at the sole expense of the Contractor.

The Traffic Signal Engineer has the authority to reject defective material and to suspend any work that is improperly performed.

404.6 ACTIVATION OF TRAFFIC SIGNAL WORK:

Notify the traffic signal shop prior to pulling conductors and activating the traffic signal system. Activation of new traffic signal intersections shall be scheduled through the Traffic Signal Engineer. An off duty Police Officer supplied by the Contractor is required to be present for the activation to provide traffic control.

404.7 SALVAGED MATERIALS:

Any existing equipment identified by the Traffic Signal Shop Foreman or his designee as salvageable shall be removed without damage, and delivered to 2141 E. Jefferson Street and unloaded where designated. Contact the Traffic Signal Shop at (602) 495-2083, 24 hours in advance for an appointment to return salvaged equipment.

Remnants of obsolete traffic signal equipment shall be delivered to the Traffic Signal scrap yard by the Contractor. Contact the Traffic Signal project inspector 24 hours in advance for an appointment to deliver obsolete equipment to the scrap yard.

404.8 WARRANTY:

The warranty period will begin the day the work is accepted by the City.

There will be a two (2) year warranty on all Contractor supplied equipment and detector loops following final acceptance of the work except as noted herein. The Contractor will warranty workmanship supplied in association with the installation of City supplied equipment for a two (2) year period following acceptance of the work. All LED indication modules furnished by the Contractor will be warranted for five (5) years following acceptance of the project.

404.9 MEASUREMENT:

Measurement for foundations, junction boxes, and loops shall be of the number of units of each satisfactorily constructed.

SECTION 404

Measurement for conduit shall be the linear feet of conduit satisfactorily installed as measured along the centerline of the conduit through fittings from end of conduit to end of conduit. Measurement shall be made to the nearest 0.5 feet.

Measurement for the temporary signal cable and the lead-in cable shall be the linear feet of cable satisfactorily installed as measured along the centerline of the cable from end to end. Measurement shall be to the nearest 0.5 feet. The temporary signal cable is a contingency item and may be eliminated without compensation by the Engineer.

404.10 PAYMENT:

Payment for traffic signal work will be made at the unit prices in the applicable proposal items, the combination of which shall be full compensation for all material and labor required to complete the work, including incidentals not specified, but required, to complete the work including temporary traffic signals as described and specified herein, on the plans and permits.

SECTION 424

PARKWAY GRADING

Subsection 424.2 ROUGH GRADING: Add the following paragraph to this Subsection:

- (C) The parkway area shall be graded at a variable slope from 1 inch below the back of sidewalk to meet the existing surface at the right-of-way line in accordance with the typical section shown on the plans. Material displaced in the grading of parkways shall not be allowed to be placed on base and surfacing material already in place on the roadway. No measurement or direct payment will be made for this work.

Subsection 424.3 FINE GRADING: Delete paragraph (B) in its entirety and replace with the following:

- (B) Where existing parkways are planted in grass, flowers or shrubs, and the level is somewhat above the top of the curb or sidewalk, the parkway shall be graded as per City of Phoenix Landscape Standards and Guideline Detail "Water Retention on Turf Installation" with the least possible damage to the planted area.

SECTION 429

TRAILS

Add SECTION 429 in its entirety:

SECTION 429

TRAILS

429.1 DEFINITION OF TERMS

- (A) Multi-Use Trail (MUT): The MUT shall be a 10' wide compacted decomposed granite (DG) surface stabilized to its full 3" depth and shall also have 2' DG shoulders, allowing pedestrian, bicycle, equestrian and maintenance vehicle use. Switchbacks and clearances for obstacles, vegetation, and plants will be measured from the edge of the MUT excluding the 2' shoulders where installed. All MUTs shall meet or exceed the Americans with Disabilities Act (ADA) requirements and shall be Barrier Free Trails.
- (B) Multi-Use Trail Easement (MUTE): The MUT shall be constructed within a dedicated 30' public MUTE.
- (C) Shared-Use Path: The Shared-Use Path (SUP) is a non-equestrian 10' wide concrete pathway providing recreation and educational experiences. All SUPs shall meet or exceed the ADA requirements.
- (D) Private Trails: The Trails Master Plan does not regulate the locations of Private Trails (PT). Construction and maintenance of PT is the responsibility of the private development. Construction of PT should follow the MUT or SUP guidelines set forth in these specifications.

429.2 SPECIFICATIONS

(A) MULTI-USE TRAIL

- (1) Users:
 - (a) Hikers, joggers, bicyclist, equestrians and the disabled.
- (2) Multi-Use Trail Easements (MUTE):
 - (a) Multi-Use Trails shall be located within an exclusive 30 foot minimum public trail easement.
 - (b) This easement is exclusive for the trail, landscaping, and PUE unless modified by Development Services.
 - (c) Trail easements along an open space or wash corridor will be a minimum 25' wide.
- (3) Sub Grade:
 - (a) The sub-grade shall be 90% compacted prior to the installation of the MUT.

SECTION 429

(4) Grade:

- (a) Maximum sustained longitudinal grade 5% (20:1).
- (b) The cross slope shall not exceed 2%.

(5) Tread Surface:

- (a) The tread surface shall be a minimum of 10' wide with a 2' shoulder on each side. No shoulder will be required for the MUT in turf area.
- (b) Trail shall allow for side-by-side travel and ease of passing by horses and bicycles. Tread conditions must provide an adequate walking or riding surface free of obstacles or hazards.
- (c) The MUT surface shall be ¼" minus decomposed granite (DG) of a color contrasting with the surrounding DG and shall be stabilized to its full 3" depth.
- (d) When located in turf, the MUT shall have a 6"x8" concrete header that meets or exceeds MAG Standards on each side. Shoulders shall not be required in turf.

(6) Path Locations:

- (a) Public Multi-use Trails shall not be placed in retention basins, drainage ways, channels or naturally occurring or manmade washes, unless otherwise approved by the Parks & Recreation Department.
- (b) There shall be a minimum 5-foot horizontal clearance between trails and other obstacles i.e., fences, walls, utility boxes and other fixed objects. Safety rails or ADA railing are the exception to this requirement.
- (c) Where the trail surface ties into another hardscape surface material i.e., sidewalk or curb, the trail shall meet and match the grade of the hardscape surface.
- (d) Trails shall feed directly into ADA ramps at all roads and driveway crossings.

(7) Switchbacks:

- (a) The inside radius of a trail switchback shall be a minimum of 5'.

(8) Vegetation Clearance and Removal:

- (a) Plant material shall not be planted or allowed to grow in the 2' shoulders.
- (b) Plant material shall be cleared to a height of 10' measured from the trail surface.
- (c) Dead vegetation will remain in place unless considered a hazard or obstruction. Tree and brush cuttings, broken limbs and other vegetative debris including fallen saguaros shall be removed from within 5' of the trail.

(9) Plants with Thorns and Poisonous Plants:

- (a) Plants with thorns such as cacti, *Acacia greggi*, *Dasyliirion* species etc., shall not be planted or allowed to grow within 10' of the MUT.
- (b) Poisonous plants such as *Nerium oleander*, *Sophora secundiflora*, *Euphorbia rigida* etc., shall not be planted or allowed to grow within 10' of the MUT.

SECTION 429

(B) SHARED-USE PATHWAY

(1) Users:

- (a) Hikers, joggers, bicyclist and the disabled.

(2) Easements:

- (a) Trails shall be located within 20' public trail/sidewalk pedestrian easements.

(3) Sub Grade:

- (a) The sub grade shall be 90% compacted.

(4) Grade:

- (a) Maximum sustained longitudinal grade 5% (20:1).
- (b) The cross slope shall be 2% maximum.

(5) Surface:

- (a) The tread surface shall be 10' wide, standard. No SUP shall be less than 8' wide unless approved by the Parks & Recreation Department.
- (b) The tread conditions shall provide an adequate walking surface free of obstacles or hazards and shall allow for side-by-side travel and ease of passing by pedestrians and bicycles.
- (c) Concrete shall meet or exceed Section 725.
- (d) Where the pathway surface ties into another hardscape surface material i.e., sidewalk or curb, the trail shall meet and match the grade of the hardscape surface

(6) Path Locations:

- (a) SUP shall not be placed in retention basins, drainage ways, and channels or in naturally occurring or manmade washes, unless otherwise approved.
- (b) There shall be a minimum 5-foot horizontal clearance between sidewalks and trails and other obstacles i.e., fences, walls, utility boxes and other fixed objects.

(7) Switchbacks:

- (a) The inside radius of a pathway switchback shall be a minimum of 5 feet.

(8) Vegetation Clearance and Removal:

- (a) Plant material shall not be planted or allowed to grow in the 2' shoulders.
- (b) Plant material shall be cleared to a height of 10' measured from the trail surface.
- (c) Dead vegetation will remain in place unless considered a hazard or obstruction. Tree and brush cuttings, broken limbs and other vegetative debris including fallen saguaros shall be removed from within 5' of the trail surface.

SECTION 429

(9) Plants with Thorns and Poisonous Plants:

- (a) Plants with thorns such as cacti, *Acacia greggi*, *Dasyllirion* species etc., shall not be planted or allowed to grow within 10' of SUP.
- (b) Poisonous plants such as *Nerium oleander*, *Sophora secundiflora*, *Euphorbia rigida* etc., shall not be planted or allowed to grow within 10' of the SUP.

(C) GRADE SEPARATED CROSSING (UNDERPASS FOR PEDESTRIAN/EQUESTRIAN USAGE)

- (1) When major trails intersect streets or roads, a pedestrian and/or equestrian cell (a barrel within a culvert) or bridge shall be provided for user safety.
- (2) The underpass/bridge shall have a minimum 12-foot vertical and 10-foot horizontal clearance and unobstructed sight lines shall be maintained.
- (3) Underpasses and bridges more than 50-foot in length shall be artificially lit to an average of 2 foot-candles minimum on the trail surface
- (4) The underpass shall be connected to the MUT/SUP with a concrete tread surface, rough broom finished. The MUT shall receive a heavy broom finish to improve equestrian footing.

SECTION 430

LANDSCAPING AND PLANTING

Delete SECTION 430 in its entirety and replace with the following:

430.1 DESCRIPTION:

This Section shall govern the preparation and planting of landscape areas required in the Plans or Specifications. Materials shall be in accordance with the Section 795.

Existing utilities and improvements not designated for removal shall be protected in place. The Contractor, at no additional cost to the Contracting Agency, will repair any damages.

Unless otherwise provided, walls, curbs, planter boxes, irrigation systems, and other improvements shall be constructed after rough grading has been completed and prior to finish grading.

430.2 GENERAL:

Furnish all labor, materials, equipment, and incidental needs to install the landscape to the drawings, details and specifications shown in the plans.

Applicable publications listed below form a part of this specification to the extent referenced:

Arizona Nursery Association Growers Committee Recommended Tree Specification (latest edition)

American Society for Testing and Materials

(ASTM) C136, Standard method for sieve analysis of fine and coarse grained aggregates;

(ASTM) F1632, Test methods for particle size analysis and sand grading of golf course greens and sports field root zone mixes;

(ASTM) D2974 Method B, Test moisture, ash, and organic matter of peat and other organic soils;

(ASTM) F1647, Test methods for organic matter content of golf course greens and sports turf root zone mixes.

All landscaping and irrigation work shall be installed by a contractor licensed to perform this specialty work.

Perform work in accordance with all applicable laws, codes and regulations required by authorities having jurisdiction over such work and provide for all inspections and permits required by Federal, State and local authorities in furnishing, transporting and installing materials as shown or for completing the work identified herein.

430.2.1 Source Quality Control: Ship materials with Certificate of Inspection required by governing authorities.

Do not make substitutions: If specified material is not obtainable, submit proof of non-availability, together with proposal for use of equivalent material, similar in appearance, ultimate height, shape, habit of growth and general soil requirements. The Contractor may make substitution of a larger size of the same species with approval by the Engineer. However, any additional cost for these substitutions will be borne by the Contractor.

Before delivery of the following materials, a letter of compliance shall be submitted, certifying that materials meet the requirements for legal transportation of State and Local government agricultural laws, and are true to analysis as specified. Certify the following:

Nursery propagated plants

Cacti, succulents, and native plants

SECTION 430

Soil Amendments, and conditioners
Lawn seeds, stolons, and sod
Native seed mixes

430.2.2 Samples and Tests: The Engineer reserves the right to take and analyze samples of materials for conformity to specifications at any time. Contractor shall furnish samples upon request. Rejected materials shall be immediately removed from the site at the Contractor's expense. The Contractor shall pay cost of testing materials not meeting specifications.

430.2.3 Herbicide / Pesticide Applicators: All herbicide / pesticide applicators shall be properly licensed for application of non-restricted use chemicals with an A-20 license or an A-21 license with Pesticide Endorsement from the State Registrar of Contractors and Structural Pest Control Commission. All landscape contractors are required to furnish a copy of their application from the Registrar of Contractors, which shall list the names of those employees approved as applicators by the Registrar of Contractors. Application of non-restricted use pesticides shall not take place until the Engineer receives a copy of the application.

430.3 PLANT ESTABLISHMENT GUARANTEE AND MAINTENANCE:

Unless otherwise authorized, the Contractor shall maintain all landscape areas on a continuous basis as they are completed during the course of work and until final Plant Establishment Guarantee and Maintenance Acceptance. The Contractor shall provide adequate personnel to accomplish maintenance. Maintenance shall include keeping the landscape areas free of debris on a weekly basis, chemical control of weeds and fertilization as needed, cultivating the planting areas, and mowing of turf where lawns are part of the project.

Plants shall be kept in a healthy, growing condition by watering, pruning, spraying, weeding and any other necessary operation of maintenance. Plant saucers and beds shall be kept free of weeds, grass and other undesirable vegetation. Plants shall be inspected at least once per week and appropriate maintenance performed. Pruning and re-staking is to include removal of any growth conflicting with vehicular or pedestrian movement.

Turf from seed or stolons shall be considered established when it is ready for use, and turf exceeds 95 percent coverage of an 18 inch diameter ring when placed on the ground by the Engineer. The turf shall be vigorously growing, uniform in color, and cut to a uniform height designated by the Engineer. Roots shall have penetrated the soil to a depth of not less than 4 inches.

The Contractor shall maintain the irrigation system and make any necessary repairs regardless of cause to assure a complete and operational system as originally designed and constructed. Repairs shall be made within 48 hours of detection.

Chemical mixing for weed control shall be done in the presence of the Engineer's representative. The method of application shall be approved by the Engineer.

The Contractor shall request an initial inspection by the Engineer when all planting and related landscape work is accomplished. After this initial inspection, and subject to approval of work by the Engineer, written field notification to the Contractor, setting the effective date for beginning of the Plant Establishment Guarantee and Maintenance Period will be issued. This Period shall last for 90 days or as specified, unless extended by the Engineer. If the landscape areas are improperly maintained; if appreciable plant replacement is required (for whatever reason); if corrective work is required for the operation of the irrigation system; or if other corrective work is necessary; the Plant Establishment Guarantee and Maintenance Period shall be extended and the Contractor shall continue to maintain the entire site until accepted at no increased cost to the Owner.

At the end of the Plant Establishment, Guarantee and Maintenance Period a final inspection will be performed. If, after inspection, the Engineer is of the opinion that all planting areas are weed free, plant materials are in satisfactory growing condition, the Engineer will give the Contractor written Notice of Acceptance of the landscape installation. Any plants which need to be replaced, regardless of the cause, shall be replaced prior to final acceptance.

SECTION 430

430.4 JOB CONDITIONS:

Site Examination: The prospective Contractors are encouraged to visit the job site prior to bidding on this project, and to satisfy their concerns as to the magnitude of the work involved.

Water costs are the Contractors responsibility, until Final Acceptance or end of Plant Establishment, Guarantee, and Maintenance Period whichever is longer and the water meters are transferred to the City.

Before the beginning of landscape work, all planting areas shall be left free of construction debris and/or toxic material and subgraded to a level to permit landscape and irrigation construction. Trenches, foundation backfill or other filled excavations shall be compacted prior to the beginning of any landscape work. No soil preparation or planting shall begin before the site has been cleared and cleaned of debris. Commencement of work indicates acceptance of job site conditions.

Cooperate and coordinate with other Contractors and trades working in and adjacent to landscape areas.

430.4.1 Utilities: Determine location of underground utilities and perform work in a manner, which will avoid possible damages. The Contractor, at no additional costs to the Contracting Agency, will repair any damages. Hand excavate, as required. Maintain stakes by others until removal is mutually agreed upon by parties concerned.

430.4.2 Obstructions: If rock or other obstructions are encountered in excavation for planting, notify the owner's representative. Proceed with work only as directed.

430.4.3 Existing Surface Soils (Borrow Excavation): Shall be used for plating non-pave (non-turf) areas, and as part of the backfill mix for planting Nursery Stock.

430.4.4 Imported clean fill: Shall be used for turf areas and amended per Subsection 430.11 Preparation for Lawn. Unless otherwise specified the minimum clean fill depth in lawn areas shall be 6 inches.

430.5 DELIVERY, STORAGE, AND HANDLING:

Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored on site.

Sod: Time delivery so that sod will be placed within 24 hours after stripping at the sod farm. Protect against drying, cracking, and breaking of soil on the rolled strips.

Trees and Shrubs: Do not prune prior to delivery unless otherwise approved by owners representative. Do not bend or bind trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape. Provide adequate protection for root systems. Protect root balls from drying wind and sun.

Deliver trees/shrubs just prior to planting. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage. Keep roots moist. Water as often as necessary.

Plant Inspection Prior to Delivery to the Project Site: Before delivery of any species to the project site, the Contractor shall make the necessary arrangements with the Engineer for an inspection of the plant material and tagging of representative plant stock. The Contractor will pay for travel to non-local Nurseries, out of the metropolitan Phoenix area, when plants are not available locally.

The Contractor shall notify the Engineer, at least 7 days in advance for inspection of the plant material. Prior to notification of the Engineer for inspection, the Contractor shall physically verify that the plant material meet the size specified.

SECTION 430

After delivery, any plants found to be unsuitable in growth or condition, or plants, which are not true to the specification, or equal to the tagged plant stock, shall be removed, and replaced with acceptable plants at the Contractor expense.

430.6 MATERIALS AND PRODUCTS:

Materials and products shall conform to the requirements of the Section 795.

430.7 SEQUENCING AND SCHEDULING:

Proceed with and complete landscape work as rapidly as portions of the site become available, working with reasonable limitations for each kind of work required.

Plant or install lawns during normal planting seasons or as directed by the Engineer.

For Bermuda, seed from April 15 to the end of September, provided nighttime temperatures are averaging above 60 degrees Fahrenheit.

For Perennial Rye Grass, when directed by the Engineer.

Coordination: Plant trees and shrubs after final grades are established and prior to planting lawns, unless otherwise accepted in the construction schedule by the Engineer. If tree and shrub planting occurs after lawn work, protect lawn areas and properly repair damage to lawns resulting from tree or shrub planting operations.

430.8 PREPARING THE SITE FOR LANDSCAPING:

All non-paved areas, as directed by the Engineer, shall be treated with a chemical control, such as Round-up or equal, to control and kill weeds. All applications of the chemical control agent shall contain a blue or green dye so that treated areas can be identified. These areas shall be cleared and grubbed, no sooner than two weeks after the last application of chemical weed control, or when week kill has been established to the satisfaction of the Engineer. Any area to receive seed mix or which is to remain undisturbed shall be excluded from treatment.

Clear and grub landscape areas in accordance with Section 201.

Remove or relocate trees, shrubs, grass, improvements or obstructions that interfere with the installation of new work. Removal includes digging out stumps and roots to a depth of 12 inches below existing or proposed grade whichever is lower.

Fill depressions caused by clearing and grubbing operations with satisfactory soil material. Place fill in 6" loose depths and compact to adjacent ground densities.

Soil Preparation in non-turf areas including planters: After clearing and grubbing is complete, rough grade and remove all deleterious materials. Fine grade the areas. Rocks and debris, including miscellaneous concrete spillage clumps, over 1 inch in any dimension, shall be removed and disposed of offsite.

The finish grade for landscape areas shall not vary more than 1 inch from specified grade and cross section and shall be a smooth, uniform surface, free of abrupt grade changes or depressions. Surface drainage shall flow as designated on the plans.

Finished soil grades, adjacent to paving, curbs or headers will consider the depth of applied toppings materials such as granite or river run. Unless otherwise specified the soil grade for granite areas shall be 3 inches below adjacent pavements, for application of 2 inches of granite. Apply a pre-emergent weed suppressant to the finish soil surface; include dye as specified with the application.

SECTION 430

430.9 HEADER INSTALLATION:

Headers shall be installed at the locations and elevations shown on the plans.

Concrete forms, shall be approved by the Engineer prior to pouring concrete. Concrete shall be Class B.

430.10 EXECUTION OF PLANTING:

Clearing and grading areas shall be free of construction debris and/or toxic materials and graded to permit landscape construction.

Landscape or planting areas shall not be cultivated when they are so wet as to cause excessive compaction or so dry as to cause excessive dust or the formation of large clods. Prior to excavating plant pits, layout individual trees and shrubs for owner's representative to approve the locations. Make minor adjustments as might be requested.

Protect existing vegetation from damage during planting operations. The Contractor is responsible to replace any damaged vegetation in kind as directed by the Engineer.

430.10.1 Deciduous and Evergreen Plantings:

Excavation: Plant pits shall be dug to produce vertical sides and flat, non-compacted but firm bottoms. If pits are dug with an auger and sides of pits are glazed, scarify the glazed surface. The size of the pits shall be twice the diameter of plant root ball or container size, and only as deep as the root ball.

Drainage: Test drainage of plant pits by filling with water twice in succession. Plant pits retaining water for more than 24 hours shall be brought to the attention of the owner's representative. Submit in writing a proposal for correction, for approval by Engineer, before proceeding.

Plant Backfill Mix: Shall consist of 1 part organic mulch, two parts excavated soil and 4 pounds gypsum and 1 pound of sulfur per cubic yard. The backfill shall be produced by thoroughly blending these components into a homogeneous mixture. The Contractor shall notify the Engineer prior to mixing prepared soil so that he may observe the mixing process. When requested submit a letter and test analysis results from a certified horticultural testing laboratory.

Setting and Backfill for Plants: Set plant material on non-compacted firm soil, plumb and in center of pit or trench. The crown (juncture of the root and shoot) shall be at grade when planting is complete. Remove pallets or containers before placing backfill. Do not handle container plants by foliage, branches or trunks. After removing plant from container, scarify side of root ball. Do not plant stock if root ball is cracked, broken, or root bound. When set at the proper elevation and orientation, place additional backfill mix, brace plant, and place fertilizer tablets. Work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water the plant thoroughly; before placing remainder of backfill. Repeat watering again after placing final layer of backfill mix until soil is completely saturated.

Place fertilizer tablets approximately 6" below grade and evenly spaced around the plant.

For one-gallon container	1 tablet
For five-gallon container	2 tablets
For fifteen-gallon container.. ..	4 tablets
For twenty-four inch box.....	6 tablets

Plant Saucers: Prepare an example plant saucer for the Engineer's review and approval. Schedule this review with the Engineer before starting planting operations.

Stake All Trees Per Plans: Set stakes vertically and spaced to avoid penetrating balls or root masses. Place tree ties for maximum support with top tie above scaffold branches and second tie midway to the ground level. Avoid "rigid"

SECTION 430

restraint of tree and allow for some trunk movement. Stakes are to be set into native soil.

430.10.2 Agave, Aloe, Cactus, Ocotillo and Yucca Plantings:

Excavation and Drainage: Shall be completed per Section 430.10.1, except plant pit shall be 6" deeper than root ball.

Backfill Mix: Shall be a mixture of 3 shovel's full of sand, or very coarse dirt (not clay or silt), one shovel of gypsum, one shovel of organic matter (avoid cow manure), 1/2 cup of sulfur, and 1/2 cup of phosphate (0-45-0). As you need more backfill mix, increase in these proportions.

Setting and Backfill: Do not set plant deeper than the plant grew naturally. Prior to placement, lay the plant down just over the hole. Trim off old dead roots to no longer than 2 inches and clean out any rocks stuck in the plant. All new plant root growth will come from the center of the root ball, not from the old roots or from the side of the stem or trunk. Sprinkle a tablespoon full of phosphate (0-45-0) in the hole. Place plant in the hole and orient to match the previous heliotropic growing condition. Set plant elevation to the visible dirt line mark of the plant and backfill the plant using the specified backfill mix. Plant shall be planted to maintain positive drainage away from the root collar of the plant. Tamp the soil to stabilize the plant. Now drench and wash off the plant.

Monitor watering closely. Normal watering for Agave, Aloe, Cactus, Ocotillo and Yuccas are once per week. During the heat of the summer, briefly spray or mist these plants from a hose, to cool the plants surface temperature. During cooler temperatures, adjust the watering schedule for the time of day and frequency.

430.11 PREPARATION FOR LAWN:

430.11.1 Soil preparation and Fine Grading New Turf areas: Excavate as necessary to accommodate depth of clean fill, topsoil and soil amendments. Prior to placing fills and amendments till to a depth of not less than 4 inches, making alternate passes at right angles. Remove rocks and debris greater than 1 inch, in any dimension. Remove high areas and fill depressions. Apply soil amendments (refer to the Section 795) as follows:

Organic matter 2 inches deep
Sulfur 10 lbs/1,000 SF
Iron Chelate 1 oz/1,000 SF

Rototill soil and amendments to homogenous fine mixture, free of lumps clots, stones, roots and other extraneous matter. Till the mixture until it is uniform in color and appearance to the satisfaction of the Engineer.

Forty-eight (48) hours prior to seeding operations fine grade lawn areas to a smooth, even surface with a loose uniformly fine texture. Finish drag or rake lawn areas removing all deleterious material 1/2" or larger from the surface and to a depth of 2 inches below the surface. Roll the lawn surface to obtain the desired compaction and remove ridges. Finish grade shall be as shown on the plans. Finish grade shall be set 1-1/2" inches below adjacent paving, curb and headers. The Engineer shall be able to push a hand probe to a depth of 4 inches at any location where turf is to be established.

Apply fertilizer (refer to Section 795) fertilizer percentages (N-P-K) and the rate of application per soil fertility test results. For bidding purposes, the fertilizer shall be (15-15-15), applied at 5 LBS/ 1000 SF. Apply additional fertilizer at the end of the turf establishment or date agreed upon with the Contracting Agency. Establishing turf is the contractor's responsibility.

430.11.2 Recondition Existing Lawn Areas: Areas damaged by Contractor's operations, including damage caused by movement of vehicles, or from the storage of materials or equipment shall be reconditioned prior to seeding or sodding.

Remove ridges, ruts, and aerate compacted soils. Fill depressions with topsoil soil. Rake surfaces to remove clumps and debris and other deleterious material 1/2" or larger from the surface. Apply fertilizer (refer to Section 795) at the rate recommended by the manufacturer (stated on bag) before initial seeding operations.

SECTION 430

430.12 LAWNS

The Contractor shall not begin planting until the irrigation system is completely installed and is adjusted for full coverage and is completely operational.

430.12.1 Sod: Allow for sod thickness in areas to be sodded. Apply commercial fertilizer at rates specified by the manufacturer and thoroughly mix into upper 2 inches of soil. Delay applications of fertilizer if planting will not follow within a few days.

Lay sod within 24 hours of initial cutting. Form a solid mass of sod with tightly fitted joints. Butt ends and sides of sod. Do not overlap joints. Stagger sod strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Sod edges and joints shall be leveled with approved soil mix.

430.12.2 Seeding Lawns: Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

Sow seed using a spreader or seeding machine at a rate of 3 1/2 pounds Bermuda per 1,000 square feet. Do not seed when wind velocity exceeds 5 MPH. Distribute seed evenly over the entire area by sowing equal quantities in two (2) directions at right angles to each other.

Bermuda seed shall be planted only at times when daytime atmospheric temperatures are consistently above 90 degrees F. and the nighttime atmospheric temperatures are consistently above 60 degrees F. If turf establishment from seed cannot be completed during the contract period, then Perennial Rye grass seed will be planted when required by the Engineer, at no additional cost to the Contracting Agency. Apply Rye grass at the rate of 15 pounds per 1,000 square feet. Distribute Rye seed evenly over the entire area by sowing equal quantities in two (2) directions at right angles to each other.

Rake lightly into top 1/8 inch of soil, roll and water with a fine spray.

430.12.3 Hydroseeding Lawn Areas: Contractor shall follow a two-step process of hydroseeding followed immediately by hydromulching. Equipment used shall be manufactured for the purpose of hydroseeding. It shall be equipped with a tank capable of continuous agitation, suspension, and blending of the slurry components. It shall be equipped with a pumping system capable of maintaining a continuous spray. It shall be equipped with nozzles and hoses to obtain a uniform application on designated areas. The tank and accessories shall be cleaned and be free of contaminants. The storage tanks shall have a means of estimating the volume used or remaining in the tank.

For hydroseeding and mulching materials refer to Section 795. All materials shall be labeled or supplied with test information concerning analysis of the various components. All work shall be performed in a professional manner to the best industry standards. Care shall be taken to avoid drift and displacement of material or any damage to structures and landscape. Protective covering shall be used where material would be objectionable. Clean up shall be done daily. Seeded areas shall be protected from traffic and construction activities.

Water, fertilizer, mulch and seed shall be combined in proportion in the first application to cover the areas at the specified rates. The ingredients shall be allowed to mix thoroughly. Allow the ingredients to mix for a minimum of 5 minutes before application of the slurry, but do not allow seed to be in the tank longer than 60 minutes, inclusive of the time to agitate.

Hydroseed an even first application of the following components:

Bermuda Seed	200 LBS / Acre
Fertilizer	200 LBS / Acre
Mulch (100% Wood Cellulose Fiber)	400 LBS / Acre

Hydromulch an even second application immediately after hydroseeding with the following components:

SECTION 430

Mulch (100% Wood Cellulose Fiber).....	1400 LBS / Acre
Tackifier	100 LBS / Acre

Hydroseeding or mulching deposited on adjacent trees and shrubs, on roadways, structures or other area surfaces where they are not specified shall be removed.

Water the hydroseed to germinate the seed and continue watering until established. Monitor watering every day. DO NOT over water or under water. It may be necessary to water several times a day. Newly germinated areas must be kept moist.

430.13 DECOMPOSED GRANITE AND RIVER RUN AREAS:

The areas on which the granite mulch or river run rock is to be placed shall be graded according to the drawings, prior to the placement of any granite or river run rock. The ground shall be reasonably smooth and rocks larger than 1" in diameter, within the top 1" of soil shall be removed and disposed of off-site.

The Contractor shall stake out all areas to receive granite mulch or river run rock. These areas shall be treated with a pre-emergent control, such as Surflan or equal, prior to and after placement of the cover material.

Decomposed granite shall be evenly distributed on the designated areas to a depth as indicated on the plans and details. If a depth is not indicated the minimum depth shall be two inches.

After placing and grading the granite mulch, the Contractor shall water granite with a light spray to settle the granite and remove fine materials from the surface. Immediately after watering, the Contractor shall roll the granite mulch with an appropriate device to an extent satisfactory to the owner's representative.

River run rock used shall be as specified on the plans. The rock shall be evenly distributed on the designated areas to depth 1-1/2 to 2 times the maximum gradation size.

430.14 CLEANUP AND PROTECTION:

During Landscape Work, keep pavements clean and work areas in an orderly conditions. Sweep, scrub or hose affected areas as directed by the owner's representative to maintain a clean and neat work area.

Protect Landscape Work and Materials from damage due to landscape installation, operations by other contractors and trades, trespassers and animals. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged work as directed by the owner's representative. Remove all debris, trash and excess materials generated by the landscape installation.

430.15 MEASUREMENT AND PAYMENT:

The lump sum or unit prices established on the schedule of values shall be full compensation for furnishing all labor, material, tools and equipment and for performing all work necessary to complete the landscaping operation to include planting of trees, shrubs and ground cover.

The quantities of lawn seeding will not be measured but shall be the quantities designated in the contract documents, except that measurements will be made for revisions requested by the Engineer, or for discrepancies of plus or minus five percent of the total quantity designated in the Contract. The quantity of lawn shall include soil preparation, fertilizer, seed, and water, established and accepted.

The quantity of sod to be measured will be the actual number of square feet, including soil preparation, water, fertilizer and sod, established and accepted.

When line item bids or schedule of values do not initially include a cost for the Plant Establishment and Maintenance

SECTION 430

Period the cost shall be assumed in the schedule of values for landscape items (i.e., plant materials, irrigation, and inert materials, such as decomposed granite, river run and boulders). Ten percent of the sum total of landscape items in addition to retention will be held for distribution during the maintenance period. Equal monthly payments for maintenance will be authorized, based on inspection and subject to extensions, where the Contractor fails to comply with previously stated requirements in Subsection 430.3. Payment may or may not be supplemental to final project payment.

SECTION 431

PALM TREE TRANSPLANTING

Add SECTION 431 in its entirety:

SECTION 431

PALM TREE TRANSPLANTING

431.1 DESCRIPTION:

This Section shall govern the relocation (transplanting) and planting of palm trees required by the plans or specifications. The Contractor shall furnish all labor, materials and equipment required to complete the excavation, lifting, transporting and transplanting of palm trees.

431.2 GENERAL:

Unless otherwise provided by this Section the work shall conform to the Section 430 and the following.

431.3 PALM ESTABLISHMENT GUARANTEE AND MAINTENANCE:

Palm establishment, guarantee and maintenance shall be per Section 430 with the following modifications or additions:

The palm establishment, guarantee and maintenance period shall be for 90 days, unless otherwise extended.

Guarantee palms against the vascular disease Penicillium (Gliocladium) vermoeseni, the fungus Fusarium oxysporum, and the root disease Phytophthora and similar vascular infections for a period of five (5) years.

Replace without additional cost to the Contracting Agency all dead palms and all palms not in a vigorous condition as determined by the Engineer. Replacement shall be when directed by the Engineer.

431.4 JOB CONDITIONS:

Prospective contractors are encouraged to visit the job site prior to bidding on this project, and to satisfy their concerns as to the magnitude of the work involved.

It may be necessary to supplement the irrigation system and provide additional water to establish newly planted palm trees. Water from the existing irrigation system will be paid for by the Contracting Agency. The Contractor is responsible for delivery and payment of water from other sources.

Remove all debris, trash and excess materials found on site or generated by the Contractor's operations.

Prior to digging and transplanting of palm trees the Contractor shall notify the Engineer at least two (2) working days before starting any work.

SECTION 431

431.5 DELIVERY, STORAGE AND HANDLING:

Palms shall be free of dead or dying fronds with all fronds of a normal size and color.

The Landscape Architect will be available to review and tag palms at place of growth and will again review palms upon delivery for conformity to the specifications. Travel to non-local Nurseries, out of the metropolitan Phoenix area, when requested by the Contractor, will be paid for by the Contractor. In lieu of non-local nursery review, the Contractor may elect to provide photographs with a person adjacent to each palm for preliminary review. Such review shall not impair the right of review and rejection during progress of the work should the palms not meet the specifications. The selected palms shall not exceed the specified height by more than 1 foot. It is unacceptable to plant the root ball deeper than 1 foot above the soil line of the palm.

The Contractor must certify that the palms are free of disease prior to shipment.

After tagging of the palms, remove all thatch from older leaves and cut back all resulting stems to within 2 inches of the base of the trunk. The crown of the palm shall be reduced per standard nursery practice prior to shipping. Use soft rope (organic twine) to tie remaining fronds to protect crown bud. Do not permit fronds to become damaged by means of restraint.

Exercise extreme caution while pruning palms, to prevent spread of vascular diseases. Dip pruning tools in a sterilizing agent before beginning pruning and before moving from one palm to another. Do not use any chain type saws for pruning operations.

Lifting, Off-loading, and Transporting: A lattice type crane, a telescoping type crane or a specially designed tree crane is acceptable for lifting and off-loading palm trees. For transporting, the trailer used shall be long enough to avoid damage to the heart of the palm. Loading and unloading of palms must be accomplished with the aid of nylon or fabric sling/straps with a minimum width of 4 inches. Excessive scarring or trunk damage will not be permitted and will be cause for rejection of the palms at the project site.

If the palms are not planted the day they arrive at the project site, the crowns and root ball should be protected from the sun and from reflected heat from the ground. Avoid storing on an asphalt surface.

Covering material must allow air movement so that heat does not build up under the covering. Do not use plastic or rubberized tarpaulins. Trees may not be stored for more than 48 hours. Do not stack palms, but lay them in a single layer on a flat surface. Covered root balls must be watered lightly every couple of hours.

431.6 MATERIALS AND PRODUCTS:

All palms shall have been grown in accordance with good horticultural practices under climatic conditions similar to those for the project for at least two (2) years prior to shipment to the site.

All palms shall be well-grown, symmetrical, without curvature or leaning trunk from the perpendicular and so trained or favored in development and appearance as to be superior in form, compactness and symmetry of crown. All palms shall be within one foot above or below the height specified, measured from the bottom of the crown bud to finish grade after installation.

All palms shall be sound, healthy and vigorous, well foliated prior to pruning and showing no signs of disease. They shall be free of disease, insect pests, eggs or larvae. They shall also have well developed root systems. All palms shall be free from physical damage or adverse conditions which would prevent thriving growth.

Verify that all field dug palms contain an adequate root ball to guarantee transplantation. Do not wrap root ball in plastic. Do not install palms that have damaged root balls.

Accessories:

SECTION 431

Clean washed river sand.

Frond Tie: Minimum 1/2 inch diameter soft sisal rope capable of maintaining frond in tied condition for 1 year.

Fungicides: Soil Drench: "Subdue" by CIBA-GIEGY

431.7 SEQUENCING AND SCHEDULING:

Coordinate delivery of palms with planting operations to avoid on site storage longer than 48 hours. Planting delays may result in rejection of the palm.

431.8 PREPARING THE SITE FOR LANDSCAPING:

Remove palms designated for replacement. Removal includes digging out stumps and roots to make room for replacement material. Remove all debris, trash and excess materials generated, and dispose of this material off-site.

Protect existing plant material, walls, pavements and other site amenities from damage.

431.9 PALM TREE SALVAGING:

Prior to excavation, the palm tree shall be thoroughly watered.

Excavation: A trenching machine, a backhoe with a narrow bucket or a properly sized tree spade is acceptable as the excavation equipment. The exact equipment used must be approved by the Engineer.

Reduce the crown of palm trees per standard nursery practice. Use soft sisal rope to tie remaining fronds to protect crown bud.

The size of the root ball taken shall be a minimum of 18" to 24" deep and have a 2" to 3" wider radius than the base of the palm, unless otherwise directed by the Engineer. Certify that all field dug palms contain adequate root ball to guarantee successful transplanting.

Carefully lift and transport palm tree to the new location so as not to cause damage to the tree or site.

431.10 EXECUTION OF PLANTING:

Layout palms at locations shown on the plans. Use 3 foot lath, color coded for each palm. The Engineer will check location of palms in the field to exact position before planting begins.

Where palms are to be replanted to permit site improvements to be installed around them, be responsible for the accurate layout of those palms, measured to their centerlines. Be responsible for the protection of those palms while work is taking place. Provide regular irrigation as necessary until final acceptance.

The palm tree excavation shall be a minimum of 1.5 times (x) larger than the root ball depth and 1 foot larger on all sides. It is acceptable for the final site grade around the palm to be 6 to 12 inches higher than the original soil line of the root ball. The depth of the pit shall be approved by the Engineer prior to planting the tree.

Water test each tree pit for drainage by filling the holes twice in succession with water. If when filled with water the second time the pit fails to drain within 24 hours, then additional excavation is necessary to break through the impermeable layer or provide a thick under layer of sand below the root ball. The cost for over excavation and for the installation of a drainage chimney will be considered should the tree pit not drain.

SECTION 431

Clean moist washed river sand should be added to the bottom of the hole and tamped or water jetted, prior to insertion of the tree.

Install drainage and viewing pipe(s) in each tree pit to assure wetting of the whole root ball and to enable monitoring and viewing of the tree pit chamber. The vents shall be 4" diameter perforated PVC, with sufficient length to extend to the bottom of the tree pit. Do not backfill drainage or viewing pipes.

Backfill should be clean washed river or concrete sand amended with 25% native soil. In areas where soils are heavy in caliche, 100% sand shall be used. After placement of the palm, moistened sand shall be thoroughly tamped as backfill is being added to assure stability of the tree.

A 6" deep swale shall be made around each palm tree to provide water holding capability.

Mulch: Apply a 2" layer of decomposed granite in all palm tree watering basins.

After planting, the crown buds of all the palms shall be within 1 foot of the designated palm height above finish grade.

After planting, drench the soil with the fungicide, "Subdue" per manufacturer's recommendations by flooding the planting basin. Reapply as often as label permits throughout the maintenance period.

Irrigation: It is essential that irrigation be deep enough to assure wetting of the whole root ball. The Contractor shall maintain the irrigation system to the existing trees and supplement additional water to newly planted trees as necessary for establishment. Use a tensiometer weekly during the maintenance period to verify correct watering at the surface and at the bottom of the root ball, report moisture levels to the Engineer.

431.11 MEASURE AND PAYMENT:

Measurement will be made on the number of trees that survive the planting operations. Unless otherwise specified by the Engineer, the Contractor shall be responsible for the cost of replacement and planting of any palm tree, in kind, that does not survive. Palms that do not survive become the property of the Contractor for disposal. Payment will be made at the unit bid price for each surviving tree which will be full compensation for all labor, materials, tools and equipment required for excavating, transporting, transplanting, and watering of the tree(s).

SECTION 440

SPRINKLER IRRIGATION SYSTEM INSTALLATION

Delete the title of this SECTION in its entirety and replace with the following:

LANDSCAPE IRRIGATION SYSTEM INSTALLATION

Delete SECTION 440 in its entirety and replace with the following:

440.1 GENERAL:

The Contractor shall furnish all labor; materials, tools, equipment, and services necessary for the execution and completion of the irrigation system work as indicated on the drawings and as described in these specifications and the General Conditions.

Due to the scale of the drawings, it is not possible to indicate all offsets, fittings and sleeves, which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and plan his work accordingly, furnishing such offsets, fittings and sleeves as may be required to meet such conditions. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.

The work of this Section generally includes provisions of an automatic underground irrigation system including the following:

Trenching, stockpiling excavation material, and refilling trenches.

Complete system including but not limited to piping, backflow preventer assemblies, valves, fittings, emitters, controllers and wiring, and final adjustments to insure complete coverage.

Replacement of unsatisfactory materials.

Clean-up, inspection, and approval.

Tests: The system shall efficiently and uniformly irrigate all areas and perform, as required, by the plans and specifications.

No irrigation work is to be performed until all areas are finished to proper grade and until soil preparation is completed, and has been approved by the Engineer.

440.1.1 Work By The Water Services Department: The Contractor will coordinate with the Engineer at the Preconstruction Meeting to schedule water service dates well in advance of need. The Engineer will contact the Water Services Department to authorize work required to be performed by Water Services Department crews. At least six weeks prior to need the Contractor will make application with the Water Services Department. At the time of application, the Contractor will contact the Water Services Department to schedule installation of a water tap and meter, and to provide them with his billing address.

The Contractor shall pay for all water used until the project is accepted, or until completion of the Landscape Maintenance period, whichever is later, and the water meter accounts are transferred back to the City. At the close of the project, the Contractor shall submit water meter account numbers to the Engineer and request transfer of the meter to the City. The Contractor will remain responsible for water used and payment thereof, until transfer.

440.1.2 Work By The Power Company: The Contractor will be responsible for coordinating with the power company to locate power drops for the irrigation controller(s), when power is not serviced by a Service Entrance Section.

Unless otherwise specified or directed by the Engineer, the Contractor will obtain an account with the utility company

SECTION 440

and will pay for all electrical power used until the project is accepted, or until completion of the Landscape Maintenance period, whichever is later, and the utility accounts are transferred. At Final Acceptance, Contractor will submit electrical meter account numbers to the Engineer and request transfer of the meter to the City, or the Contractor will remain responsible for electrical use and payment thereof, until transfer.

440.2 REFERENCES:

Conform to the requirements of reference information listed below except where more stringent requirements are shown or specified in the Contract Documents.

American Society of Testing Materials (ASTM) - Specifications and Test Methods specifically referenced in this Section.

Underwriters Laboratories (UL) - UL Wires and Cables.

440.3 QUALITY ASSURANCES:

Work involving plumbing for installation of copper piping, backflow preventer(s), and related work shall be executed by licensed and bonded plumber(s). Secure a permit at least 48 hours prior to start of installation.

440.3.1 Tolerances: Specified depths of mains and laterals and pitch of pipes are minimums. Settlement of trenches is cause for removal of finish grade treatment, refilling, re-compaction, and repair of finish grade treatment.

440.3.2 Coordinate Work with Other Trades: For a period of one year from Final Acceptance, guarantee/warranty irrigation materials, equipment, and workmanship against defects. The Contractor shall replace any pavement damage resulting from the installation of the irrigation system and repair damage to grading, soil preparation, seeding, sodding, or planting at no additional cost to the owner. Make repairs within 3 days following notification by the Engineer.

440.3.3 Delivery Storage and Handling: During storage protect pipe from heat and sunlight. Provide shade protective cover and allow air to circulate between pipe. Transport pipe so as not to subject pipe to bending or concentrated external loads. Pipe, which is sun tanned, dented, or damaged will be rejected.

440.4 SUBMITTALS:

440.4.1 Shop drawings and product information: Prepare and make submittals in accordance with conditions of the Contract, and as follows: A minimum of ten days prior to beginning work on the irrigation system the Contractor shall submit six (6) copies of manufacturers literature. Highlight product specifics including name, and model numbers of materials listed below and any other items requested by the Engineer. Do not order materials until the Engineer approves products.

Items to be submitted:

Sprinklers (turf heads, shrub bubblers, emitters)	Backflow Preventers	Flowmeters
Pipe & Fittings	Automatic Valves	Flushcaps
Swing Joint Assemblies	Controllers	Micro-tubing & Stakes
Quick Coupling Valves	Solvents	Wire & Connectors
Gate Valves	Wye Strainers	Valve Boxes, Pull Boxes, etc.
Pressure Regulating Valves		

All items shall be those specified and approved by the Engineer. Substitutions will not be allowed without approval.

440.4.2 Record Drawings: The Contractor shall maintain an accurate set of as-built plans on site. At the end of each day work accomplished shall be updated on the as-built plans. The Contractor shall dimension from two permanent points of reference, building corners, sidewalk, or road intersections, etc., the location of the following:

2015 City of Phoenix Supplement to 2015 MAG Uniform Standard Specifications

SECTION 440

Connection to existing water lines
Connection to existing electrical power
Gate valves
Routing of Sprinkler pressure lines (dimension at a minimum of 100 feet along routing)
Emitter control valves
Routing of control wiring
Quick-coupling valves
Other related equipment as directed by the Engineer

The Contractor shall indicate any non-pressure pipe routing changes on the as-built drawings.

Before the final inspection, the Contractor shall deliver to the Engineer one copy of the as-built plans to review. Delivery of this set of plans does not relieve the Contractor of the responsibility of furnishing required information that may be requested by the Engineer. The Contractor shall make corrections noted and submit final as-built plans to the Engineer for approval and acceptance. The Engineer will not certify payment requests or make final payment if as-built plans are not current or complete.

440.4.3 Controller Charts: As-Built drawings shall be approved by the Engineer before controller charts are prepared. The chart shall show the area controlled by the automatic controller and shall be 24" x 36" sheet size, unless a reduced size is approved by the Engineer. Identify the area of coverage of each remote control valve, using a distinctively different color, drawing over the entire area of coverage. Following review of the charts by the Engineer, they shall be hermetically sealed between two layers of 20 mm thick plastic sheets. These charts shall be completed and approved prior to final inspection of the irrigation system. When approved by the Engineer a separate card listing stations and areas covered may be substituted for the 24" x 36" hermetically sealed plan sheet(s).

440.4.4 Operation and Maintenance Manuals: Submit four (4) operation and maintenance manuals to the Engineer for review prior to final acceptance. The manuals should include the complete technical description of materials and products used; guarantee statement, complete operating and maintenance instructions on all major equipment. Contractor to provide a demonstration to maintenance personnel, with the Owner's Representative present, of how to adjust and maintain all sprinkler head types, controller functions, and recommended controller programs, as established by the Contractor. Contractor is also to review recommended watering rates for new plant materials.

440.4.5 Equipment to be Furnished: All materials to be new and bear the appropriate National Association seal of approval for example, NSF, UL, etc. Similar units shall be procured from the same manufacturer and internal parts shall be common and interchangeable. Parts listing and source replacement will be furnished to the Engineer.

Equipment to be furnished:

- a. Two sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied to the project.
- b. Two quick-coupler keys and matching hose swivels for each type of quick-coupling valve installed.
- c. One five foot valve key for operation of gate valves

Extra Stock to be furnished:

- a. 2 sprinklers of each type and 5 nozzles of each precipitation rate.
- b. 2 bubblers of each flow rate used.
- c. 5 Single Port Emitters of each flow rate used.
- d. 2 Multi-port Emitters of each flow rate used.

The above mentioned equipment and stock shall be turned over to the Owner at the conclusion of the project. Before final inspection, evidence that the Owner has received this material must be provided to the Engineer.

SECTION 440

440.5 PERMITS:

All permits for installation or construction of the work included under this Section, which are required by legally constituted authorities having jurisdiction, shall be obtained and paid for by the Contractor, each at the proper time. He shall also arrange for and pay all costs in connection with any inspections and examinations required by these authorities.

440.6 EXECUTION:

Examine areas and conditions under which work of this Section is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.

440.6.1 Staking: Mark the routing of the pressure supply line with powdered lime, and stake the locations of various components. Coordinate locations with other trades. Coordinate sleeves with other trades. Preliminary adjustments to conform to actual site conditions shall be accomplished during staking. Should changes be required, the Contractor shall obtain approval of the Engineer prior to actual work being performed. Utility connections, both water and electrical, shall be as shown on the plans or as designated by the utility concerned.

440.6.2 Trench Excavation: Trenches and other excavations shall be sized to accommodate the irrigation system components, conduit, and other required facilities. Additional space shall be provided to assure proper installation and access for inspection. Unless otherwise specified, the minimum depth of cover over pipelines and conduits shall be as follows:

- a. Electrical conduit - 18 inches cover
- b. Waterlines continuously pressurized - 18 inches cover
- c. Lateral sprinkler lines - 12 inches cover
- d. Plastic lines under pavement - 24 inches cover

The bottom of the trenches shall be true to grade and free of protruding stones, roots or other matter, which would prevent proper bedding of pipe or other facilities. Where ledge rock, hard pan, or boulders are encountered, the trench bottom shall be undercut and filled with sand or fine grained material approved by the Engineer.

Clearances:

- a. Piping 3" and larger - minimum trench width of 12 inches.
- b. Piping smaller than 3" - minimum trench width of 7 inches.
- c. Provide not less than 4 inches of clearance between each line, and not less than 12 inches of clearance between lines of other trades, to permit service or replacement without disturbing the other line.

Grading and Stockpiling of trenched materials shall comply with Section 601.

440.6.3 Sleeving: Piping located under asphalt, concrete, or other pavements shall be sleeved, size and schedule as noted on the plan. If not noted, sleeves shall be Schedule 40, sized to easily accommodate piping. Use separate sleeve for wiring.

Boring will be permitted only where pipe must pass under obstructions, which cannot be removed, or when approved by the Engineer. When any cutting or removal of asphalt and or concrete work is necessary, it shall be saw cut in accordance with Section 601. Permission to cut asphalt or concrete shall be obtained from the Engineer. When piping on the drawings is shown in paved areas, but running parallel and adjacent to planted areas, the intent of the drawings is to install the piping in the planted area.

440.6.4 Piping: Provide pipe, schedule and size as shown on the drawings and per these specifications.

PVC Pipe: Snake pipe in trench as much as possible to allow for expansion and contraction. Provide a firm, uniform bearing for the entire length of each pipeline to prevent uneven settlement. Installation of pipe shall be installed in

SECTION 440

accordance with ASAE Standard: ASAE 376. Pipe shall be clean prior to installation and shall be maintained in that condition during installation. When pipe lying is not in progress, the open ends of the pipe shall be closed by approved means.

If reclaimed water is used, all piping and associated appurtenances shall meet the applicable requirements of the Arizona Administrative Code R18-9-602(G). Signage will be placed to indicate the use of non-potable water.

Sand bedding or fine-grained material shall be provided where ledge rock, hard pan, or boulders are encountered. Compact bedding material is to provide a minimum depth of bed between pipe and rock of 4 inches.

Solvent welded joints shall be made in accordance with ASTM D-2855, and the type of solvent and primer recommended by the pipe manufacturer shall be used. Primer and solvent shall be applied to the pipe ends in such a manner that no material is deposited on the interior surface or forced into the interior of the pipe during insertion. Excess solvent on the exterior of the joint shall be wiped clean immediately after assembly. The pipeline will not be exposed to water for at least 12 hours after the last solvent welded joint has been made.

Schedule 80 pipe shall be used for threaded joints. Field threading shall be accomplished in the same manner as specified for steel pipe, except that a plug will be installed in the bore of the pipe prior to threading to prevent distortion. Solvent will not be used on threaded pipe. Threaded joints shall be hand tightened with final tightening as necessary to prevent leaks with a strap wrench.

The pipe shall be protected from damage during assembly. All vises shall have padded jaws and only strap wrenches will be used. Any plastic pipe, which has been nicked, scarred, or otherwise damaged, shall be removed and replaced. Care shall be exercised so that stress on a previously made joint is avoided.

When PVC to metal pipe connectors are required, these connections shall be accomplished first. A plastic adapter with external pipe threads should be used, screwing it into the metal internal pipe threads. Use a non-hardening pipe dope, such as Permatex #2, or equal, on all plastic to metal threaded joints. The joint shall be hand-tightened. Utilize a light wrench, as necessary, to prevent leaks.

When wrapped pipe is specified, joints and connectors shall not be wrapped until completion of the pressure test.

Use 45 degree fittings at all changes in depth of pipe. Couplings to be schedule 80 unless otherwise noted. Minimum length of PVC nipple shall be 3 inches.

440.6.5 Wiring: Service wiring shall be installed in rigid conduit from the service point to the controller at the minimum depth specified. A separate disconnect switch or combination meter socket, as required, shall be installed between the source of power and the controller. The minimum Service wire shall be No. 12 AWG copper 600 volt type, TWH or larger, as required by the contract documents or controller manufacturer. Wire splices for Service wiring shall be located in pull boxes where required to facilitate installation of wiring. Pull Boxes shall be plastic, except where subject to vehicular traffic, concrete rated boxes shall be required. Service wiring shall be per current Local, State, National NEC requirements.

Low Voltage Control Wiring issuing from the controller shall be direct burial, type UF, No.12 AWG copper, unless otherwise required and installed in main or lateral waterline trenches wherever practical. Install common ground wire (type UF No. 12 AWG Copper) and one pilot or hot wire (type UF No. 14 AWG Copper) for each remote control valve (These are minimum wire sizes allowed when not noted otherwise on plans.). Multiple valves on a single control wire are not permitted.

Install two (2) control wires along the entire length of the mainline. Locate wire adjacent to main line piping. Never place wire on top of pipe. Bundle wires at 10 foot intervals with plastic electrical tape. Sufficient slack shall be left in the wiring to provide for expansion and contraction. Provide 12" loop (2 feet) at all changes in direction or at a minimum of 250 feet. When control wiring cannot be installed in the pipe trench it shall be installed a minimum of 18 inches below finish grade. Attach wire markers to the ends of the control wires and label valve stations at controller

SECTION 440

locations.

All pilot or "hot" wires are to be of a different color and all common wires are to be of another (common) color. If multiple controllers are being utilized, and wire paths of different controllers cross both common and control wires, from each controller, shall be of different colors.

Splices in control wire shall be made only in Junction Boxes with approval from the Engineer. Splices shall be made with waterproof connector, approved for underground use. Sufficient slack shall be left to allow splices brought to the surface without disconnecting the wire. No splices shall be permitted under pavements.

All wiring shall be tested for continuity, open circuits, and unintentional grounds prior to connecting the equipment. All controllers shall be grounded independent of any other controller as recommended by the controller manufacturer, and all valves shall be connected to the common ground wire of their respective controller. A single separate pilot or hot wire (different color) shall be extended from the valve to the specified controller. Low voltage wire splices outside of the valve box are not permitted, unless approved by the Engineer, at which case they must be made in a PVC Pull Box.

One spare #12 AGW wire "Pilot" (orange) and one #12 "Common" wire, (total 2 - #12 wires) shall be installed from the controller along the entire length of pressure lines to last (farthest) electric control valve on each and every leg of the mainline. The color of the spare control wire is to be of an alternate color. Provide 3 foot length of all spare wires in each remote control valve box along wire routing.

440.6.6 Valves, Valve Boxes, and Special Equipment: Backflow Preventer Assembly: The Backflow Prevention assembly shall be installed per the details shown on the drawings and associated governing code requirements. Provide pipe supports and the accessories to properly secure the assembly. The irrigation system shall not be operated until the assembly has been tested and certified to meet the requirements of the Water Services Department.

After the backflow assemblies have been properly installed by the Contractor and approved by Planning and Development Department, the Contractor shall pay for testing and be responsible for having the assembly(ies) tested by a certified backflow prevention assembly tester, approved by the City. The tester shall prepare test report(s), showing the condition of the assemblies and confirming that the assemblies are properly functioning. It is the Contractors responsibility to submit the forms to the Engineer. Final acceptance will not be given until the reports are approved by the Engineer.

Valves, Pressure Regulators, and Related Accessories shall be installed as shown on the plans, or as specified. They shall be installed in a normal upright position unless otherwise recommended by the manufacturer, and shall be readily accessible for operation, maintenance and replacement. The equipment shall be set at a sufficient depth to provide clearance between the valve box cover and the valve handle, cap, or key for operation of the system.

Gate Valves and Isolation Valves shall be installed below ground and shall be housed in a concrete or plastic pipe, with bolt down locking cover that will permit access for servicing. The pipe shall be centered on the valve stem. Isolation valves shall not be located within range of the sprinklers they control without approval of the Engineer.

Drain Valves shall be installed at all low points in pressure supply line as detailed. Provide drainage sump for each drain valve based on the table below:

SECTION 440

TABLE 440-1
CUBIC FEET OF GRAVEL PER DRAIN VALVE
DISTANCE OF PIPING TO BE DRAINED

Pipe Size	0-250 LF	251-500 LF	501-750 LF	751-1000 LF
1"	0.75	1.50	2.25	3.00
1-1/4"	0.75	1.50	2.25	3.00
1-1/2"	1.50	3.00	4.50	6.00
2"	2.50	5.00	7.50	10.00
2-1/2"	4.00	8.00	12.00	16.00
3"	6.00	12.00	18.00	24.00
4"	11.00	22.00	33.00	44.00
6"	25.00	50.00	50.00	50.00

Quick Couplers and Hose Bibcocks shall be installed as shown on the plans, or as specified. Their location shall be a minimum of 3 feet from curbs, pavements and walks, unless approved otherwise by the Engineer. Hose bibcocks shall be set 12 inches above finish grade and installed on a galvanized riser or as detailed.

Quick Coupler Assemblies: shall have double swing joint mobility to allow for full and optimal positioning. A pre-manufactured swing joint assembly as manufactured by Lasco Inc., or approved equal is specified. All quick couplers shall be set perpendicular to finish grade unless otherwise designated on the plans or instructed by the Engineer.

Valve Boxes: Install one valve box for each valve installed as shown on the plans, or specified unless directed otherwise by the Engineer. Install gravel sump after compaction of all trenches. Place final portion of gravel inside valve box after valve box is backfilled and compacted. Set valve boxes 1/2 inch above finish grade.

The valve boxes shall be branded with the controller letter and station number of the contained valve. The letter and number size shall be no smaller than 1 inch and no greater in size than 1-1/2 inches. Depth of branding shall not be more than 1/8 inch into the valve box lid. All labeling shall be neat and legible.

440.6.7 Sprinklers, Bubblers, and Emitters: Sprinklers, Bubblers, and Emitters: Install where indicated on the drawings, staked and approved. Set to finish grade as detailed; spacing of Sprinklers shall not exceed maximum recommended by the manufacturer without approval of the Engineer. Assemblies shall be installed as detailed, provide at least 4 inches clearance from vertical elements projecting above grade such as walls, planter boxes, curbs, and fences.

Turf Heads Assemblies shall have double swing joint mobility to allow for full and optimal positioning. A pre-manufactured swing joint assembly such as that manufactured by Lasco Inc., or approved equal is specified. All sprinkler heads shall be perpendicular to finish grade unless otherwise designated on the plans or instructed by the Engineer. Install for head to head coverage and uniform distribution throughout the turf area.

Plant Bubbler Assemblies shall consist of a horizontal connection to the lateral line with 1/2" S.D.R. 13.5 PVC lateral extension, schedule 40 fittings, and 1/2" flex hose riser (sch 40) with male adaptor (slip x thread) to receive the bubbler. Install bubbler assemblies as detailed on the plans. Locate the top of bubbler:

- a. 1" above finish grade in shrub beds.
- b. In turf areas - provide 4" diameter (times 12" long) PVC class 200 vertical sleeve filled with pea gravel. Install bubbler 3" below top of sleeve. Set top of pipe flush with finish grade of turf.

Emitter Assemblies provide a horizontal connection to the lateral line using schedule 40 PVC fittings and PVC to flex adapters (slip x slip), 1/2" schedule 40 flex tubing (max. length, 20') and slip x threaded male adaptor to receive the emitter. Emitter outlets shall be installed to the high side of the plant. Provide a minimum of 1 outlet per shrub, and 3 outlets per tree, equally space around the plant, unless otherwise noted in the plans. Single port emitters shall be located 1 inch above grade as detailed. Multi-port emitters shall be located below finish grade, as detailed, and the distribution tubing staked in place then covered with 2 inches of mulch. The distribution tube outlet end shall be exposed above the

SECTION 440

soil/mulch surface to water the root ball of the plant.

440.6.8 Controller System: The controller and accessories shall be installed at the locations designated and per the details shown on the contract documents. Submit shop drawings of components.

Controllers located outdoors shall be installed in cabinets specifically design to house the controller, or as detailed on the plans. The concrete pad for controller enclosures shall be Class B, size shall be as shown, or if not shown, as recommended by the manufacturer. All copper pipes in contact with concrete shall be type k copper and sleeved or wrapped with "Scotchwrap #50" or equal minimum thickness 40 mils.

Controllers located in building: Prepare an elevation plan detailing placement of equipment, conduit, sleeves and wire gutter runs to the Engineer, for approval. Stub out all conduit 2 feet beyond concrete foundations or walls and provide bushings for all conduit. All RGS conduit in contact with earth shall be wrapped with "Scotchwrap #50, or equal, minimum thickness 40 mils.

440.6.9 Pipe Bedding, Backfill, and Compaction: Bedding: Pipe shall be bedded in at least 4 inches of finely graded native soil or sand to provide a firm uniform bearing. After laying the pipe shall be surrounded with additional finely grained native soil, or sand, then covered with not less than 4 inches of the same material. Bedding sand shall be required when site conditions dictate and clean finely grained native soil is not available. Contractor shall verify site conditions and satisfy his concern prior to bidding; no separate payment shall be made for bedding sand.

Backfill trenches and excavations with clean material. Remove organic material, as well as rocks larger than 1 inch in diameter. Place acceptable backfill material in lifts, the height of which shall not exceed that which can be effectively compacted, pending on the type of equipment and methods used. Trenches and excavations shall be backfilled to match engineered earthwork sections.

Partially backfill the irrigation trenches and pressure test the system, prior to completing backfill operations. Center load the pipe with sufficient backfill to hold the line in place, keeping the joints exposed for observation until completion of testing.

Compaction shall be in accordance with Section 601. Water settling of the trenches is not permitted unless approved by the Engineer.

440.6.10 Cleaning: Maintain continuous cleaning operations throughout the duration of the work. Dispose of, off-site at no additional cost to the Owner, all trash or debris generated by installation of the irrigation system.

440.7 FLUSHING AND TESTING:

After completion and prior to the installation of any terminal fittings, the entire pipeline system shall be thoroughly flushed to remove all foreign material. After flushing, the following tests shall be conducted in the sequence listed below. All equipment, materials, and labor necessary to perform the tests shall be furnished by the Contractor, and all tests shall be conducted in the presence of the Engineer.

Pipeline Pressure Test: A water test shall be performed on all pressure mains. Pressure mains shall be tested with all control valves installed and in the closed position. The constant test pressure and duration of the test shall be for 6 hours at 125 psi. Any leaks, which occur during the test period, will be repaired immediately following the test. The pressure mains will then be re-tested until accepted by the Engineer.

Sprinkler Coverage Test: The coverage test shall be performed after the sprinkler heads have been installed and shall demonstrate that each section or zone in the irrigation system is balanced to provide uniform and adequate coverage of the areas served. The Contractor shall correct any deficiencies in the system.

SECTION 440

Operational Test: The Contractor shall perform an operational test of the system to ensure proper and even distribution of water to all plants. Adjust or replace any type of irrigation equipment not operating correctly prior to the walk-through inspection.

440.8 PRELIMINARY, SUBSTANTIAL AND FINAL WALK-THROUGH INSPECTIONS:

Arrange for a preliminary walk-through with the general contractor's superintendent, when the entire system is operational. Operate each zone in its entirety, additionally, open all valve boxes and expose items covered, if directed. Generate a list of items to be corrected and make adjustments, "fine tuning" the entire system by regulating valves, adjusting patterns and break-up devices, and setting pressure regulators at proper and similar pressure to provide optimum and efficient coverage. Flush and adjust all outlet devices for optimum performance and to prevent run-off or spray on to walks, roadways, and buildings.

Arrange for a Substantial Completion walk-through with the Engineer when all items generated from the preliminary walk-through have been corrected. Items deemed not acceptable by the Engineer shall be reworked to complete satisfaction. The Landscape Maintenance Period will not begin unless the irrigation system is operating correctly and until authorization by the Engineer. All accessories, charts, record drawings and equipment, as required, will be provided before scheduling the Final walk-through.

Following the Landscape Maintenance Period a Final walk-through inspection will be scheduled to review the system and make adjustments to the watering schedules.

440.9 MEASUREMENT AND PAYMENTS:

Measurement and payment shall be in accordance with the General Conditions. The lump sum established in the schedule of values shall be full compensation for furnishing all labor, materials, tools and equipment, and performing all work necessary for completion of the irrigation system described or specified in the contract documents.

When unit bid items are included in the proposal sheets, the unit prices quoted shall include the following items of work and material.

- (A) Water Service Tap and Meter: The work under this item will be performed by the City of Phoenix Water Services Department and consists of furnishing and installing a curb stop, concrete meter box with cover, tap to main and pipeline to the curb stop at the locations and in accordance with the details shown on the plans. The curb stop and water meter box will be paid for under this item. Payment will be made at the current price for this service as charged by the City of Phoenix. With some projects an allowance may be shown in the bid proposal for this item (refer to Subsection 440.1.1).
- (B) Backflow Prevention Unit: The unit price for this item shall include the backflow prevention unit, locking cage assembly, risers and concrete thrust blocks, complete and in place.
- (C) Electrical Remote Control Valve and Assembly: The unit price for this item shall include the valve, the valve box with stainless steel hex bolt secured cover, pea gravel and specified pipe to the meter or backflow prevention unit.
- (D) Sprinkler Controller: The unit price for this item shall include:

Cost of sprinkler controller (automatic);

All wiring for a complete underground control system, including trenching, wire, conduit, boring or jacking;

Steel security cabinet with concrete base, grounding system, metal hasp and padlocks, and all wiring within the cabinet unless controller is placed on a building or within a walled enclosure.

SECTION 440

The junction box and any work and materials required from the stub out provided by the power company in order to complete the installation of the controller.

- (E) Irrigation Pipe: The contract price for this item shall include the pipe and fittings, trenching, backfilling and any necessary boring or jacking to install the pipe. Sleeves shall be Schedule 40.
- (F) Pull Box: The contract price for this item shall include the pull box (plastic irrigation valve box with stainless steel hex bolt secured cover).
- (G) Sprinkler Head: The contract price for this item shall include the head and all fittings, nipples and risers from lateral to the head.

PART 500
STRUCTURES

SECTION 505

CONCRETE STRUCTURES

Subsection 505.1 DESCRIPTION: Delete the last paragraph and replace it with the following:

Permanent ladders, embedded ladder rungs, and permanently embedded tie-off points are not permitted and shall not be installed.

SECTION 515

STEEL STRUCTURES

Subsection 515.1 DESCRIPTION: Add the following paragraph to the end of this Subsection:

This Section shall govern the construction of steel structures within the public right of way and public right of way easements.

Subsection 515.1.3 As Built Plans: Delete this Subsection in its entirety and replace with:

Before formal acceptance of the work, the Contractor shall submit detailed As-Built plans of the structure to the Engineer. Scans of the As-Built plans will be retained by the City as permanent records. As-Built plans shall be submitted on bond paper and shall be of a quality satisfactory to the Engineer. Mylar or Vellum plans may be submitted at the Contractor's option at no additional cost to the City.

Subsection 515.1.4 Methods and Equipment: Add the following paragraph to the beginning of this Subsection:

Special provisions shall specify special inspection requirements for the fabrication, erection and assembly of structural members and connections.

Subsection 515.2 STEEL BUILDING AND MISCELLANEOUS STEEL STRUCTURES: Delete the first paragraph in its entirety and replace with the following:

Details of design, fabrication and erection of such buildings and structures shall conform to the City of Phoenix Construction Code.

SECTION 520

STEEL AND ALUMINUM HANDRAILS

Subsection 520.2 FABRICATION: Add the following after the fourth paragraph:

Aluminum railings or members shall be Aluminum Alloy 6063-T6 as per the Aluminum Alloy Association Standards for Handrails.

Aluminum railings shall be approved for use by the City Engineer or City Materials Lab Supervisor prior to being installed in concrete. Aluminum items shall have an approved, continuous, protective coating on all surfaces that will be in contact with a Portland cement concrete product.

PART 600
WATER, SEWER, STORM DRAIN AND IRRIGATION

SECTION 601

TRENCH EXCAVATING, BACKFILLING AND COMPACTION

Delete SECTION 601 in its entirety and replace with the following:

601.1 DESCRIPTION:

The work covered by this specification consists of furnishing all plant, labor, equipment, appliances and materials, and performing all operations in connection with the excavation and backfilling of trenches in accordance with the plans and special provisions.

Excavation for appurtenant structures, such as manholes, inlets, transition structures, junctions, structures, vaults, valve boxes, catch basins, etc., shall be deemed to be in the category of trench excavation.

601.2 EXCAVATION:

601.2.1 General: No extra monetary compensation or additional time will be authorized for claims that soil conditions differ from those anticipated or those indicated by soil logs and/or reports. It is the Contractor's responsibility to make his own determination as to actual existing conditions.

601.2.2 Trench Widths: Trenches for other than cast-in-place concrete pipe shall conform to the following dimensions, unless otherwise specified in the special provisions, indicated on the plans, and/or approved by the Engineer.

Table 601-1

Size of Pipe (I.D.)	Max. Width at Top of Pipe Greater Than O.D. of Barrel	Min. Width at Springline Each Side of Pipe
Less than 18"	16"	6"
18" to 24" inclusive	19"	7-1/2"
27" to 39" inclusive	28"	12"
42" to 60" inclusive	1/2 O.D.	12"
Over 60"	36"	12"

The width of the trench shall not be greater than the maximum indicated above, at and below the level of the top of the pipe. If the maximum trench width as specified above is exceeded at the top of the pipe, the Contractor shall provide, at no additional cost to the Contracting Agency, the necessary additional load bearing capacity by means of bedding, having a higher bedding factor than that specified, higher strength pipe, a concrete cradle, cap or encasement, or by other means approved in writing by the Engineer.

The width of the trench above the top of the pipe may be made as wide as necessary for shoring, sheeting or other wall support measures necessary for a safe and proper installation. The Contractor may elect to slope the trench walls in lieu of shoring, sheeting or other wall support measures. In all cases the Contractor shall be responsible for any and all problems encountered and costs incurred as a result of increased trench width.

No increases in contract time will be allowed as a result of sloping trench walls. Table 601-1 shall be used for computing trench pay width.

601.2.3 Trench Grade: Alignment and elevation stakes shall be furnished as requested by the Contractor at set intervals and agreed upon offsets. On water main projects, elevation stakes will be furnished only when deemed necessary by the Engineer. In all cases where elevation stakes are furnished, the Engineer will also furnish the Contractor with cut sheets.

For all pipe 8 inches or greater in diameter, the Contractor shall excavate for and provide a granular bedding at least four inches thick or 1/12 the O.D. of the pipe whichever is greater. This bedding material shall be placed at a

SECTION 601

uniform density with minimum compaction and accurately fine graded to provide uniform bearing and support along the bottom of the pipe except where necessary to excavate for bells and pipe joint couplings.

601.2.4 Overexcavation: Except at locations where excavation of rock from the bottom of the trench is required, care shall be taken not to excavate below the depth indicated.

Whenever rock is encountered in the trench bottom, rock shall be overexcavated no less than 6 inches below the exterior bottom of the pipe. The overexcavation shall be backfilled with ABC material compacted to a uniform density of not less than 95 percent.

If the Engineer determines that overexcavation and backfilling, below the bedding material is required as a result of unsuitable material, it will be considered extra work. Payment and construction time extension will be negotiated with the Contractor. As a condition of the Contractor receiving payment for the extra work, agreement on method of payment and construction time extensions shall be reached prior to start of work.

Unauthorized excavation below the specified grade line shall be backfilled at the Contractor's expense with ABC material compacted to a uniform density of not less than 95 percent.

601.2.5 Excavation for Manholes, Valves Inlets, Catch Basins and Other Accessories: When placing concrete for a poured-in-place structure, the Contractor may place the poured concrete directly against the excavated surface, provided that the faces of the excavation are firm and unyielding and are at all points outside the structure lines shown on the plans. If the native material is such that it will not stand without sloughing or if precast structures are used, the Contractor shall overexcavate to place the structure.

When the structure is within the maximum trench limit, backfilling shall be in accordance with the requirements specified for the adjoining pipe. If the item is being constructed outside of the maximum trench limits, the overexcavation shall be backfilled with ABC compacted to 100%.

Any excavation below the elevation indicated for the foundation of any structure shall be filled with ABC per Section 702 and compacted to at least 95% at the expense of the Contractor.

601.2.6 Grading and Stockpiling: All grading in the vicinity of trench excavation shall be controlled to prevent surface water from flowing into the trenches. Any water, either surface or ground, accumulated in the trench shall be removed by pumping or by other approved methods. There shall be no additional payment for this work.

Excavated material, with excessive or inadequate moisture content, shall be considered unsuitable for proper compaction. The Contractor shall, at his own expense, remove or add moisture to the excavated material to bring it within the range of +2 to -2 percent of the optimum moisture content in order that proper compaction, as per Table 601.3, can be obtained.

In lieu of the above, the Contractor may, at no cost to the Contracting Agency, haul-off and dispose of excessively wet or dry material and replace it with material conforming to the backfill specifications. Disposal shall be in accordance with the project specifications.

In either event, the proper compaction and stability shall be obtained.

There will be no additional payment or time extension for this work.

601.2.7 Shoring and Sheet piling: All shoring and sheet piling necessary to protect the excavation, and provide a stable trench condition to safeguard vehicular and pedestrian traffic, the Engineer's representatives during inspection and testing procedures, and any other permitted public uses shall be installed and maintained. See Section 107.

601.2.8 Open Trench: Where a trenching operation crosses under existing 12 inch or smaller ACP waterlines (excluding service lines) and four feet or more of the existing ACP pipe is exposed, the Water Services Department - Water Distribution Division will isolate the exposed waterline by either cutting in any necessary valves or by the use of existing

SECTION 601

valves. After the exposed waterline has been isolated, the Contractor shall remove that part of the exposed waterline to the limits shown in MAG Standard Detail 403-3. The waterline shall then be replaced by the Contractor (during the trench backfilling operation) with the same size, Class 350, ductile iron pipe as shown in MAG Standard Detail 403-3. The removal and replacement section shall extend at least five feet beyond the trenching operation's trench wall and into undisturbed ground. The Contractor shall request a shut-down, at least one week in advance, from Water Distribution (262-4711 or 4712). City forces will perform the shutdown and/or valve cut-in. There will be no charges to the Contractor for this work. On permit work, the Contractor shall pay for any and all work required.

The Contractor will be paid for the ductile iron pipe at the unit price bid per each crossing under the bid schedule item WATERLINE REPLACEMENT. If there is an unanticipated conflict at the crossing which can be resolved with "offset pipe joints", the Water Services Department will supply the offset joints to the Contractor at no cost. Offset pipe joints will be picked up by the Contractor at the City's Water Stores Warehouse at 2640 South 22nd Avenue. Requests to pick up such material must be conveyed to the Water Services Department at least 24 hours in advance by the City Inspector. The Contractor shall install the offset joints at no additional cost. The WATERLINE REPLACEMENT item shall include costs for trench excavation, backfill, compaction, and surface restoration.

601.3 FOUNDATION, BEDDING, BACKFILLING AND COMPACTION:

601.3.1 Bedding: Bedding is ABC material (unless otherwise specified in Subsection 601.3.10) placed below the bottom of the pipe at a uniform density with minimum compaction to provide uniform bearing and support along the bottom of the pipe except where necessary to excavate for bells and other pipe joint couplings. Lime-treated bedding material shall be prohibited.

Bell and joint coupling holes shall be dug after the trench grade has been fine graded. Such holes shall be of sufficient width to provide room for caulking, banding or bolting. Holes shall be excavated only as necessary to permit accurate work in making of the joints and to ensure that the pipe will rest upon the prepared foundation material, and not be supported by any portion of the joint.

Depression of joints, other than bell and spigot, shall be made in accordance with the recommendations of the joint manufacturer for the particular joint used.

601.3.2 Haunching and Initial Backfill: Haunching is the material placed from the bottom of the pipe to the pipe springline. Initial backfill is the material placed from the pipe springline to one foot above the top of the pipe or conduit (1-inch above the top of pipe for SRPE pipe). Haunching and initial backfill material type is dependent upon the type of pipe and on the type of utility. Haunching and initial backfill shall be Aggregate Base (ABC) or Controlled Low Strength Material (CLSM), unless otherwise specified in Subsection 601.3.10. Lime-treated haunching and initial backfill material shall be prohibited. Open graded rock will not be used without the written approval of the Engineer.

Where water consolidation is used, haunching and initial backfill for pipes, 24 inches or less in I.D., may be placed in one lift. For larger pipes, the first lift shall not exceed the springline of the pipe. Where mechanical compaction is used, the moisture content shall be within a range of +2 to -2 percent of the optimum moisture content prior to placing the material in the trench. The first lift shall be eight inches or 2/3 of the distance to the springline whichever is greater. Succeeding lifts shall not exceed one foot loose and extreme care will be taken to prevent damage to or movement of the conduit by the compaction equipment.

The Contractor shall employ the necessary means and methods to maintain roundness of CMP, HDPE and SRPE type pipe during haunching, initial backfilling and final backfilling. The Contractor shall adequately anchor the pipe against buoyant forces to maintain grade and alignment during the placement of the CLSM haunching and initial backfill.

601.3.3 Haunching and Initial Backfill for Storm Drains Maintained by the City of Phoenix: Haunching and initial backfill for public storm drain pipe lines maintained by the City of Phoenix shall conform to this Subsection.

SECTION 601

The Contractor shall employ the necessary means and methods to maintain roundness of CMP, HDPE and SRPE type pipe during haunching, initial backfilling and final backfilling. The Contractor shall adequately anchor the pipe against buoyant forces to maintain grade and alignment during the placement of the CLSM haunching and initial backfill.

601.3.3.1 Haunching and Initial Backfill for Storm Drain Mainline Pipe: Controlled Low Strength Material (CLSM) haunching shall be placed from the outside bottom of the pipe to the springline of the pipe for all approved storm drain pipe types, except cast-in-place pipe that is cast against the trench walls.

ABC initial backfill shall be utilized from the springline to 1 foot above reinforced concrete pipe (RGRCP), and cast-in-place concrete pipe storm drains.

The Contractor, at his option, may substitute CLSM for other initial backfill materials specified at no additional cost.

High density polyethylene (HDPE) pipe shall have CLSM initial backfill from the springline to one 1 foot over the outside top of pipe.

Steel reinforced polyethylene pipe (SRPE) shall have CLSM initial backfill from the springline to one 1 inch over the outside top of pipe. No additional initial backfill will be required over the CLSM initial backfill.

601.3.3.2 Haunching and Initial Backfill for Storm Drain Catch Basin Connector Pipe: Aggregate Base Coarse (ABC) haunching or Controlled Low Strength Material (CLSM) haunching shall be placed from the outside bottom of the pipe to the springline of the pipe for all approved storm drain pipe types. ABC initial backfill shall be utilized from the springline to 1 foot above the pipe for all approved storm drain pipe types.

The Contractor, at his option, may substitute CLSM for other haunching and initial backfill materials specified at no additional cost.

601.3.3.3 Haunching and Initial Backfill for Storm Drain Culverts: Controlled Low Strength Material (CLSM) haunching shall be placed from the outside bottom of the pipe to the springline of the pipe for all approved storm drain culvert types, except cast-in-place pipe that is cast against the trench walls. ABC initial backfill shall be utilized from the springline to one (1) foot above the top of culvert.

The Contractor, at his option, may substitute CLSM for other initial backfill materials specified at no additional cost.

Corrugated Metal Pipe (CMP) culvert shall have CLSM haunching and initial backfill from the outside bottom of pipe to one (1) foot over the outside top of pipe.

601.3.4 Final Backfill: Final backfill is the material placed above the initial backfill. The type of final backfill required shall conform to Subsection 336.3. Final backfill shall be sound material free from broken concrete, broken pavement, wood or other deleterious material. Unless otherwise specified, this may be native material or borrow material with no piece larger than eight inches, select material or aggregate base course. Under pavement, parking lots, sidewalks, etc., pieces larger than three inches will not be used in the final 12 inches below the pavement subgrade.

Where water consolidation is used, final backfill will be placed in lifts as required in the following table prior to settlement.

TABLE 601-2

TRENCH WIDTH	FINAL BACKFILL LIFTS (FOR WATER CONSOLIDATION)
18" TO 24"	NOT TO EXCEED 4'
25" TO 36"	NOT TO EXCEED 6'
OVER 36"	NOT TO EXCEED 8'

SECTION 601

The above final backfill lift limitations are not applicable when water consolidation is accomplished by the jetting method.

When mechanical compaction is to be used, the Contractor will provide a test section demonstrating his proposed method and equipment to be used. Upon agreement with the Engineer as to the acceptability of the Contractor's proposed method and equipment, they shall not be changed without the prior approval of the Engineer. Mechanical compacted lifts in excess of one foot will not be allowed without the written consent of the Engineer.

Final backfill material shall be within the range of +2% to -2% of the optimum moisture content, prior to placing the material in the trench. The moisture content shall be uniform throughout the final backfill material. If clayey material is encountered within the trench excavation, the optimum moisture deviation range shall be determined by the Engineer. Clayey material will not be utilized as trench backfill without the approval of the Engineer.

Material not meeting these requirements may be required to be removed from the trench and moisture added or removed to correct the deficiencies prior to replacement, all at no increase in cost to the Contracting Agency.

It shall be the Contractor's responsibility to blend excavated material, removing or adding moisture as may be necessary to meet the requirements of the specifications, all at no increase in cost to the Contracting Agency.

Excavated material, when used for final backfill, shall meet the requirements of Subsection 601.2.6.

The moisture content requirements contained herein are waived when granular final backfill material is used and water consolidated.

The Engineer may require all or any part of the trench to be load tested for stability with Contractor's equipment prior to placement of asphalt or Portland cement concrete pavement. Unstable pumping areas as determined by the Engineer shall be corrected by the Contractor at no increase in cost to the Contracting Agency.

TABLE 601-3				
MINIMUM TRENCH COMPACTION DENSITIES				
Backfill Type	Location	From Surface To 2 feet Below Surface	From 2 feet Below Surface To Top of Initial Backfill	Haunching and Initial Backfill
I	Under any existing or proposed pavement, curb, gutter, sidewalk, or such construction included in the contract, or when any part of the trench excavation is within 2-feet of the above.	100% for granular and non-granular	95%	95%
II	On any utility easement street, road or alley right-of-way outside limits of (I).	95%	95%	95%
III	Around any structures or exposed utilities.	95% in all cases		

Note: The compaction type required will generally be shown on the plans and the plans will govern. Where no compaction type is shown on the plans the compaction type shall comply with the above.

A consideration in determining the compaction types as shown on the plans is based on the trench widths as shown in the Contract Documents. If these trench widths are increased beyond those widths referred to above and fall within the 2-foot limit of paved surfaces and other improvements due to construction means and method or site conditions, the compaction designation for that portion within the 2-foot limit of such improvements shall be Type I even though Type II may be shown on the plans.

SECTION 601

601.3.5 Compaction Methods: Water consolidation by jetting shall be accomplished with a 1-1/2" pipe of sufficient length to reach the bottom of the lift being consolidated with adequate hose attached and a water pressure of not less than 30 psi.

All jetting shall be accomplished transversely across the trench at intervals of not more than 6 feet with the jetting locations on one side of the trench offset to the jetting locations on the other side of the trench. The entire lift shall be leveled and completely saturated working from top to the bottom.

Jetting shall be used as the consolidation method for all conduit haunching and initial bedding. The Contractor shall be entirely responsible for establishing each lift depth so as to avoid floating the conduit being placed and shall make any repair or replacement at no cost to the Contracting Agency. However, for conduit larger than 24 inches I.D. the first lift shall not exceed the springline of the conduit.

Flooding is not acceptable as a water consolidation method unless authorized in the specification or by a written change order. It will consist of the inundation of the entire lift with water and then puddled with poles and bars to ensure saturation of the entire lift.

Where jetting or flooding is utilized and the surrounding material is such that it does not permit proper drainage, the Contractor shall provide, at his expense, a sump and a pump at the downstream end to remove the accumulated water.

The use of water consolidation does not relieve the Contractor from the responsibility to make his own determination that such methods will not result in damage to existing improvements. The Contractor shall be responsible for any damage incurred.

Where water consolidation is not permitted or does not result in adequate compaction, the haunching, initial backfill and final backfill material shall be compacted with hand and/or mechanical work methods using equipment such as rollers, pneumatic tamps, hydro-hammers or other approved devices which secure uniform and required density without injury to the pipe or related structures.

Water consolidation will not be permitted for non-granular material.

601.3.6 New Residential Development Area: In a new development area, prior to paving and prior to opening the area to public traffic, the following deviation to water consolidation, haunching, initial backfill, and compaction shall only apply to new local streets:

- (A) Water consolidation by jetting of non-granular material will be permitted only at the Engineer's discretion and approval. Increased quantity of compaction testing (100% increase per lift) will be required in accordance with the Streets Lab minimum testing requirements.
- (B) Water consolidation by flooding shall be allowed ONLY where backfill material meets the specification for granular backfill material (Subsection 601.3.7) OR the bottom of the lift is less than 4 feet from top of subgrade. Increased quantity of compaction testing (100% increase per lift) will be required in accordance with the Streets Lab minimum testing requirements.
- (C) The minimum density required for haunching and initial backfill shall be 95%. Manholes shall be compacted to 95% within 24" of the structure. Outside these limits, 95% shall be required. Native material is acceptable.
- (D) The minimum density required for backfill from 2 feet below the surface to the top of initial backfill shall be 95%. The minimum density from the surface to 2 feet below the surface shall be as prescribed in Table 601-3.
- (E) Sewer services shall require compaction tests on 30% of the total sewer services in new subdivision.

601.3.7 Specifications for Granular Backfill Material: Granular Backfill Material shall not be used in the pipe

SECTION 601

embedment zone. For purposes of this specification, Granular Backfill Material shall be defined as material for which the sum of the plasticity index and the percent of the material passing No.200 sieve shall not exceed 23. The plasticity index shall be tested in accordance with AASHTO T-90.

601.3.8 Rights of Way Belonging To Others: Bedding, initial backfill, final backfill and compaction for irrigation lines of the Salt River Valley Water User's Association and Roosevelt Irrigation Districts and for trenches on State of Arizona and Maricopa County rights-of-way, outside the limits of the City of Phoenix, shall be accomplished in accordance with their permit and/or their specification.

601.3.9 Test Holes: Boring logs shown on the plans or included in the specifications do not constitute a part of the contract and are included for the Contractor's convenience only. It is not intended to imply that the character of the material is the same as that shown on the logs at any point other than that where the boring was made. The Contractor shall satisfy himself regarding the soils moisture content and the amount of rock, gravel, sand, silt, clay and water to be encountered in the work to be performed.

601.3.10 Bedding, Haunching and Initial Backfill for Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines: Bedding, haunching and initial backfill for these underground facilities shall be native material or sand which conform the grading requirement of ASTM C-33 for fine aggregate. Lime-treated bedding, haunching and initial backfill shall be prohibited. When final backfill material consists of aggregate base course, crushed stone or other material containing stones, only sand will be used for bedding, haunching and initial backfill. The bedding depth shall be six inches and initial backfill depth shall be one foot above the top of the facility. Compaction will be in accordance with Section 601.

601.4 PAVEMENT REPLACEMENT AND SURFACE RESTORATION:

601.4.1 Grading: The Contractor shall do such grading in the area adjacent to backfilled trenches and structures as may be necessary to leave the area in a neat and satisfactory condition approved by the Engineer.

601.4.2 Restoring Surface: All streets, alleys, driveways, sidewalks, curbs, or other surfaces in which the surface is broken into or damaged by the installation of the new work, shall be resurfaced in kind or as specified to the satisfaction of the Engineer in accordance with Section 336.

601.4.3 Clean-Up: The job site shall be left in a neat and acceptable condition. Excess soil, concrete, etc., shall be removed from the premises.

601.4.4 Temporary Pavement: The Contractor shall install temporary asphalt pavement or the first course of permanent pavement replacement in accordance with Section 336 immediately following backfilling and compaction of trenches that have been cut through existing pavement. Except as otherwise provided in Section 336, this preliminary pavement shall be maintained in a safe and reasonably smooth condition until required backfill compaction is obtained and final pavement replacement is ordered by the Engineer. Temporary paving removed shall be hauled from the job site and disposed of by the Contractor at no additional cost to the Contracting Agency.

601.5 PAYMENT:

The cost for work covered in this Section, which may include the removal of asphalt pavement, removal of obstructions, trench excavation, overexcavation, bedding, haunching and initial backfilling (including CLSM), final backfilling, compaction, testing and placement of temporary pavement shall be considered incidental to the respective structure, pipe and conduit work and shall be included in the unit price bid in the proposal for the structure, pipe and conduit work.

SECTION 603

INSTALLATION FOR HIGH DENSITY POLYETHYLENE PIPE

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 604

PLACEMENT OF CONTROLLED LOW STRENGTH MATERIAL

Subsection 604.1 DESCRIPTION: Delete this Subsection in its entirety and replace it with the following:

The work covered by this specification consists of furnishing all materials, labor and equipment for the placement of controlled low strength material (CLSM).

CLSM may be specified as fill in areas where post-construction consolidation would be detrimental and in areas not accessible for the proper compaction of other fill material types.

The type of backfill to be used shall be as specified in the special provisions, plans or by the Engineer.

The following is a brief description of the types of CLSM:

1/2 SACK: A non-compressible, self-consolidating, fill material that allows future excavation with conventional hand tools and can be used as a general backfill, structure backfill, pipe bedding and embankment fill. 1/2 SACK CLSM is the default CLSM type unless otherwise specified.

1 SACK: A non-compressible, self-consolidating, fill material used, when specified, for additional compressive strength.

1-1/2 SACK: A non-compressible, self-consolidating, fill material used, when specified, under structure foundations, as thermal fill, and as mechanical protection for duct banks and conduits.

Subsection 604.2 MATERIALS: Delete this Subsection in its entirety and replace it with the following:

CLSM shall conform to the requirements of Section 728. Ready-mixed concrete, including timed-out, rejected, and truck wash-out material, shall not be used in lieu of CLSM without prior approval from the Engineer and shall be subject to rejection.

Subsection 604.5 ACCEPTANCE: Delete the first paragraph in its entirety and replace it with the following:

CLSM shall be considered deficient and may be rejected at the discretion of the Engineer when it does not conform to Section 728.

Subsection 604.5 ACCEPTANCE: Delete subparagraphs (A) and (B) in their entirety.

Subsection 604.6 PAYMENT: Delete the first sentence in the first paragraph and replace it with the following:

No separate measurement or payment will be made for CLSM.

SECTION 610

WATERLINE CONSTRUCTION

Subsection 610.3 MATERIALS: Delete the second, third, and fourth paragraphs in their entirety and replace with the following:

4-inch to 24-inch diameter pipe shall be ductile iron per Section 750 unless a specific material is specified. Class shall be designated in the plan or special provisions.

24-inch and larger diameter pipe may be concrete pressure pipe, steel cylinder type, per Section 758.

Subsection 610.4 CONSTRUCTION METHODS: Add the following Subsections:

610.4.6 Construction Work by City Forces:

- (A) City forces shall perform all valve cut-ins, waterline shutdowns, and wet taps that are necessary for construction.

The Contractor shall contact the inspector to make the necessary arrangements to have the City forces perform the required work. With the exception of permit work, there will be no charge for valve cut-ins, waterline shutdowns, and wet taps that are necessary for construction.

For any valve cut-ins, waterline shutdowns, or wet taps requested by the Contractor, which are not necessary and are for the convenience of construction, the Contractor shall make application and pay the required charges to the City.

On permit work, the Contractor shall pay all costs incurred.

- (B) When an existing waterline, other than as noted on the plans, conflicts with any proposed new work in the contract and no provision has been made in the proposal for relocating such lines, the City has the option to make any necessary adjustments or relocations, alter the proposed new work or negotiate with the Contractor for relocating the obstructing line.

610.4.7 Construction work by Other Utility Owners: Except as otherwise provided in the plans or project specification, all private utilities in conflict with the new work will be relocated by the owner thereof. Utility companies will adjust their manholes. In the event of an unanticipated conflict between the new work and a utility and the owner thereof disclaims responsibility for relocation, the Contracting Agency will negotiate with the owning utility and the conflict shall be resolved without extra cost to the Contractor. It will be necessary for the Contractor to coordinate his work with the utility companies in the relocation of their facilities during construction.

610.4.8 Construction Work by the Contractor:

- (A) The Contractor shall adjust valve and meter boxes to final grade as described in Section 345.
- (B) Where the centerline of the new waterline parallels the existing curb and gutter and is approximately two feet from the lip of the gutter, the Contractor shall remove and replace the pavement to the lip of the gutter. The Contractor will be paid for the extra pavement replacement in addition to the normal pavement re-placement over the pipe trench in accordance with Section 336.
- (C) The Contractor shall accomplish the cutting and plugging of City water mains, where required on the plans, in accordance with COP Standard Detail P1343.

The cuts and plugs will remain exposed until line pressure is restored and they can be inspected for leakage. The Contractor shall schedule the restoration of line pressure through the Engineer.

Payment shall be at the unit bid price or lump sum bid price for "CUTTING AND PLUGGING EXISTING

SECTION 610

WATER LINES." This payment shall be full compensation for material, labor, tools and equipment necessary to complete the work.

- (D) Unless other adequate provisions are made for fire protection, a fire hydrant will not be out of service for a period exceeding 24 hours. When relocating water meters which utilize either galvanized or polyethylene service pipe (or any other non-standard service pipe) the entire service piping shall be replaced using the approved service pipe material for that particular meter size. The existing corporation stop can be used provided and approved copper pipe adapter is used. Approved adapters are the Ford C04-43 and C04-54 conversion assembly or equal.
- (E) The Contractor shall submit record drawings and make a record of the locations of all work completed as part of the project. The as-builts shall show the locations of the beginning(s) and end(s) of the construction; all valves, fire hydrants, blow-off hydrants, pipe fittings, service connections, meters, and where pipes change alignment. The as-builts shall also show the locations and elevations where pipe changes elevation abruptly. Locations shall be shown by stationing and dimensioning from appropriate monument lines or, in their absence, appropriate lot lines, property lines or easement line references.

610.4.9 Approved Water Service Components: Approvals shown are not necessarily exclusive. If approval of a similar device, believed to be comparable and equal, is desired, a request should be submitted supported by appropriate information and data.

If general approval is desired, request should be submitted directly to the Water Services Department.

**TABLE 610-1
CORPORATION STOPS**

MANUFACTURER	COPPER SERVICES	W/DIELECTRIC INSULATION
FORD	P-1600	F-1000
HAYES		
JONES	J-3401	
McDONALD	4701 T	
MUELLER	H- 15028 B- 25028	

**TABLE 610-2
ADAPTERS**

MANUFACTURER	IPS COPPER, ELL
FORD	L-84-33 L-84-44
HAYES	
JONES	J-2619
MUELLER	H-15531
McDONALD	4779 MT

**TABLE 610-3
CURB STOPS AND METERING COUPLINGS**

MANUFACTUREER	CURB STOPS *	METERING COUPLINGS
FORD	B-11-333 B-11-666 B-11-444 B-11-777	SPM-2R
JONES	J-1900	J-130 J-134
McDONALD	6101	4622 or 4624
MUELLER	B-20283	H-10890

SECTION 610

		H-10891
HAYES	4000	5680 or 5682

*Heads of all curb stops shall be drilled 1/4" diameter for locks.

610.4.10 Concrete Pressure Pipe - Steel Cylinder Type: Where concrete, steel cylinder, pressure pipe is installed the following shall apply:

- (A) The Contractor shall mortar the inside and outside of all pipe joints. The mortar shall be applied in the field on the inside joints such that the mortared surface is flush with the adjacent pipe mortar lining. The outside of the joints shall be mortar coated by the diaper method. The mortar shall be a Type "M" mortar per Section 776 using Type II, low alkali cement.
- (B) All non-mortar coated steel, including flanges, shall be covered with a minimum of two (2) inches of hand-packed mortar. Wire mesh shall be used to hold the mortar in place. Mortar shall be the same as applied to the joints. Field-applied coal tar coatings will not be accepted in lieu of mortar. Except, coat tar enamel in accordance with AWWA C-203 shall be applied to the non-mortar coated steel and flanges on the 24" side outlets in access manholes.
- (C) Joint restraints shall be provided by means of welded joints. The extent of welded joints shall be as shown on the pipeline and layout drawings, and shall in no case be less than that shown on the plan drawings. Where welded joints are required, the weld shall be continuous about the entire circumference of the pipe joint. Welds shall be made intermittently, in short sections of about six (6) inches, to avoid overheating the gaskets on points where a gasket is used. Welds shall conform to that shown on the approved shop drawings and calculations.

610.4.11 For Mains Eighteen (18) Inches and Larger, the following shall apply:

- (A) Backfill and compaction for the full distance encompassed by welded/restrained joints shall be completed prior to testing.
- (B) All mainline valves shall be covered with a minimum of two (2) inches of hand-packed mortar. Wire mesh shall be used to hold the mortar in place. Field applied coal tar coatings will not be accepted in lieu of mortar. Portions of valves within manholes shall not be mortar coated. The mortar shall be a Type "M" mortar per Section 776 using Type II, low alkali cement.
- (C) Where plans call for welding joints and ductile iron pipe is furnished, the Contractor shall restrain the joints by an approved joint restraint method.

610.4.12 Restrained Joints on Mains Less Than Eighteen (18) Inches in Diameter: Where restrained joints are specified on mains less than eighteen (18) inches in diameter, ductile iron pipe shall be used with an approved joint restrain method.

610.4.13 Joints in Fire Hydrant "Run-Out" Piping: Joints in fire hydrant "run-out" piping to conform to the Subsection 750.3. All joints in the fire hydrant "run-out" from the main through the shut-off valve shall be restrained by an approved joint restraint method, which may include the use of thrust blocks as approved the City of Phoenix Engineer.

610.4.14 Payment for Water Used During Construction: The Contractor shall pay for all water used during the course of construction. This cost shall be included in the unit bid price for pipe. The final fill of the pipeline with replacement water shall not be included in the cost. Water rates shall be obtained from the Water Services Department - Accounting Division (602) (262-6687).

Measurement will be through a fire hydrant meter or, if this is not possible, calculated by one of the procedures listed below:

- (A) Unmetered water used for testing, flushing and chlorination shall be calculated on a cubic foot basis, using the

SECTION 610

volume per foot pipe multiplied by the number of times the pipe is filled and by the total length of pipe installed for each hydrostatic test, flushing and chlorination procedure. If any additional testing, flushing or chlorination is required, because of failure to meet any of the above conditions, the volume of water used for each procedure shall be calculated as on the above basis for first procedure.

**TABLE 610-4
FOR ONE FOOT LENGTH OF PIPE**

Diameter (Inches)	Cubic Feet	Gallons	Gallons Per Mile
3	.0491	.3673	1,939
4	.0873	.6528	3,447
6	.1963	1.469	7,756
8	.3490	2.611	13,786
10	.5455	4.081	21,547
12	.7854	5.876	31,025
14	1.069	7.977	42,224
16	1.396	10.44	55,123
18	1.767	13.22	69,802
20	2.182	16.32	86,170
24	3.142	23.50	124,080
30	4.909	36.72	193,882
36	7.069	52.88	279,203
42	9.620	71.96	379,950
45	11.044	82.62	436,233
48	12.566	94.02	496,326
54	15.90	118.97	628,162
60	19.63	146.88	775,526
66	23.76	177.72	938,362
72	28.27	211.44	1,116,403

- (B) Unmetered water used for settling trench backfill for small waterlines 12" and less in diameter shall be estimated at a volume of 2.66 cubic feet of water per linear foot of trench settled.
- (C) Water used for settling trench backfill on waterlines 14" and larger, shall be metered by a fire hydrant meter, or other means approved by the Engineer.

Subsection 610.6.1 GENERAL: Delete the title of this Subsection and replace with the following:

General

Subsection 610.6.1 GENERAL: Delete this Subsection in its entirety and replace with the following:

Pipe, valves and fittings shall be protected from corrosion by encasement in a polyethylene protective wrapping referred to hereafter as polywrap. Although not intended to be a completely air and water tight enclosure the polywrap shall provide a continuous barrier between the pipe and surrounding bedding and backfill.

Subsection 610.6.2 Materials: Add the following sentence to the beginning of the first paragraph:

Materials shall meet requirements of ANSI/AWWA C105/A21.5-10, most current version.

Subsection 610.6.2 Materials: Delete "Table 610-1" in the last paragraph and replace with the following:

Table 610-5

SECTION 610

Subsection 610.6.2 Materials: Delete the title for TABLE 610-1 and replace with the following:

TABLE 610-5 (from AWWA C105-05) POLYWRAP FLAT TUBE WIDTHS

Subsection 610.9 FIRE HYDRANTS: Add the following to the end of this Subsection:

Except where otherwise required on the plans, the City of Phoenix will furnish the Contractor fire hydrants without cost for City of Phoenix projects. To secure the hydrants, the Contractor shall obtain a permit at the Water Distribution Special Operations office at 3045 S. 22nd Avenue, and then pick up the hydrants at the City of Phoenix Water Stores, 2500 South 22nd Avenue.

Whereas a new fire hydrant furnished by the City of Phoenix is found to be defective, the Contractor shall remove the defective hydrant, return it to the **water stores**, pick up a new one and install as indicated on the plans. The second installation will be treated as a new fire hydrant installation and the Contractor will be paid for both installations, each at the unit bid price in the proposal for fire hydrant installations.

All connections from the main to the fire hydrant shall be cast iron or ductile iron pipe as shown on the detail drawings. Fire hydrants shall be the dry-barrel type. If plugs are present in the weep holes, they shall be removed before installation.

Extenders for hydrants or valves are not permitted on new fire hydrant installations unless approved by the Water Services Department.

Subsection 610.11 CONNECTION TO EXISTING MAINS: Add the following to the end of this Subsection:

For any tie-ins/connections or required shutdowns to existing transmission mains (16-inch and larger) and systems, the Contractor shall submit a shutdown/tie-in plan to the City Inspector and / or Engineer and shall be approved at least two weeks prior to the start of the event. The plan shall include dates, durations, procedures, staffing, and any other information pertinent to shutting down the system and connecting to a new system.

Subsection 610.13 METER SERVICE CONNECTIONS: Delete the second paragraph in its entirety and replace with the following:

All water service connections shall be made using Type K copper tubing which conforms to Subsection 754.1 and fittings which conform to Subsection 754.2. Joints in the copper tubing shall be made by the use of approved compressing fittings such as flared joints or pack joints. Soldered joints are not acceptable.

Subsection 610.13 METER SERVICE CONNECTIONS: Delete subparagraph (A) in its entirety and replace with the following:

- (A) When a meter is specified to be relocated, the Contractor shall replace and/or extend water service lines in accordance with COP Standard Detail P1342. The Engineer will determine when the existing service lines are unsatisfactory and must be replaced. Existing copper services in good condition, with sufficient cover, may be extended. Where the existing service pipe material is other than copper, the entire service shall be replaced from main to meter.

Subsection 610.13 METER SERVICE CONNECTIONS: Add the following subparagraph:

- (E) The use of direct taps on water mains for meter service connections will not be allowed. New service taps shall be installed using an all bronze double-strap tapping saddle or a tapped coupling.

SECTION 611

WATER, SEWER AND STORM DRAIN TESTING

Subsection 611.1 HYDROSTATIC TESTING: Delete this Subsection in its entirety and replace with the following:

The Contractor shall test waterlines for water tightness, including all fittings and connections to the waterlines. Each pipe shall be tested for leakage and pressure in accordance with applicable provisions of AWWA standards and/or Manuals, except as modified below.

The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pump, including measuring device and all other equipment necessary for making the tests.

The pipe shall be tested between the closed ends of the pipe. There shall be no testing against a valve unless otherwise approved. Pipe test section shall be limited to 2,500 linear feet, or less, unless otherwise approved in writing by the Engineer. The new pipeline must be separated from any potable system in such a way to prevent any potential for cross-contamination between the existing potable water system and the new pipeline.

The test shall be made after the backfilling is completed or compacted, regardless of the compaction method.

All connections, blowoffs, hydrants and valves shall be tested with the main, where practical.

The test section shall be slowly filled with potable water and all air shall be vented from the line. The rate of filling shall be as approved by the Superintendent of Water Distribution, with at least 24-hour notice required before filling is scheduled.

- (A) Pressure Tests: Waterlines, including all fitting and connections shall be tested for water tightness by subjecting each test section to pressure test. The test pressure shall be measured at the lowest end of the test section. The test pressure shall be 188 psi unless otherwise specified. The duration of each pressure test shall be at least 2 hours.

The pressure test shall begin after the pipe has been filled with water for at least 24 hours to allow for absorption.

- (B) Leakage Tests: Leakage tests shall be made after pressure test has been completed, pressure test results are satisfactory, and all backfilling and compaction is completed.

The duration of each leakage test shall be at least 2 hours. Leakage test pressure shall be at least 150 psi and the test pressure shall be maintained within 5 psi of the specified leakage test pressure during the test. Water may be continually fed or added when the pressure drops 5 psi.

The maximum allowable leakage from the pipe line shall be determined by the formula:

$$\frac{L = ND\sqrt{P}}{7400}$$

in which:

L = allowable leakage in gallons per hour

N = number of joints in the pipe being tested, with no allowance for joints at branches, blowoff, fittings, and similar appurtenances. "N" is calculated using the standard length of pipe installed divided into the length being tested.

D = nominal inside diameter of pipe in inches.

SECTION 611

P = average test pressure, in psi gage, as measured at the lowest point in the test section.

Should the test on any section of the pipeline show leakage greater than specified above, the Contractor shall locate and correct until the leakage is within the specified allowance for a 2-hour duration. All repairs and retests shall be at the Contractor's expense.

Leakage is defined as the quantity of make-up water necessary for the test section to maintain the specified leakage test pressure after the pipeline has been filled with water and all air expelled.

All water must be dechlorinated to negligible levels prior to discharge to any location. Connections to existing pipelines or existing valves shall be made after new construction has satisfactorily passed both the pressure and leakage tests and potable water piping has been flushed and disinfected in accordance with Section 611.

Subsection 611.2.11 Final Flushing, Sampling and Testing: Delete this Subsection in its entirety and replace with the following:

Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipeline at its extremities until the replacement water throughout its length shall, upon testing, be proved comparable in quality to the water served to the public from the existing water system. Prior to sample collection for laboratory testing, the residual chlorine shall be verified using a color comparator or chlorine meter at each sample point to ensure the chlorine residual is not less than 0.2 ppm or greater than 4.0 ppm. Swimming pool test kits or chlorine test strips are not sensitive enough to provide results within this range and shall not be used. Once the required residual chlorine level in the pipeline is achieved, samples shall be taken as outlined below. The quality of water in the new main shall be as determined by laboratory examination and analysis of the samples over a period of up to three full days (72 hours).

Water Services Department laboratory technicians will perform sampling for tests of new water mains upon receipt, from the inspector, of a written request by the Contractor. The written request should be made to the Water Services Department no less than 24 hours prior to the time when samples are to be taken, so that the Department can properly schedule laboratory work. Waterlines less than 150 feet in length require one sampling riser installed as near the end as possible; lines 150 feet to 300 feet in length, two sampling risers, one near each end of the line; lines 300 feet to 3,000 feet in length, a minimum of three sampling risers. In addition, dead ends on main lines should be represented with a sampling riser.

Samples shall be taken from a tap and riser located and installed in such a way as to prevent outside contamination. Samples shall never be taken from an unsterilized hose or fire hydrant, because such samples will seldom meet bacteriological standards. One sample shall be taken at each sampling riser.

Results of all tests shall be sent by the laboratory to the Water Services Department. Results of laboratory analysis will be interpreted by the Water Services Department, and reported to the Engineer. Under no circumstances shall the Contractor contact the laboratory. If there is need for test results before written reports are submitted, such information shall be obtained only from the Water Services Department.

Subsection 611.3 SEWER LINE TESTING: Delete Subsections (C) and (D) in their entirety and replace with the following

(C) Closed Circuit T.V. Inspection:

The Contracting Agency reserves the right to visually inspect the interior of the sewer line using a television camera. Sanitary sewer lines eight inches and larger in diameter shall be subject to closed circuit T.V. inspection.

The Contractor shall notify the Engineer at least 48 hours prior to completion of the backfilling so that the inspection can be scheduled. Closed circuit T.V. inspections will be conducted by the City of Phoenix Water Services Department after backfilling has been completed.

SECTION 611

Any defects in the pipe or construction methods revealed shall be corrected by the Contractor at no additional cost to the Contracting Agency.

Subsection 611.4 POST INSPECTION OF NEW MAINLINE STORM DRAINS: Delete the first sentence in Subsection (A) and replace with the following:

The Contractor shall provide the Engineer with an annotated video inspection record (either VHS or DVD format) of the new mainline storm drain pipeline and laterals.

Subsection 611.4 POST INSPECTION OF NEW MAINLINE STORM DRAINS: Delete "PVC" from the title of Subsection (B) and replace with the following:

SRPE

Subsection 611.4 POST INSPECTION OF NEW MAINLINE STORM DRAINS: Delete the first paragraph of Subsection (B) in its entirety and replace with the following:

The Contractor shall perform a deflection test on the system by use of a mandrel or other approved method as directed by the Engineer. Any part of the installation which shows deflection in excess of 5% of the nominal inside diameter per Section 738 shall be evaluated and appropriate remedy, if any, shall be performed.

Subsection 611.4 POST INSTALLATION INSPECTION OF NEW MAINLINE STORM DRAINS: Add the following to the end on this Subsection:

(C) Leakage Test for Mainline HDPE, or SRPE Storm Sewer Pipe:

In addition to full CLSM haunching and initial backfill of HDPE and SRPE mainline storm sewer pipe, the Engineer may require the Contractor to also perform random leakage tests on the mainline. Field leakage tests, if required, will be conducted in accordance with the following criteria:

1. After placement of CLSM haunching and initial backfill to 1 foot above HDPE pipe and 1 inch above SRPE pipe, the Engineer will select a minimum of three (3) joints of mainline pipe to be tested in accordance with the following procedure:
 - a. Testing shall be accomplished by plugging the pipe test section and all branch lines and filling the pipe with water. Equipment for the test shall be furnished by the Contractor, and shall include a standpipe, a suitable meter or other acceptable method of measuring the quantity of water used. A period of at least one (1) hour shall be allowed for absorption before making the test.
 - b. The allowable water loss shall not exceed 1.0 gallon per hour per 100 linear feet of pipe per inch of pipe diameter under a minimum test head of 4 feet above the top of the pipe at the upper end of the test section. A minimum test time of one (1) hour shall be required after the initial one (1) hour for absorption.
 - c. The leakage test shall be made by the Contractor in the presence of the Engineer.
2. If the first test exceeds the specified leakage limit, the Contractor shall repair or replace all sections that fail the leakage test at no additional cost to the City of Phoenix. All repaired or replaced pipe sections shall be retested for compliance. The Engineer reserves the right to require additional leakage tests as deemed necessary during the course of construction to ensure that the remainder of the pipeline is leak resistant.

Subsection 611.5 PAYMENT: Add the following as the third paragraph of this Subsection:

There will be no measurement and payment for sewer line testing. The Contractor shall include all associated costs in the

SECTION 611

unit bid price for sewer pipe installation.

Subsection 611.5 PAYMENT: Add the following as the last paragraph of this Subsection:

There will be no separate pay item for the HDPE or SRPE Storm Drain Pipe Leakage Tests. If requested by the Engineer, initial leakage tests shall be paid by the City of Phoenix. Retests shall be paid by the Contractor at no cost to the City of Phoenix.

SECTION 615

SEWER LINE CONSTRUCTION

Subsection 615.1 DESCRIPTION: Delete the second paragraph in its entirety and replace with the following:

Concrete pipe shall conform to Section 735. Vitrified clay pipe shall conform to Section 743. Ductile iron pipe shall conform to Section 750.

Subsection 615.2 MATERIALS: Delete the fourth and sixth bulleted items listed in this Subsection.

Subsection 615.3 TRENCHING: Delete the first paragraph in its entirety and replace with the following:

Excavation of trenches shall be accomplished in accordance with Section 601.

Subsection 615.3 TRENCHING: Delete the fourth paragraph in its entirety.

Subsection 615.4 SEPARATION: Delete the first paragraph in its entirety and replace with the following:

To protect water lines from contamination by sewer lines, separation and extra protection shall be in accordance with Section 610 and MAG Standard Detail No. 404-1, 404-2, and 404-3.

Subsection 615.7.2 Water Stops: Delete the Subsection number, Subsection title and this Subsection in its entirety.

Subsection 615.8 SANITARY SEWER SERVICE TAPS: Delete this Subsection in its entirety and replace with the following:

When the construction of sanitary sewer service taps are called for in the special provisions, they shall be constructed in accordance with standard details for sewer taps.

The locations of the service tap for each property shall be in the downstream $\frac{1}{2}$ of the lot, or as requested by the property owner. Sewer service taps shall not be covered until they have been plugged and marked in accordance with standard details and their location has been recorded by the Engineer. Electronic markers shall be placed at no greater depth than electronic locating devices can locate them (typically 2'-4').

When sewer taps are found to be in conflict with the new work and no provision has been made in the proposal for relocating such taps, they shall be relocated by the Contracting Agency or the Contracting Agency will negotiate with the Contractor for their relocation. When a sewer tap or other sewer line is in conflict with the new work and it is impractical or impossible to raise or lower the tap or sewer to clear the new work, the Contracting Agency will negotiate with the Contractor to relocate the sewer on a different alignment or grade to avoid the conflict.

Subsection 615.11 BACKFILLING: Delete the first paragraph in its entirety and replace with the following:

Backfilling and compaction shall be done in accordance with Section 601.

Subsection 615.16 MEASUREMENT AND PAYMENT: Add the following Subsection:

(D) Concrete Encasement:

Measurement and payment for concrete sewer encasement shall be by the linear foot of sewer concrete encased, which price shall include trenching, backfill, compaction, materials, and any pavement and surface replacement in excess of the applicable pay widths assigned to the adjacent water pipe.

SECTION 618

STORM DRAIN CONSTRUCTION WITH CONCRETE PIPE

Delete the title of this SECTION in its entirety and replace with the following:

STORM DRAIN CONSTRUCTION WITH PRE-CAST CONCRETE PIPE, HIGH DENSITY POLYETHYLENE PIPE, OR STEEL REINFORCED POLYETHYLENE PIPE

Subsection 618.1 DESCRIPTION: Delete this Subsection in its entirety and replace with the following:

This Section covers rubber-gasketed reinforced concrete pipe (RGRCP) line, high density polyethylene (HDPE) pipe line and steel reinforced polyethylene (SRPE) pipe line construction used for the conveyance of storm drainage in public storm drains.

This Section does not include irrigation pipe lines for private irrigation systems, the Salt River Valley Water Users' Association system or other irrigation districts' systems. Irrigation pipe lines shall conform to the specifications and permit requirements of the respective irrigation district and project special provisions.

Installation of pipe in State Highways shall conform to the specifications and permit requirements of the Arizona Department of Transportation.

Subsection 618.2 MATERIALS: Delete this Subsection in its entirety and replace with the following:

In general, the pipe class or strength specified will be based upon the maximum anticipated design loads and trench conditions to which the pipe will be subjected upon completion of the project.

The structural design of the pipe for any depth of cover shall be in conformance with Section 6 of the City of Phoenix Storm Water Policies and Standards Manual (Latest Edition), applicable ASTM's, applicable AASHTO Standards, and established manufacturer recommended design procedures. The pay width for pavement replacement shall remain in accordance with Section 336 unless otherwise noted in the plans and specifications.

Should the Contractor, as a result of his construction means and methods, or for any other reason, subject the pipe to loading or trench conditions that do not conform to the plans and specifications, it shall be the Contractor's responsibility to take whatever steps are necessary to remediate, strengthen or otherwise protect the pipe from damage at the Contractor's expense.

Pipe that is stronger than that specified may be furnished at the Contractor's option and expense.

The RGRCP, HDPE and SRPE pipe, specials, joints, gaskets, and testing shall be according to Sections 735, 738, and 739, except as specified below.

(A) Specials: Pipe specials such as closure pieces, wyes, tees, bends, and manhole shafts shall be provided as indicated on the plans, and such specials shall be made equal in strength, diameter, and other physical characteristics to the standard straight pipe lengths by the use of extra concrete, extra reinforcing, or steel items. Drawings of specials shall be submitted to the Engineer for approval before their fabrication.

(B) Gasket Joints: The joint shall be sealed with a continuous ring gasket made in such size and cross-section as to fill the annular space provided for it. The gasket shall be the sole element depended upon to make the joint watertight, and shall have smooth surfaces, free from pits, blisters, porosity, and other imperfections.

(C) Water Stops: Water Stops will be required when connecting HDPE and SRPE pipe to concrete structures, manholes, etc. The water stop shall comply with Section 738 or Section 739 and will be installed per manufacturer recommendations.

(D) Storm Drain Pipe Size Option: The Contractor may substitute the next larger multiple of 6 inch size storm drain pipe

SECTION 618

for the intermediate 3 inch size pipes shown on project plans at his discretion. The cost of the increase in size shall be borne by the Contractor. The intermediate 3 inch size pipe will remain in the bid proposal as the required size. If the Contractor elects to use the next larger multiple of 6 inch size pipe he shall be responsible for any utility or any other conflict caused by the increase in the size of the pipe. There shall be no extension of time granted for any delay caused by these conflicts.

Subsection 618.3 CONSTRUCTION METHODS: Delete this Subsection in its entirety and replace with the following:

Excavation, bedding, haunching, backfilling, compaction or consolidation, and testing shall be accomplished in accordance with Section 601 except as specified below.

The laying of the pipe shall be in finished trenches free from water or debris, and shall be commenced at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden off-sets of the flowline. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

Variation from prescribed alignment and grade shall not exceed 0.10 foot and the rate of departure from or return to established grade or alignment shall be no more than 1 inch in 10 feet of pipe line unless otherwise approved by the Engineer. Curves, bends and closures shall be made in accordance with Section 735, 738, and 739. Pipe shall be of the type, class and size shown on the plans or in the special provisions.

The minimum and maximum cover for HDPE and SRPE pipe shall be in conformance with Subsection 6.4 of the City of Phoenix Storm Water Policies and Standards Manual (Latest Edition), applicable ASTM's, applicable AASHTO Standards, established manufacturer recommended design procedures and special provisions.

All pipes installed in railroad rights-of-way shall be reinforced concrete pipe per ASTM C76, Class V and the minimum cover over all pipes shall be as specified in the railroad permit and/or special provisions. Bedding and backfill shall be in accordance with the railroad's standards and details and/or special provisions.

HDPE and SRPE pipe is prohibited as an alternate pipe material for culverts. HDPE and SRPE pipe is also prohibited as an alternate pipe material within a minimum distance of 24ft from an open end condition requiring a headwall, trash rack or access barrier. The pipe transition shall utilize an external, gasketed coupling band with cinching straps or bolts to provide a waterproof connection. The transition shall be fully bedded with CLSM or a concrete pipe collar. No separate payment will be made for the transition and the cost shall be considered incidental to the cost of the pipe.

The Contractor shall employ the necessary means and methods to maintain roundness of the HDPE and SRPE pipe during haunching, initial backfilling and backfilling. The Contractor shall employ all necessary means and methods to adequately anchor the pipe against buoyant forces to maintain grade during the placement of the CLSM haunching and initial backfill. The Contractor shall schedule a meeting with the HDPE and/or SRPE pipe supplier, the installing contractor and the Engineer to discuss the installation procedures prior to trench excavation.

618.3.1 Pipe Joints for RGRCP: Either O-ring gasket joints, or offset spigot-profile gasket joints will be used. Hydrostatic water tests may be required at the discretion of the Engineer. Certification for Hydrostatic tests will be required for all pipe joints. Gasket joints will not require mortaring and grouting.

618.3.2 Procedure for Connecting Pipes to New Storm Drain and Temporary Pipe Closure: All inlet connecting pipes and lateral pipes shall remain temporarily plugged until all lines and facilities downstream have been completed to the satisfaction of the Engineer.

Existing storm drains shall be connected to the new storm drain where indicated on the plans. However, existing storm drain systems shall remain intact or a by-pass maintained until mainline downstream has been completed to the satisfaction of the Engineer.

SECTION 618

All pipes shall have a temporary closure placed at the open end at the end of each work day.

618.3.3 Connecting Extensions to Mainline Storm Drains: Prior to extending any existing mainline storm drain, the Contractor shall verify the depth, size, pipe type, and horizontal location of the existing storm drain in the field. If the new pipe extension is the same type and size as the existing, or if the pipe manufacturer makes a standard watertight adapter fitting made specifically to join with the existing pipe type, a standard manufacturer-recommended connection may be used. Otherwise, a concrete field collar in accordance with COP Standard Detail P1505 shall be used. The cost of connections shall be considered incidental to the cost of the project. No separate measurement or payment will be made for field connecting extensions to existing mainline storm drain pipes except that the removal of an existing pipe plug shall be paid under a separate item.

618.3.4 Structures: Inlets, manholes and similar reinforced concrete structures generally built underground as part of the storm drain are shown on the plans and shall conform to Section 505. Castings shall conform to Section 787. Miscellaneous steel shall conform to Sections 727 and/or 770.

Through manhole, lateral manhole or transition manhole, when specified on the plans, shall denote the construction and installation of a complete manhole including the base, shaft, reinforced concrete rings, frames and covers, concrete caps, frame adjustment to grade, etc., as shown on the plans and standard details. Note: Manhole steps shall not be installed. If installed they shall be removed and the holes filled with approved epoxy or approved commercial-source non-shrink, non-metallic, patching grout with an approved bonding agent.

As an option, MAG Standard Detail 522 is hereby modified to allow precast unreinforced manhole shaft pipe and cones which shall have a thickness of 6 inches and be manufactured of an approved portland cement concrete mix per Section 725. All other features of MAG Standard Detail 522 shall remain unchanged.

618.3.5 Cleaning Pipe: All pipe shall be swabbed, flushed with water, or subjected to a combination of these or other methods in order to leave the pipeline clean and free from debris, garbage, rubbish, stones, and deposits, and like foreign materials.

618.3.6 Material and Layout Submittals: At least 6 weeks prior to the manufacture and delivery of the storm drain pipe, the Contractor shall submit material and layout drawings to the Engineer for review and approval.

Submittals shall show pipe material type, layout, stationing, laying length, pipe class or gauge thickness (as appropriate), detailed fabrication drawings for mainline, curvilinear sections, prefabricated bends, special sections, etc., and any other pertinent data including certification that pipe joints have been independently tested and conform to watertight joints per ASTM D3212.

In addition, a list of catch basin connector pipes shall be submitted. The list shall contain the following information:

1. Inside diameter and type of material to be used, (RGRCP, HDPE, SRPE).
2. If RGRCP is used for connector pipe, the pipe class shall be shown.
3. Station at which connector pipes join mainline.
4. Number of sections of pipe and laying length of sections.

Subsection 618.6 MEASUREMENT: Delete the title of Subsection (B) and replace it with the following:

Catch Basin Connector Pipe

SECTION 618

Subsection 618.6 MEASUREMENT: Add the following Subsections to the end of this Subsection:

(C) Prefabricated Tees and Wyes: When separate bid items are provided in the proposal, they shall be measured by the number of such tees and wyes constructed.

(D) Concrete Pipe Collars: There shall be no measurement for construction of pipe collars for pipe less than 24 inches in diameter. For pipe collars on pipe 24 inches or larger, measurement shall be the number of such pipe collars constructed.

Subsection 618.7 PAYMENT: Delete this Subsection in its entirety and replace with the following:

(A) Main Line Pipe: Will be paid at the unit price bid per linear foot, to the nearest foot, for each size of pipe and shall be compensation in full for furnishing and installing the pipe as specified and as shown on the plans including removal of asphalt pavement, removal of obstructions, excavation, foundation, bedding, backfilling, compacting, testing, temporary pavement, joint materials, joining, and field closures.

(B) Catch Basin Connector Pipe: Will be paid at the unit price bid per linear foot, to the nearest foot for each size of pipe and shall be compensation in full for furnishing and installing complete in place as shown on the plans and as specified, the connecting pipe and specials including spur connections, removal of asphalt pavement, removal of obstructions, excavation, foundation, bedding, backfilling, compacting, temporary pavement, joint materials, joining, collars, field closures, and testing.

(C) Prefabricated Tees and Wyes: The cost of prefabricated tees and wyes shall be included in the unit price bid for main and connector pipes unless separate bid items are included in the proposal.

(D) Concrete Pipe Collars: There shall be no payment for construction of pipe collars for pipe less than 24 inches in diameter. Payment for pipe collars, on pipe 24-inches or larger, shall be made at the unit price bid for each and will be compensation in full for all labor, material, equipment and incidentals required for construction.

SECTION 620

CAST-IN-PLACE CONCRETE PIPE

Delete the title of this SECTION in its entirety and replace it with the following:

STORM DRAIN CONSTRUCTION WITH CAST-IN-PLACE CONCRETE PIPE

Subsection 620.1 GENERAL: Delete the first sentence of the first paragraph and replace it with the following:

This specification covers cast-in-place non-reinforced concrete pipe intended for use in storm drain systems.

Subsection 620.1 GENERAL: Delete subparagraph (D) in its entirety and replace with the following:

In systems that will not exceed a 15 ft operating head at any time during the life of the system.

Subsection 620.1 GENERAL: Add the following subparagraph:

- (E) When designated as an allowable alternate pipe material on the Alternate Pipe Chart Sheet of the Plans. Designation of CIPP as an allowable alternate pipe material shall not be construed to indicate that the site conditions will be suitable for its use. The Contractor shall be responsible for all costs incurred to properly evaluate, prepare and utilize CIPP as part of a complete storm drain pipeline.

Subsection 620.1 GENERAL: Add the following subparagraph:

- (F) When approved by the Engineer as a result of a formal Value Engineering Process that considered all location, geologic, hydrologic, and maintenance conditions. The Contractor shall be responsible for all costs incurred for developing and presenting the engineering and documentation of the Value Engineering proposal for a thorough evaluation.

Subsection 620.1 GENERAL: Add the following to the end of this Subsection:

CIPP is prohibited from being placed:

- (A) Within the curb lines of arterial and major collector streets.
- (B) Within the curbs of signalized and potentially signalized intersections to the limits of the curb returns.
- (C) Within railroad rights-of-way.
- (D) In fill, unless it can be demonstrated to the satisfaction of the Engineer, that the fill will adequately support the pipe.
- (E) Where expansive or collapsible soils are encountered below the top of pipe.

Subsection 620.2.2: Delete the first sentence and replace with the following:

Sand aggregate used for concrete and mortar shall conform to Section 701

Subsection 620.2.4: Delete this Subsection in its entirety and replace with the following:

Concrete shall be a minimum Class A per Section 725. Concrete shall be of a type, and have a design strength and slump necessary for the site conditions and the Contractor's construction methods. The slump shall not exceed 3 inches (75MM).

SECTION 620

Subsection 620.3.1 Excavation: Delete the last sentence in the second paragraph.

Subsection 620.3.1 Excavation: Add the following paragraph after the second paragraph of this Subsection:

Excavated trench shall be checked for compliance with requirements for grade and alignment prior to placement of concrete. The Contractor shall submit his proposed method of grade and alignment control and checking of same for conformance with specifications to the Engineer for his approval prior to start of work. The Contractor shall supply manpower, equipment and materials, as are required, to provide and confirm compliance with grade and alignment requirements. This is a non-pay item and all costs incurred shall be included in the bid item(s) for the pipe installation.

Subsection 620.3.2 Placement: Add the following paragraphs after the third paragraph of this Subsection:

Under no circumstances will the Contractor be allowed to continue the pipe installation if the vibrators of the cast-in-place machine are inoperable. Portable vibrators or "stingers" shall only be used to supplement internal vibrators on the machine and not as a sole source to consolidate and distribute the concrete mix.

The Contractor shall make provisions for removing sloughed material, debris and any foreign objects from trench before and during placement of concrete such that build-up of material does not occur ahead of the machine. In addition, small transverse trenches shall be dug across the trench bottom, at distances not to exceed 25 linear feet, to receive soil any build-up that is pushed ahead of the slipform.

Subsection 620.3.2 Placement: Delete the first paragraph of Subsection (A) in its entirety and replace it with the following:

When pipe placement stops in excess of ninety (90) minutes, a construction joint shall be formed. The ends of the pipe that are to be butt contact shall be left in rough condition with a slope between 20 and 45 degrees. Number 4 reinforcing bars shall be embedded 12 inches in the previous pour and 12 inches into the next pour and shall be placed 12 inches on center for pipe 42 inches in diameter or less and 18 inches on center for pipe diameters in larger than 42 inches. For pipe diameters 60 inches or less an excavation shall be made along the sides and bottom of the joint before resuming to permit casting of a concrete collar around the outside of the joint. This collar shall have a minimum thickness of 1-1/4 times the wall thickness of the pipe and shall lap the entire joint by at least two (2) times the wall thickness. Immediately before resuming concrete placement the surface to be bonded shall be cleaned of all laitance, coatings, foreign materials, and loose or defective concrete thoroughly wetted and coated with a layer of bonding mortar (Subsection 620.2.5) approximately 1/4 inch (6MM) thick. In lieu of the bonding mortar, neat cement paste may be thoroughly scrubbed onto the wet surface of the previously placed concrete.

Subsection 620.3.2 Placement: Delete Item (2) of Subsection (B) in its entirety and replace with the following:

The minimum wall thickness shall be 1/12th of the inside diameter plus 1 inch.

Subsection 620.3.3 Curing and Backfilling: Delete this Subsection in its entirety and replace it with the following:

The Contractor shall be responsible for proper curing of the concrete and backfilling the trench to an even grade. Final backfill and compaction shall not be started sooner than seven days after concrete placement and only after the concrete has attained a compressive strength of at least 3000 psi. The pipe shall be checked for grade, alignment and thickness prior to backfilling. Curing shall be performed in such a manner as to prevent the premature drying of the concrete.

Polyethylene film complying with ASTM C-171, nominal thickness 0.0015 inches (0.038 MM), shall be placed on the exposed top surface of the pipe immediately after the pipe is cast. The film shall be anchored in place with loose soil to assure continuous, adequate curing.

SECTION 620

A humid atmosphere within the pipe, as evidenced by condensation on the interior surface, shall be maintained for at least seven (7) days following concrete placement. To prevent air drafts which may dry the pipe and to maintain a humid atmosphere inside the pipe, all openings, ends, manholes, connector pipes shall be kept closed or securely covered, except when actual work is in progress on the inside of the pipe. The pipeline shall be partially filled with water during the curing period when work is not being performed on the inside of the pipe. If necessary, a maximum 24 hour period will be permitted within the seven days following placement for removal of forms and repairs.

Subsection 620.3.4 Repair: Delete this Subsection in its entirety and replace with the following:

Immediately after removal of the forms, the inside of the pipe shall be inspected for required repairs and conformance with all dimensional requirements including alignment and grade.

The Engineer shall be the sole judge as to the repairability of deficiencies. He shall require removal and replacement of those sections of pipeline which he judges to be non-repairable or are not within required dimensional tolerances including alignment and grade.

When concrete placement is done by a method requiring the use of metal inner forms, the Contractor shall schedule his work force, by extended, staggered or multiple shifts, as required, to provide for removal of forms within 4 to 6 hours of placement of concrete and start of repairing, patching and finishing of pipeline to conform with specification requirements.

When concrete placement is done by methods using pneumatically inflated inner liner, the Contractor shall schedule his work force, by extended, staggered or multiple shifts, as required, to provide for removal of the pneumatic inner liner within 12 hours of placement of concrete and start of repairing, patching and finishing of pipeline to conform with specification requirements.

All rock pockets, non-longitudinal cracks or indentations shall be cleaned out, moistened and filled with 1:2 cement grout or approved epoxy material. Except where, in the opinion of the Engineer, the width and/or length of the crack may indicate a structural deficiency, repairs shall be made as required for longitudinal cracks.

At the discretion of the Engineer, longitudinal cracks exceeding 0.01 inches in width and 12 inches in length may be cause for rejection and removal and replacement of that portion of the pipe. Subject to the approval of the Engineer, cracks may be repaired using a pressure applied epoxy compound capable of providing structural correction to the area in addition to sealing the void. A longitudinal crack shall be defined as one which has the general direction of a 30 degree angle or less with the alignment of the pipe.

Irrespective of concrete placement method, all repairs, patches and finishing shall be completed within 24 hours of concrete placement.

The Contractor, prior to start of concrete placement on project shall submit a written schedule of his proposed work activities and work time schedules for the Engineer's review and approval. No time schedule requiring overtime by the Engineer's staff is authorized without specific written approval of the Engineer.

Subsection 620.3.5 Finish: Delete this Subsection in its entirety and replace with the following:

Except for the form offsets, the interior surface of the pipe shall be equivalent to or better than a wood float finish. Form offsets shall be trimmed so as to provide a reasonably tapered slope from surface to surface. The bottom of the pipe below the metal forms shall be finished in a workmanlike manner and shall conform to the general circular circumference of the pipe without sags, dips and humps. All extraneous concrete shall be removed from the interior surface.

SECTION 620

Subsection 620.4 METHOD OF TESTS: Delete the title of this Subsection in its entirety and replace with the following:

TESTS

Subsection 620.4 METHOD OF TESTS: Delete this Subsection in its entirety and replace with the following:

Random tests shall be made of the wall thickness at the top, bottom and sides, approximately every 100 feet, on a daily basis by probes through fresh concrete or small holes drilled through the concrete. Holes shall be properly and permanently closed and sealed, flush with the inside surface of the pipe, after measurements are made, in accordance with the requirements of the fourth paragraph of Subsection 620.3.4.

Test cylinders shall be prepared and tested per Section 725. If the 28-day strength test does not comply to the specified compressive strength requirements, cores shall be taken from the same section of concrete represented by the non-compliant test under the supervision of the Engineer. The diameter of the core specimens for the determination of compressive strength should be at least three (3) times the maximum nominal size of the coarse aggregate used and must be at least twice the maximum nominal size of coarse aggregate.

The length of the specimen, when capped, should be twice the core diameter. A core having a maximum height of less than 95 percent of its diameter before capping or a height less than its diameter after capping shall not be tested.

If cores are taken, the Contractor shall patch all core holes in a manner that will be permanent, will be watertight to a minimum of 15 ft of internal pressure head, and will have a smooth interior finish flush with the interior surface of the pipe.

Obtaining the core specimens, preparing the specimens, testing the specimens, restoring the pipe, and the Engineer's supervision shall be at the Contractor's expense.

The Engineer will evaluate the test results and his decision as to required corrective action will be final.

Subsection 620.6 PAYMENT: Delete this Subsection in its entirety and replace with the following:

Payment will be made at the contract unit price bid per linear foot to the nearest foot for each size of pipe and shall be compensation in full for furnishing and installing the cast-in-place concrete pipe complete as specified including removal of paving and obstructions; excavating, backfilling and compacting; testing; repair and all necessary incidental costs not specifically covered in other items in the proposal.

SECTION 621

CORRUGATED METAL PIPE AND ARCHES

Delete the title of this SECTION in its entirety and replace it with the following:

STORM DRAIN CULVERT AND CATCH BASIN CONNECTOR PIPE CONSTRUCTION WITH CORRUGATED METAL PIPE AND ARCHES

Subsection 621.1 DESCRIPTION: Delete this Subsection in its entirety and replace it with the following:

This Section covers corrugated metal pipe and arches used as culverts and catch basin connector pipes for the conveyance of storm drainage in public storm drains.

This Section does not include irrigation pipe lines for private irrigation systems, the Salt River Valley Water Users' Association system or other irrigation districts' systems. Irrigation pipe lines shall conform to the specifications and permit requirements of the respective irrigation district and project special provisions.

Installation of pipe in State Highways shall conform to the specifications and permit requirements of the Arizona Department of Transportation.

Subsection 621.2 MATERIALS: Delete the second paragraph in its entirety and replace with the following:

The structural design of pipe and arches shall be in conformance with Section 6 of the City of Phoenix Storm Water Policies and Standards Manual (Latest Edition), applicable ASTM's, applicable AASHTO Standards, and established manufacturer recommended design procedures. The pay width for pavement replacement shall remain in accordance with Section 336.

All helical corrugated metal pipe shall have a marking system which shall provide a quick external visual check of diameter variations during and after the manufacturing process.

All prefabricated fittings for connector and culvert pipes larger than 24 inches shall be welded fittings.

Subsection 621.3 INSTALLATION: Delete the first paragraph in its entirety and replace with the following:

Excavation, bedding, haunching, initial and final backfill and compaction shall be in accordance with Section 601.

Subsection 621.3 INSTALLATION: Delete the last sentence of the second paragraph and replace with the following:

All pipes and arches shall be equipped with lifting lugs as required and shall have connecting bands designed to provide positive connection without damaging the coating on the pipe or pipe arch.

Subsection 621.3 INSTALLATION: Delete the third paragraph in its entirety.

SECTION 621

Subsection 621.3 INSTALLATION: Delete the fourth paragraph in its entirety and replace with the following:

Corrugated metal pipe and pipe arches shall be laid with separate section joined together in such a manner that the joint space shall not exceed ½ inch, with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the side. Elliptical pipe shall be installed so that the major or minor axis, whichever the case may be, and which should be indicated by suitable markings on the top of each end of the pipe sections, coincides with the survey alignment of the trench excavation. CMP shall be carefully handled at all times to prevent damage to the coating. Each length of pipe shall be carefully inspected immediately prior to placing in the trench to verify that no damage has been done to the coating that will be concealed when the pipe is placed. Damaged coating shall be repaired in accordance with AASHTO M-36. As determined by the Engineer, pipe and arch that is damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced at no additional cost to the Contracting Agency.

Subsection 621.3 INSTALLATION: Add the following to the end of this Subsection:

Where a curved alignment is indicated, curves shall be formed by straight pipe and fabricated specials. Pipe shall be of such length that no deflection angle of the pipeline exceeds 10 degrees. All deflection angles shall occur between the point of curvature and point of tangent of the curve as shown on the plans.

Transition manhole bases, for pipe larger than 48 inches, may be constructed with a prefabricated transition and a 48 inch stubbed manhole shaft cast as one structure. Dimensions of this structure shall be equivalent to those shown in the Standard Detail. A shop drawing of this option shall be submitted to the Engineer for review. Corrugated steel manhole shafts will not be permitted unless a detail of construction is included and reviewed with the shop drawing.

Pipe layout shall be such that for manholes not located at a joint, the outside edge of the manhole shaft shall be a minimum of 1.5 pipe diameters away from the nearest joint, on both sides of the manhole.

If the manhole cannot be so located, then the concrete encasement shall be extended to include the joint or joints, not outside to minimum distance of 1.5 pipe diameters from the outside of the manhole shaft.

Subsection 621.3.1 Joints: Delete this Subsection in its entirety and replace with the following:

Joint materials shall be in accordance with Section 760.

Pipe sections shall be joined together with annular corrugated type bands or hugger type bands locking in at least one annular corrugation and shall be designed to form a leak-resistant joint. The hugger type band shall use an O-ring gasket. The annular corrugated type band shall use a 1/4 inch thick rubber sleeve gasket the same width as the connecting band.

One-piece bands may be used on pipe with diameters up to and including 48 inches. O-ring gaskets or one-piece bands shall be a minimum of 3/4 inch diameter. Two or more piece bands shall be used on all pipe diameters exceeding 48 inches. For pipe with diameters exceeding 48 inches, O-ring gaskets shall be a minimum of 7/8 inches in diameter. The minimum connecting band width shall be 7 inches for pipe diameters of 12 inches through 30 inches, 10-1/2 inches for pipe diameters of 33 inches through 60 inches, and 13-1/2 inches for pipe diameters greater than 60 inches through 120 inches. The connecting bands may be two numerical gage thickness lighter than the gage specified for the pipe material, but not less than 0.064 inches (16 gage) nor more than 0.109 inches (12 gage).

When flanges are provided on the pipe ends, the coupling shall be made by interlocking the flanges with a preformed hugger type band and gaskets or other type band incorporating a locking channel and gaskets.

The band shall be tightened evenly, keeping equal tension on the bolts. The joint shall remain uncovered over a period designated by the Engineer, and before covering the joint, the nuts shall be testing for tightness. If the nut has a tendency to loosen its grip on the bolt, it shall be tightened again and remain uncovered until a tight, permanent joint can be obtained.

Subsection 621.3.2 Pipe Elongation: Delete the title of this Subsection in its entirety and replace with the

SECTION 621

following:

Vertically Elongating Catch Basin Connector Pipe

Subsection 621.3.2 Pipe Elongation: Delete this Subsection in its entirety and replace with the following:

When connector pipe is not fully bedded with CLSM, pipe may be vertically elongated. Pipe may be elongated $5 \pm \frac{1}{2}$ percent of the nominal diameter to take advantage of the buildup of side support as it settles back toward a full round shape under the backfill load. The method or technique for obtaining and releasing the elongation shall be optional to the Contractor. Under no circumstances shall the vertical dimension of the pipe at any point along the pipe section, after backfill and compaction is completed, be less than the nominal diameter of the pipe, or more than 5 percent greater than the nominal diameter of the pipe as shown on the plans or specified elsewhere in this specification. Any damage done as a result of strutting shall be repaired as directed by the Engineer at no additional cost to the Contracting Agency. Strutting of pipe shall be approved by the Engineer.

Subsection 621.3 INSTALLATION Delete Subsection 621.3.3 Cutting in its entirety.

Subsection 621.2 INSTALLATION: Delete Subsection 621.3.4 Repair of Damage to Coatings in its entirety.

Subsection 621.4 TEST SPECIMENS: Delete the first paragraph in its entirety.

Subsection 621.5 MEASUREMENT: Delete this Subsection in its entirety and replace with the following:

Measurement of corrugated metal pipe will be the number of linear feet of pipe, measured horizontally, from end to end of the pipe through manholes and specials. No separate measurement will be made for specials and other necessary fabrications. At changes in diameter the measurement will be to center of manhole or special.

Subsection 621.6 PAYMENT: Delete this Subsection in its entirety and replace with the following:

Payment will be made at the unit price bid per linear foot, to the nearest foot, for each size of pipe and shall be compensation in full for furnishing and installing the corrugated metal pipe, specials and necessary fabrications, including removal of asphalt paving, removal of obstructions, excavation, foundation, bedding, backfilling, compacting, temporary pavement, joints, joint materials, transitions with other pipe types, testing, and all incidental costs not specifically covered in other items in the proposal.

SECTION 625

MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS

Subsection 625.2 MATERIALS: Delete the second paragraph in its entirety and replace with the following:

Brick may be used for maintenance of existing brick manholes and for adjustment of manhole frames per Section 345. Bricks for manholes per Section 775.

Subsection 625.3.1 Manholes: Delete the first paragraph in its entirety and replace with the following:

Manholes shall be constructed of brick or precast concrete risers, cones, flat tops, or of cast in place concrete, with cast iron frames and covers. Brick or precast manholes shall be constructed in accordance with the standard details. All manholes shall be constructed with cast in place bases. Precast manhole bases shall not be used. Cast in place manholes shall be constructed from details sealed by a licensed structural engineer in the State of Arizona. Manhole steps are prohibited. The invert channels shall be smooth and semi-circular in shape, conforming to the inside of the adjacent sewer sections. Changes in direction of flow shall be made with a smooth curve, having a radius as large as the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly.

Subsection 625.3.1 Manholes: Delete the fourth paragraph in its entirety and replace with the following:

Cast-in-place manhole bases shall be constructed with Class A concrete in accordance with the standard details and Section 505.

Subsection 625.3.1 Manholes: Delete the first sentence of the fifth paragraph and replace with the following:

Brickwork, precast concrete structures, or cast in place concrete shall not be laid upon a concrete manhole base less than 24 hours after such manhole base has been poured. No brickwork, precast concrete structures, or cast in place concrete shall be laid in water, nor, except as prescribed for curing, shall water be allowed to stand or run on any brickwork until the mortar has thoroughly set.

Subsection 625.3.1 Manholes: Delete the seventh paragraph in its entirety and replace with the following:

All machined surfaces on the frame and cover shall be such that the cover will lie flat in any position in the frame and have a uniform bearing through its entire circumference. Manhole covers in pavement shall be standard open pickslot unless otherwise designated by Engineer. When specified, provide concealed pickslot, watertight or bolt-down covers and frames in lieu of open pickslot. Refer to COP Standard Detail P1424. Any frame and cover which creates any noise when passed over by automobiles shall be replaced. Frames shall be set firmly in a bed of mortar true to line and grade. The frame and cover shall be continuously and solidly supported per MAG Standard Detail 422 prior to placing the collar concrete. A concrete collar per MAG Standard Detail 422 shall be constructed around the frame and cover after the frame and cover is adjusted to grade and solidly supported.

SECTION 625.3 CONSTRUCTION METHODS: Add the following Subsection and Table 625-1 to this Subsection:

625.3.3 Sanitary Sewer Manhole Testing: All new sanitary sewer manholes installed shall be tested for exfiltration either by a watertightness test or by a negative air pressure (vacuum) test modified for the timeframes listed below. Exfiltration testing shall be performed in accordance with Subsection 611.3(B) and Arizona Department of Environmental Quality (ADEQ) Engineering Bulletin No. 11, Chapter 4, Section B.

When using the watertightness test method, exfiltration loss shall not exceed 0.1 gallons per vertical foot of manhole in a 24-hour period.

Negative air pressure (vacuum) testing shall be performed in accordance with ASTM C 1244, modified for the timeframes below. Testing shall be performed at the top of the manhole cone for manholes located in paved areas. Manholes outside paved areas shall be vacuum tested at the ring and cover. A negative air pressure of ten (10) inches of

SECTION 625

mercury shall be drawn on the manhole. The time shall be measured for the vacuum to drop from ten (10) inches to nine (9) inches of mercury. The manhole shall pass this test if the time to drop in mercury meets or exceeds the following values:

TABLE 625-1

MANHOLE DEPTH	MINIMUM TEST DURATION (SECS) 48-INCH DIAMETER MANHOLE	MINIMUM TEST DURATION (SECS) 60-INCH DIAMETER MANHOLE
12 feet or less	60	75
Greater than 12 feet to 15 feet	Not Applicable*	90
Greater than 15 feet	Not Applicable*	105

*Manholes greater than 12 feet in depth shall be 60-inch diameter

If manhole joint compound is pulled out during the vacuum test, the manhole shall be disassembled and the joint repaired or replaced as necessary. The vacuum testing shall then be repeated until the manhole passes.

Exfiltration testing of sanitary sewer manholes is considered incidental to the cost of furnishing and installing the manhole. There will be no separate measurement or payment for this testing.

SECTION 626

CORROSION COATING OF SANITARY SEWER MANHOLES

Add SECTION 626 in its entirety:

SECTION 626

CORROSION COATING OF SANITARY SEWER MANHOLES

626.1 GENERAL

626.1.1 Description

- (A) Scope: All new concrete manholes and access structures constructed over 15-inch diameter or larger sanitary sewers shall have an internal corrosion coating as specified herein. When specified, existing sanitary sewer manholes shall be similarly coated.
- (B) Requirements
 - (1) Contractor shall furnish all labor, materials, and equipment required to clean and line the manholes.
 - (2) Contractor shall comply with the local authority and all occupation safety and health administration (OSHA) requirements for confined space entry.
 - (3) All materials specified by name brand or manufacturer shall be delivered unopened to the job in original containers.
 - (4) All Safety precautions recommended by the manufacturer in printed instructions or special bulletins shall be obtained and followed.
 - (5) For existing manholes, application of coating shall be carried out after all planned repairs to cone, walls, pipe penetrations, bench and invert are completed.
 - (6) Contractor's applicator shall be certified by the coating and underlayment material manufacturers as properly trained for applying the manufacturer's coating and underlayment products. Underlayment products include repair materials, fillers, primers, etc.

626.1.2 Quality Assurance

- (A) Standardization: Materials and supplies provided shall be the standard products of manufacturers. The standard products of manufacturers other than those specified will be accepted when it is demonstrated to the Engineer that they are equal in composition, durability, and usefulness for the purpose intended. Requests for submission shall include directions for the application, descriptive literature, safe storage, handling, and disposal of the product.
- (B) Warranty:
 - (1) A written warranty against coating failure shall be provided for the entire coating system, including all repair material, defect fillers, primers, intermediate, and finish coats. The minimum duration of the warranty shall be five (5) years. The product and the installation may be both covered by the manufacturer's warranty, or separate warranties may be issued by the manufacturer and installer.
 - (2) This warranty shall state that the coating will not fail for a minimum period of five years. Coating failure is defined as blistering, cracking, embrittlement, or softening, or failure to adhere to the substrate. The warranty shall also apply to any underlayment materials used in the application. If any repair or replacement is necessary within the warranty period, a new 5 year warranty period shall start at the date that

SECTION 626

the manhole is placed back into service.

626.1.3 Submittals

(A) Contractor Shall Submit:

(1) Manufacturer's data:

- (a) Manufacturer's technical literature on coating material.
- (b) Description of installation method including:
 - (I) Product material safety data sheets (MSDSI).
 - (II) Maximum storage life and storage requirements.
 - (III) Mixing and proportioning requirements (as applicable).
 - (IV) Environmental requirements for application and worker safety, including ventilation, humidity, and temperature ranges.
 - (V) Application film thickness PM coat of primer and finish coat.
 - (VI) Curing time required.

(2) Sample of finished product showing final color: Coating shall be light in color.

(3) Contractor (or subcontractor) applying coating shall be an Arizona licensed contractor: Each of the Contractor's employees applying coatings and underlayments shall be certified by manufacturer as having sufficient training and knowledge to properly apply their products. Contractor shall submit certification documents. Such certification shall be no more than two (2) years old for any applicator.

626.2 PRODUCTS

626.2.1 Coating Material

(A) Approved Materials: Coating materials shall be one of the following pre-approved products:

- (1) Sauereisen corrosion-clad polymer lining No. 210, and Sauereisen underlayment. No. F-120, as manufactured by Sauereisen Cements, Pittsburgh, PA 15238. The underlayment shall be used to repair and reprofile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and requirements herein prior to application of any underlayment and coating.
- (2) Sewer shield 100 topcoat as manufactured by Environmental Coating, Mesa, AZ 85207. An underlayment recommended by the manufacturer shall be used to repair and reprofile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and requirements herein prior to application of any underlayment and coating.
- (3) Raven 405, as manufactured by Raven Living Systems, 1024 North Lansing Avenue, Tulsa, OK, 74106. An underlayment recommended by the manufacturer shall be used to repair and reprofile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and requirements herein prior to application of any underlayment and coating.
- (4) COR+GARD, Polymer and Permacast MS 10,000 underlayment as manufactured by AP/M Permaform P.O. Box 55, 620 NW Beaver Drive, Suite 1 Johnston, IA 50131. The underlayment shall be used to repair and reprofile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and requirements herein prior to application of any underlayment and coating.

SECTION 626

NOTE: This product is a trial product with limited applications. A maximum of 50 total manholes in City of Phoenix until February 26, 2019, or five (5) years following first installation, whichever is later. All applications shall be reported to the Water Services Department Wastewater Engineering and Construction Management Section.

- (B) Dry film thickness of epoxy/polymer coatings shall be minimum 1/8-inch (125 Mils) thick.
- (C) Cured underlayment thickness shall equal or exceed minimum thickness recommended by manufacturer, but shall provide uniform finished surface for application of epoxy/polymer.

626.3 EXECUTION

626.3.1 Manhole Cleaning

- (A) Cleaning shall remove all sediment, rocks, debris, roots, grease accumulations, and obstructions from the manholes. Cleaning of the manhole walls, bench, and channel shall remove all grease, scale encrustation, and loose mortar so that no foreign intrusion shall cause imperfections in the coating. Cleaning methods shall include washing with high-pressure water, mechanical removal, or other as approved by the Engineer.
- (B) The Contractor shall use water blasting with a minimum water pressure of 3,000 PSI to clean the manhole prior to applying the coating. Contractor shall also be responsible for any additional surface preparation beyond water blasting as required by the coating system manufacturer. Where additional preparation is required, the Contractor shall provide all labor materials and equipment as necessary at no additional cost to the City.
- (C) Before installation of the coating system, the surface must be clean. Excess water shall be blown from the surface using compressed air equipment with oil-trapping filters. Suitable heaters shall be used as needed to produce a surface-dry condition. The surface shall be vacuumed to make sure that loose particles are not present.
- (D) Any sediment or debris from cleaning operations larger than U.S. #8 sieve shall not be deposited downstream in the sewer. Sedimentation deposited downstream, as determined by the Engineer, shall be removed at no cost to the City.

626.3.2 Coating Installation and Repair

- (A) With Engineer's approval new manholes may have corrosion coating applied at manhole manufacturer's facility but all final acceptance testing shall be performed in field following installation of manhole.
- (B) If new manhole is coated at manufacturer's facility then joints will require sealing and coating in the field after manhole assembly. After the joint is assembled in field the Contractor shall prepare the coated surface above and below the joint to receive the protective coating in accordance with the manufacturer's recommendations. Typically a light abrasion blast to 2-inches above and below the joint will clean the surface and give the coating a good surface to adhere to.
- (C) If new manhole is coated at manufacturer's facility, coating of joints, chimney, bench and invert, and any necessary repairs to barrel or cone shall be performed in the field after successful leakage testing per Section 625.
- (D) New manholes that do not have corrosion coating applied at manhole factory shall be fully coated in the field including barrels, cones, joints, chimney, and bench and invert after successful leakage testing per Section 625.
- (E) When identified for corrosion coating existing manholes shall be prepared in accordance with these specifications and the manufacturer's recommendations. Weak and deleterious material shall be removed down to sound substrate. Repairs shall be made with coating manufacturer's recommended underlayment. Coating shall be applied to barrels, cones, joints, chimney, and bench and invert. If flows cannot be bypassed or diverted with a

SECTION 626

flow thru plug, Engineer may waive coating of invert.

- (F) If frame and cover of an existing coated manhole is adjusted in the field, the existing or added chimney adjustment rings shall be coated or have coating repaired as necessary in accordance with the manufacturer's recommendations.

626.3.3 Inspection and Testing:

- (A) Contractor shall give Engineer a minimum of three days advance notice before start of any surface preparation work, underlayment application work, coating application work or testing.
- (B) All work and testing shall be performed in presence of Engineer, unless Engineer has granted prior approval to perform portions of the work in his/her absence.
- (C) Acceptance for holidays testing and adhesion testing shall be witnessed by an independent Testing Agency or Laboratory approved by the City of Phoenix. Cost of this inspection and testing shall be the responsibility of the Contractor. At owner's option, owner may waive requirement for Contractor provided testing agency or laboratory and have Engineer witness this testing.
- (D) Additional illumination, scaffolding, and confined space entry equipment and support shall be provided by Contractor as necessary to facilitate inspection by Engineer and/or Testing Agency when requested.
- (E) Contractor shall furnish appropriate equipment and supplies for holiday testing, dry and wet film thickness testing, and coating adhesion testing. Contractor shall provide trained personnel for performing required acceptance testing including operation of holiday detection devices.
- (F) Holiday testing equipment and procedures shall be performed in strict accordance with latest edition of NACE "Standard Recommended Practice-Discontinuity (Holiday) Testing of Protective Coatings." Areas containing holidays shall be marked repaired or re-coated and re-tested in accordance with coating manufacturer's printed instructions. Holiday detectors shall be:

High voltage pulse-type holiday detectors as manufactured by Tinker & Rasor or D.E. Stearns Co. Unit shall be adjusted to operate at voltage required to cause sparks jump across air gap equal to twice specified coating thickness. Minimum applied voltage for 125 Mil coating shall be 12,500 volts.

- (G) Wet film thickness measurement shall be provided by report submitted by Contractor to Engineer. The report shall be presented after completion of underlayment, top coating operations, and shall state number of manufacturer's product units used and total square footage of surface area covered. Engineer shall have option of requiring Contractor to document number of units (coating materials) on hand before and after coating operations to verify actual minimum dry film thickness applied.

All film thicknesses not meeting required minimums will be re-coated per manufacturer's recommendations to required minimum 125 mil thickness.

- (H) Contractor shall perform adhesion tests on 15% of the manholes coated on any given project (at least one manhole if 15% is less 1.0). Adhesion tests shall conform to ASTM D7234, minimum pull off strength shall be 200 PSI on concrete and 100 PSI on brick and some portion of substrate shall be adhered to coating and dolly. A minimum pull off strength of 150 PSI on concrete will be acceptable if substrate is adhered to coating and dolly on more than ½ the area of the dolly. 50mm dollies shall be used for adhesion testing. In the event of a failure, Engineer and Contractor shall determine limits of failure through additional investigation, sounding and pull tests. Failed areas shall be removed and repaired in accordance with these specifications and manufacturers recommendations. Repaired area shall be tested.

SECTION 626

626.3.4 Warranty Period Inspection:

Owner may conduct inspection any time prior to five (5) years following completion of new coating work and/or repaired coating work. Contractor and representative of coating manufacturer shall be notified of any apparent coating failures. Defective work or coating failures shall be repaired in accordance with specifications and to satisfaction of Owner. If warranty inspections are not held, Contractor is not relieved of responsibilities under Contract Documents.

626.4 MEASUREMENT

Measurement shall be per square foot of manhole wall coated.

626.5 PAYMENT

Payment shall be made at unit price bid per square foot, and be full compensation for cleaning, surface preparation materials, application, testing, and any incidentals, thereto, in conformance with the plans and specifications.

-End of Section-

SECTION 627

PAINTING SANITARY SEWER MANHOLES WITH INSECTICIDE

Add SECTION 627 in its entirety:

SECTION 627

PAINTING SANITARY SEWER MANHOLES WITH INSECTICIDE

627.1 GENERAL

This specification pertains to manholes on sewer, 15-inch in diameter and under.

All new manholes shall be painted with insecticide.

After the new pipe has been tested, inspected, and accepted for service and the manhole has been adjusted to final grade, the top 8 feet or from the manhole bench to the finish grade whichever is less shall be painted. The entire interior circumference shall be covered, including adjusting rings.

The interior of the manhole shall be free from all loose material to provide a clean bonding surface. Refer to manufacturer's specifications for preparation instructions.

Existing manholes to which corrosion coatings are applied, shall be painted with insecticide.

627.2 INSECTICIDE PAINT

Product shall meet requirements of the current City of Phoenix IFB Requirements Contract for Manhole Insecticide Application.

627.3 APPLICATION

Product shall be applied in accordance with requirements of the current City of Phoenix IFB Requirements Contract for Manhole Insecticide Application. Paint must be applied to top 8-feet of manhole cone and barrel. Paint must be applied by a State of Arizona Licensed Pest Control Applicator.

Existing manholes to which a tap or main connection is made do not require insecticide paint.

627.4 MEASUREMENT

Measurement shall be per manhole.

627.5 PAYMENT

Payment shall be made at unit price bid per manhole, and be full compensation for cleaning, surface preparation, materials, application, and any incidentals, thereto, in conformance with plans and specifications.

SECTION 630

TAPPING SLEEVES, VALVES AND VALVE BOXES ON WATER LINES

Subsection 630.3 GATE VALVES: Delete the paragraph “630.3.2 Supplements Specifically Relating to Valve Size:” in its entirety and replace it with the following Subsection:

630.3.2 Supplements Specifically Relating to Valve Sizes: Iron body resilient-seated gate valves are allowed up to 30 inches in accordance with AWWA C509-01.

Subsection 630.4.2 Tapping Sleeves: Add the following as the first paragraph of this Subsection:

All tapping sleeves where the tap size is the same size as the size of the main to be tapped shall conform to Subsection 630.4.2 (A) (1).

Subsection 630.5 BUTTERFLY VALVE: Add the following subparagraphs to Subsection (A):

- (14) The rubber valve seats shall be located in the valve body for valves 16-inches in diameter and larger. Valve seat configurations which rely on the mating pipe flange to hold the seat in position in the valve body will not be acceptable. The seating surfaces mating with rubber seats shall be AISI Type 304 or 316 stainless steel, monel or plasma-applied nickel-chrome overlay for all valves.
- (15) Valve shafts shall be fabricated of AISI Type 304 or 316 stainless steel. The use of shafts with a hexagonal cross section is not acceptable. The connection between the shaft and the disc shall be mechanically secured by means of a solid, smooth sided, stainless steel or monel taper pin or dowel pin. Each taper pin or dowel pin shall extend through or shall wedge against the side of the shaft and shall be mechanically secured in place. The use of bolts, setscrews, knurled or fluted dowel pins, expansion pins, roll pins, tension pins, spring pins, or other devices instead of the solid, smooth sided, stainless steel or monel taper pins or dowel pins shall not be acceptable.
- (16) Prior to installation of the butterfly valve, Contractor shall provide to the inspector, certification statements from the valve manufacturer indicating the leakage tests in both directions, proof of design tests were performed and successfully met per AWWA C504-06 Section 5.1.2. If certifications are not provided, Contractor can elect to perform tests per AWWA C504-06 Section 5.1.2 and witnessed by the inspector. If the tests are not successful, the contract is required to contact the manufacturer to have the seats adjusted until such a time the tests are successful in both directions.

PART 700
MATERIALS

SECTION 701

AGGREGATE

Subsection 701.4 RECLAIMED CONCRETE MATERIAL (RCM): Delete the first two sentences of the second paragraph and replace with the following:

The use of RCM in any manner shall require prior approval from the Engineer. In accordance with Section 7 of AASHTO M319, RCM shall not contain more than five percent by mass of brick or concrete block and shall be free of wood, metal, plaster, and gypsum board. RCM shall be free of all materials that fall under the category of solid waste or hazardous materials as defined by the state or local jurisdiction.

Subsection 701.5 RECLAIMED ASPHALT PAVEMENT (RAP): Delete the title of this Subsection in its entirety and replace with the following:

RECLAIMED ASPHALT PAVEMENT (RAP) AND RECLAIMED ASPHALT SHINGLES (RAS)

Subsection 701.5 RECLAIMED ASPHALT PAVEMENT (RAP): Delete the last two sentences in the first paragraph and replace with the following:

RAP shall not be used in Asphalt Concrete, Portland Cement Concrete or CLSM. RAP shall not be used in Structure Backfill. The use of RAP in other fill shall require prior approval from the Engineer.

Subsection 701.5 RECLAIMED ASPHALT PAVEMENT (RAP): Add the following paragraph to the end of this Subsection:

Reclaimed asphalt shingles (RAS) is defined as all recovered, salvaged or recycled asphalt roof shingles that have been processed to make the material reusable. RAS shall not be used in Asphalt Concrete, Portland Cement Concrete or CLSM. RAS shall not be used in Structure Backfill. The use of RAS in other fill shall require prior approval from the Engineer.

SECTION 702

BASE MATERIALS

Delete this SECTION in its entirety and replace with the following:

702.1 GENERAL:

Base material (Select Material Type A, Select Material Type B, Aggregate Base ABC), shall be crushed aggregate, with gradation per Table 702-1.

The Contractor shall submit documentation to the Engineer from a City approved testing laboratory showing compliance with Table 702-1 ten (10) days prior to placement of base material except where base materials are being obtained from an approved source that is on a list maintained by the City of Phoenix, Street Transportation Department, Design and Construction Management Division, Materials Lab Section.

RCM and RAP will not be utilized as base material without prior approval from the City of Phoenix Materials Lab.

Cement or lime treated base, meeting the requirements of Section 705, can be utilized as base material, except within the pipe embedment zone around Reinforced Concrete Pipe (RCP) and metal pipe.

702.2 PHYSICAL PROPERTIES:

Crushed aggregate shall consist of crushed rock or crushed gravel or a combination thereof as defined in Section 701.

TABLE 702-1			
Sieve Analysis			
Test Methods AASHTO T-27, T-11			
	Accumulated Percentage Passing Sieve, by Weight		
Sieve Sizes (Square Openings)	Select Material		Aggregate Base
	Type A	Type B	
3"	100	--	--
1 ½"	--	100	100
1"	--	--	90-100
No. 4	30-75	30-70	38-65
No. 8	20-60	20-60	25-60
No. 30	10-40	10-40	10-40
No. 200	0-12	0-12	3-12
CBR			
Test Method AASHTO T-193			
Minimum at 0.2000 inch penetration at 65 blows, 100% compaction	50		50
Liquid Limit			
Test Method AASHTO T-89 Method A, T-90, T-146 Method A			
Maximum allowable value	25		25
Plasticity Index			
Test Methods AASHTO T-89 Method A, T-90, T-146 Method A			
Maximum allowable value	5		5
Fractured Face, One Face			
Test Method ARIZ 212, Percent by Weight of the Material Retained on a #4 Sieve			
Minimum required value	50		50
Resistance to Degradation and Abrasion by the Los Angeles Abrasion Machine			
Test Method AASHTO T-96, Percent Loss by Weight			

SECTION 702

TABLE 702-1		
Maximum allowable value 100 revolutions	10	10
Maximum allowable value at 500 revolutions	40	40
Friable or Deleterious Substances		
Test Method ASTM C-142, Percent by Weight		
Maximum allowable in fine aggregate	3	3
Maximum allowable in coarse aggregate	3	3
Soundness		
Test Method ASTM C-88, Percent Loss by Weight		
Maximum allowable in fine aggregate	10	10
Maximum allowable in coarse aggregate	12	12
Apparent Specific Gravity		
Test Method ASTM C-127		
Minimum (considering other factors)	2.65	2.65
pH and Resistivity		
Test Method ARIZ 236		
pH (For Pipe Embedment Zone Only)	5.0 – 9.0	5.0 -9.0
Minimum resistivity	2,000 ohm-centimeters	2,000 ohm-centimeters

SECTION 710

ASPHALT CONCRETE

Delete this SECTION in its entirety and replace with the following:

710.1 GENERAL

Asphalt concrete shall consist of a mixture of paving asphalt and mineral aggregate which, with or without the addition of mineral filler and blending sand as may be required, shall be mixed at a central mixing plant in the proportions hereinafter specified to provide a homogeneous and workable mixture.

Asphalt concrete is designated as Type A-1½ Base Course; Type C-3/4 Base, Surface or Single Course; Type D-½ Single or Surface Course, and Gyratory (on specified projects).

Each mix shall be designed using Marshall compaction methods, unless Gyratory is specified. Marshall Mixes may be used for low or high traffic conditions, as determined by the agency. Low traffic conditions are conditions where the asphalt mix will be subject to low volume and low weight vehicle usage. Examples of this condition are residential streets, most parking lots and residential minor collector streets. High traffic conditions are conditions where the asphalt mix will be subject to high volume and/or heavy weight vehicle usage as found on major collector, arterial and commercial streets. Street classifications (i.e. minor collector and major collector) shall be determined by the specifying agency.

710.2 MATERIAL

710.2.1 Asphalt: The asphalt to be mixed with mineral aggregate shall be paving grade asphalt conforming to Section 711, and shall be PG 64-16 or PG 70-10 as directed by the Engineer, unless otherwise specified in the special provisions.

710.2.2 Aggregate: Coarse and fine aggregates shall conform to the applicable requirements of Section 701 except as modified herein.

Coarse aggregate is material retained on the No. 4 sieve and fine aggregate is material passing the No. 4 sieve.

Blending sand shall be clean, hard and sound material, either naturally occurring sand or crushed fines, which will readily accept asphalt coating. The exact grading requirements shall be such that, when it is mixed with the mineral aggregate, the combined product shall meet the requirements of the designated mix as specified elsewhere in this specification.

710.2.3 Mineral Filler and Anti-Stripping Agent:

- (A) Mineral filler shall conform to the requirements of AASHTO M-17. The mineral filler shall be dry hydrated lime conforming to the requirements of ASTM C 1097, or Portland cement conforming to Section 725 or other approved mineral filler shall be added to the aggregate in accordance with the requirements contained herein. The amount of mineral filler to be used shall be determined by the Engineer. The method of adding the mineral filler shall be such that the aggregate is uniformly coated and the mineral filler is uniformly distributed without loss or waste within the material prior to adding the asphalt to the mixture.
- (B) When aggregate is subject to stripping, dry hydrated lime conforming to the requirements of ASTM C 1097, Portland cement conforming to Section 725 or other approved anti-strip agent shall be added. Hydrated lime and Portland cement shall be added in accordance with Subsection 710.2.3(A).

Other approved no strip agents shall be added in accordance with the manufacturer's recommendations and approved by the Engineer.

710.2.4 Combined Aggregates: The combined aggregates sampled after all processing, except the adding of asphalt and mineral filler, shall conform to the following quality requirements.

SECTION 710

At least 85 percent by weight of the aggregate retained on the No. 8 sieve shall consist of particles which have at least one rough, angular surface produced by crushing.

710.2.5 Mix Design Criteria: Should the Contractor wish to utilize a City of Phoenix mix design from a non-approved source, the mix design(s) shall be submitted to the City of Phoenix Materials Lab 15 working days prior to the start of the asphalt placement. Included with the mix design, the Contractor shall also submit the appropriate asphalt concrete for mix verification and laboratory calibrations as specified by the City of Phoenix Materials Lab. These samples will not include standard City of Phoenix mix designs approved through annual asphalt concrete supplier calibrations.

The mix design shall be performed by the Marshall Mix Design method and shall conform to the requirements specified herein. After the asphalt mix designs have been approved by the Engineer, the Contractor and/or the asphalt supplier shall not change the mix design or utilize additional mixing plants without prior approval of the Engineer.

TABLE 710-1						
CRITERIA FOR STANDARD COP MARSHALL MIX DESIGNS						
LOW AND HIGH VOLUME						
	A 1-1/2"		C 3/4"		D 1/2"	
Sieve Size	Target	Tolerance	Target	Tolerance	Target	Tolerance
1 1/2"	100	---	100	---	100	---
1"	93	+/-7%	100	---	100	---
3/4"	90	+/-7%	95	88-100	97-100	---
1/2"	---	---	85	+/-7%	88	+/-7%
3/8"	63	+/-7%	75	+/-7%	78	+/-7%
No. 4	45	+/-7%	58	+/-7%	58	+/-7%
No. 8	35	+/-5%	44	+/-5%	45	+/-5%
No. 30	20	+/-5%	24	+/-5%	25	+/-5%
No. 200	5	+/-2%	4	+/-2%	5	+/-2%
	High Volume	Low Volume	High Volume	Low Volume	High Volume	Low Volume
Oil Content %	4.3 +/- .4	---	5.0 +/- .4	5.5 +/- .4	5.1 +/- .4	5.6 +/- .4
Air Voids % (Recommended)	5.0 +/- 1.0	---	4.5 +/- 1.0	4.0 +/- 1.0	4.5 +/- 1.0	4.0 +/- 1.0

SECTION 710

TABLE 710-2				
MARSHALL MIX DESIGN CRITERIA				
Criteria	Requirements			Designated Test Method
	1/2" Mix	3/4" Mix	1.5" Mix	
Voids in Mineral Aggregate: %, Min.	14.0	13.0	12.0	AI MS-2
Effective Voids: %, Range (Recommended)	4.0 ±0.2 (LV) 4.5 ±0.2 (HV)	4.0 ±0.2 (LV) 4.5 ±0.2 (HV)	5.0 ±0.2	AI MS-2
Absorbed asphalt: %, Range*	0-1.0	0-1.0	0-1.0	AI MS-2
Dust to Eff. Asphalt Ratio, Range **	0.6-1.4	0.6-1.4	0.6-1.4	AI MS-2
Tensile Strength Ratio: % Min.	60	60	60	ASTM D 4867
Dry Tensile Strength: psi, Min.	100	100	100	ASTM D 4867
Stability: pounds, Min.	2,500	2,500	3,000	AASHTO T-245
Flow: 0.01-inch, Range	8-16	8-16	8-16	AASHTO T-245

710.2.6 Gyratory Mix Designs: Gyratory Mix Designs shall be performed in accordance with the requirements of latest edition of the Asphalt Institute's SP-2 manual. Mix design laboratory compacted specimens shall be prepared using a gyratory compactor in accordance with AASHTO T-312.

The mix design shall be formulated in a manner described for volumetric mix designs in the current edition of the Asphalt Institute Manual SP-2, except the number of trial blend gradations necessary will be determined by the mix design laboratory. Duplicate gyratory samples shall be prepared at a minimum of four (4) binder contents to select the recommended binder content. The gyratory specimens shall be compacted to 160 gyrations. Volumetric data for the design number of gyrations, N_{des} , and the initial number of gyrations, N_{ini} , are then back calculated based on the bulk specific gravity, G_{mb} , of the N_{max} specimens and the height data generated during the compaction process of those same specimens. For Low traffic designs, volumetric data for 115 gyrations, N_{max} for Low Traffic designs, is also back calculated from the specimens compacted to 160 gyrations.

The corrected density of the specimens shall be less than 89.0 percent of maximum theoretical density at N_{ini} . The corrected density of the specimens shall be less than 98.0 percent of maximum theoretical density at N_{max} . The Gyratory mix shall comply with the criteria in Table 710-3.

SECTION 710

TABLE 710-3				
GYRATORY MIX DESIGN CRITERIA				
Criteria	Requirements			Designated Test Method
	3/8" Mix	1/2" Mix	3/4" Mix	
Voids in Mineral Aggregate: %, Min.	15.0	14.0	13.0	AI SP-2
Effective Voids: %, Range	4.0 +/- 0.2	4.0 +/- 0.2	4.0 +/- 0.2	AI SP-2
Absorbed Asphalt: %, Range *	0 - 1.0	0 - 1.0	0 - 1.0	AI SP-2
Dust to Eff. Asphalt Ratio, Range **	0.6 - 1.4	0.6 - 1.4	0.6 - 1.4	AI SP-2
Tensile Strength Ratio: %, Min.	75	75	75	ASTM D 4867
Dry Tensile Strength: psi, Min.	75	75	75	ASTM D 4867
Mineral Aggregate Grading Limits				AASHTO T-27
Sieve Size	Percent Passing with Admix			
	3/8 inch Mix	1/2 inch Mix	3/4 inch Mix	
1 inch			100	
3/4 inch		100	90 - 100	
1/2 inch	100	90 - 100	43 - 89	
3/8 inch	90 - 100	53 - 89	-	
No. 8	32 - 47	29 - 40	24 - 36	
No. 40	2 - 24	3 - 20	3 - 18	
No. 200	2.0 - 8.0	2.0 - 7.5	2.0 - 6.5	
Number of Gyration	Low Traffic		High Traffic	
N _{ini}	7		8	
N _{des}	75		100	
N _{max}	115		160	

* Unless otherwise approved by the Engineer.

** The ratio of the mix design composite gradation target for the No. 200 sieve, including admixture, to the effective asphalt content shall be within the indicated range.

710.3 COMPOSITION AND GRADING:

The grading of the combined aggregates shall be such as to conform to the requirements indicated on the approved list. Contact the City of Phoenix Materials Lab for approved list of all standard COP mixes.

710.4 GENERAL REQUIREMENTS:

Mixtures shall be delivered to the site of the work without segregation of the ingredients and within the temperature range specified in Section 321.

At the time of delivery to the job site, the Engineer shall be provided with a legible weight master's certificate (delivery ticket) containing the following information:

- (1) Date
- (2) Supplier's name;
- (3) Plant location and/or plant number;
- (4) Ticket number;

SECTION 710

- (5) Truck number;
- (6) Contractor's name;
- (7) Project name and/or location;
- (8) Product code/description with percent asphalt;
- (9) Mineral filler/additive and percent;
- (10) Temperature at batching;
- (11) Time of batching, arrival and unloading;
- (12) Material weight or vehicle weight with and without material;
- (13) Weight of accumulative loads.

SECTION 717

ASPHALT-RUBBER ASPHALT CONCRETE

Subsection 717.2.1.3 Asphalt-Rubber Portions and Properties: Delete Table 717-2 in its entirety and replace with the following Table 717-2:

TABLE 717-2	
PHYSICAL PROPERTIES OF ASPHALT RUBBER BINDER	
Grade of base asphalt cement	PG 64-16
Property	Requirement
Rotational Viscosity*; 350° F, Pascal seconds	1.5-4.0
Penetration; 39° F (4° C), 200g, 60 sec. (ASTM D5); dmm, min	10
Penetration, 77° F, 100g, 5 sec: 1/10 mm (ASTM D5), min.	20
Softening Point; (ASTM D36); °F, min.	135
Resilience; 77°F (ASTM D3407); %,min	25
Flash Point: °F (ASTM D92), min.	450
* The Viscometer used must be a hand held rotational viscometer, such as a Rion (formerly Haake) Model VT – 04, or an equivalent, using Rotor No. 1. The rotor, while in the off position, shall be completely immersed in the binder at a temperature from 350° to 355° F for a minimum heat equilibrium period of 60 seconds, and an average viscosity determined from three separate constant readings (± 0.5 pascal-seconds) taken within a 30 second time frame with the viscotester level during testing and turned off between readings. Continuous rotation of the rotor may cause thinning of the material immediately in contact with the rotor, resulting in erroneous results.	

Subsection 717.2.2 Aggregate: Delete Table 717-3 in its entirety and replace with the following Table 717-3:

TABLE 717-3		
MIX DESIGN GRADATION REQUIREMENTS		
LOW AND HIGH VOLUME		
Modified D 1/2" ARAC		
Sieve Size	Target	Tolerance
3/4"	100	+/-0%
1/2"	97-100	+/-0%
3/8"	85	+/-7%
No. 4	35	+/-7%
No. 8	18	+/-5%
No. 30	8	+/-5%
No. 200	4	+/-2%

Subsection 717.3.1 General: Delete the second paragraph in its entirety and replace with the following:

The date of the design shall not be older than one year from the date of submittal, unless supportive documentation is submitted to, and approved by, the Engineer.

SECTION 717

Subsection 717.3.2 Mix Design Criteria: Delete Table 717-5 in its entirety and replace with the following Table 717-5:

TABLE 717-5		
MARSHALL MIX DESIGN CRITERIA		
Criteria	Low Volume Traffic	High Volume Traffic
Asphalt Rubber Binder Content	8.5% minimum	8.0% minimum
Mixture Air Voids, %	3.5 +/-1	5.0 +/- 1
Voids in Mineral Aggregate, %	19.0 min	19.0 min
Tensile Strength Ratio, AASHTO T-283	60% min	60% min
Marshall Stability, pounds minimum	800	800
Marshall Flow, 0.01 inch minimum	16	16

SECTION 725

PORTLAND CEMENT CONCRETE

Subsection 725.8.1 Field Sampling and Tests: Delete the eighth paragraph in its entirety and replace with the following:

Sampling and testing for the 7-day cylinder, the 14-day cylinder, the two 28-day concrete acceptance test cylinders and the two HOLD cylinders will be at the expense of the Contracting Agency. Sampling and testing for the Contractor's purposes of quality control or other needs shall be at the Contractor's expense.

Subsection 725.8.2 Concrete Cylinder Test: Add the following sentence after the fourth sentence:

A single 7-day and a single 14-day cylinder shall be made and tested to provide progress information only and neither shall be considered an acceptance test. Two HOLD cylinders shall also be made and shall be acceptance tested at a 56-day when the 28-day test fails to comply.

SECTION 728

CONTROLLED LOW STRENGTH MATERIAL

Subsection 728.1 GENERAL: Delete this Subsection in its entirety and replace with the following:

Unless approved by the Engineer, the Controlled Low Strength Material (CLSM) shall be from an approved commercial-source and is a mixture of cementitious materials, aggregates, admixtures\additives, and water that, as the cementitious materials hydrate, forms a soil replacement. Approved CLSM shall be identified by a product code that includes "PHCLSM". CLSM is a self-compacting, flowable, cementitious material primarily used as a backfill, structural fill, or a replacement for compacted fill or unsuitable native material. Placement and usage of each type of CLSM is described in Section 604.

Subsection 728.3 PROPORTIONING OF MIXTURES AND PRODUCTION TOLERANCES: Delete Note (2) for Table 728-1 and replace with the following:

(2) Ready-mixed concrete, including timed-out, rejected, and truck wash-out material, shall not be used in lieu of CLSM without prior approval from the Engineer and shall be subject to rejection.

SECTION 735

REINFORCED CONCRETE PIPE

Subsection 735.1 GENERAL: Add the following after the second paragraph of this Subsection:

The size, type, and class of pipe shall be as shown on the plans, or specified under the item of work for the project of which the pipe is a part.

When specified in the special provisions, four sets of pipe line layout drawings shall be furnished to the Engineer prior to the manufacture of the concrete pipe. The pipe layouts will be used by the Contracting Agency for reference only, but their use shall in no way relieve the Contractor of the responsibility for the correctness of the layout. Catch basin connector pipe need not be included in the pipe line layout; however, pipe stubs shall be included. In lieu of including catch basin connector pipe in the pipe layout, a list of catch basin connector pipes shall accompany the layout. The connector pipe list shall contain the following information.

- (A) Size, and class of pipe.
- (B) Station at which pipe joins main line.
- (C) Number of section of pipe, length of section, type of sections (straight, horizontal bevel, vertical bevel, etc.).

All pipe installed in tunnels shall be ASTM C76, Class III. Pipe stronger than that specified may be furnished at the Contractor's option, and at no additional cost to the Contracting Agency, provided such pipe conforms in all other respects to the applicable provisions of these specifications.

Subsection 735.2 JOINTS: Delete the last paragraph in its entirety.

Subsection 735.4 MATERIALS: Add the following as the last sentence of subparagraph (C):

The area of steel used shall be the same as that shown on the shop drawing for that pipe.

SECTION 736

NON-REINFORCED CONCRETE PIPE

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 738

HIGH DENSITY POLYETHYLENE PIPE & FITTINGS FOR STORM DRAIN AND SANITARY SEWER

Delete the title of this SECTION in its entirety and replace with the following:

HIGH DENSITY POLYETHYLENE PIPE & FITTINGS FOR STORM DRAIN

Delete this SECTION in its entirety and replace with the following:

738.1 GENERAL:

This specification covers the requirements of open profile high density polyethylene (HDPE) pipe manufactured per ASTM F894 or AASHTO M-294 (corrugated Type S) for gravity flow storm drain. When noted on the plans or in the special provisions, gravity flow storm drain may be constructed using HDPE pipe. The HDPE pipe will be 15 inch diameter through 48 inch diameter only.

All pipe joints shall conform to the controlled pressure test of 10.8 psi of air or 25 feet of water as stipulated in ASTM D3212.

The size and class of the HDPE pipe to be furnished shall be designed by the Engineer and shown on the plans or in the project specifications. At no time will the class designed be less than RSC-63 for ASTM F894 open profile pipe, or the Pipe Stiffness (PS) for corrugated Type S pipe per the requirements of AASHTO M-294.

738.2 MATERIALS:

738.2.1 Base Material Composition: Open profile pipe base material and fittings shall, in accordance with ASTM F894, be made from a PE plastic compound meeting the requirements of Type III, Class C, Category 5, Grade P34 as defined in ASTM D1248 and with established hydrostatic design basis (HDB) of not less than 1250 psi for water at 73.4 degrees F° as determined in accordance with Method ASTM D2837. Materials meeting the requirements of cell classification PE 334433 C or higher cell classification, in accordance with ASTM D3350 are also suitable. Corrugated Type S pipe base material shall comply with the requirements of AASHTO M-294 and have a minimum cell classification PE 335420C.

738.2.2 Other Pipe Materials: Materials other than those specified under Base Materials shall comply with ASTM F894, or AASHTO M-294.

738.2.3 Gaskets: Gaskets shall be manufactured from a natural rubber, synthetic elastomer or a blend of both and shall comply in all respects with the physical requirements in ASTM F477.

738.2.4 Water Stops: Water stops shall be manufactured from a natural or synthetic rubber and shall conform to the requirements of ASTM C923. The water stop shall have expansion rings, a tension band, or a take-up device used for mechanically compressing the water stop against the pipe.

738.2.5 Thermal Welding Material: The material used for thermally welding the pipe material shall be compatible with the base material.

738.2.6 Lubricant: The lubricant used for assembly shall comply to manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

738.3 JOINING SYSTEMS:

738.3.1 Gasket Type: Joints for the piping system and fittings shall consist of an integrally formed bell and spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket located on the spigot is compressed radially on the pipe or fitting bell to form a water tight seal. The joint shall be designed so to prevent

SECTION 738

displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM F477.

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configurations for the fittings shall be compatible to those used for the pipe.

Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear, shall be smooth and free of any imperfections, which would adversely affect sealability. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

738.3.2 Thermal Weld Type: The pipe ends shall consist of an integrally formed bell and spigot, with or without the elastomeric centering gasket, which join together to form an interface between bell and spigot, such that it is suitable to seal by thermal weld using the extrusion welding process, in accordance with the manufacturer's recommended procedure.

Thermal welded joints may be effected by welding from inside the pipe or outside, or both.

The assembly of the welded joints shall be in accordance with the manufacturer's recommendations.

Thermal welded joints shall be used only when specified on plans or in specifications.

738.4 FITTINGS:

Fittings for HDPE open profile or corrugated Type S pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket type or thermal weld type joints in accordance with Subsection 738.3.

A clamp gasket or approved method shall be provided at manhole entry or connection to reduce infiltration and exfiltration. Where precast manholes are used, entrance holes must be large enough to allow for proper grouting around the manhole gasket. A non-shrink grout shall be used for grouting.

Storm drain manholes in public rights-of-way, right-of-way easements, and dedicated public drainage easements shall conform to COP Standard Detail P1520, MAG Standard Detail 522 excluding steps, and Section 625.

738.5 CERTIFICATION:

A manufacturer's certification that the material was manufactured, sampled, tested and inspected in accordance with ASTM F894 and been found to meet the requirements shall be submitted. A report of the test results shall be included in the submittal.

Pipe and resin producers that manufacture according to AASHTO M-294 shall be certified according to the Plastic Pipe Institute protocol for their Third Party Certification Program.

A manufacturer's certification that the material was manufactured, tested and supplied in accordance with AASHTO M-294 and found to meet the requirements shall be submitted. A report of the test results shall be included in the submittal.

738.6 DIMENSIONS AND TOLERANCES:

Open profile HDPE pipe dimensions shall comply with dimensions given in Table 1 of ASTM F894. The "average or nominal inside diameter" of profile wall HDPE pipe shall not deviate from its normal pipe size by more than as specified in Table 1 of ASTM F894. Corrugated Type S HDPE pipe dimensions shall be "nominal inside diameter" dimensions and shall not deviate from its nominal pipe size by more than the minimum and maximum tolerances as described in AASHTO M-294, Section 7.2.3.

SECTION 738

Pipe shall have a Ring Stiffness Constant (RSC) or Pipe Stiffness (PS) as shown on the plans. The minimum RSC for open profile HDPE pipe shall be RSC-63. The minimum PS for corrugated Type S pipe shall be as shown in AASHTO M-294 (Section 7.4), and tested per ASTM D2412. In no case shall the minimum PS be less than the equivalent PS value for RSC-63.

738.7 CLASSIFICATIONS:

HDPE open profile pipe products shall be made in four standard Ring Stiffness Constant (RSC) classifications, 40, 63, 100 and 160. These are referred to as RSC-40, RSC-63, RSC-100 and RSC-160. The RSC test shall be conducted in accordance with ASTM D2412 with the exceptions listed in accordance with ASTM F894. HDPE corrugated Type S pipe shall meet the minimum Pipe Stiffness (PS) requirements of AASHTO M-294. The PS test shall be conducted in accordance with ASTM D2412 with the exceptions listed in accordance with AASHTO M-294.

738.8 MARKINGS:

Markings on pipe shall be per ASTM F894 or AASHTO M-294. These markings shall be clearly shown on the pipe at intervals of approximately 12 feet and include but not limited to the following: the manufacturer's name or trademark, nominal size, the specification designation, plant designation code, date of manufacture or an appropriate code. All fittings shall be marked with the designation number of the specification and with the manufacturer's identification symbol. In addition, manufacturers of AASHTO M-294 corrugated Type S pipe shall print on or affix the appropriate Plastic Pipe Institute Program Mark on each length of pipe produced that meets the requirements of the program.

738.9 CARE OF PIPE AND MATERIALS:

All pipe and materials shall be manufactured, handled, loaded, shipped and unloaded in such manner as to be undamaged and in sound condition, in the completed work. Particular effort shall be exercised to protect the ends of pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer otherwise they shall not be used in the work and shall be replaced with an equal pipe or special in an acceptable condition. Pipe that is gouged, marred or scratched forming a clear depression shall not be installed, and it shall be removed if damaged during the installation.

Open profile pipe in shipping or storage shall not be stacked higher than three rows for pipes 21 inches in diameter or less, nor higher than two rows for pipes 24 to 36 inches in diameter inclusive. Pipe shall not be stacked, shipped, or stored with weight on the bells of the pipe.

Corrugated Type S pipe in shipping and storage shall be stacked per manufacturer's recommendation, but in no case higher than 5 rows for pipe 24 inches or less in diameter, or 3 rows for pipe greater than 24 inches in diameter.

SECTION 739

STEEL REINFORCED POLYETHYLENE PIPE & FITTINGS FOR STORM DRAIN, IRRIGATION AND SANITARY SEWER

Delete the title of this SECTION in its entirety and replace with the following:

STEEL REINFORCED HIGH DENSITY POLYETHYLENE PIPE & FITTINGS FOR STORM DRAIN

Delete this SECTION in its entirety and replace with the following:

739.1 GENERAL:

This specification covers the requirements of ribbed-pipe profile steel reinforced polyethylene pipe (SRPE) pipe manufactured per ASTM F2562 for gravity flow storm drains. When noted on the plans or in the special provisions, gravity flow storm drains may be constructed using SRPE pipe. The SRPE pipe will be 24 inch diameter through 48 inch diameter only.

All gasketed pipe joints shall conform to the controlled pressure test of 10.8 psi or 25 feet of water as stipulated in ASTM D3212.

All electro fusion pipe joints shall conform to the controlled pressure test of 30.0 psi or 69 feet of water as stipulated in ASTM D3212.

The size and class of the SRPE pipe to be furnished shall be designed by the Engineer and shown on the plans or in the project specifications. At no time will the class designed be less than Class 1 per the requirements of ASTM F2562.

739.2 MATERIALS:

739.2.1 Base Steel Materials: Continuous high strength galvanized ribs shall be cold rolled steel meeting the requirements of either ASTM A1008 or ASTM A1011 with minimum yield strength of 80,000 psi. Steel ribs shall be completely encased within the HDPE profile.

739.2.2 HDPE Material Composition: SRPE pipe high density polyethylene material and fittings shall, in accordance with ASTM 2562, be made from a high density polyethylene plastic compound meeting the minimum requirements of cell classification 335464C or higher cell classification, in accordance with ASTM D3350.

739.2.3 Gaskets: Rubber gaskets shall be manufactured from a natural rubber, synthetic elastomer or a blend of both and shall comply in all respects with the physical requirements in ASTM F477.

739.2.4 Water Stops: Water stops shall be manufactured from a natural or synthetic rubber and shall conform to the requirements of ASTM C923. The water stop shall have expansion rings, a tension band, or a take-up device used for mechanically compressing the water stop against the pipe.

739.2.5 Thermal Welding Material: The material used for thermally welding the pipe material shall be compatible with the base material.

739.2.6 Lubricant: The lubricant used for assembly shall comply with manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

739.2.6 Other Materials: Materials other than those specified above shall comply with ASTM F2562.

739.3 JOINING SYSTEM:

739.3.1 Gasketed Type: Steel reinforced bell and spigot joints for the piping system and fittings shall consist of an

SECTION 739

integrally formed steel reinforced bell and steel reinforced spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket is compressed radially on the pipe or fitting bell to form a water tight seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM F477.

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configurations for the fittings shall be compatible to those used for the pipe.

Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear, shall be smooth and free of any imperfections, which would adversely affect seal ability. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

739.3.2 Thermal Weld Type: Electro fusion (EF) joints shall utilize plain ended pipe welded together by internal pressure testable couplers. The internal couplers shall have a minimum wall thickness equal to or greater than the pipe wall thickness as defined in pipe specification, ASTM F2562. The assembly of the welded joints shall be in accordance with the manufacturer's recommendations.

739.4 FITTINGS:

Fittings for SRPE pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket type or thermal weld type joints in accordance with Subsection 739.3.

A clamp gasket or approved method shall be provided at manhole entry or connection to reduce infiltration and exfiltration. Where precast manholes are used, entrance holes must be large enough to allow for proper grouting around the manhole gasket. A non-shrink grout shall be used for grouting.

Storm drain manholes in public rights-of-way, right-of way easements, and dedicated public drainage easements shall conform to COP Standard Detail P1520, MAG Standard Detail 522 excluding steps, and Section 625.

739.5 CERTIFICATION:

A manufacturer's certification that the product was manufactured and tested in accordance ASTM F2562 and found to meet the requirements shall be submitted. A report of the test results shall be included in the submittal.

739.6 DIMENSIONS AND TOLERANCES:

Profile wall SRPE pipe dimensions shall comply with dimensions given in Table 2 of ASTM F2562. The "inside diameter" of profile wall SRPE pipe shall not deviate from its published inside diameter by more than as specified in Section 6.2.3 of ASTM F2562.

739.7 MARKINGS:

Markings on pipe shall be per ASTM F2562. These markings shall be clearly shown on the pipe at intervals of approximately 12 feet and include but not limited to the following: the manufacturer's name or trademark, nominal size, the specification designation, plant designation code, date of manufacture or an appropriate code. All fittings shall be marked with the designation number of the specification and with the manufacturer's identification symbol.

739.8 CARE OF PIPE MATERIALS:

All pipe and materials shall be manufactured, handled, loaded, shipped and unloaded in such manner as to be undamaged and in sound condition, in the completed work. Particular effort shall be exercised to protect the ends of pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer otherwise they shall not be used in the work and shall be replaced with an equal pipe or special in an acceptable condition. Pipe that is gouged, marred or scratched forming a clear depression shall not be installed, and it shall be removed if damaged during the installation. Gaskets shall remain

SECTION 739

covered at all times by the supplied gasket cover material until the joint is ready for lubrication and assembly.

SRPE pipe in shipping and storage shall be stacked per manufacturer's recommendation, but in no case higher than 4 rows. Pipe shall not be stacked, shipped or stored with weight on the bells of the pipe.

SECTION 740

POLYETHYLENE PIPE AND FITTINGS FOR STORM DRAIN, IRRIGATION AND SANITARY SEWER

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 741

LINING FOR REINFORCED CONCRETE SANITARY SEWER PIPE

Delete this SECTION in its entirety and replace with the following:

741.1 GENERAL:

The interior area of the reinforced concrete pipe as indicated on the plans shall be protected with lining, as specified below.

The installation and application of the pipe lining shall be accomplished by the supplier of the reinforced concrete pipe.

All work for and in connection with the installation of lining in concrete pipe and the field welding of joints shall be done in strict conformance with all applicable published specifications, instructions and recommendations of the approved lining manufacturer.

741.2 MATERIALS:

741.2.1 Material Composition: The material shall be a liner plate which is a combination of inert, synthetic resins, pigments, and plasticizers, compounded to make a permanently flexible sheet.

The liner plate shall be resistant to the following: Oxidizing agents, sulfuric, phosphoric, nitric, chromic, oleic, and stearic acids; sodium and calcium hydroxides; ammonia, sodium, calcium, magnesium, and ferric chlorides; ferric sulfate, petroleum oils and greases; vegetable and animal oils, fats, greases and soaps that normally occur in sanitary sewers.

Liner plate shall be impermeable to sewage gasses and liquids and shall be nonconductive to bacterial or fungus growth. All liner plates shall be factory checked electrically to insure freedom from any porosity with a high voltage holiday detector set at a minimum of 20,000 volts.

Joint strips and welding strips shall have the same general composition and corrosion resistance as liner plate, but shall not have locking extensions.

The lining shall have good impact resistance, shall be flexible and shall have an elongation sufficient to bridge up to a ¼ inch settling crack which may take place in the pipe or in the joint after installation without damage to the lining.

Once cast into the pipe, the lining shall be permanently and physically attached to the concrete by locking extensions and shall not rely on an adhesive bond.

741.2.2 Material Details and Dimensions: The liner plate shall not be less than 0.065 inches in thickness. Locking extension shall be of the same material as the liner and shall be integrally extruded with the sheets. If steel bands are used to secure the liner plate to the forms transversely, strap channels shall be formed by removing the locking extensions as required.

Liner plate shall be supplied either as pipe size sheets or tubes and fabricated by shop welding together using the di-electric welding process. Tensile strength measured across the shop welded joint shall be in accordance with ASTM D412 using Die B and shall be at least 2000 PSI.

Joint strips shall be 4-inches \pm 0.25 inches in width and shall have each edge beveled prior to application.

Welding strips shall be 1-inch \pm 0.125 inch in width and shall have the edges beveled at time of manufacture.

The Contractor shall submit a shop drawing showing liner plate details for approval by the Engineer, prior to fabrication of the pipe.

741.3 INSTALLER QUALIFICATIONS:

SECTION 741

The application of joint strips, weld strips and plastic liner to forms and other surfaces is considered to be specialized work. Personnel performing such work shall be adequately trained in the methods of liner installation and shall demonstrate their ability to the Engineer prior to commencing work.

Each welder shall pass an approved qualification welding test before doing any welding. Certification shall be renewed on a yearly basis and the list of qualified personnel shall be maintained by the pipe manufacturer. All test welds shall be made in the presence of the Agency's representative and shall consist of the following:

- (A) Two pieces of liner at least 15-inches long and 9-inches wide, shall be lapped 1 ½-inches and held in a vertical position.
- (B) A welding strip shall be positioned over the edge of the lap and welded to both pieces of liner. Each end of the welding strip shall extend at least 2-inches beyond the liner to provide tabs.

The weld sample shall be tested by the Engineer as follows:

- (A) Each welding strip tab, tested separately, shall be subjected to a 10-pound pull normal to the face of the liner with the liner secured firmly in place. There shall be no separation between the welding strip and liner
- (B) Three test specimens shall be cut from the welded sample and the weld shall be tested for tensile strength in accordance with ASTM D412 using Die B. Tensile strength measured across the welded joint shall be at least 2000 PSI.
 - (1) If none of these specimens fails when tested as indicated above, the weld will be considered as satisfactory.
 - (2) If one specimen fails to pass the tension test, a retest will be permitted. The retest shall consist of testing three additional specimens cut from the original welded sample. If all three of the retest specimens pass the test, the weld will be considered satisfactory.
 - (3) If two of three specimens fail, the welder will be considered to be an unqualified welder and shall be disqualified.

A disqualified welder may submit a new welding sample when he has had sufficient off-the-job training or experience to warrant re-examination.

741.4 INSTALLATION OF LINER PLATE:

The installation of liner plate, including the welding of all joints, shall be done in accordance with the manufacturer's recommendations. Liner plate shall be installed with locking extensions parallel with the longitudinal axis of the sewer, unless otherwise shown on the plans. All joints between individual sheets or sections of liner plates shall be continuously heat-welded by the use of welding strips of the same general composition and equivalent thickness of material as the liner plates (with the exception of the integral extension ribs).

Liner plate shall be held snugly in place against inner forms by means of light gage steel wire, light steel banding straps or other suitable means. If steel banding straps are used, they shall be applied in strap channels provided for this purpose or onto flaps created at pipe ends.

Locking extensions (T-shaped) shall be integrally extruded to all lower, terminal or longitudinal edges of liner plate as applied to concrete pipe. If banding straps are used, a steel rod ¼-inch in diameter may be inserted in each locking extension along the longitudinal edges of each sheet of liner plate for concrete pipe or some other approved method for holding the lower edge of the liner plate snugly against the form shall be provided. Concrete poured against liner plate shall be compacted in a careful manner so as to protect the liner plate and to produce a dense, homogeneous concrete securely anchoring the lock extensions into the concrete.

SECTION 741

In removing forms, care shall be taken to protect liner plate from damage. Sharp instruments shall not be used to pry forms from lined surfaces. All holes, cuts, torn or seriously abraded areas in the liner plate shall be patched. Patches made entirely with welding strip shall be fused to the liner plate over the entire patch. Larger patches may consist of smooth liner plate applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the sound liner plate adjoining the damaged area.

The Contractor shall take all necessary measures to prevent damage to installed liner plate from equipment and materials used in or taken through the work.

The applied lining shall be free from bubbles due to poor workmanship, and the Contractor shall cut out said bubbles and weld a similar sheet in place of the bubble, unless otherwise directed by the Engineer.

Application on Concrete Pipe-Special Requirements: Type P-1 joint, Liner plate shall be set to within ¼" of the inner edge of the bell or groove end of a pipe section and shall extend to within ¼" of the spigot or tongue end. Type P-2 joint, Liner plate shall be set to within ¼" of inner edge of the bell or groove end of a pipe section and shall extend a minimum of 3" beyond the spigot or tongue end.

Wherever concrete pipe, which are protected with liner plate, join structures not so lined, such as brick structures, concrete pipe, cast-in-place structures or clay pipe, the liner plate shall be extended over and around the end of the pipe and back into the structure for not less than 2-inches.

Where a pipe spur, not of plastic lined concrete, is installed through lined concrete pipe, the liner plate shall be returned not less than 2-inches at the surface of contact. The seal between the liner plate and the spur shall be made using an approved adhesive material and strapped in place. If the joint space is too wide or the joint space surface too rough to allow satisfactory sealing with this adhesive, the joint space shall be filled with 2-inches of densely caulked lead wool or other approved caulking material.

Lined concrete may be cured by standard curing methods. Care shall be exercised, in handling, transporting and placing lined pipe to prevent damage to the liner plate. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or with a suitable forklift lifting the pipe only from the exterior.

No pipe with damaged lining will be accepted until and unless the damage has been repaired to the satisfaction of the Engineer.

741.5 FIELD JOINTS:

The Contractor shall obtain the services of qualified and approved personnel to weld the liner plate field joints. Pipe joints must be dry before the liner plate joints are made. All mortar and other foreign material shall be removed from liner plate surfaces adjacent to the pipe joint, leaving them clean and dry.

No field joint shall be made in liner until the lined pipe or structure has been backfilled and 7 days have elapsed after the flooding, jetting, or other means of compaction has been completed. Where groundwater is encountered, the joint shall not be made until pumping of groundwater has been discontinued for at least 7 days and no visible leakage is evident at the joint. The liner at the joints shall be free of all mortar and other foreign material and shall be clean and dry before joints are made. When the pipe liner coverage is 360 degrees, 6 to 8-inches of the downstream side of the joint strip or flap at the pipe invert shall not be welded.

Heated joint compound shall not be brought in contact with liner.

No coating of any kind shall be applied over any joint, corner, or welding strip, except where nonskid coating is applied to liner surfaces.

Field joints in the liner plate at pipe joints may be either of the following described types:

SECTION 741

Type P-1 joint shall be made with a separate 4-inch joint strip and two (2) 1-inch welding strips. The 4-inch strip shall be centered over the joint, secured to the liner plate by heat sealing with hot air and welded along each edge to adjacent liner plate with a 1-inch weld strip. The width of the space between adjacent liner plate sheets shall not exceed 2-inches. The 4-inch joint strip shall lap over each liner plate a minimum of 1-inch.

Type P-2 joint shall be made with an integral joint flap with locking extensions removed, extending a minimum of 3-inches beyond the spigot end of the pipe. The flap shall overlap the adjacent lined pipe and shall be heat sealed to this lining and then welded on the edge to the adjacent liner with 1-inch weld strip. Care shall be taken to protect the flap from damage. Excessive tension and distortion while bending the flap back to facilitate laying and joint mortaring shall be avoided. Heat shall be applied to straighten the PVC flaps as needed to prevent cracking of the PVC.

Any flap which has been bent back and held shall be allowed to return to its original shape and flatness well in advance of making the liner joint.

If joints are to be mortared, field joints on liner at pipe joints shall not be made until the mortar in the pipe joint has been allowed to cure for at least 48 hours and the pipe has successfully passed the leakage tests.

741.6 INSTALLATION OF WELDING STRIP:

Welding strips shall be fusion welded to joint strips and liner by welders approved by the Engineer, and trained by the manufacturer, using only approved methods and techniques.

Adequate ventilation shall be maintained during all welding operations.

Hot air welding tools shall provide clean effluent air at constant pressure to the surfaces to be joined within a temperature range between 260°C and 315°C (500°F and 600°F).

For lap welds, the welding strip shall be positioned so that approximately 1/3 of the width is placed on the high side of the lap and properly fused. The weld strip shall be completely fused across its' entire width, except for a small allowable gap in the center. Incomplete fusion, charred, or blistered welds will be rejected by the Engineer.

741.7 JOINT REINFORCEMENT:

A 12-inch long welding strip shall be applied as reinforcement across each transverse joint, weep channel, or return which extends to the lower terminal edge of liner. These reinforcement strips shall be centered over the joint being reinforced and located as close to the edge of liner as possible.

741.8 TESTING AND REPAIRING DAMAGED LINER SURFACES:

After the pipe is installed in the trench, all surfaces covered with liner plate shall be tested with an approved electrical holiday detector set at a minimum of 20,000 volts. All welds shall be physically tested by a non-destructive probing method. All patches over repairs to the liner plate wherever damage has occurred shall be done in conformance with the instructions and recommendations of the liner plate manufacturer.

The Contractor shall provide adequate ventilation, ladders for access, barricades or other traffic control devices, and shall be responsible for opening and closing entrances and exits. All areas of liner failing to meet the field test shall be properly repaired and retested. The electrical holiday detector shall be supplied by the Contractor and shall be a Tinker & Rasor Holiday Detector (Model AP-W).

The Contractor, at his expense, shall have an independent inspection service perform the visual inspection and the probing of all weld joints. The independent inspection service and the inspection and probing procedures shall be approved by the Engineer. In addition, the independent inspection service shall witness the spark testing and any repairs performed by the Contractor. Inspectors employed by the independent inspection service to test the welds shall have

SECTION 741

passed the qualification welding test specified in Section 741.3. Upon completion of all liner testing and inspection, the Contractor shall submit certification by the independent inspection service that all installation and weld joints have been tested and inspected and are in compliance with the Specifications. However, this certification shall not relieve the Contractor of the responsibility to correct defective work.

741.9 PAYMENT:

Payment for plastic liner materials, their installation and testing shall be included in the price bid for the pipe or structure to which they are applied.

SECTION 742

PRECAST MANHOLES

Subsection 742.1 GENERAL: Delete this Subsection in its entirety and replace with the following:

This specification covers requirements for precast manhole sections except precast manhole bases. All precast manhole manufacturers shall be NPCA (National Precast Association) certified and shall provide all NPCA certifications upon request. Loading criteria for the precast manhole sections shall meet or exceed the AASHTO HS20-44 loading requirements. All precast manhole risers shall be monolithically cast to ensure water tightness and have a certified structural design and the manhole sections shall be cast in a fashion to achieve water tightness.

Subsection 742.2.2 Precast Sections: Delete the first sentence and replace with the following:

Precast sections shall conform to ASTM C478 (except Section 15 and 16) and AASHTO M199 (except Sections 15 and 16).

Subsection 742.3 MANHOLE PENETRATIONS: Delete the title of this Subsection in its entirety and replace with the following:

MANHOLE BASES

Subsection 742.3 MANHOLE PENETRATIONS: Delete this Subsection in its entirety and replace with the following:

Sanitary sewer manhole bases shall be cast-in-place concrete in accordance with MAG Standard Details 420-1 and 420-2.

Storm drain manhole bases shall be cast-in-place concrete in accordance with COP Standard Details P1520 and P1560.

Subsection 742.5 GASKETS: Delete this Subsection in its entirety and replace with the following:

Sanitary sewer manhole joints shall have gaskets and cement mortar in accordance with MAG Standard Details 420-1 and 420-2.

Storm drain manhole joints shall have grouted joints in accordance with MAG Standard Detail 522 and COP Standard Details P1520 and P1560.

Subsection 742.6 LIFTING POINTS: Delete this Subsection in its entirety and replace with the following:

Lifting points shall be designed and evaluated by a registered professional engineer and have a minimum safety factor of four. After installation, the lifting holes shall be thoroughly packed with an approved commercial-source, non-shrink, non-metallic patching grout with an approved bonding agent. Bent reinforcing steel bars shall not be used as lifting devices. Through lifting holes will not be allowed.

SECTION 744

ABS TRUSS PIPE AND FITTINGS

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 745

PVC SEWER PIPE AND FITTINGS

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 750

IRON WATER PIPE AND FITTINGS

Delete the title of this SECTION in its entirety and replace with the following:

DUCTILE IRON PIPE AND FITTINGS

Subsection 750.1 CAST IRON WATER PIPE: Delete the title of this Subsection in its entirety and replace with the following:

SANITARY SEWER PIPE

Subsection 750.1 CAST IRON WATER PIPE: Delete this Subsection in its entirety and replace with the following:

All ductile iron pipe for conveying sewerage shall be in accordance with AWWA C-150:

- 14" inside diameter and smaller shall be pressure class 350
- 16" inside diameter through 24" inside diameter shall be pressure class 250
- 30" inside diameter and larger shall be pressure class 150

Ductile iron pipe with a minimum wall thickness of Class 50 may be substituted in lieu of the above.

The lining shall cover, at a minimum, the inner surfaces of the pipe and the fitting from the plain end or beveled spigot end to the rear of the gasket socket. If flanged fittings and pipe are included in the project, the lining must not be used on the face of the flange, however full face gaskets must be used to protect the ends of the pipe. At the ends of the pipe and fittings, the lining thickness shall taper for a distance of four inches to a minimum thickness of ten mils.

All ductile iron sewer pipe shall have a protective lining with a nominal thickness of 40 mils and a minimum thickness of 35 mils of Protecto 401 (ceramic epoxy), Polythane (polyurethane), throughout the barrel area of the pipe. However, the lining in the bell area shall transition to a minimum thickness of ten mils at the edge of the gasket socket. The ten-mil lining shall extend into the gasket socket area to a point where the gasket would overlap the lining when it is compressed due to pipe assembly during construction. The ten-mil lining shall also continue from inside the barrel area, around the spigot end of the pipe and along the outside of the pipe to a point where the center of the gasket of the next pipe section would contact the edge of the lining on the spigot end of the previous pipe section. The thickness of the linings shall be determined by using a dry film thickness magnetic gauge at four quadrants.

Each section of pipe and each fitting shall be tested and shall have an absence of holidays when tested by a suitable holiday detector. In all cases, the barrel area of the pipe shall be tested using a voltage of 2,500 volts and a dry conductive probe.

Holiday testing shall conform to ASTM G 62-87 and NACE Standards RP0274-74 and RP0188-90 (latest revision).

The pipe manufacturer shall be solely responsible for the quality of the lining and shall supply a certification as to compliance to the specification. The certification shall state specifically the following items:

- (A) All ductile sewer pipe and fittings have a protective lining of 40 mils (35 mils min) in the barrel area, ten mils in the bell area and ten mils minimum on the exterior of the spigot end.
- (B) Each section of pipe and each fitting have been tested for holidays utilizing a test voltage of 2,500 volts with a dry conductive probe in the barrel area and a test voltage of 67.5 volts with a wet sponge in both the bell area and the exterior of the spigot end, and no holidays were found.
- (C) The lining material used meets the current specifications and that the material was applied as required by the specification.

SECTION 750

If the Contractor makes a field cut of the lined ductile pipe, the Contractor shall comply with the recommendations of the pipe manufacturer in applying a field coating to the end of the pipe ends. In all cases, as a minimum, a ten mil coating shall be applied to the pipe end and shall overlap the lining by four inches and extend around the pipe end and along the outside of the pipe a minimum of ten inches. The coating shall be allowed to dry before assembly. In addition, the overlapped surface of the lining shall be roughed up to produce a three to five mil profile over the entire surface. The end result of this process is to insure proper adhesion of the field coating.

750.1.1 Repair: Repair of the damaged sections of the lining shall be in accordance with the lining manufacturer's recommendation or as specified above so that the repair area is equal to the undamaged lined area in all respects. All damaged lined areas and holidays shall be repaired immediately after discovery.

Holiday testing may be required by the Engineer before pipe assembly when deemed appropriate. The testing and repair requirements shall follow the procedures called for in this specification and all cost for such repairs will be the responsibility of the Contractor.

There will be no other provision for repair of the lining of DIP.

750.1.2 Protective Collar: In order to protect the exterior spigot end against abrasion and damage during shipping and handling, the manufacturer shall install temporary collars on the exterior of each spigot end of each pipe section. The manufacture shall secure the collars to the pipe to prevent accidental removal during shipping and normal handling by the Contractor. The collars are not to be removed from the pipe until right before the pipe section is to be installed or field cut.

Subsection 750.2 DUCTILE IRON WATER PIPE: Delete the last paragraph in its entirety and replace with the following:

Manufacturer shall have a minimum of five years of experience producing ductile iron pipe and fittings, and shall be able to show evidence of at least five installations in satisfactory operation of similar diameters, lengths, and pipe class required for the Work.

All ductile iron pressure water pipe shall be furnished by a single manufacturer and fully manufactured in the USA, including casting, testing, and all applicable linings and coatings. The supplier shall be responsible for the provisions of all test requirements specified in AWWA C151 as applicable. In addition, all ductile iron pressure water pipe to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the Contracting Agency. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection of all pipe approved for this Contract, will be borne by the Contracting Agency.

Ductile iron water pipe shall be of minimum pressure class as follows in accordance with AWWA C-150:

14" and smaller... ..	350
16" through 24"	250
30" and larger	150

The wall thickness of all flanged and grooved end pipe shall be minimum Class 53 except where the specified pressure requires heavier pipe.

All ductile iron water pipe shall be cement-mortar lined and seal coated in accordance with AWWA C-104.

For ductile iron pipe eighteen (18) inches and larger, a manufacturer's pipeline layout shall be submitted showing the line layout with each fitting specified and detailed. Numbering of each standard joint is not required.

All ductile iron pipe shall have polyethylene wrap per Section 610.

SECTION 750

Subsection 750.3 JOINT REQUIREMENTS: Add the following to the end of this Subsection:

Joints for piping located in vaults shall be flanged unless mechanical clamp-type couplings or flange adapters are shown on the Drawings.

Bolts and nuts for joints shall conform to ANSI B18.2.1 and ANSI B18.2.2, respectively. Exposed and buried bolts and nuts shall be ASTM A 307, Grade B, with buried bolts and nuts coated with a petroleum based mastic and wrapping tape system Denso Paste primer and Densyl Tape finish as manufactured by Denso, or approved equal.

The following are approved integral restrained joint ductile iron pipes:

Pacific States Pipes.....	Thrust-Lock
U.S. Pipe.....	TR Flex
U.S. Pipe	HP Lok
American Ductile Iron Pipe.....	Flex Ring
American Ductile Iron Pipe.....	Lok-Ring
Clow Water Systems	Super-Lock
Griffin Pipe.....	Snap-Lok
Griffin Pipe.....	Bolt-Lok

The following are approved restrained joint glands for mechanical joint pipe and fittings:

Star Pipe Products	Stargrip Series 3000
Romac Industries	Romagrip
Romac Industries	GripRing
EBAA Iron	Megalug Series 1100
Ford Meter Box	Uni-Flange Series 1400
Tyler Union	Tuf-grip
Sigma Corporation	Sigma One Lok Series

Split restrained joint glands for mechanical joints, or wedge action restrained joint glands for push (non-mechanical) joints, are only allowed for connection or repair to existing installed pipe. The following are approved split restrained joint or wedge glands:

Star Pipe Products	Stargrip Series 3000S, 3100P, 3100S
EBAA Iron	Megalug Series 1100SD, 1100HD
EBAA Iron	Megalug Series 1700
Ford Meter Box	Uni-Flange Series 1450
Sigma Corporation	Sigma One Lok Series

All pipeline valves and fittings shall have thrust blocks as shown or referenced on the drawings designed for the working pressure in addition to the above restraining systems.

Flanged joints are allowable for above ground piping installations only, except for locations where valves are connected. Buried flanged joints shall be coated with a petroleum based mastic and wrapping tape system Denso Paste primer and Densyl Tape finish as manufactured by Denso, or approved equal.

Weld-on boss outlets are not acceptable.

750.3.1 Welded-On Outlets For Ductile Iron Pipe Larger Than 16 Inches:

750.3.1.1 Scope: Welded-on outlets shall be limited to branch outlets having a nominal diameter not greater than 50% of the nominal diameter of the main line pipe or 12-inch whichever is smaller (see Table 750-1). Welded-on outlets may be

SECTION 750

provided as a radial (tee) outlet, or lateral outlet fabricated at a specific angle to the main line pipe, as indicated on the drawings. Welded outlets for ductile iron pipe are not acceptable for a tangential configuration unless shown on the plans or approved by the Engineer. No welding shall be permitted within 24-inches from the end of the pipe. Spacing of welded outlets shall not be closer than two times the diameter of the largest outlet. The pipe manufacturer or fabricator shall have a minimum of 5 years' experience in the fabrication and testing of outlets of similar size and configuration.

Table 750-1
Main Line Nominal Diameter Versus Maximum Nominal Branch Outlet Diameter

Main Line Nominal Diameter	Maximum Nominal Branch Outlet Diameter
18"	8"
20"	10"
24"	12"
30"	12"
36"	12"
42"	12"
48"	12"
54"	12"
60"	12"
64"	12"

750.3.1.2 Outlet Joint Types: The joints on welded-on branch outlets shall meet, where applicable, the requirements of ANSI/AWWA C111/A21.11 and/or ANSI/AWWA C115/A21.15.

750.3.1.3 Design: Weldment for welded-on outlets shall be based on the method described in Section VIII of the ASME Unfired Pressure Vessel Code. Reinforcing welds shall be placed using Ni-Rod FC 550 cored wire or Ni-Rod 550 electrodes manufactured by INCO Alloys (or an electrode with equivalent performance properties). Carbon Steel electrodes are not acceptable.

Parent pipe and branch outlet pipe shall be centrifugally cast ductile iron pipe designed in accordance with ANSI/AWWA C150/A21.50 and manufactured in accordance with ANSI/AWWA C151/A21.51. Minimum classes shall be: for sizes 4-inch through 54-inch, Special Thickness Class 53; for sizes 60-inch through 64-inch, Pressure Class 350.

Welded outlets require submittal and approval of design calculations, welding procedures, and actual structural testing results for both hydrostatic pressure as well as transverse and axial loading imposed on the outlet itself.

750.3.1.4 Testing: All welded-on outlets shall be rated for a working pressure of 250 psi and must have a minimum safety factor of 2.0 based on proof of design hydrostatic test results. The manufacturer shall, at the request of the owner or owner's Engineer, provide representative proof test data confirming hydrostatic test results and safety factors.

Prior to the application of any coating or lining in the outlet area all weldments for branch outlets to be supplied on this project shall be subjected to an air pressure test of at least 15 psi. Air leakage is not acceptable. Any leakage shall be detected by applying an appropriate soapy water solution to the entire exterior surface of the weldment and adjoining pipe edges or by immersing the entire area in a vessel of water and visually inspecting the weld surface for the presence of air bubbles. Any weldment that shows signs of visible leakage shall be repaired and retested in accordance with the manufacturer's written procedures.

750.3.1.5 Quality Assurance: The manufacturer shall have a fully documented welding quality assurance system and maintain resident quality assurance records based on ANSI/AWS D11.2, the Guide for Welding Iron Castings. The manufacturer shall maintain appropriate welding procedure specification (WPS), procedure qualification (PQR), and welder performance qualification test (WPQR) records as well as appropriate air test logs documenting air leakage tests. The manufacturer shall have ISO 9001 or 9002 registration.

Prior to the start of manufacturing any proposed manufacturer not meeting ISO 9001 or 9002 registration requirements

SECTION 750

shall submit to the owner or owner's Engineer the name of an Independent Inspection Agency and the agency's qualifications. Submitted qualifications shall include but are not limited to the following:

- (A) List of project references for projects of similar type and size
- (B) Resumes for inspection and testing personnel
- (C) Capacities for chemical and mechanical testing of material specimens
- (D) Frequencies for all instrument and testing equipment certifications

The independent inspection agency shall be responsible for all of the following:

- (A) Verify compliance to written welding procedures specification (WPS) and procedure qualification (PQR)
- (B) Verify qualification of all welders (WPQR) per ANSI/AWS D11.2 criteria
- (C) Document use of Ni-Rod FC 550 cored wire or Ni-Rod 550 electrodes manufactured by INCO Alloys (or an electrode with equivalent performance properties)
- (D) Witness and document all air testing of outlet welds

750.3.1.6 Field Welding: No field welding or field repairs shall be allowed. Should a leak be detected at a welded-on outlet after installation, the piece shall be removed and returned to the pipe manufacturer's facility, where originally produced, for repair.

Subsection 750.4 FITTINGS: Delete the second paragraph in its entirety and replace with the following:

Mechanical joint fittings shall conform to AWWA C110, and flange fittings shall conform to AWWA C110 and C115. AWWA C153 compact fittings are acceptable for use unless otherwise specified. Long-radius elbows shall be provided where specified.

Fittings for water pipe shall be cement mortar lined and seal coated in accordance with AWWA C-104.

SECTION 750 IRON WATER PIPE AND FITTINGS: Add the following Subsection:

750.5 CATHODIC PROTECTION:

All ductile iron pipe 16-inches and larger shall have cathodic protection. Pipelines less than 16 inches shall have cathodic protection where called for in the plans and specifications or directed by the Engineer.

750.5.1 Bonded Joints: Bond wires shall be provided across all non-conductive ductile iron pipe joints to ensure electrical continuity. Joint bonds shall be installed as shown on the drawings. Joint bonds shall be made utilizing #4 AWG type HMWPE stranded conductors. Bond wires shall not exceed 18 inches in length. Joint bond wires shall be installed as shown on the plans. Connections shall be made utilizing the exothermic weld process per Section 750.5.2.

750.5.2 Exothermic Welds: Exothermic welds shall be provided for wire to structure connections in strict accordance with the manufacturer's recommendations. Connections shall be made at locations shown on plans. Exothermic welds shall be "Cadweld", as manufactured by Erico Products, Inc., "Thermoweld" as manufactured by Continental Industries, Inc., "Pin Brazing" by BAC, or approved equal. Duxseal packing as manufactured by Johns-Manville or approved equal shall be used where necessary to prevent leakage of molten weld metal.

The shape and charge of the exothermic weld shall be chosen based on the following parameters:

SECTION 750

- Pipe Material
- Pipe Size
- Wire Material
- Number of Strands to be Welded
- Orientation of Weld (Vertical or Horizontal)

Type of exothermic weld to be used shall be submitted to the Construction Manager for approval. Copper sleeves specifically designed for the purpose shall be crimped on all bare wire ends of all stranded wires prior to exothermic welding to improve mechanical strength and thermal capacity.

Exothermic weld connections shall be installed in the manner and at the locations shown on the plans. Coating materials shall be removed from the surface over an area of sufficient size to make the connection. The steel surface shall be cleaned to shiny metal by grinding or filing prior to welding the conductor. The use of resin impregnated grinding wheels will not be allowed. The conductor shall be welded to the pipe by the exothermic welding process with a copper sleeve fitted over the conductor. Only enough insulation shall be removed such that the copper conductor can be placed in the welding mold. After the weld has cooled, all slag shall be removed and the metallurgical bond shall be tested for adherence to the pipe or casing. All defective welds shall be removed and replaced. All exposed surfaces of the copper and steel shall be covered with insulating materials as shown in the detail drawings. No connections to the piping shall be buried prior to inspection and approval of the Engineer. Connections made in violation of this requirement shall be rejected.

Welds shall be primed with an elastomer resin based primer, covered with a weld cap, and then over-coated with bitumastic.

750.5.3 Weld Caps: Welds to be buried or submerged shall be primed with an elastomer resin based primer then be covered with a 100% solids mastic filled plastic cap. Use the plastic cap on dielectric coated pipe following the manufacturer's instructions. Primer shall be Roybond Primer 747 as manufactured by Royston Laboratories, or equivalent. Weld caps shall be Royston Handy Cap, as manufactured by Royston Laboratories, Inc. Thermit Weld Cap, as manufactured by Phillips Petroleum Co. or an approved equal.

750.5.4 Testing: The Contractor shall be responsible for testing the corrosion monitoring and cathodic protection systems. All testing shall be performed by or under the direct supervision of a Corrosion Engineer. All field tests shall be performed at the expense of the Contractor. This testing shall include all insulators, wires, continuity testing, and cathodic protection system activation. The tests shall be conducted in the presence of the Owner or its representative. The Contractor shall correct, at his expense, all deficiencies in the installation observed by these tests and inspections.

The Contractor shall pay for all retests made necessary by the corrections.

- (A) Services of Corrosion Engineer: Contractor shall obtain the services of a Corrosion Engineer to inspect, activate, adjust, locate electrical discontinuities, and evaluate the effectiveness of the cathodic protection system. The Corrosion Engineer is herein defined as a registered Professional Engineer with certification or licensing that includes education and experience in cathodic protection of buried or submerged metal structures, or a person accredited or certified by NACE International at the level of Corrosion Specialist or Cathodic Protection Specialist (i.e. NACE International CP Level 4). Such a person shall have not less than five years' experience inspecting pipeline cathodic protection systems.
- (B) Services of Cathodic Protection Technician: If necessary, obtain the services of a Cathodic Protection Technician to inspect, activate, adjust, and evaluate the effectiveness of the cathodic protection system. The Cathodic Protection Technician is herein defined as a person accredited or certified by NACE International as a Cathodic Protection Level 2 Technician. Such a person shall have not less than five years' experience inspecting pipeline cathodic protection systems and shall be under the direct supervision of the Corrosion Engineer.

Upon completion of installation of all components in accordance with these specifications, testing shall be performed to demonstrate that the installation has been completed and is in working order in conformance with the plans and

SECTION 750

specifications. In no case shall the testing be less than those outlined herein unless requested in writing by the Contractor and approved by the Construction Manager. The testing described herein shall be in addition to and not a substitution for any required testing of individual items at the manufacturers' plant. The Contractor shall provide testing of the system. The test data shall be submitted to the Engineer for acceptance to demonstrate that the system is in proper working order.

The cost of the testing shall be borne by the Contractor, including any additional expenses which result from retesting due to equipment or installation which is not in conformance with these specifications and drawings.

750.5.4.1 Exothermic Weld Testing: Exothermic welds shall be tested by the Contractor for adherence to the pipe or casing and for electrical continuity between the pipe or casing and wires. Test completed weld by striking weld with a hammer and pulling on wire. A 22-ounce hammer shall be used for adherence testing by striking a blow to the weld. Care shall be taken to avoid hitting the wires.

750.5.4.2 Joint Bond Testing: After installation, all joint bonds shall be tested for effectiveness. The testing shall be performed prior to backfill of the pipe and shall be verified upon completion of backfilling operations. Prior to backfilling, current shall be circulated through the pipe and the measured resistance shall be compared to the theoretical resistance of the pipe and bond cables. The resistance measured shall not exceed 120 percent of the theoretical resistance. Once backfilling operations have been completed, the testing shall be repeated to ensure continued effective continuity. All data shall be tabulated and submitted upon completion of testing and prior to final acceptance of the contract.

SECTION 752

ASBESTOS-CEMENT WATER PIPE AND FITTINGS

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 753

GALVANIZED PIPE AND FITTINGS

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 755

POLYETHYLENE PIPE FOR WATER DISTRIBUTION

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 756

DRY BARREL FIRE HYDRANTS

Subsection 756.3 HYDRANTS: Add the following after the first paragraph of this Subsection:

Approved fire hydrants allowed for installation in the City of Phoenix include:

- Mueller Super Centurion 250
- Clow Medallion (new model)
- Kennedy K-81 Guardian
- American Darling B-84-B
- East Jordan Iron Works CD-250

All fire hydrants shall be supplied to meet a 42-inch bury depth.

SECTION 757

SPRINKLER IRRIGATION SYSTEM

Delete the title of this SECTION in its entirety and replace with the following:

LANDSCAPE IRRIGATION SYSTEM

Subsection 757.1 GENERAL: Add the following to this Subsection:

The Manufacturer of component equipment shown on the drawings or specified in the Special Provisions form the basis of the irrigation design as well as the physical and operational standards for which the components were selected. Component equipment from other manufacturers may be submitted, by the Contractor, to the Engineer for approval. No equipment however is to be ordered without approved shop drawings.

All buried galvanized pipe and fittings shall be protected from corrosion by the application of a tight fitting, extruded or wrapped coating. Coatings shall be not less than 0.030 inches in thickness at any point. Extruded coatings shall be of polyethylene or polyvinyl chloride, Extracoat or equal. Wrapped coatings shall be of polyethylene, polyvinyl chloride, asphalt tape, Pretecto Wrap No. 200, Safe-t-Clad FOS No. 655, Tapecoat, Trantex VID-10 or E-12, Polyken No. 900, Scotchrap No. 50, or approved equal. Tape shall be edge lapped no less than 1/4 inch.

Subsection 757.2.1 Steel Pipe: Delete this Subsection in its entirety and replace with the following:

All steel pipe shall be newly galvanized, welded or seamless steel pipe conforming to the requirements of ASTM A53, standard weight, schedule 40.

Subsection 757.2.2 Plastic Pipe: Delete this Subsection in its entirety and replace with the following:

Rigid Plastic Pipe shall be extruded from 100% virgin normal impact unplasticized polyvinyl chloride (PVC) Type I, Grade I or II resin 2000 psi (PVC 1120 or PVC 1220), design stress ASTM D1784, Department of Commerce PS-21-70, PS-22-70, Standard Dimension Ratio (SDR) 26 or less than 160 psi. Pipe shall conform to ASTM D-2241 and D-2672.

Testing of pipe: Provide written certificate by supplier that polyvinyl chloride pipe has successfully passed the following tests:

Acetone test: Immerse a sample of pipe in 99% pure anhydrous acetone for 15 minutes; at the end of this time there should be no evidence of flaking or delamination on the inner or outer walls of pipe. Evidence of softening or swelling shall not constitute failure.

Flattening: Cut a specimen two inches long from each end of the pipe sample. Flatten each test specimen from parallel plates of a press until the distance between the plates, in inches, is equal to sixty (60) percent of the pipe O.D., and there shall be no evidence of cracking, splitting or breaking.

The pipe shall be homogeneous throughout, free from visible cracks, holes, or foreign materials. The pipe shall be free from blisters, dents, wrinkles or ripples and die and head marks.

Piping up to and including 2-1/2" size shall be SDR solvent welded.

Pressure mainline piping 3" size and larger shall be gasket pocket type, as manufactured by the Swanson Co. or approved equal, and shall conform to ASTM F-477.

Continuously and permanently mark pipe with manufacturer's name or trademark, kind and size (IPS) of pipe, material, manufacturer's lot number, schedule or type and NSF seal of approval.

SECTION 757

Subsection 757.2.3 Pipe Fittings and Couplings: Delete this Subsection in its entirety and replace with the following:

- (A) Steel Pipe Fittings and Couplings: Steel pipe fittings and couplings shall be 150 psi pressure rated, banded, galvanized, malleable iron screwed fittings and couplings.
- (B) Plastic Pipe Fittings and Couplings: For pipe fittings up to and including 2-1/2" size, fittings and couplings shall be either threaded type or slip fitting tapered socket solvent weld type. Schedule 80 pipe will only be used for threaded joints. Tapered socket solvent weld fittings may be either Schedule 80 or Schedule 40, but in either case, will be equal to or greater than the schedule and Pressure Rating of the plastic pipe being joined. Tapered fittings shall be sized so that a dry, unsoftened taper cannot be inserted more than halfway into the socket. Plastic saddles and flange fittings are not permitted.

PVC fittings shall be marked with manufacturers name or trademark, type PVC, size and NSF seal of approval. Extruded couplings to be produced from NSF rated raw materials and meet ASTM standards.

For pipe 3" and greater, fittings shall be ductile iron, grade 80-55-06, in accordance with ASTM A-536. Fittings shall have mechanical joints with gaskets meeting ASTM F-477. Fittings shall have radii of curvature conforming to AWWA C110.

Subsection 757.2 PIPE AND FITTINGS: Add the following Subsection:

757.2.5 PVC Primer: The primer shall be specifically formulated for the pipe and type of connection, as recommended by the pipe manufacturer.

Subsection 757.3.1 General: Add the following to this Subsection:

Valves on galvanized pipelines shall be all bronze, double disc wedge, non-rising stem with wheel handle on top, such as Jones J373 or equal, with bodies, bonnets, yokes and wedges made of material conforming to ASTM B62.

Subsection 757.3.4 Electrical Remote Control Valves: Delete this Subsection in its entirety and replace with the following:

The electric remote control valve listed on the plans or specifications and described by the manufacturer's most recent literature (catalogue cut sheet), constitute the quality and performance standards for the specified valve.

Subsection 757.3.7 Valve Boxes: Delete this Subsection in its entirety and replace with the following:

All valve boxes shall have stainless steel bolts and washers with lock down covers. Valve boxes and covers shall be molded, non-corrosive plastic, ASTM D638, D-356, except when located in paved surfaces. These shall be concrete boxes with lock down steel or concrete cover rated for traffic conditions to which it will be exposed.

Subsection 757.4 BACKFLOW PREVENTER ASSEMBLY: Delete this Subsection in its entirety and replace with the following:

The Backflow Preventer Assembly shall consist of Pressure type or Reduced Pressure type backflow preventer unit and associated components conforming to the governing code requirements and as shown on the plans or specifications. The backflow preventer unit shall be equal in quality and performance to the unit listed in the Contract Documents.

757.4.1 Backflow Preventer Cage: Pre-manufactured units shall be approved for use by the Engineer. The Contractor shall submit catalog information. Pipe used to support the units shall be not less than 1-1/4" schedule 40 and shall be ASTM A-53 Grade A electric weld Pipe, expanded metal shall be 1/2" spacing, #13 gauge flattened diamond pattern steel. There shall be no exposed ends of expanded metal on the outside of the enclosure. The expanded metal shall be "die formed" for uniformity. Welds shall be a minimum of 1/4" long weld on a 4" spacing. All units shall withstand a

SECTION 757

minimum of 200 lbs. per square foot for 24 hours without deflection or distortion. Cage locking mechanism shall be vandal resistant. Cage shall be powder coated by electrostatic application to 1.5 to 2 mil thickness. Color shall be approved by the Engineer.

Subsection 757.5 SPRINKLER EQUIPMENT: Delete the last two paragraphs in their entirety and replace with the following:

Spray heads, impact sprinkler heads, rotor pop-up sprinkler heads, bubblers, emitters, etc., as shown on the plans or specifications and as described in the Manufacturer's latest literature (Catalogue cut sheets) constitute the performance and quality standards for this equipment.

Subsection 757.6.1 Conduit: Delete this Subsection in its entirety and replace with the following:

Conduit shall be as designated on the plans or specifications.

Subsection 757.6.3 Electro-Mechanical Controller Unit: Delete the title of this Subsection in its entirety and replace with the following:

Controller Unit and Assembly

Subsection 757.6.3 Electro-Mechanical Controller Unit: Delete this Subsection in its entirety and replace with the following:

The Controller unit and assembly listed on the plans or specifications and as described in the Manufacturer's latest literature (Catalogue cut sheets) constitute the quality, performance and operational standards for the specified Controller.

SECTION 758

CONCRETE PRESSURE PIPE - STEEL CYLINDER TYPE

Subsection 758.1 GENERAL: Add the following before the first paragraph:

All pipe shall be designed for 150 psi working pressure plus 60 psi surge pressure unless otherwise specified. Test pressure shall be 188 psi.

The pipe shall be designed to support the earth cover over the pipe as shown by the pipeline profiles on the plans. Where the earth cover over the pipe is less than eight (8) feet, the design shall be based on eight (8) feet minimum cover. When the plans show both existing and future surface profiles, the critical cover shall be used for design purposes.

Earth loads on pipe shall be calculated assuming the pipe is installed in a positive projecting embankment condition. The loading for positive projecting embankment condition shall be derived using a product of the projection ratio and the settlement ratio of 0.5. The Ku factor shall be 0.150. The soil unit weight shall be 140 pounds per cubic foot.

Pipe reinforced with ring stiffeners will not be permitted. Dimensions of fittings and specials shall conform to AWWA C-208.

Field joints for specials and fitting shall be as called for on the plans. Flanges shall be Class D steel ring flanges in accordance with AWWA C-207, unless otherwise specified.

Subsection 758.1 GENERAL: Delete the second and third paragraphs of Subsection (A) in their entirety and replace with the following:

Reinforced concrete cylinder pipe (CCP) may be furnished in pipe diameters of twenty-four (24) inches through sixty (60) inches.

Pipe and fittings shall be designed by the methods described in AWWA Manual M9 to resist the internal pressures and external loading conditions designated on the approved plans or in the project specifications.

The pipe shall be designed for the maximum stress to be encountered in place as indicated on the plans, whether it is internal pressure, external backfill load, H-20 truck load on the backfill, or any combination of loading.

The pipe shall be designed to limit the deflection of the pipe, in inches, under the external loads specified to not more than the square of the diameter of the pipe in inches divided by 4,000. Deflection shall be calculated by "Spangler's" formula using a bedding constant (K) of 0.1 and an appropriate modulus of soil reaction (E'). An E' value of 1,500 psi may be used for pipe bedding material based on 90 percent Standard Proctor or 70 percent relative density for pipe cover depths between 5 feet and 15 feet. For pipe burial depths less than 5 feet or greater than 15 feet or alternative pipe bedding materials, designer may use alternate E' values provided that the rationale for developing the alternate E' value is acceptable to the Owner. E' = 2,500 psi may be used for controlled low-strength material (CLSM).

The pipe shall be designed for external loading based on an H-20 truck loading and impact factors recommended by AASHTO for highway truck loads in "Standard Specifications for Highway Bridges."

Immediately after the cement-mortar coating has been placed, the ends of each section of pipe shall be tightly capped with waterproof covers to prevent the escape of moisture when water curing. When steam curing, waterproof covers may not be necessary until completion of cure, provided prompt application of steam is begun. The waterproof covers shall become a component part of the completed pipe section, to protect the interior of the pipes, and shall remain on the pipe until it is installed in the trench.

The minimum steel plate thickness for fittings and special pipe shall be 0.25 inches.

For fittings and special pipe, the minimum cement mortar or concrete lining thickness shall be 0.75 inches and the 0.75 inches shall be the maximum thickness allowed for resisting any external loads and shall be so used and shown in any design calculations. External or outside cement mortar coating shall be limited to a maximum of 1.25 inches for the

SECTION 758

purpose of resisting any external loads.

For standard pipe, the maximum allowable cement mortar coating shall be 1.25 inches, measured from the bar wrap.

Subsection 758.1: GENERAL: Add the following paragraphs to the end of Subsection (B):

Pipe shall be embedded cylinder type. Stress analysis of pipe shall be made using "Olander's" coefficients for a 120 degree bedding angle.

Prestressed concrete cylinder pipe (PCCP) may be furnished in forty-two inch and larger diameters.

Except as otherwise provided in this Section, fabricated steel plate fittings and specials shall be designed for internal pressure only. The internal pressure design shall be based upon a design stress of 15,000 psi. The minimum steel plate thickness shall be 1/4 inch.

Outlets, where specified on the plans, with an internal diameter of less than one-half the diameter of the mainline pipe may be installed on prestressed concrete cylinder pipe. Outlets with an internal diameter greater than one-half the diameter of the mainline pipe or twenty-four (24) inches shall be designed and manufactured as a separate fabricated steel plate fitting.

The exterior of fabricated steel plate fittings and specials shall not be mortar coated, but shall be shop painted as provided in this Section.

All fabricated steel plate fittings and specials shall be encased in reinforced concrete as shown on the details in the plans.

At mainline valves, where a steel plate section is required to comply with plans and/or attach a companion flange for connection to the valve, the following shall apply to such plate sections:

- (a) Design shall limit deflection to the square of the diameter in inches divided by 4,000 for pipe diameters less than sixty (60) inches. For pipe diameter sixty (60) inches and greater, deflection is limited to one and one-half (1-1/2) percent of the diameter.
- (b) Unless otherwise specified, plate sections shall not be longer than one (1) foot.
- (c) Plate sections shall comply with all other applicable provisions, MAG Specifications, Phoenix supplement to MAG and AWWA Standards and AWWA Manual of Water Supply Practices-M9, second edition, with the following exception. For design, the minimum cement mortar or concrete lining thickness shall be 0.75 inches and the 0.75 inches shall be the maximum thickness allowed for resisting any external loads and shall be so used and shown in any design calculations. External or outside cement mortar coating shall not be considered for the purposes of resisting any external loads.

Subsection 758.2 MANUFACTURE: Add the following paragraphs to the end of this Subsection:

An affidavit of compliance as specified in Section 1.11 of AWWA C-301 and Section 1.11 of C-303 shall be furnished to the Engineer.

Cement used in manufacture of pipe shall conform to ASTM C-150, Type II, low alkali.

No concrete admixture shall be used except as approved in writing by the Engineer.

Liquid membrane-forming compounds shall conform to ASTM C-309, Type I, and shall be of such composition that after drying they will not impart taste or odor to water flowing through the pipe, nor will they contain any toxic materials. The

SECTION 758

use of such compounds shall be subject to the approval of the Engineer.

Rust inhibitors used for preventing rust on steel surfaces at holdbacks of mortar lining and/or coating shall be quick-drying material with good bonding properties to the steel, and shall be tack-free and smooth within four (4) hours after applying.

All joints shall be the Carnegie Bell and Spigot type with rubber gaskets. The joint rings for spigot ends for rubber gasket joints shall be Carnegie Shape M-3516, M-3818 or M-3836.

Openings, connections and outlets shall be cement mortar lined and concrete coated as detailed on the plans.

Prestressing wire shall be wrapped directly over steel shorting straps (Minimum of 4). Steel bars shall be welded between prestress anchor assemblies and joint rings.

Design steel cylinders and welds between cylinders and joint rings for the longitudinal thrust exerted by full test pressure. Minimum cylinder thickness for AWWA C 301 pipe shall be 10 gauge where restrained joints are required.

SECTION 758 CONCRETE PRESSURE PIPE - STEEL CYLINDER PIPE: Add the following Subsections:

758.3 MATERIAL DRAWINGS:

The Contractor shall furnish the Engineer with six (6) copies of shop drawings, pipe layout diagrams, manufacturer's catalog data, and detailed information, in sufficient detail to show complete compliance with all specified requirements, covering but not limited to the following items:

Fabricated pipe and specials; design calculations; field closures; reinforcing steel and concrete mix designs.

The manufacturer's complete design calculations shall be submitted to the Engineer for review prior to or with the Joint Detail submittal.

The procedure outlined in American Water Works Association Manual M-9 will be used in determining the length of pipe requiring welded joints. Joint restraints design shall be based on test pressures. Shop drawing submittal shall include calculations showing the length of welded joints, tensile stress to be resisted by, and design of joint welds and pipe longitudinal reinforcement. Minimum design parameters shall be as follows: Soil unit weight is 110 pounds per cubic foot; soil friction coefficient 0.3; height of backfill over pipe - maximum four (4) feet or as shown on plans (if less than four (4) feet). Throat thickness of welds shall be based on an allowable stress of 8,800 pounds per inch per inch of throat thickness using an E60 low-hydrogen electrode. The allowable stress in the steel cylinder shall not exceed 15,000 psi.

Shop Drawings and Line Layout:

- (A) The manufacturer's pipeline layout shall be furnished together with standard details for review. The line layout shall show each standard pipe joint and each special joint or fitting by number. Manufacturer's standard details shall be furnished in sufficient details to assure that the detail design of the pipe and specials will comply with the design concept and structural requirements of the project as presented in the Contract Documents. Full details of reinforcement, concrete, cement, mortar, joint dimensions, etc., for the straight pipe, specials and connections shall be furnished. Layout drawings shall show stations and the invert elevations of the pipeline.
- (B) Manufacturer's shop drawings shall be furnished for fabrication, inspection and record purposes in accordance with the "General Conditions". The manufactured pipe and specials shall conform to the approved standard details and shall meet all specified requirements unless otherwise approved in writing.
- (C) Valves and fittings to be incorporated in the pipeline shall be considered when preparing the pipeline layout.

SECTION 758

758.4 SHOP INSPECTION AND TESTS:

(A) Inspection:

- (1) The City and its representatives shall have access to the work wherever it is in preparation or progress, and the Contractor shall provide proper facilities for access and for inspection during the manufacturing process.
- (2) Inspection by the City or its representatives, or failure of the City or its representatives to provide inspection, shall not relieve the Contractor of his responsibility to furnish materials and to perform work in accordance with this specification.
- (3) Material, fabricated parts, and pipe which are discovered to be defective or which do not conform to the requirements of this specification, will be subject to rejection at any time prior to final acceptance. Rejected material and pipe shall promptly be removed from the site of the work.

(B) Test and Materials:

- (1) In advance of manufacture of the pipe, the Contractor shall furnish to the Engineer three (3) copies of the mill test certificate for all steel products incorporated in the pipe. Three (3) copies shall be furnished of mill test reports on each heat from which the steel is rolled.
- (2) Methods of Tests for Cement, Mortars and Concrete:
 - (a) Mortar Lining: The mortar for all mortar lined pipe shall be sampled and molded by the following procedure:

The mortar sample shall be taken directly from the transfer bucket between the mixer and the charging trough which injects the mixed mortar into the spinning pipe. A sufficient amount shall be extracted to make four (4) 4" x 8" cylinders, and shall be placed in a wheelbarrow or other suitable container. The mortar sample material shall then be transported to the location at which the cylinder cans are to remain without moving for the next 24 hours. The mortar shall be thoroughly mixed immediately prior to pouring into the cylinders in order to prevent segregation. After the mortar has been thoroughly mixed, it shall be poured in a continuous stream into the cylinder cans. The cans shall immediately be capped and allowed to remain without disturbing for twenty-four (24) hours.
 - (b) Mortar Coating: Mortar for all mortar coated pipe shall be sampled by molding four (4) cylinders for compressive tests of the representative material being used to seat the pipe. The mortar sample shall be molded in 4" diameter cylinders in accordance with applicable provisions of ASTM D-558.
 - (c) Curing of Test Cylinders: The curing of concrete, lining and coating cylinders for the first twenty-four (24) hours shall be the same as that for the pipe, except that the mortar for coating cylinders shall be covered with a piece of damp burlap to retard the drying out or the low moisture content of the mortar coating. At the end of twenty-four (24) hours, the cylinders shall be transported to a moist curing cabinet and cured in accordance with ASTM C-192.
- (3) Strength of Cement Mortar Lining, Coating, Concrete and Steel:
 - (a) Mortar Lining: The average compressive strength, as per Section C below, of cylinders for mortar lining for the several types of pipe shall be as follows:
 - (i) Semi-Rigid Pipe: Steel pipe and steel cylinder pipe, single wrap, pretensioned, the average compression strength of cylinders shall not be less than 1700 psi at seven days, and 2300 psi at 28 days.

SECTION 758

- (ii) Rigid Pipe: Steel cylinder pipe prestressed, the average compressive strength of cylinders shall not be less than 3000 psi at seven days, and 4500 psi at 28 days. Steel cylinder pipe, double wrapped shall not be less than 3000 psi at seven days, and 4500 psi at 28 days.
- (b) Mortar Coating and Concrete for Prestressed Pipe:
 - (i) Semi-Rigid Pipe: Steel pipe and steel cylinder pipe, single wrap, pretensioned, the average compression strength of cylinders shall not be less than 3000 psi at seven days, and 4500 psi at 28 days.
 - (ii) Rigid Pipe: Steel cylinder pipe prestressed, and steel cylinder pipe, double wrap pretensioned, the average compressive strength of cylinders shall not be less than 3000 psi at seven days, and 4500 psi at 28 days.
- (c) To conform to these requirements (a and b above), the average of any five (5) consecutive strength tests of the laboratory cured specimens shall be equal to or greater than the specified strength, and no more than 20% of the strength test shall have values less than the specified strength. If any one cylinder falls below 80% of the specified strength at seven days, an extra cylinder from the same batch shall then be broken, and if the strength of this cylinder also falls below 80% of the specified strength, then the entire production represented by these cylinders will not be accepted for use until the results of the twenty-eight day test is known, and if it also falls below 80% of the specified strength, the above non-acceptance will become final. The expense of the required tests of cylinders and mortar shall be the responsibility of the Contractor.
- (d) Testing of Steel Pipe Cylinders (Hydrostatic Pressure Test): Each steel pipe cylinder, prior to embedment in cement mortar, or concrete, shall be hydrostatically tested under a water pressure which stressed the steel to a unit stress of at least 22,000 psi after the bell and spigot ends have been welded in place, utilizing companion bell and spigot test heads. While under this stress, the welded seams shall be hammered vigorously at one foot intervals with a one pound sledge hammer, and shall be thoroughly inspected.

All parts of the cylinder showing leakage shall be marked for rewelding. After rewelding, such cylinders shall be subjected to another hydrostatic test as stipulated above. The costs of hydrostatic pressure test shall be at the Contractor's expense.
- (e) Testing of Fittings and Specials: The seams in angle pipe, short-radius bends and special fittings shall be welded in two or more passes, and each weld tested for tightness by the air-soap method or by the dye-penetrant method. However, if the fitting is fabricated from cylinders which have been previously tested hydrostatically, no further test is required for seams so tested. Hydrostatic testing of fittings to 150% of the design operating pressure may replace the tests described above. Any defect revealed under any of the alternate test methods shall be rewelded, and the weld tested again. The cost of these tests shall be at the Contractor's expense.

758.5 MARKING, HANDLING AND DELIVERY:

- (A) Marking: Identification markings, for each type of water pipe as specified herein, shall be placed on the pipes. These markings shall show the proper location of the pipe or special in the line by reference to layer drawings. All bends shall be marked on the ends with the angle of deflection and the plane through the axis of the pipe. All beveled pipe shall be marked with the amount of the bevel, and the point of maximum bevel shall be marked at the end of the spigot.
- (B) Handling and Delivery: All pipe shall be manufactured, handled, loaded, shipped, unloaded and stored at the job site in such a manner as to prevent any damage to the pipe. Any pipe section that becomes damaged shall be

SECTION 758

repaired as directed by the Engineer if, in his opinion, a satisfactory repair can be made. Otherwise, it shall be replaced with an undamaged section, at the Contractor's expense. Lifting from the inside of the pipe will not be permitted.

758.6 CATHODIC PROTECTION:

- (A) Joint Bonding: Except where otherwise specified, all non-welded joints shall be bonded in accordance with the details shown on the drawings. The pipe shall be cleaned to bare bright metal at the point where the bond is installed. The steel bonding clips (1.25-inches wide) shall be welded to the joint rings during installation. The total resistance of the bonds at the joint shall not be more than 150-percent of the linear resistance of a pipe section. A minimum of two bonding clips shall be furnished at each joint and installed at the pipe springline, one on each side of the pipe.
- (B) Cathodic Protection: Corrosion mitigation and testing materials, such as magnesium anodes, reference electrodes, test lead wires and test stations shall be installed where shown. See *Water Services Department Guide Specifications* Section 13110, Cathodic Protection Systems for additional requirements

SECTION 760

COATING CORRUGATED METAL PIPE AND ARCHES

Delete the title of this SECTION in its entirety and replace with the following:

CORRUGATED METAL PIPE AND ARCHES

Subsection 760.1 GENERAL: Add the following paragraph to the end of this Subsection:

Corrugated metal pipe and arch utilization in public storm drain facilities is limited to culverts and catch basin connectors.

Subsection 760.2 MATERIALS: Delete this Subsection in its entirety and replace with the following:

Corrugated metal products covered by this specification shall be aluminum-coated Type 2 conforming to the requirements of AASHTO M-36 Type I or Type II as modified herein. No other coating is approved for use in the City of Phoenix.

Subsection 760.3 BASE METAL, SPELTER AND FABRICATION: Delete the title of this Subsection in its entirety and replace with the following:

FABRICATION

Subsection 760.3 BASE METAL, SPELTER AND FABRICATION: Delete this Subsection in its entirety and replace with the following:

The nominal pipe diameter shall meet the tolerances of this specification. Elliptical pipe and arches, when specified, shall be shaped after fabrication and coating have been completed.

Corrugated Metal Pipe and Arches: The pipe and arches shall be manufactured per AASHTO M-36, Type 1 or II. Nominal pipe sizes and corrugations furnished shall be in accordance with Table 6 of AASHTO M-36. Arches furnished shall be in accordance with Tables 2, 3, 4 and 5 of AASHTO M-36. Other shapes shall be as shown on the plans. Pipe and arches with helical corrugations shall have a continuous lock or weld seam extending from end to end of each length of pipe. The seams shall be fabricated in such a manner that they will not affect the shape or nominal diameter of the pipe and so that they will not create an element of weakness in the pipe.

Subsection 760.4 COUPLING BANDS: Delete the first sentence of the first paragraph and replace with the following:

Watertight joints shall be fabricated for corrugated metal pipe by the use of couplers or connecting bands per AASHTO M-274, aluminum-coated Type 2, with each band overlapping by at least 2 inches.

Subsection 760.4 COUPLING BANDS: Add the following paragraph to the end of this Subsection:

The rubber O-ring gasket shall conform to the requirements of ASTM C-361. The sleeve gasket shall be a closed cell rubber in accordance with ASTM D-1056, grade SCE 43.

Subsection 760.5 PERMISSIBLE VARIATIONS IN DIMENSION: Delete the last paragraph in its entirety.

SECTION 775

BRICK AND CONCRETE MASONRY UNITS (BLOCKS)

Subsection 775.1.1 Manhole Brick: Delete the first paragraph in its entirety and replace with the following:

Manhole brick shall conform to the requirements of ASTM C216, Grade SW. Brick may be used for maintenance of existing brick manholes and for adjustment of manhole frames.

SECTION 787

GRAY IRON CASTING

Subsection 787.3 MANHOLE FRAME AND COVER SETS: Add the following to the end of this Subsection:

ASTM A-48 Class 35, gray cast iron manhole frames and covers are approved for use on improvements within dedicated public right-of-way and dedicated public easements. The weights of the 30-inch frame and cover castings shall be a minimum of 219 pounds for the frame and 207 pounds for the cover. The weights of the 24-inch frame and cover castings shall be a minimum of 170 pounds for the frame and 180 pounds for the cover. The Contractor shall provide manufacturer's certification that the product meets the required H-20 traffic loading.

The casting shall be tested in accordance with the method and procedure that is outlined in AASHTO M306 Section 7.0, proof load testing. The casting shall be tested on a suitable and calibrated load testing machine and the casting shall hold a 40,000-pound proof load for one minute without experiencing any cracks or detrimental permanent deformation. Any added costs for testing are assumed by the manufacturer.

A foundry certification shall be furnished to the Owner stating that the samples have been tested, inspected, and are in accordance with these specifications.

SECTION 795

LANDSCAPE MATERIAL

Delete this SECTION its entirety and replace with the following:

795.1 GENERAL:

Material used for landscaping purposes shall be in conformance with this Section.

795.2 TOPSOIL:

Topsoil shall be a fertile, friable soil, obtained from well-drained arable land, and shall be free from nut grass, refuse, roots, heavy clay, clods, weed seed or any other material toxic to plant growth. At least 10 days prior to delivery of topsoil to the site, the Contractor shall furnish the Engineer, at no additional cost, with a soil sample from each source for analysis and tests.

Soil tests will be accomplished by an approved independent soil testing laboratory capable of doing the appropriate horticultural soil test. The results of the test will determine the acceptability of the soil. The testing laboratory may suggest ways to amend the soil to make it suitable to grow plants. The Contractor may be directed by the Engineer to provide the amendments at no additional cost.

To be acceptable, the pH factor shall not exceed 8.0 or be lower than 5.5, soluble salts shall not exceed 1500 PPM, the plasticity index shall be in the range of 3 and 10 inclusive, and it shall contain between 1 and 2%, by dry weight, organic matter either natural or added.

Gradation shall be as follows:

TABLE 795-1

SIEVE SIZE	PERCENT PASSING
1/2"	100
No. 4	90-100
No. 10	70-100
No. 200	15-70

795.3 SOIL AMENDMENTS AND CONDITIONERS:

795.3.1 Chemical Conditioners: Fertilizing material shall comply with the applicable requirements of the State Agricultural Code. Fertilizing material shall be packaged, first grade, commercial quality products identified as to source, type of material, weight and manufacturer's analysis. It shall not contain toxic ingredients or fillers in quantities harmful to human life, animals, or plants. Material which has become caked or otherwise damaged shall not be used.

Fertilizing material for plants shall be similar to the product "Super Start" or approved equal, with the following additive ingredients (% by weight): 3% Nitrogen, 10% Sulfur, 4% Iron, 1% Zinc, 0.08% Manganese, and 0.13% Viterra. All fertilizing material shall be in 40 pound packages with additive ingredient derived from:

1. Nitrogen from Urea Formaldehyde and M.A.P.
2. Sulfur from Potassium Sulfate
3. Iron from Sequestrene 138 Iron
4. Zinc from Sequestrene Zinc
5. Manganese from Sequestrene Manganese
6. Viterra from a synthetic, superabsorbent co-polymer.

Slow Release Fertilizer Plant Tablets: Shall be Agriform 21 gram tablets or equal with 20-10-5 analysis.

Fertilizing Material for lawn areas or used in revegetation shall be a commercially approved brand or a mixture of standard commercial forms to meet the requirements recommended by horticultural test results.

SECTION 795

Slow Release Nitrogen: Shall be Methylene urea (38-0-0) or equivalent. It is use to extend nitrogen availability over time on sites where long term nitrogen availability is a limiting factor.

795.3.2 Organic Soil Amendments:

General Soil Conditioner: Compost shall be naturally organic, free of weeds and weed seeds, and contain no plant growth inhibiting factors. This material shall be tested and meet the following minimum requirements.

Germination Rate (full strength extract)	85% minimum
Maturity Index (full strength extract)	50% minimum
Conductivity EC mmhos/cm.....	less than 8
Exchangeable Sodium Percentage.....	less than 15
Carbon/Nitrogen Ratio	less than 20:1
Total Nitrogen (not added).....	0.5% minimum
pH range of extract	5.5 – 8.0

When cow manure is used as a soil conditioner in turf areas, it shall be the product of yard fed cattle, free of weed seeds, straw or any other inert material and aged at least 3 months. This manure shall have been processed by grinding and screening and shall be treated with a non-toxic agent so as to be hydrophilic.

Plant Conditioner: Shall consist of a ground or processed wood product derived from redwood, ground or shredded fir, redwood or ponderosa bark. It shall have a nitrogen content of 1%, a ph not exceeding 7.5% and organic matter not less than 85%. Mulch gradation shall be treated with a non-toxic agent so as to be hydrophilic. Cow Manure shall not be used as organic mulch in plant backfill mixes.

Bone Meal: Commercial grade product uniform in composition.

Sand: Shall be brown washed natural mortar sand passing at least a #7 screen, free of weeds, organic material, stones, deleterious materials, non-toxic to plant and human life and usable for backfill mixtures.

Hydromulch shall be packaged in units containing current labels, with the manufacturer's name, the net weight, and certification that the material meets the forgoing requirements. The mulch shall be dyed green to aid in the visual metering application. The dye shall be biodegradable and not inhibit plant growth.

(A) 100% Wood Cellulose Fiber Hydromulch: Shall be shall be used as mulch when hydroseeding turf grass.

Moisture content.....	10.0% + 3.0%
Organic Matter (Wood Cellulose Fiber).....	99.3% + 0.2%
Ash content.....	0.7% + 0.5%
pH.....	4.9 + 0.5%
Water Holding Capacity	10 : 1

(B) Cellulose Fiber Hydromulch: Shall be used as mulch when hydroseeding native seed. Cellulose fiber mulch shall consist of at least 70% specially prepared virgin wood cellulose fiber which has been thermo-mechanically processed for specific use as hydromulch. It shall contain no growth inhibiting factors. It shall have the following properties:

Wood Cellulose Fiber	70% (minimum)
Recycled Cellulose Fiber.....	30% (maximum)
Ash Content.....	0.8% + 0.3% (maximum)
pH.....	4.5 + 1.0
Water Holding Capacity ratio; water: fiber	10:1

SECTION 795

Upon application, the mulch material shall form a blotter-like mat covering the ground. This mat shall have the characteristics of moisture absorption and percolation and shall cover and hold seed in contact with the soil.

Tackifier: Used in hydroseeding shall consist of a free-flowing, noncorrosive powder produced from the natural plant gum of *Plantago insularis* (Desert Indianwheat), applied in a slurry with water and wood fiber. The powder shall possess the following properties:

Protein content	1.6 + 0.2 %
Ash content.....	2.7 + 0.2%
Fiber	4.0 + 0.4%
pH 1% solution.....	6.5 –8.0 %

The material used for mulch tackifier shall not contain any mineral filler, recycled cellulose fiber, clays, or other substance which may inhibit germination or growth of plants.

Activated Charcoal: Agricultural grade powdered activated charcoal is used in the hydromulching slurry to boost seed germination during cold weather as a soil colorant.

Granular humus based soil conditioner used in hydromulching operations shall be tested and meet the following:

Total humus.....	50% minimum
Total humic acid.....	15% minimum

Liquid humic acid soil based conditioner used in hydromulching operations shall be tested and meet the following:

Total humic acid.....	6% minimum
-----------------------	------------

795.4 SEEDS:

795.4.1 Native Seeds: Shall be certified to scientific name, lot number or other identification, origin of the seed, purity of the seeds as a percentage of pure live seed by weight, germination percentage and percentage of firm ungerminated seeds, name and address of person who labeled or offers seed for sale.

Pure Live Seed (PLS) percentage = (% germination + % ungerminated firm seed) x (% purity). The seed rate specified is pounds of Pure Live Seed.

795.4.2 Turf Seed: Shall be fresh clean seeds, pre-mixed to the specified proportion. They shall be delivered to the site in original, unopened containers bearing the dealer's name guaranteed analysis and germination percentage. They shall have a certification or a stamp or a release accomplished by an agricultural commission.

795.5 PLANTS:

Plants shall be nursery grown or plantation grown stock conforming to ANSI 260-1 and shall be of the varieties specified in the plant list bearing botanical name listed. Plants shall meet the standards established by the Arizona Nursery Association Grower's Committee recommended specifications.

Planting stock shall be well broached and well formed, sound, vigorous, healthy and free from disease, sun-scald, windburn, abrasion and harmful insects or insect eggs and shall have healthy, normal and unbroken root system which is neither root or pot-bound and are free of kinked or girdling roots. Plants shall have been grown under climate conditions similar to those at the project site.

795.6 SOD:

The sod shall be Midiron Bermuda if not specified on the plans and meet State standards to insure high quality and

SECTION 795

freedom from noxious weeds.

Sod shall be machine cut at a uniform soil thickness of 1/2 inch (plus or minus 1/4 inch), at time of cutting. Measurement excludes top growth and thatch.

Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 30% of the section.

Sod shall be free from disease, nematodes, and soil born insects.

795.7 MISCELLANEOUS MATERIAL:

795.7.1 Lumber: Lumber in contact with the earth shall be redwood heartwood, sized according to the drawing. When unit bid items that include headers or lumber are included in the proposal sheets, the unit prices quoted shall be per linear foot.

795.7.2 Clean fill: Clean fill shall be soil free of weeds, boulders, clods, heavy clay, aggregate base, asphalt or concrete or other deleterious material.

795.7.3 River Run Rock: Rock shall be clean, hard, durable, uniform in quality, free from seams and coatings, rounded and water-worn. The gradation shall be as specified and approved by the Engineer.

This Page Reserved for Future Use

2015

**CITY OF PHOENIX
SUPPLEMENTAL
STANDARD DETAILS
FOR
PUBLIC WORKS
CONSTRUCTION**



**2015 CITY OF PHOENIX SUPPLEMENTAL STANDARD DETAILS TO THE 2015 MAG
UNIFORM STANDARD, SPECIFICATIONS AND DETAILS FOR PUBLIC WORKS CONSTRUCTION**

The **2015 edition** of the City of Phoenix Supplemental Standard Details to the 2015 Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction is effective **July 1, 2015**. The **2015 edition** supersedes all previous editions.

All public works construction contracts advertised and all permits issued on or after **July 1, 2015** shall be governed by the **2015 edition**.

A copy of the **2015 edition** is available for review and download on the City of Phoenix Website at the following address:

<https://www.phoenix.gov/streets/reference-material/2015maguniformstd>

For more information, or a copy of this publication in an alternate format, contact Street Transportation Department at 602-262-6284 (Voice) and 602-256-4286 (TTY).

New Supplemental Standard Details:

Detail Number	Title
P1240-2	CURB RAMP DETAIL WITH DETACHED S/W (CORNER AT A DIAGONAL)
P1240-3	CURB RAMP DETAIL WITH ATTACHED S/W (CORNER AT A DIAGONAL)
P1243-1	WITHOUT DECELERATION LANE
P1243-2	WITHOUT DECELERATION LANE
P1243-3	WITH DECELERATION LANE
P1243-4	WITH DECELERATION LANE

Updated Supplemental Standard Details:

Detail Number	Title
P1020-1	PLANNED AREA DEVELOPMENT
P1200	TRENCH BACKFILL & SURFACE REPLACEMENT
P1230	SIDEWALKS
P1231	APRON JOINTS
P1232	TRUNCATED DOMES DETAIL
P1233	CURB RAMP DETAIL – 25', 30', & 35' RADII 8' LANDSCAPE PLANTERS, BOTH LEGS
P1234	CURB RAMP DETAIL – 25', 30', & 35' RADII 8' & 5' LANDSCAPE PLANTERS
P1235	CURB RAMP DETAIL – 25', 30', & 35' RADII 8' LANDSCAPE PLANTERS, ONE SIDE
P1236	CURB RAMP DETAIL – 25', 30', & 35' RADII NO LANDSCAPE PLANTERS
P1238-1	CURB RAMP DETAIL – 20' RADIUS LANDSCAPE PLANTERS, BOTH / ONE LEG(S)
P1238-2	CURB RAMP DETAIL – 20' RADIUS NO LANDSCAPE PLANTERS
P1239	CURB RAMP DETAIL – 20' RADIUS 4" VERTICAL CURB RETURN
P1240	SINGLE CURB RAMP DETAIL ALL RADIUS CURB RETURNS

Deleted Supplemental Standard Details:

Detail Number	Title
P1422	CONCRETE COLLAR AROUND MANHOLE FRAME

This Page Reserved for Future Use

**1000 SERIES
TRAFFIC ENGINEERING**

NO	TITLE	DATE
P1010	MINIMUM ARTERIAL STREET CROSS SECTIONS	2008
P1013	MINIMUM COLLECTOR STREET CROSS SECTIONS	2008
P1014	MINIMUM LOCAL STREET CROSS SECTIONS	2008
P1017	ACCESS ROAD OPENING	1992
P1018	ACCESS ROAD TERMINATION AT ALLEYS	2000
P1019	ACCESS ROAD TERMINATION AT INTERSECTION	2008
P1020-1	PLANNED AREA DEVELOPMENT	REV. 2015
P1020-2	PRIVATE ACCESSWAY	2008
P1021	PRIVATE DRIVEWAY (STREET) (FOR PLANNED AREAS, SUB-LOTS, SPECIAL PERMITS, ETC.)	1992
P1024	STEEL PIPE BARRICADE	1992

**1100 SERIES
GENERAL INFORMATION**

NO	TITLE	DATE
P1102	DEPTH OF BASE COURSE RESIDENTIAL STREET	1992
P1103	DEPTH OF BASE COURSE (LOCAL COMMERCIAL & LIGHT INDUSTRIAL STREETS)	1992
P1104	DEPTH OF BASE COURSE (MAJOR STREETS & HEAVY INDUSTRIAL STREETS)	2002
P1105	STEEL COVER FOR OPEN TRENCHES	1992
P1106	BARRICADE	1992
P1120	V.C.P. TRENCH LOADING	2012
P1121	8" & 10" V.C.P. TRENCH LOADING	1992
P1122	12" & 15" V.C.P. TRENCH LOADING	1992
P1123	18" & 21" V.C.P. TRENCH LOADING	1992
P1124	24" & 27" V.C.P. TRENCH LOADING	1992
P1125	30" & 33" V.C.P. TRENCH LOADING	1992
P1126	36" & 39" V.C.P. TRENCH LOADING	1992
P1127	42" V.C.P. TRENCH LOADING	1992
P1130	MULTI-USE TRAILS AND SHARED-USE PATHS	2008
P1131	VERTICAL CLEARANCE, MULTI-USE, SHARED-USE, AND UNDERPASS/BRIDGE CLEARANCE	2008
P1164	MAXIMUM DRIVEWAYS & ALLEYS SLOPE	1994
P1165	DEBRIS CAP INSTALLATION	2008
P1170	TRENCHING STEEL PLATE	1992
P1173	SAFETY RAILING DETAIL	2012
P1174	CONDITIONS WHERE SAFETY RAILS ARE REQUIRED	2012

**1200 SERIES
STREET INFORMATION**

NO	TITLE	DATE
P1200	TRENCH BACKFILL & SURFACE REPLACEMENT	REV. 2015
P1230	SIDEWALKS	REV. 2015
P1231	APRON JOINTS	REV. 2015
P1232	TRUNCATED DOMES DETAIL	REV. 2015
P1233	CURB RAMP DETAIL - 25', 30', & 35' RADII 8' LANDSCAPE PLANTERS, BOTH SIDES	REV. 2015
P1234	CURB RAMP DETAIL - 25', 30', & 35' RADII 8' & 5' LANDSCAPE PLANTERS	REV. 2015
P1235	CURB RAMP DETAIL - 25', 30', & 35' RADII 8' LANDSCAPE PLANTER, ONE SIDE	REV. 2015
P1236	CURB RAMP DETAIL - 25', 30', & 35' RADII NO LANDSCAPE PLANTERS	REV. 2015
P1237	CURB RAMP DETAIL - ALL RADIUS CURB RETURNS, LIMITED RIGHT OF WAY	2008

**1200 SERIES
STREET INFORMATION (CONTINUED)**

NO	TITLE	DATE
P1238-1	CURB RAMP DETAIL - 20' RADIUS LANDSCAPE PLANTERS, BOTH/ONE LEG(S)	REV. 2015
P1238-2	CURB RAMP DETAIL - 20' RADIUS NO LANDSCAPE PLANTERS	REV. 2015
P1239	CURB RAMP DETAIL - 20' RADIUS 4" VERTICAL CURB RETURN	REV. 2015
P1240	SINGLE CURB RAMP DETAIL ALL RADIUS CURB RETURNS	REV. 2015
P1240-1	SINGLE CURB RAMP DETAIL WITH LIMITED R/W	2012
P1240-2	CURB RAMP DETAIL WITH ATTACHED S/W (CORNER AT A DIAGONAL)	NEW 2015
P1240-3	CURB RAMP DETAIL WITH DETACHED S/W (CORNER AT A DIAGONAL)	NEW 2015
P1241-1	CURB RAMP DETAIL (MID BLOCK)	2012
P1241-2	CURB RAMP DETAIL (MID BLOCK) WITH DETACHED SIDEWALK	2012
P1241-3	CURB RAMP DETAIL (MID BLOCK) WITH 4" ROLL CURB	2012
P1241-4	CURB RAMP DETAIL (MID BLOCK) MODIFIED (LIMITED RIGHT OF WAY)	2012
P1243	RETURN TYPE DRIVEWAYS WITH ATTACHED SIDEWALK	2004
P1243-1	LIMITED ACCESS DRIVEWAY WITH NO LT-IN AND WITHOUT DECELERATION LANE	NEW 2015
P1243-2	LIMITED ACCESS DRIVEWAY WITH NO LT-IN/OUT AND WITHOUT DECELERATION LANE	NEW 2015
P1243-3	LIMITED ACCESS DRIVEWAY WITH NO LT-IN AND WITH DECELERATION LANE	NEW 2015
P1243-4	LIMITED ACCESS DRIVEWAY WITH NO LT-IN/OUT AND WITH DECELERATION LANE	NEW 2015
P1244	DRIVEWAY - PEDESTRIAN RAMP COMBINATION (FOR USE AT T TYPE INTERSECTIONS)	2008
P1255-1	DRIVEWAY ENTRANCE - TYPE I (SIDEWALK ADJACENT TO CURB)	2008
P1255-2	DRIVEWAY ENTRANCE - TYPE II (DETACHED SIDEWALK)	2008
P1255-3	DRIVEWAY ENTRANCE - ADA RETROFIT	2003
P1255-4	DRIVEWAY WIDTHS POLICY	2008
P1256-1	BUS BAY (TYPE 1)	2008
P1256-2	BUS BAY (TYPE 2)	2008
P1258	BUS SHELTER PAD LOCATION (BUS STOP)	2008
P1260	BUS SHELTER/ACCESSORY PAD BUS STOP	2008
P1261	BUS SHELTER/ACCESSORY PAD BUS BAY	2008
P1262	PARKWAY BUS SHELTER/ACCESSORY PAD	2008
P1263-1	BUS SHELTER/ACCESSORY PAD FRONTAGE ROAD MID-BLOCK	2008
P1263-2	PARKWAY BUS SHELTER/ACCESSORY PAD	2008
P1270	FRAME AND COVER INSTALLATION AND GRADE ADJUSTMENT	2008
P1270-1	SECURE VALVE BOX LID TYPE A	2001

1300 SERIES
WATER INFORMATION

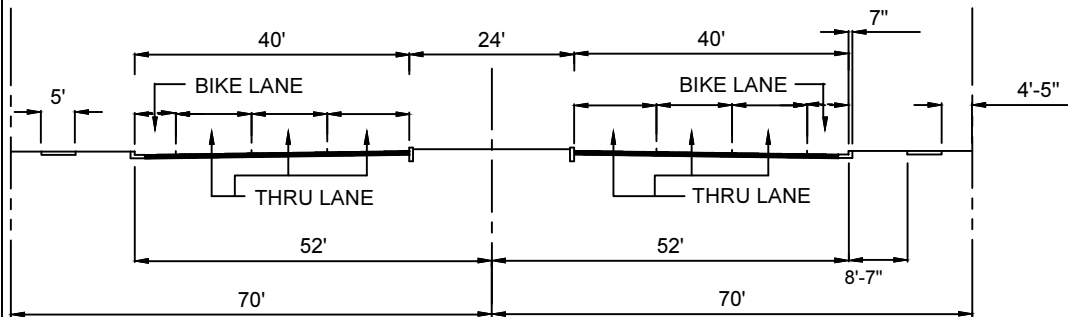
NO	TITLE	DATE
P1315	STEEL WATER METER BOX COVER	1992
P1342	WATER SERVICE CONNECTIONS	2008
P1343	WATERLINE - CUT AND PLUG FOR 12" DIA. MAIN AND SMALLER	1994
P1344	WATERLINE CUT OUT (TEES & CROSSES) FOR 12" DIA. MAIN AND SMALLER	1992
P1351	REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION ASSEMBLY INSTALLATION - 3" AND OVER	2001
P1352	DOUBLE CHECK VALVE BACKFLOW PREVENTION ASSEMBLY INSTALLATION - 3" AND OVER	2001
P1353	DOUBLE CHECK VALVE BACKFLOW PREVENTION ASSEMBLY INSTALLATION - 2 1/2" AND UNDER	2001
P1354	REDUCED PRINCIPLE BACKFLOW PREVENTION ASSEMBLY INSTALLATION - 2 1/2" AND UNDER	2001
P1355	PRESSURE VACUUM BREAKER ASSEMBLY INSTALLATION 2" AND UNDER	2001
P1356	TEMPORARY SUPPORT FOR FIRE HYDRANT BACKFLOW ASSEMBLY	2001
P1359	HYDRANT GUARDS	2001
P1360	FIRE HYDRANT ASSEMBLY	2008
P1361	FIRE HYDRANT THREADS 2 1/2" & 4"	1992
P1362	FIRE HYDRANT LOCATION	2004
P1363	WATER METER LOCATION	2000
P1370	VERTICAL REALIGNMENT OF WATERLINE	2012
P1391	VALVE BOX INSTALLATION	2008
P1391-1	VALVE OPERATING NUT EXTENSION	2001
P1394	PRESSURE REDUCING & SUSTAINING VALVE	1992
P1395	WATER LINE SUSPENSION	1992
P1396	DOUBLE CHECK VALVE ASSEMBLY	1992

1400 SERIES
SANITARY SEWER INFORMATION

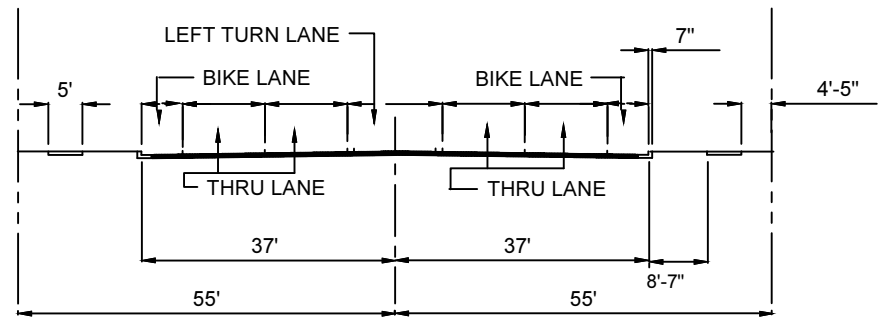
NO	TITLE	DATE
P1422	CONCRETE COLLAR AROUND MANHOLE FRAME	DELETED 2015
P1424	24" & 30" MANHOLE COVERS	2012
P1424-1	STORM DRAIN MANHOLE COVER	REV. 2105
P1431	SEWER TAP DEPTH & MARKING	1999
P1432	SEWER TAP RETROFITTING	1999
P1435	SANITARY SEWER MANHOLE KNOCKOUT	2004
P1440	SEWER BUILDING CONNECTION & ELECTRONIC MARKERS	2012

1500 SERIES
IRRIGATION & STORM INFORMATION

NO	TITLE	DATE
P1505	CONCRETE PIPE COLLAR	2012
P1520	STORM DRAIN MANHOLE BASE 48" & SMALLER	1992
P1560	STORM DRAIN MANHOLE BASE TRANSITION 51" & LARGER	REV. 2015
P1561	FRAME AND COVER CATCH BASIN ACCESS	2008
P1562	BARRIER SPECIFICATION SCHEDULE	2003
P1563	STORM DRAIN OUTFALL ACCESS BARRIER	REV. 2015
P1564	CATCH BASIN GRATE FRAMES	1992
P1565	CATCH BASIN GRATES	REV. 2015
P1566	CATCH BASIN COMBINATION TYPE "J" WITH CONCRETE APRON	2012
P1567	CATCH BASIN COMBINATION TYPE "K"	2012
P1568	CATCH BASIN - TYPE "L" CURB & PARKWAY OPENING INLET DETAILS	2012
P1569-1	CATCH BASIN TYPE "M"	2012
P1569-2	CATCH BASIN - TYPE "M" TOP MODIFICATION IN LANDSCAPE PARKWAY	2012
P1570	CATCH BASIN TYPE "N"	2012
P1571	CATCH BASIN - TYPE "P" DOUBLE CURB OPENING FOR FRONTAGE ROAD ISLANDS	2012
P1572	CATCH BASIN TYPE "Q"	2012
P1573	CATCH BASIN TYPE "R"	2012
P1574	INLET CURB OPENING & PIPE ENTRY DETAIL	1992
P1575	CONSTRUCTION SUB-GRADE DRAIN	1992
P1576	CAST-IN-PLACE PIPE LATERAL PIPE CONNECTION	1999
P1577	SMALL STORM DRAIN LATERAL OR CATCH BASIN CONNECTOR PIPE CONNECTION TO EXISTING STORM DRAIN MAIN	REV. 2015
P1578	LARGE STORM DRAIN LATERAL OR CATCH BASIN CONNECTOR PIPE TO EXISTING RCP STORM DRAIN MAIN	REV. 2015
P1581	CATCH BASIN - TYPE "M" MODIFIED (OFFSET OPENING)	2000
P1583	CATCH BASIN - TYPE "L-R" MODIFIED (WITH REAR INLET)	2012
P1584	CATCH BASIN - TYPE "R" MODIFIED (WITH WING AND OFFSET OPENING)	2012

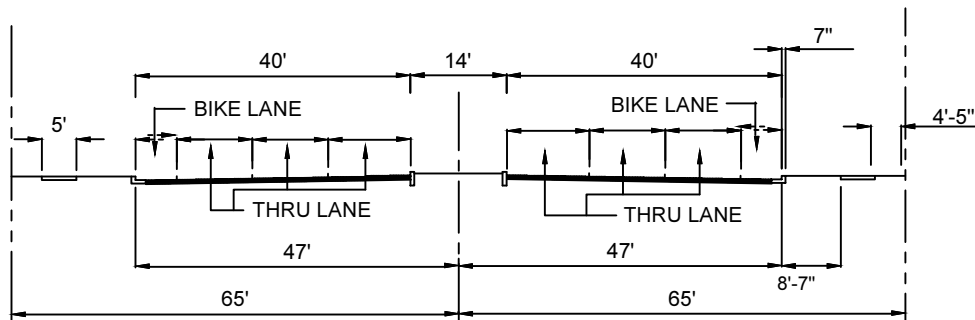


CROSS SECTION A

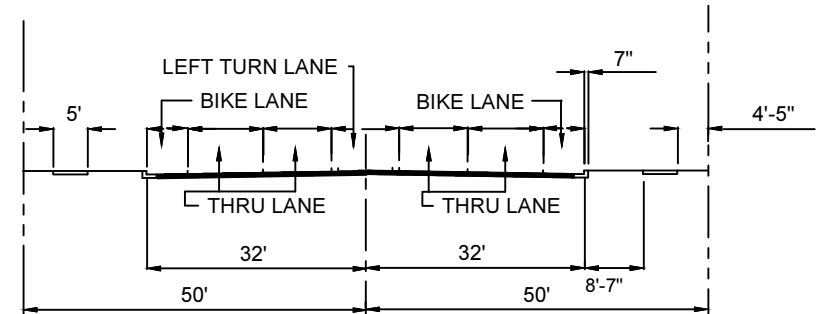


CROSS SECTION C

CROSS SECTION C-M. (SEE NOTE 4)



CROSS SECTION B



CROSS SECTION D

NOTES:

1. LANE WIDTHS AND CONFIGURATION ARE CONCEPTUAL ONLY. FINAL LANE WIDTHS AND CONFIGURATION TO BE APPROVED BY THE STREET TRANSPORTATION DEPT.
 2. ADDITIONAL RIGHT-OF-WAY MAY BE REQUIRED FOR DRAINAGE, UTILITIES, SLOPE RIGHTS, TRAFFIC SIGNALS, IRRIGATION FACILITIES OR TRAILS.**
 3. CROSS SECTION "C" HAS A 14' TWO WAY LEFT TURN LANE.
CROSS SECTION "C-M" HAS A 14' RAISED MEDIAN.
 4. ALL DIMENSIONS ARE TO THE FACE OF CURB.
- ** ACCORDING TO THE TRAILS PLAN, A 10 FOOT SIDEWALK MAY BE REQUIRED ON CROSS SECTIONS A, B, C, D, E, F, & G.

DETAIL NO.
P1010



City of Phoenix
STANDARD DETAIL

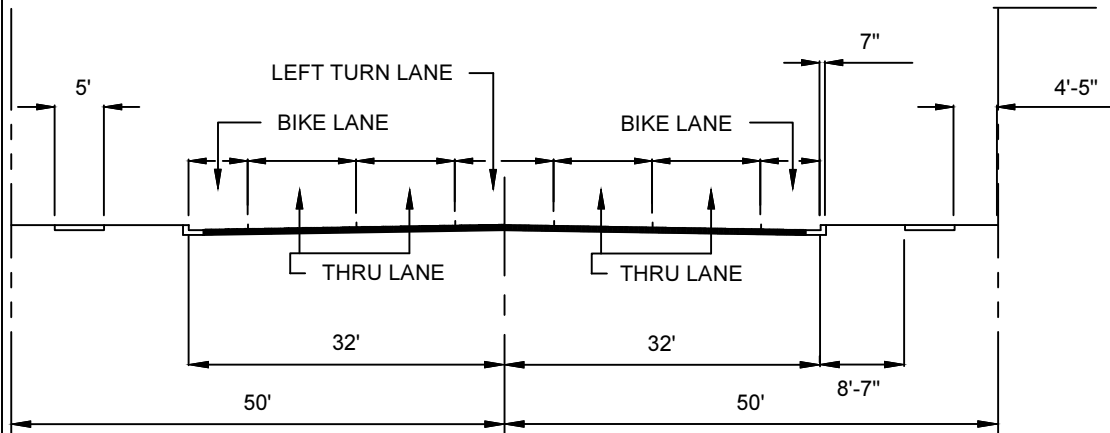
MINIMUM ARTERIAL STREET
CROSS SECTIONS

APPROVED

[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

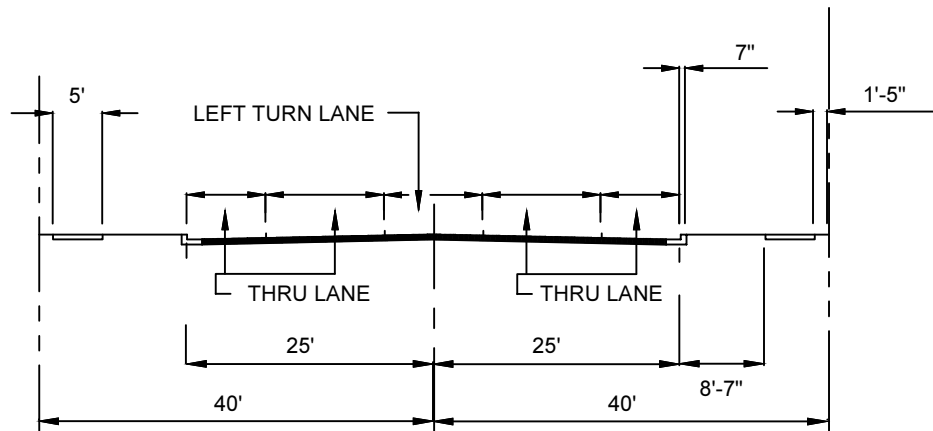
DETAIL NO.
P1010



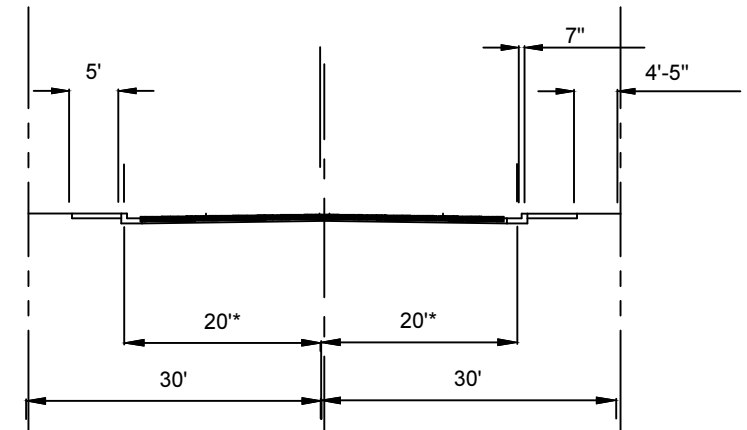
CROSS SECTION D

NOTES:

1. LANE WIDTHS AND CONFIGURATION ARE CONCEPTUAL ONLY. FINAL LANE WIDTHS AND CONFIGURATION TO BE APPROVED BY THE STREET TRANSPORTATION DEPT.
2. ADDITIONAL RIGHT-OF-WAY MAY BE REQUIRED FOR DRAINAGE, UTILITIES, SLOPE RIGHTS, TRAFFIC SIGNALS, IRRIGATION FACILITIES OR TRAILS.
3. ALL DIMENSIONS ARE TO THE FACE OF CURB.



CROSS SECTION E



CROSS SECTION F

* COLLECTORS WITH RESIDENTIAL BACKUP TREATMENT MAY BE 18'.

DETAIL NO.
P1013



City of Phoenix
STANDARD DETAIL

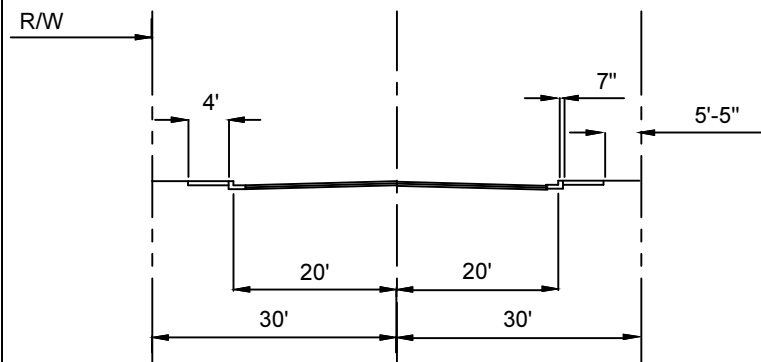
MINIMUM COLLECTOR STREET
CROSS SECTIONS

APPROVED

[Signature]
ACTING CITY ENGINEER

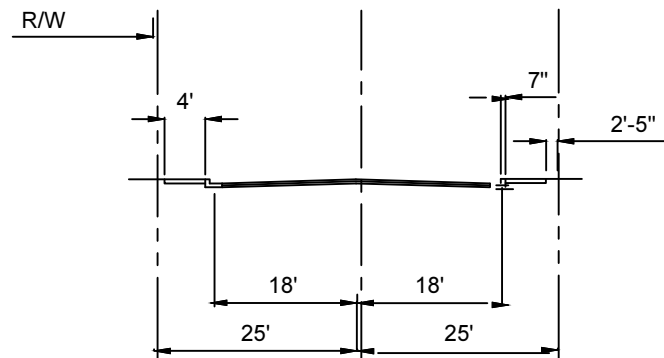
7/31/08
DATE

DETAIL NO.
P1013



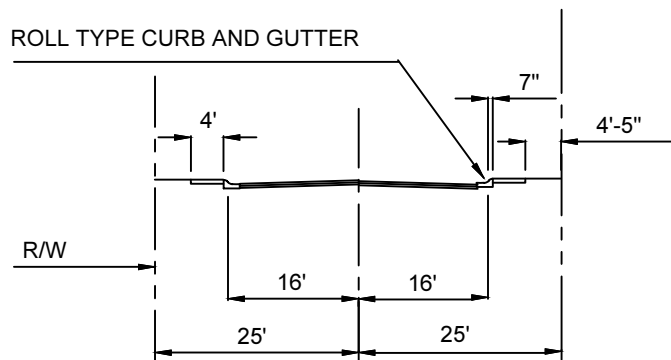
CROSS SECTION F

INDUSTRIAL LAND USE
VERTICAL CURB AND ADJACENT SIDEWALK



CROSS SECTION G

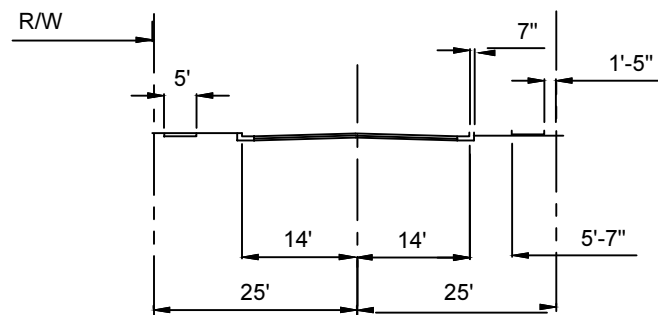
COMMERCIAL & MULTI FAMILY
RESIDENTIAL LAND USE
VERTICAL CURB AND ADJACENT SIDEWALK



CROSS SECTION H

SINGLE FAMILY RESIDENTIAL LAND USE

OPTION A:
ROLL CURB AND ADJACENT SIDEWALK



CROSS SECTION I

SINGLE FAMILY RESIDENTIAL LAND USE

OPTION B:
VERTICAL CURB AND SET BACK SIDEWALK

NOTES:

LANE WIDTHS AND CONFIGURATION
ARE CONCEPTUAL ONLY. FINAL
LANE WIDTHS AND CONFIGURATION
TO BE APPROVED BY THE STREET
TRANSPORTATION DEPT.

ADDITIONAL RIGHT-OF-WAY
MAY BE REQUIRED FOR DRAINAGE,
UTILITIES, SLOPE RIGHTS,
IRRIGATION FACILITIES, OR TRAILS.

ALL DIMENSIONS ARE TO THE
FACE OF CURB.

ALL CURBS ARE VERTICAL
UNLESS NOTED.

DETAIL NO.
P1014



City of Phoenix
STANDARD DETAIL

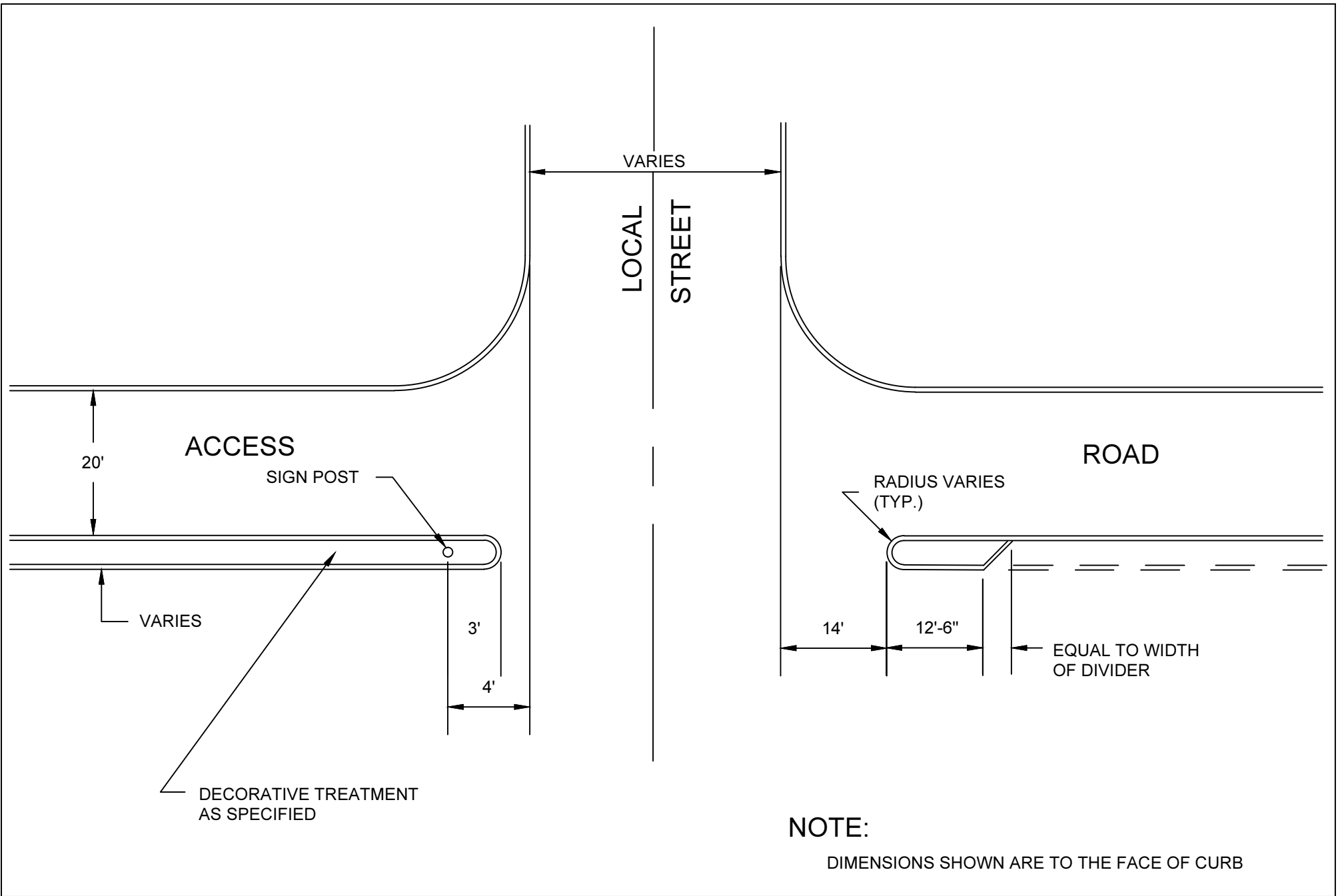
MINIMUM LOCAL STREET
CROSS SECTIONS

APPROVED

[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

DETAIL NO.
P1014



DETAIL NO.
P1017



City of Phoenix
STANDARD DETAIL

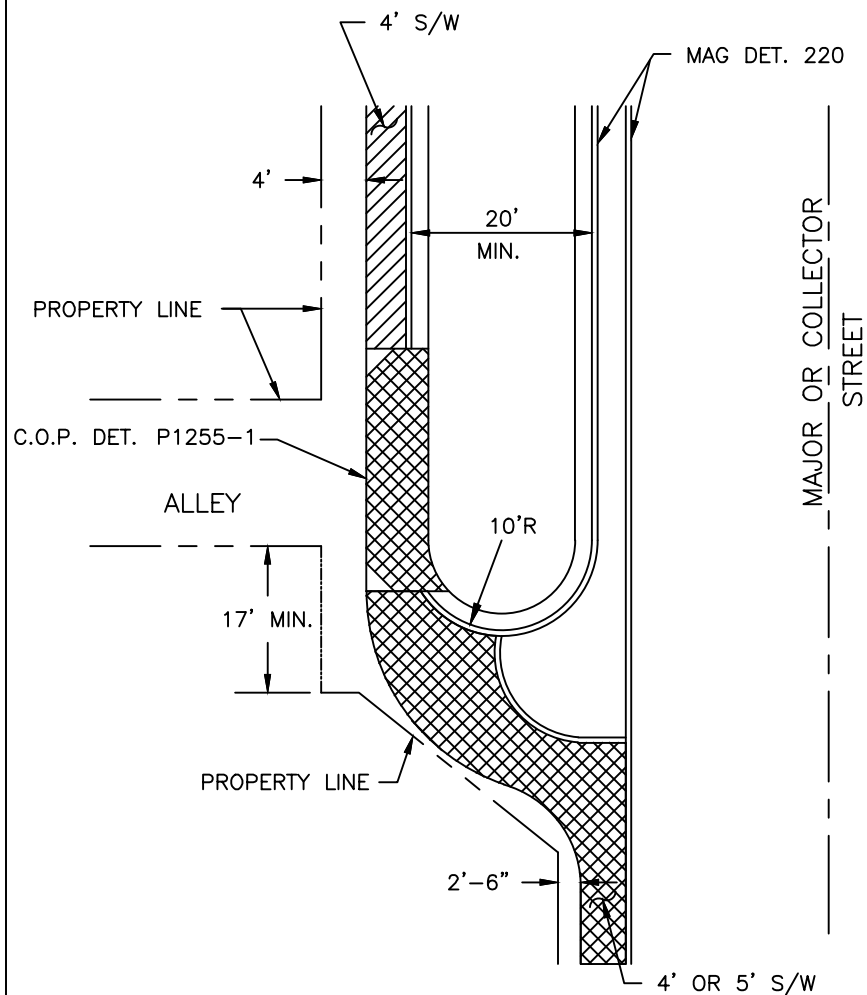
ACCESS ROAD OPENING

APPROVED

Kenny W. Hain
FOR CITY ENGINEER

7/9/92
DATE

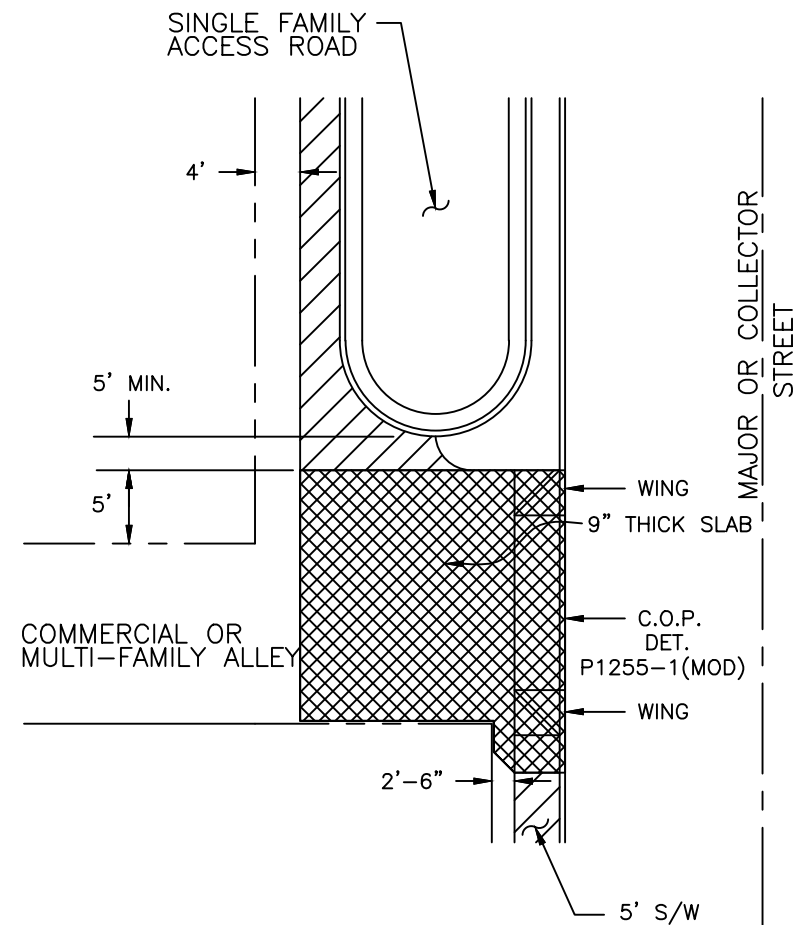
DETAIL NO.
P1017



NOTE:

SUFFICIENT RIGHT-OF-WAY MUST BE AVAILABLE TO
CONSTRUCT ACCESS ROAD TERMINATION

SINGLE FAMILY ALLEY



NOTE:

1. COMMERCIAL AND MULTI-FAMILY ALLEYS MAY NOT PROVIDE ACCESS TO SINGLE FAMILY ACCESS ROADS.
2. ONLY ALLOWED FOR LOCATIONS WHERE REFUSE COLLECTION IS NOT PROVIDED ALONG THE ACCESS ROAD.

COMMERCIAL OR MULTI-FAMILY ALLEY

DETAIL NO.
P1018



City of Phoenix
STANDARD DETAIL

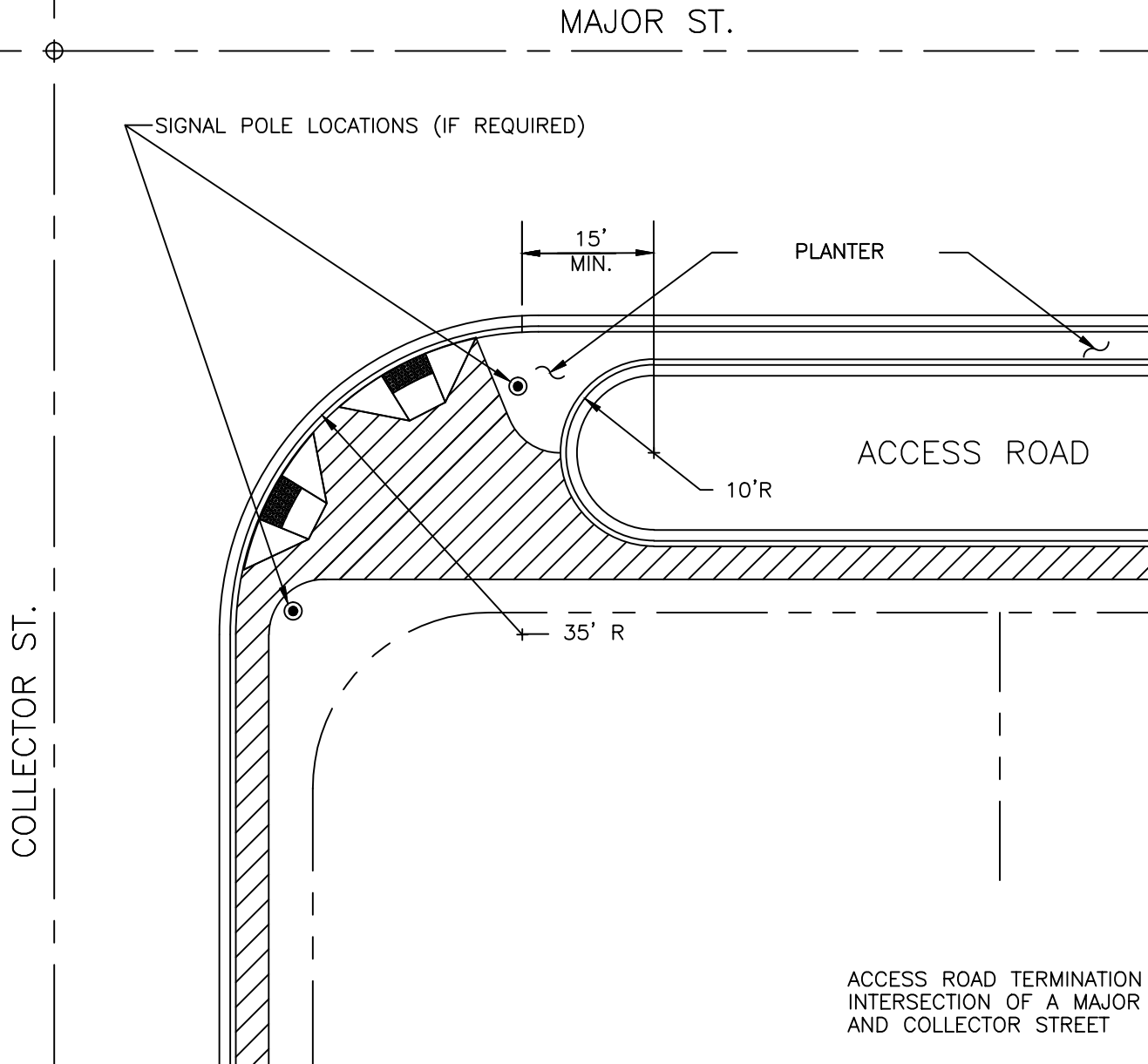
ACCESS ROAD TERMINATION
AT ALLEYS

APPROVED

Kenny W. Hain
CITY ENGINEER

7/3/00
DATE

DETAIL NO.
P1018



DETAIL NO.
P1019



City of Phoenix
STANDARD DETAIL

ACCESS ROAD TERMINATION
AT INTERSECTION

APPROVED

[Signature]
ACTING CITY ENGINEER

REVISED 4/14/08

7/31/08
DATE

DETAIL NO.
P1019

A PRIVATE ACCESSWAY IS INTENDED TO APPLY TO PRIVATE STREETS WITHIN DEVELOPMENTS SUCH AS PRD'S PAD'S, MOBILE-HOME PARKS, AND HILL SIDE DEVELOPMENTS WHERE LOT SALES ARE PROPOSED.

1. PRIVATE ACCESS WAYS WILL BE ALLOWED IN NEW DEVELOPMENTS WHERE THEIR USE IS LOGICALLY CONSISTENT WITH A DESIRE FOR NEIGHBORHOOD IDENTIFICATION AND CONTROL OF ACCESS, AND WHERE SPECIAL OVERALL DESIGN CONCEPTS MAY BE INVOLVED.
2. PRIVATE ACCESS WAYS WILL BE PERMITTED ONLY WHERE A SATISFACTORY MEANS OF PROVIDING FOR THEIR MAINTENANCE AND OPERATION IS DEMONSTRATED.
3. THE USE OF PRIVATE ACCESS WAYS AS A DEVICE FOR PERMITTING INADEQUATE DESIGN WILL NOT BE ALLOWED.
4. THE USE OF PRIVATE ACCESS WAYS IS ORDINARILY LIMITED TO CUL-DE-SACS AND TO LOCAL STREETS NOT CARRYING THROUGH TRAFFIC. NORMALLY COLLECTOR STREETS WILL BE PUBLIC. FURTHER, THERE WILL BE AN ADEQUATE INTERNAL CIRCULATION SYSTEM AND NO PROPERTY WILL BE LANDLOCKED BY A PRIVATE ROAD SYSTEM.
5. THE DESIGN OF ALL PRIVATE ACCESS WAYS SHALL BE REVIEWED AND APPROVED BY D.S.D. THE CONSTRUCTION SHALL BE INSPECTED BY D.S.D., WITH A STANDARD INSPECTION FEE TO BE PAID.
6. NOTE TO BE PLACED ON PLAT "PRIVATE ACCESS WAY, NOT DEDICATED FOR PUBLIC USE".
7. THE HOMEOWNER'S ASSOCIATION CONSTITUTION AND BY-LAWS SHALL INCLUDE ACKNOWLEDGEMENT OF THE OWNERSHIP AND MAINTENANCE RESPONSIBILITY OF THESE PRIVATE FACILITIES, INCLUDING RESPONSIBILITY FOR ENFORCEMENT OF TRAFFIC CONTROL.
8. GATED ENTRIES ARE ALLOWED IF TURNAROUND AREAS ARE PROVIDED PER DSD GATED ENTRY DETAILS

I GENERAL

1. PRIVATE ACCESS WAYS, AND/OR REFUSE COLLECTION EASEMENTS MAY BE USED IN PAD'S, MOBILE-HOME DEVELOPMENTS AND PRD'S AND SHALL BE KNOWN AS "PRIVATE ACCESS WAYS". UTILITIES MAY BE PLACED IN A PRIVATE ACCESS WAY IF THEY ARE AT LEAST 28' WIDE.
2. MAJOR DRAINAGE WAYS SHALL BE DEDICATED.
3. SIDEWALKS ARE NORMALLY REQUIRED ADJACENT TO ALL COLLECTOR STREETS AND IN ALL MULTIFAMILY DEVELOPMENTS AND DEVELOPMENTS WITH LOTS LESS THAN 18,000 SQ. FT. OR IN THE SAID EASEMENT RIGHT OF WAY UNLESS OTHER MEANS OF ACCOMMODATING PEDESTRIAN TRAFFIC ARE PROVIDED IN THE DEVELOPMENT.
4. PRIVATE ACCESS WAYS SHALL BE ADEQUATELY DESIGNED TO CITY SPECIFICATIONS TO PROVIDE FOR LANE DELINEATION, STREET SWEEPING, AND DRAINAGE CONTROL. NORMALLY, A CROWN SECTION WITH CONCRETE CURB OR CONCRETE CURB AND GUTTER ON BOTH SIDES WILL BE REQUIRED; HOWEVER, OTHER MEANS OF PROVIDING SIMILAR FUNCTIONAL CHARACTERISTICS MAY BE CONSIDERED IF APPROVED BY THE PLAN REVIEW TEAM.
5. RETURN-TYPE DRIVEWAY ENTRANCE MAY BE USED ON PRIVATE ACCESS WAYS. IF THE STREET IS 28' OR GREATER. DEPRESSED DRIVEWAY APPROACHES SHALL BE USED WHERE THERE IS ONLY DIRECT ACCESS TO A PARKING AREA OR WHERE THE STREET IS LESS THAN 28' WIDE.

II MINIMUM PAVEMENT WIDTHS

THE ENTIRE WIDTH OF THE PRIVATE ACCESS WAY SHALL BE DESIGNATED BY PLAT AS A "PRIVATE ACCESS WAY".

STREET CLASSIFICATION	CURB TO CURB	CURB RETURNS
COLLECTOR	36'-40'	35'
LOCAL STREETS		
WITH PARKING PLANNED ON BOTH SIDES	29'-36'	20'
WITHOUT PLANNED PARKING	24'	25'
ONE-WAY, PLANNED PARKING ONE SIDE	22'-24'	25'

III GRADES

1. DESIRABLE MAXIMUM - 10%
2. MAXIMUM - 15%
3. MINIMUM - 0.30% - GRADES LESS THAN 0.30% SHALL REQUIRE CONCRETE VALLEY GUTTERS, ABSOLUTE MINIMUM GRADE 0.15%.

IV ALIGNMENT

1. STREET SHALL NORMALLY INTERSECT AT RIGHT ANGLES AND NO GREATER DEFLECTION THAN 15' FROM A RIGHT ANGLE WILL BE ALLOWED AND SHALL HAVE AT LEAST 20' TANGENT ADJACENT TO INTERSECTIONS. THE TANGENT LENGTH SHALL BE INCREASED WHERE SHORT RADIUS CURVES ARE USED NEAR THE INTERSECTIONS.
2. CUL-DE-SACS SHALL NOT ORDINARILY EXCEED 400' IN LENGTH. CURB RADIUS TO FACE OF CURB AT THE TURNAROUND SHALL BE 45' RADIUS MINIMUM.
3. IN SPECIAL SITUATIONS WHERE CITY REFUSE COLLECTION AND/OR CITY MAINTENANCE IS NOT REQUIRED, DEAD-ENDED PRIVATE ACCESS WAYS MAY BE USED AND SHOULD NOT EXCEED 300 LINEAL FEET. ADEQUATE TURNAROUND FACILITIES MAY BE REQUIRED AT THE END OF EACH DEAD-ENDED PRIVATE ACCESS WAY FOR EMERGENCY VEHICLE TURNAROUND.
4. CENTERLINE RADIUS SHALL BE 100' MINIMUM FOR LOOP STREETS AND LOCAL STREETS OVER 800' IN LENGTH. WHERE RIGHT-ANGLED BENDS ARE USED IN THE STREET PATTERN IN LIEU OF THE MINIMUM RADII REQUIRED ABOVE, WIDENING SUFFICIENT TO ACCOMMODATE TRUCK-TURNING MOVEMENTS SHALL BE PROVIDED BY USE OF KNUCKLES OR OTHER APPROPRIATE MEANS.

V STRUCTURAL SECTION

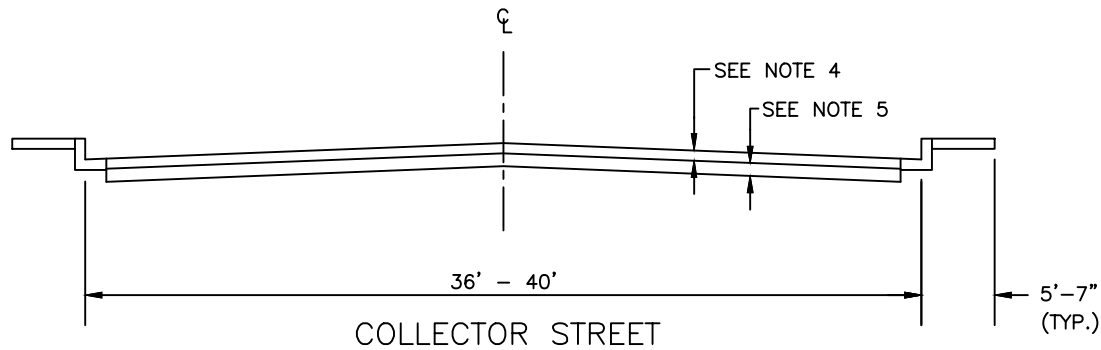
THE MINIMUM STRUCTURAL DESIGN OF PAVING, CURB, GUTTER, AND SIDEWALK SHALL BE IN ACCORDANCE WITH CITY STANDARDS AND SPECIFICATIONS.

VI UTILITIES

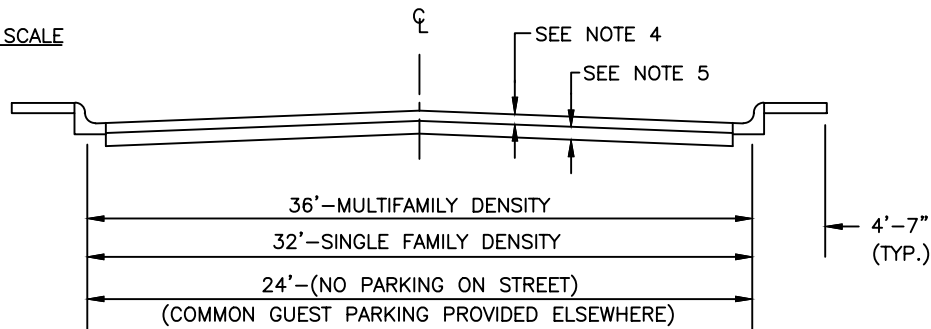
1. ADEQUATE PROVISIONS FOR PUBLIC UTILITIES SHALL BE MADE.
2. FIRE HYDRANTS SHALL BE LOCATED ON THE PUBLIC STREET AT THE ENTRANCE TO THE PRIVATE ACCESS WAYS AND ALONG PRIVATE ACCESS WAYS AS REQUIRED BY THE CITY OF PHOENIX WATER AND WATER SERVICES DEPARTMENT STANDARDS.
3. STANDARDS OF CONSTRUCTION AND INSPECTIONS ON PRIVATE ACCESS WAYS SHALL BE TO CITY OF PHOENIX STANDARDS AND SPECIFICATIONS.
4. COSTS OF MAINTENANCE AND REPAIRS OF PRIVATE ACCESS WAYS, LIGHTS, AND NON-PUBLICLY-OWNED UTILITIES ARE TO BE THE RESPONSIBILITY OF THE HOMEOWNER'S ASSOCIATION.
5. PUBLIC WATER AND SEWER LINES ARE ACCEPTABLE WITHIN 28' WIDE OR GREATER PRIVATE ACCESSWAYS WITH AN EXCLUSIVE EASEMENT FOR PUBLIC WATER & OR SEWER.
6. SOME TYPE OF PRIVATE STREET LIGHTS ARE TO BE PROVIDED.

VII SIGNS

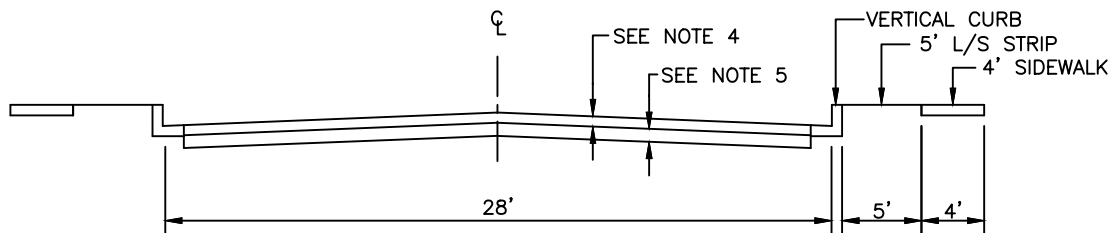
1. ALL NEW CURB SHALL BE IMPRINTED WITH THE WORDS, "PRIVATE STREET - NO CITY MAINTENANCE" IN 2" HIGH LETTERS AT EVERY CURB RETURN AND AT EVERY ENTRANCE INTO A NEW PRIVATE PROPERTY SUBDIVISION.
2. A STOP SIGN SHALL BE POSTED AT ALL INTERSECTIONS OF PRIVATE ACCESS WAYS WITH PUBLIC STREETS. SIGNS SHALL BE IN ACCORDANCE WITH THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES AND SHALL BE MAINTAINED BY THE HOMEOWNER'S ASSOCIATION.



NOT TO SCALE



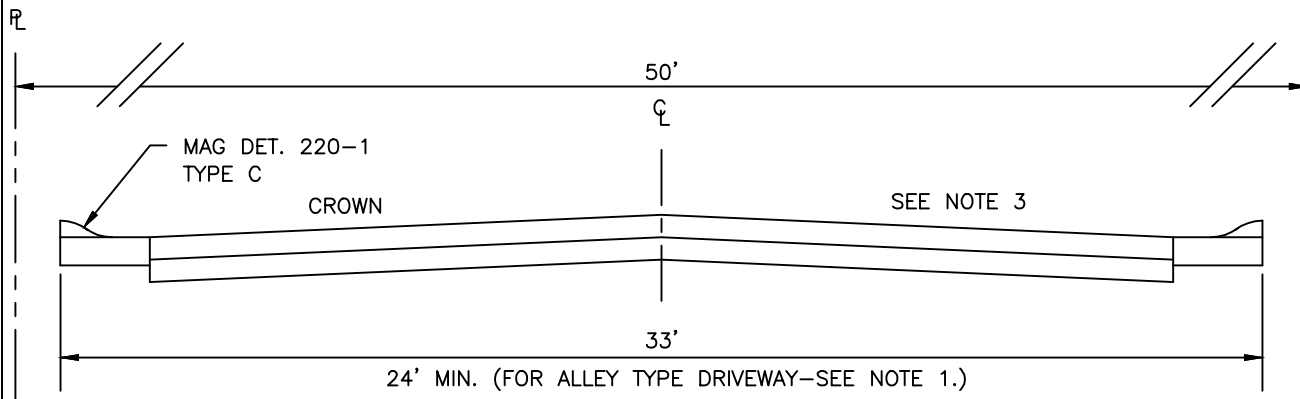
NOT TO SCALE



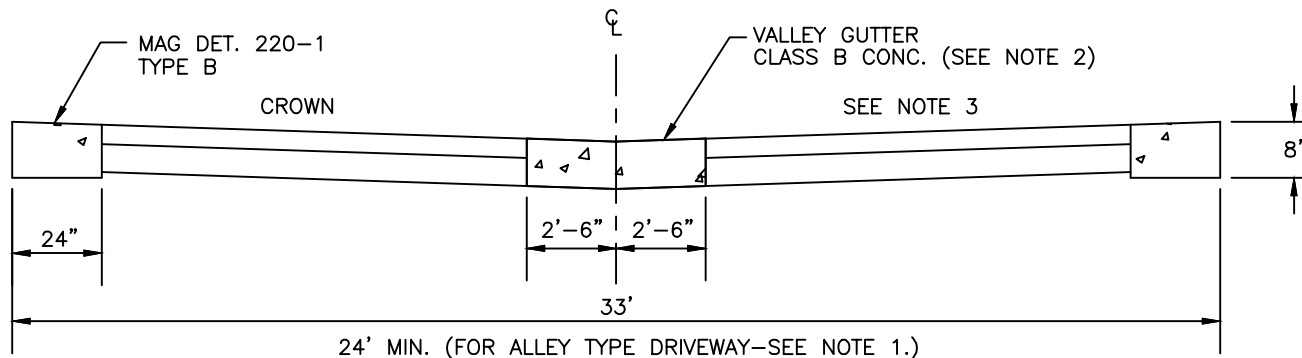
NOT TO SCALE

NOTES:

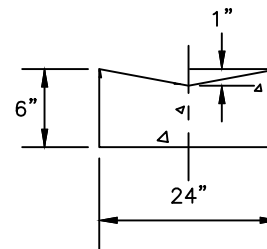
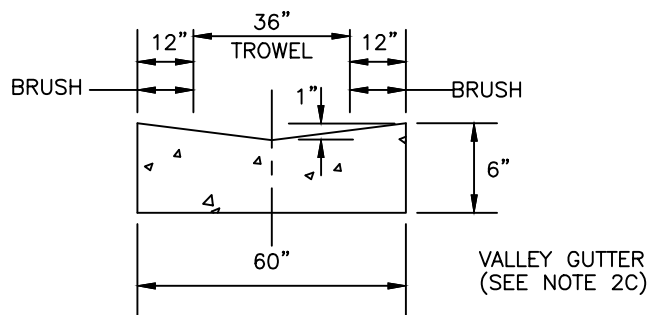
1. DRIVEWAY ENTRANCE RETURNS - VERTICAL CURB FACE
 - A. COLLECTOR STREET - 35' RADIUS TO FACE OF CURB
 - B. LOCAL STREET (36' OR 32' WIDE) - 20' RADIUS TO FACE OF CURB
 - C. LOCAL STREET (24' OR 28' WIDE) - 25' RADIUS TO FACE OF CURB
2. SIDEWALK-STD. DET. P1230. THE SITE DEVELOPMENT MANAGER MAY WAIVE THE REQUIREMENT FOR SIDEWALKS, IF SIDEWALKS PROVIDED ELSEWHERE IN THE DEVELOPMENT WILL SATISFACTORILY SERVE THE SAME PURPOSE.
3. CURBS
 - A. COLLECTOR STREET & MULTIFAMILY DENSITY - STD. DET. 220-1 TYPE "A" (VERTICAL CURB AND GUTTER)
 - B. LOCAL STREET-STD. DET. 220-1 TYPE "C" (ROLL CURB AND GUTTER) OR STD. DET. 221 WHEN SIDEWALK IS ADJACENT, RIBBON CURBS WILL BE PERMITTED WHERE DRAINAGE WILL BE RETAINED OR ADEQUATE DRAINAGE CHANNELS ARE PROVIDED THROUGH ADJACENT PROPERTY. RIBBON CURB MAY NOT BE USED ADJACENT TO SIDEWALK.
4. ASPHALT CONCRETE-2" THICKNESS, CONFORM TO M.A.G. SECT. 321. OTHER TYPES OF SURFACE TREATMENT MAY BE PERMITTED BY AUTHORITY OF THE PAVING PLAN REVIEW SUPERVISOR AFTER DEMONSTRATION THAT STRUCTURAL STRENGTH IS EQUAL TO OR GREATER THAN THAT OF THE EXISTING CITY STANDARDS.
5. AGGREGATE BASE COURSE-THICKNESS TO CONFORM WITH P1103. INSTALL TO CONFORM WITH M.A.G. SECT. 310.
6. STREET FURNITURE, FIRE HYDRANTS AND MAJOR PLANTINGS SHALL BE SET BACK A MINIMUM OF 5' FROM THE BACK OF CURB AND BUILDINGS SHALL BE SET BACK A MINIMUM OF 10' FROM THE BACK OF CURB.
7. GARAGES ARE TO BE SETBACK 18' FROM BACK OF SIDEWALK.



NORMAL CROWN



INVERTED CROWN



CURB DET.
(ALTERNATE FOR NORMAL
CROWN STREET)

NOTES:

- 24' MIN. WIDTH MAY BE APPROVED FOR SHORT DEAD-END OR CUL-DE-SAC DRIVEWAYS OR DRIVEWAYS IN APARTMENT TYPE DEVELOPMENT. A 3' UTILITY EASEMENT TO BE DEDICATED ADJACENT.
- GRADES
 - MAX.—15%. STREET GRADES EXCEEDING 12% SHOULD HAVE MAX. LENGTH OF 600'.
 - DESIRABLE MIN. GRADE—0.25%.
 - WHEN THE LONGITUDINAL GRADE OF INVERTED CROWN IS LESS THAN 0.30%, CONC. VALLEY GUTTER SHALL BE INSTALLED.
- CROWN
 - 5" TO 6" WHERE STREET GRADE IS LESS THAN 0.25%.
 - 4" TO 5" WHERE STREET GRADE EXCEEDS 0.25%.
 - INVERTED CROWN 4" TO 6", NOTE: FOR 24' WIDTH DRIVEWAYS DEDUCT 1" FROM ABOVE CROWNS.
- WITH INVERTED CROWN STREETS, ROLL CURB, WITH DEPRESSED LIP, MAY BE SUBSTITUTED FOR RIBBON TYPE CURB.
- RIBBON TYPE CURB IS NOT TO BE INSTALLED IF S/W ARE PROPOSED.
- CONCRETE PER MAG SEC. 725 & 505.

DETAIL NO.
P1021



City of Phoenix
STANDARD DETAIL

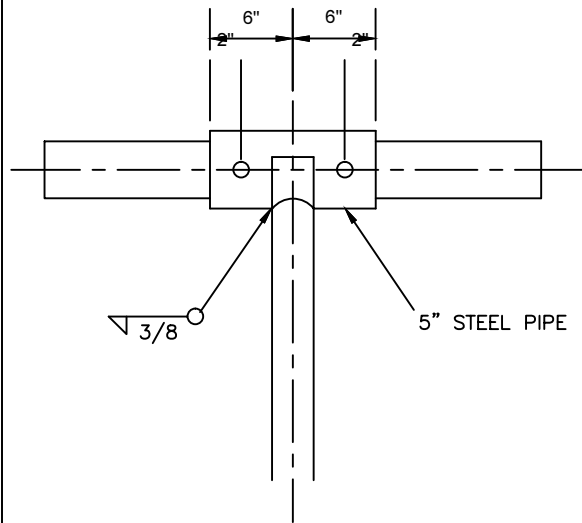
PRIVATE DRIVEWAY (STREET) (FOR
PLANNED AREAS, SUB-LOTS, SPECIAL PERMITS, ETC.)

APPROVED

Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

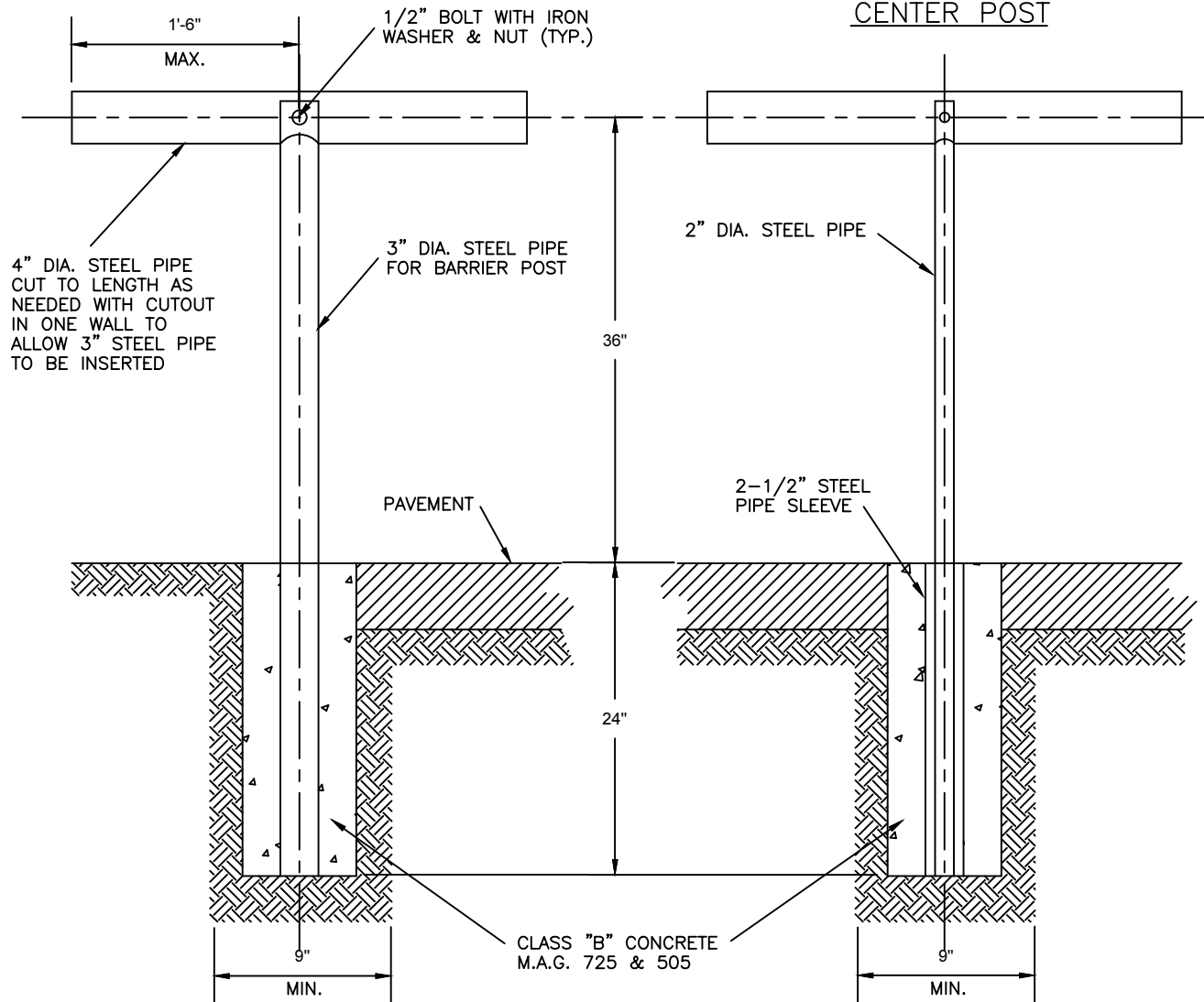
DETAIL NO.
P1021



"T" SLEEVE OPTION

NOTES:

1. 1'-6" MAX. OVERHANG
2. MAX. OVERALL LENGTH IS 33'
3. CENTER POST REQUIRED IF CLEAR SPAN EXCEEDS 15'.
4. CENTER POST SHALL BE 2" DIA. WITH A 2-1/2" DIA. SLEEVE IN THE FOOTING.
5. ALL PIPE IS SCHEDULE 40, GALVANIZED STEEL. (ASTM A 53)



DETAIL NO.
P1024



City of Phoenix
STANDARD DETAIL

STEEL PIPE BARRICADE

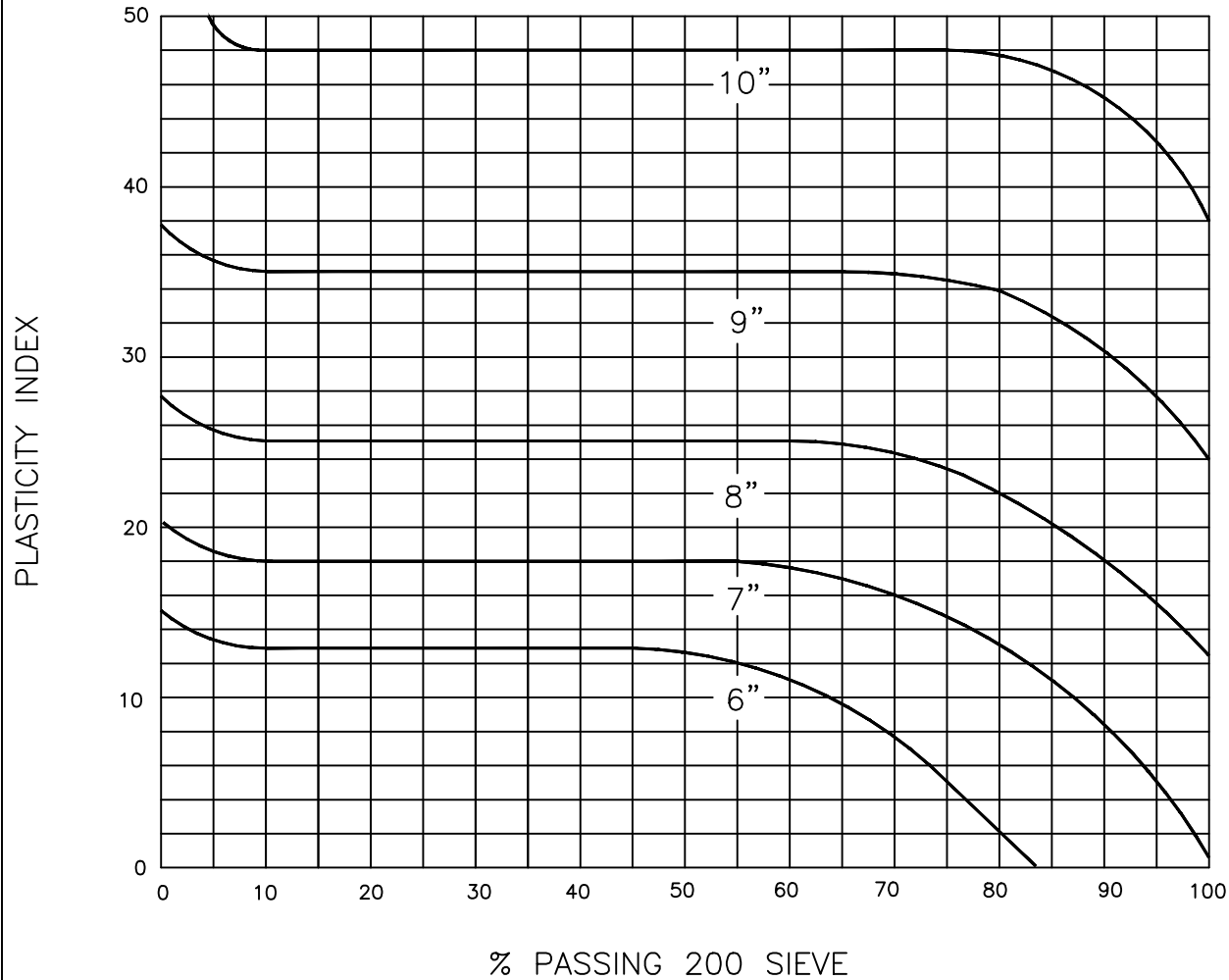
APPROVED

Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

DETAIL NO.
P1024

BASE THICKNESS CHART



NOTES:

1. TOP 4" OF BASE SHALL BE A.B.C. BALANCE SHALL BE A.B.C. OR SELECT MATERIAL.
2. MINIMUM-DEPTH OF FLEXIBLE BASE COURSE REQUIRED UNDER 2" (MIN.) BITUMINOUS SURFACE.
3. CHART TO BE USED ONLY WHEN "R" VALUES ARE NOT AVAILABLE.

DETAIL NO.
P1102



City of Phoenix
STANDARD DETAIL

DEPTH OF BASE COURSE
RESIDENTIAL STREET

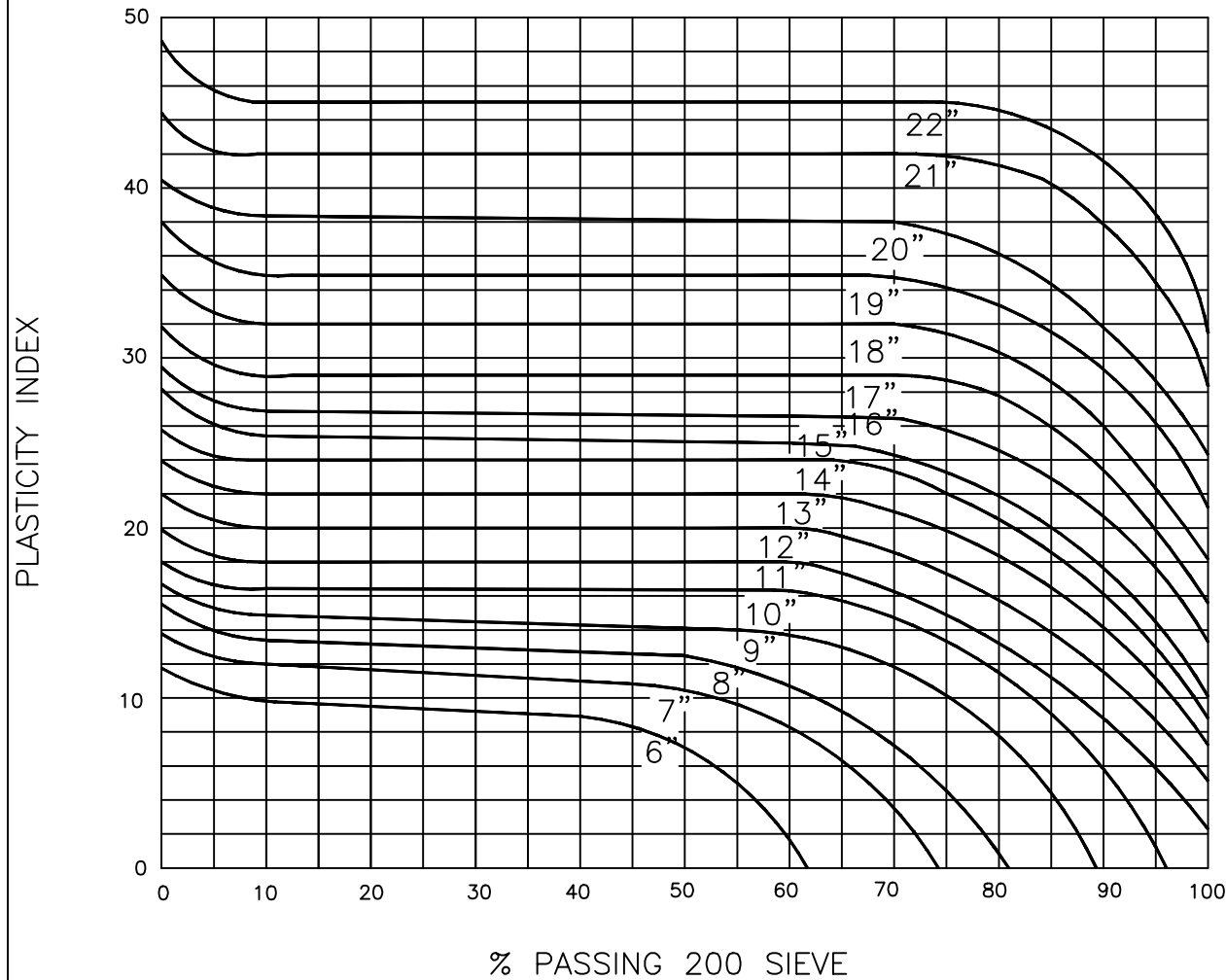
APPROVED

Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

DETAIL NO.
P1102

BASE THICKNESS CHART



NOTES:

1. TOP 4" OF BASE SHALL BE A.B.C. BALANCE SHALL BE A.B.C. OR SELECT MATERIAL.
2. MINIMUM-DEPTH OF FLEXIBLE BASE COURSE REQUIRED UNDER 2" (MIN.) BITUMINOUS SURFACE.
3. CHART TO BE USED ONLY WHEN "R" VALUES ARE NOT AVAILABLE.

DETAIL NO.
P1103



City of Phoenix
STANDARD DETAIL

DEPTH OF BASE COURSE
(LOCAL COMMERCIAL & LIGHT INDUSTRIAL STREETS)

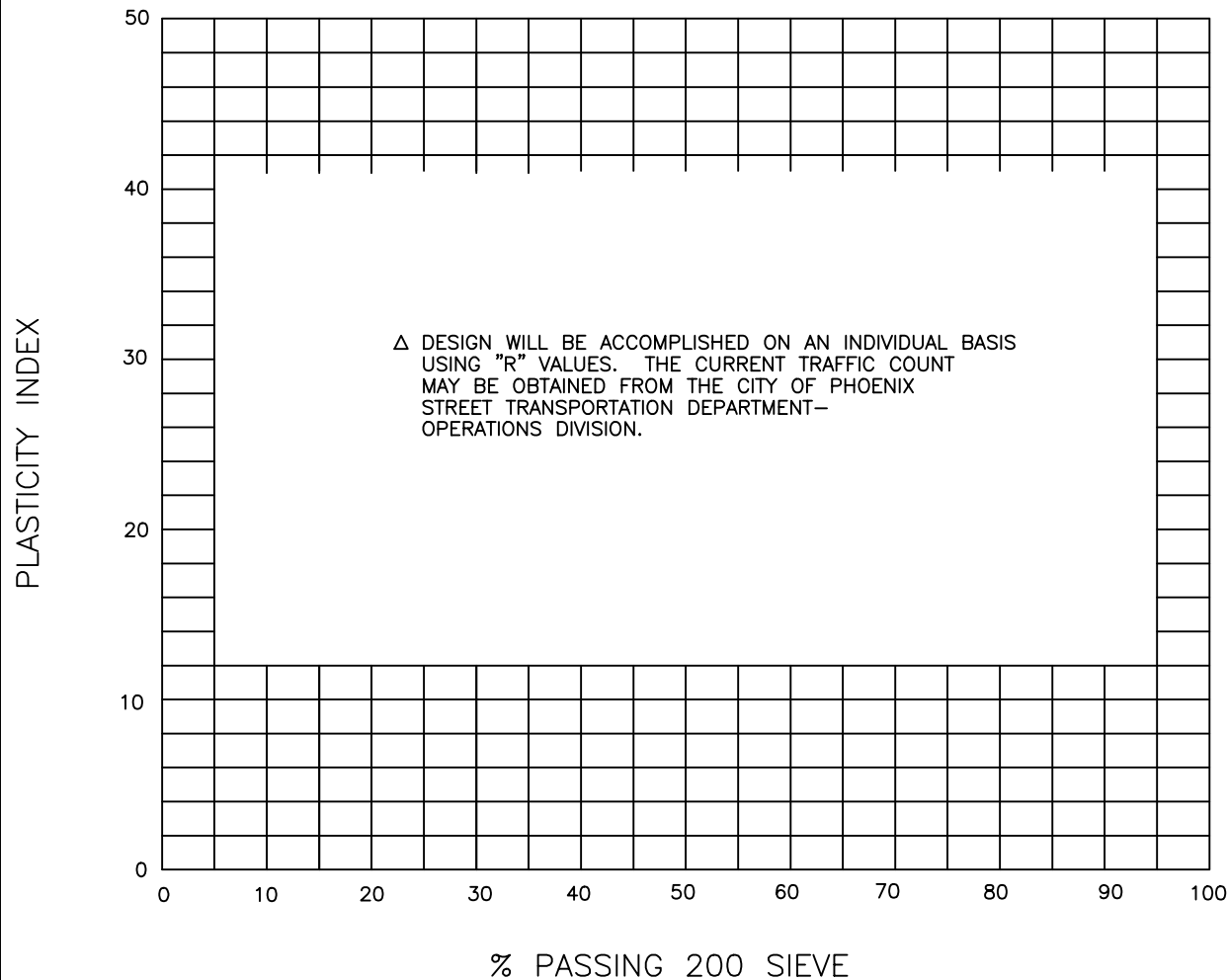
APPROVED

Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

DETAIL NO.
P1103

BASE THICKNESS CHART



NOTES:

1. TOP 4" OF BASE SHALL BE A.B.C. BALANCE SHALL BE A.B.C. OR SELECT MATERIAL.
2. MINIMUM—DEPTH OF FLEXIBLE BASE COURSE REQUIRED UNDER 5" (MIN.) BITUMINOUS SURFACE.
3. CHART TO BE USED ONLY WHEN "R" VALUES ARE NOT AVAILABLE.

DETAIL NO.
P1104



City of Phoenix
STANDARD DETAIL

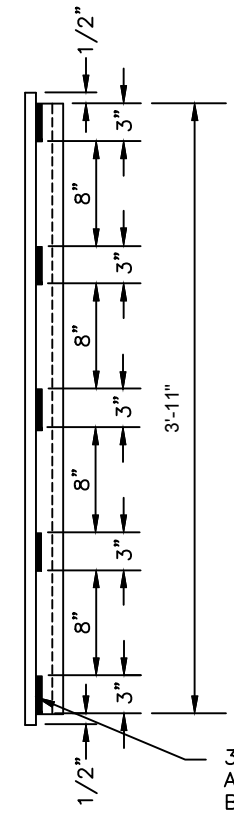
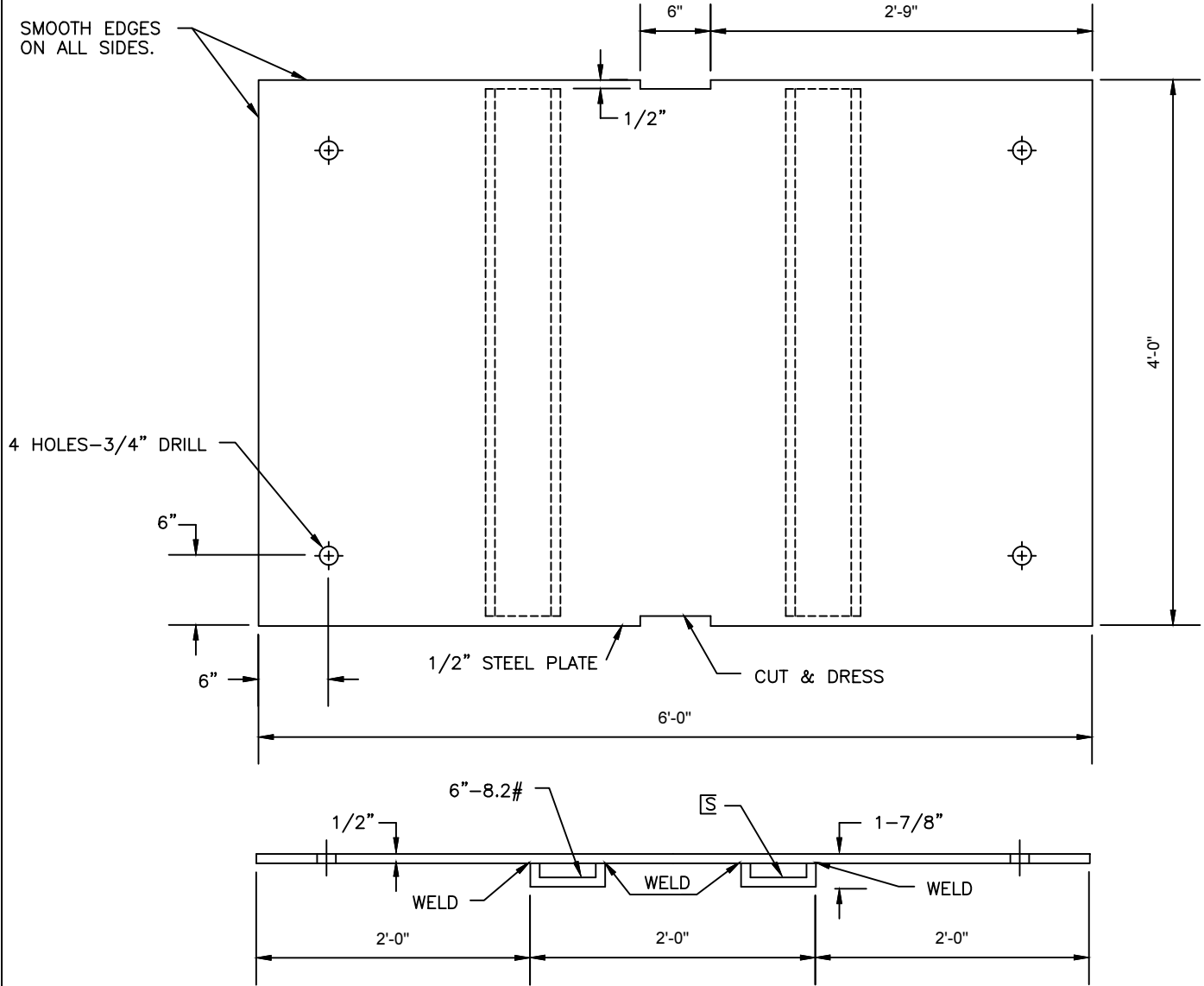
DEPTH OF BASE COURSE
(MAJOR STREETS & HEAVY INDUSTRIAL STREETS)

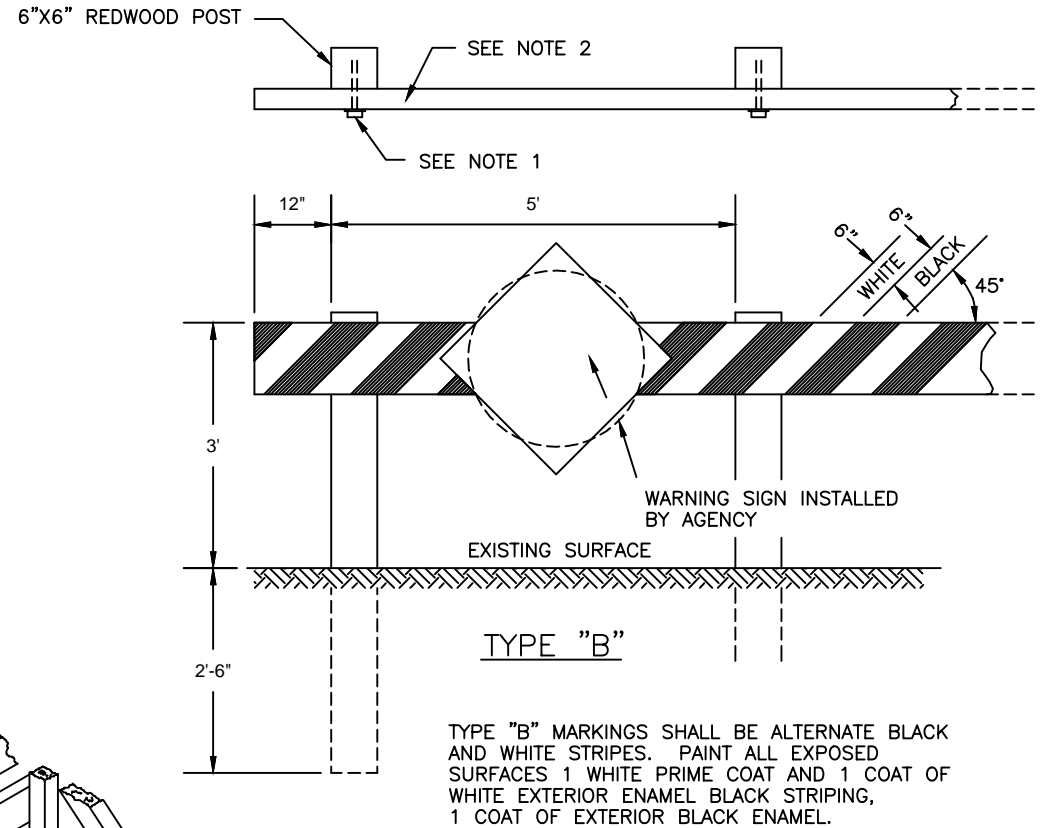
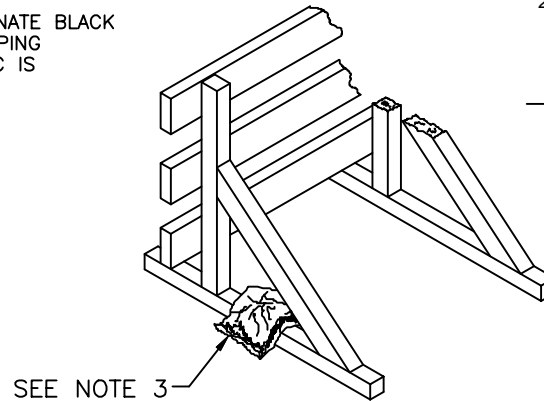
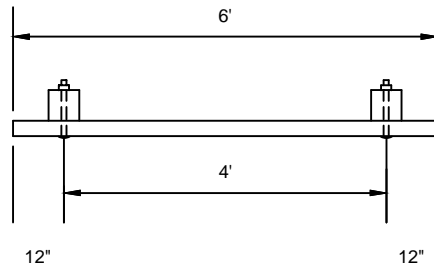
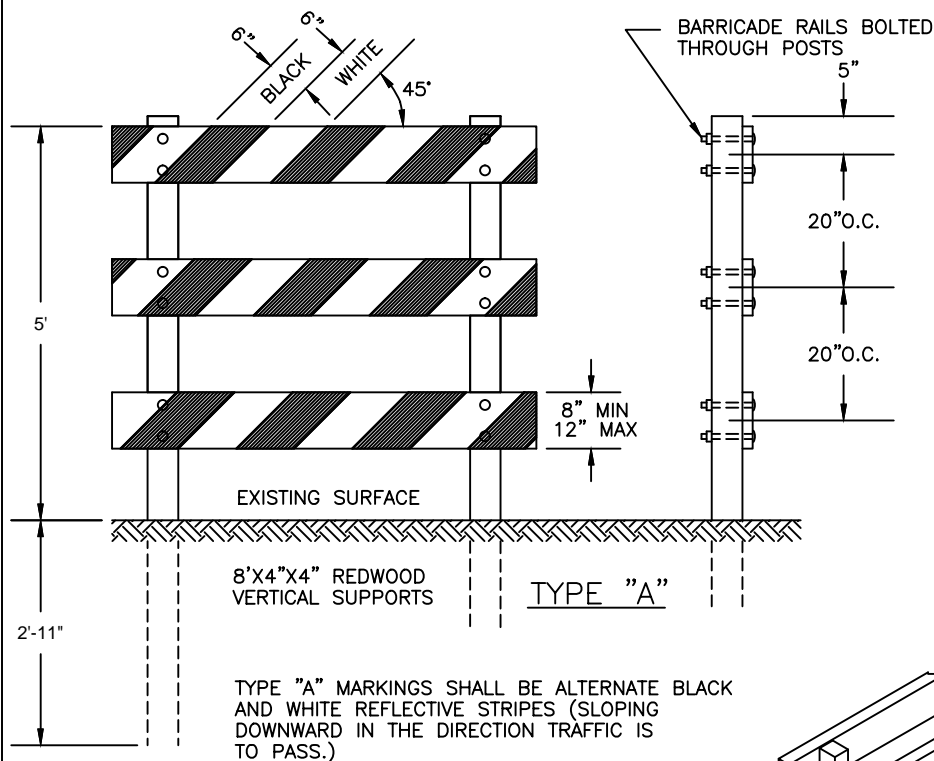
APPROVED

Maria S. Delamando
CITY ENGINEER

2/11/02
DATE

DETAIL NO.
P1104



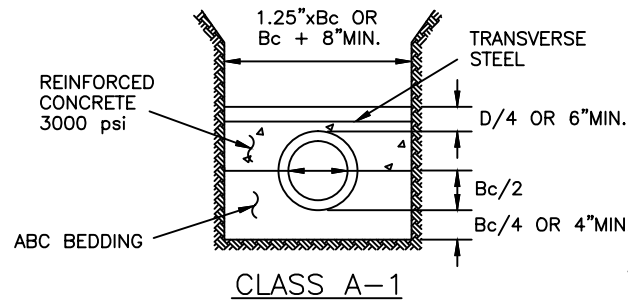


NOTES:

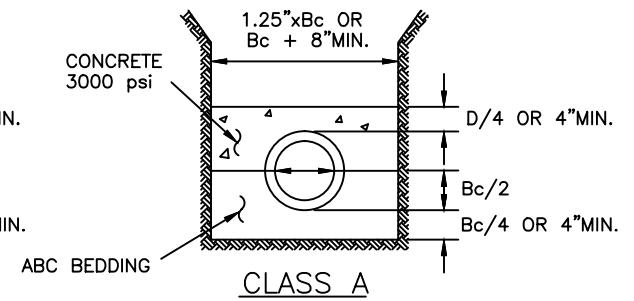
1. FASTEN WITH 1/2"x8" LAG SCREWS WITH 2 FLAT WASHERS OR (2) 5/8" BOLTS, WITH 4 FLAT WASHERS.
2. 3"x10" DOUGLAS FIR PLANK (LENGTH TO BE DETERMINED ON PLANS).
3. WHEN BARRICADE (TYPE "A") IS CONSTRUCTED ON BASED INSTEAD OF POSTS SET INTO THE GROUND, IT MAY BE DESIRABLE TO BALLAST THE BASES WITH SAND BAGS OR BY STAKING TO PROVIDE RESISTANCE TO OVERTURNING DURING PERIODS OF HIGH WINDS.

ALLOWABLE V.C.P. TRENCH LOADING

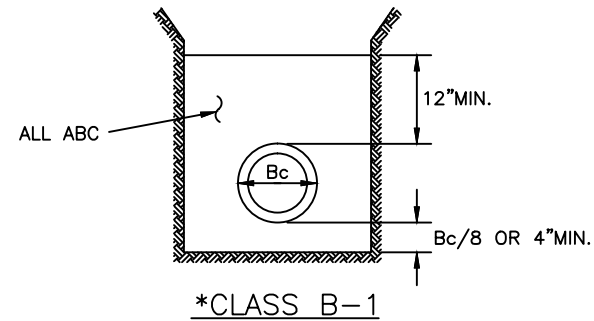
PIPE SIZE (INCHES)	V.C.P. THREE EDGE BEARING STRENGTH MIN.	ALLOWABLE TRENCH LOAD PER CLASS OF BEDDING SOIL WT.=130#/CU.FT. SAFETY FACTOR=1.5		
		CLASS A-1 L.F.=3.4	CLASS A L.F.=2.8	*CLASS B-1 L.F.=2.2
8	2200	4987	4107	3227
10	2400	5440	4480	3520
12	2600	5893	4853	3813
15	2900	6573	5413	4253
18	3300	7480	6160	4840
21	3850	8727	7187	5647
24	4400	9973	8213	6453
27	4700	10653	8773	6893
30	5000	11333	9333	7333
33	5500	12467	10267	8067
36	6000	13600	11200	8800
39	6600	14960	12320	9680



LOAD FACTOR: 3.4 REINFORCED CONCRETE, $p=0.4\%$



LOAD FACTOR: 2.8 PLAIN CONCRETE



LOAD FACTOR: 2.2 ABC ENCASEMENT

NOTE:

SECTION 601 APPLIES FOR FOUNDATION, BEDDING, BACKFILL, MATERIALS AND COMPACTION.

8" V.C.P. 3 EDGE BEARING STRENGTH=2200#/L.F.							
FILL OVER TOP OF PIPE (FT.)	TRENCH WIDTH AT TOP OF PIPE						FILL OVER TOP OF PIPE (FT.)
	18"	24"	30"	36"	42"	WIDER THAN 42"	
	CLASS OF BEDDING						
6 —	B-1						6 —
8 —							8 —
10 —							10 —
12 —							12 —
14 —							14 —
16 —							16 —
18 —							18 —
20 —	A						20 —

10" V.C.P. 3 EDGE BEARING STRENGTH=2400#/L.F.							
FILL OVER TOP OF PIPE (FT.)	TRENCH WIDTH AT TOP OF PIPE						FILL OVER TOP OF PIPE (FT.)
	24"	30"	36"	42"	48"	WIDER THAN 48"	
	CLASS OF BEDDING						
6 —	B-1						6 —
8 —							8 —
10 —							10 —
12 —							12 —
14 —							14 —
16 —							16 —
18 —							18 —
20 —	A						20 —

SEE DETAIL P1120 FOR BEDDING DETAILS

DETAIL NO.
P1121



City of Phoenix
STANDARD DETAIL

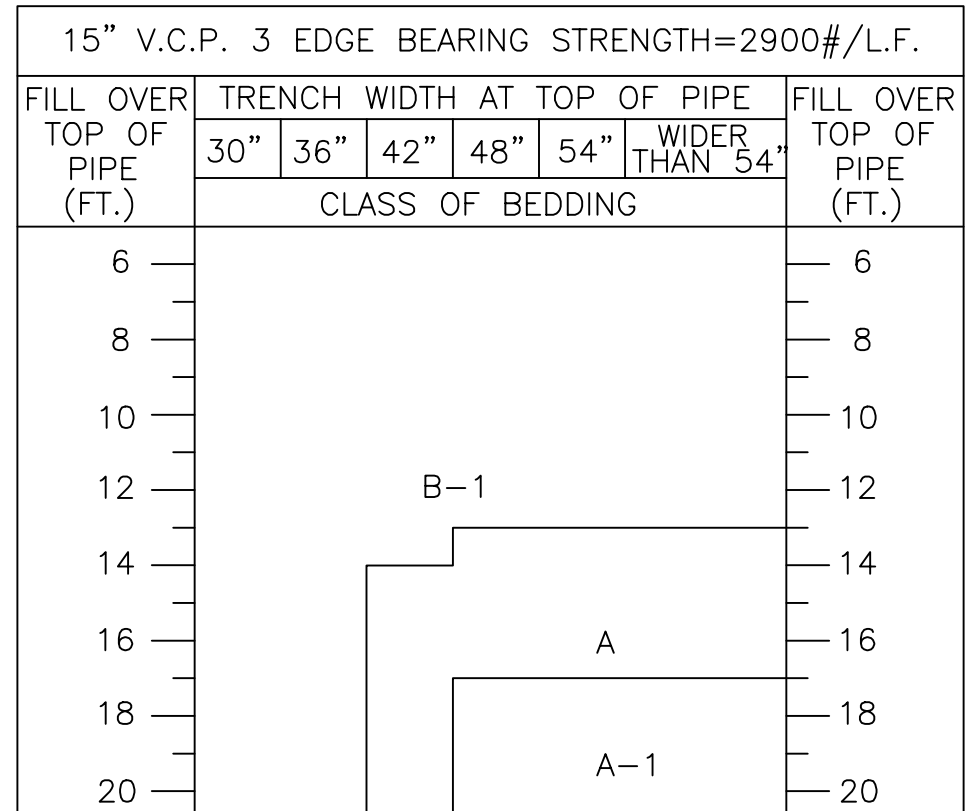
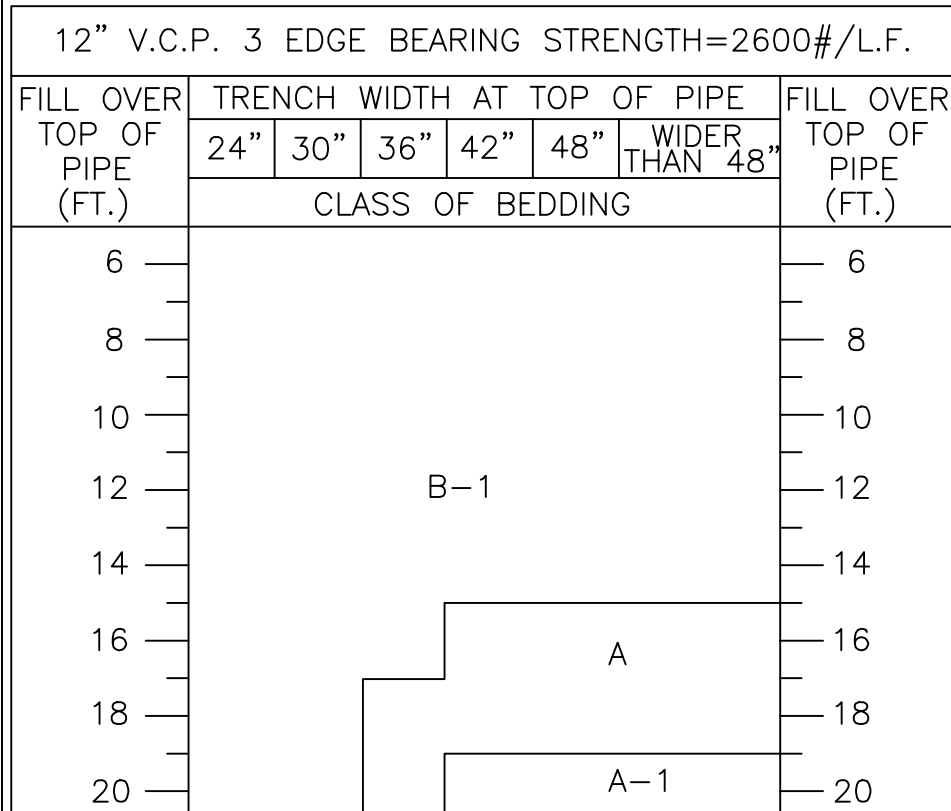
8" & 10" V.C.P. TRENCH LOADING

APPROVED

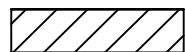
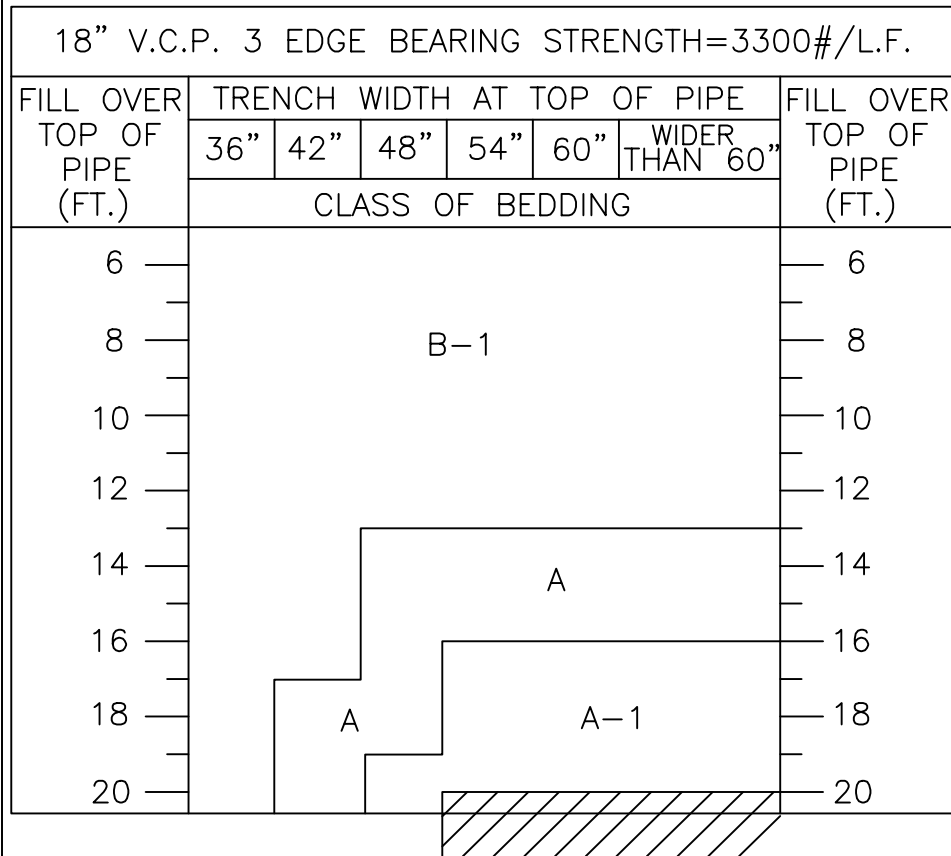
Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

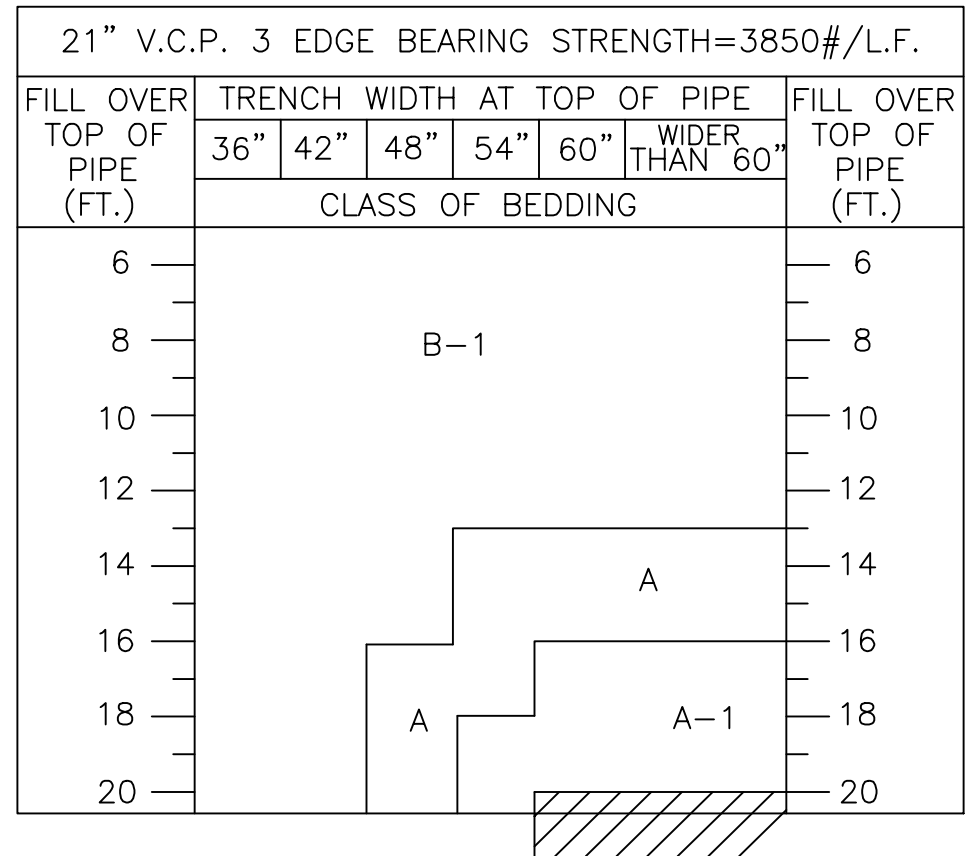
DETAIL NO.
P1121



SEE DETAIL P1120 FOR BEDDING DETAILS



REQUIRES DESIGN ACTION



SEE DETAIL P1120 FOR BEDDING DETAILS

DETAIL NO.
P1123



City of Phoenix
STANDARD DETAIL

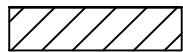
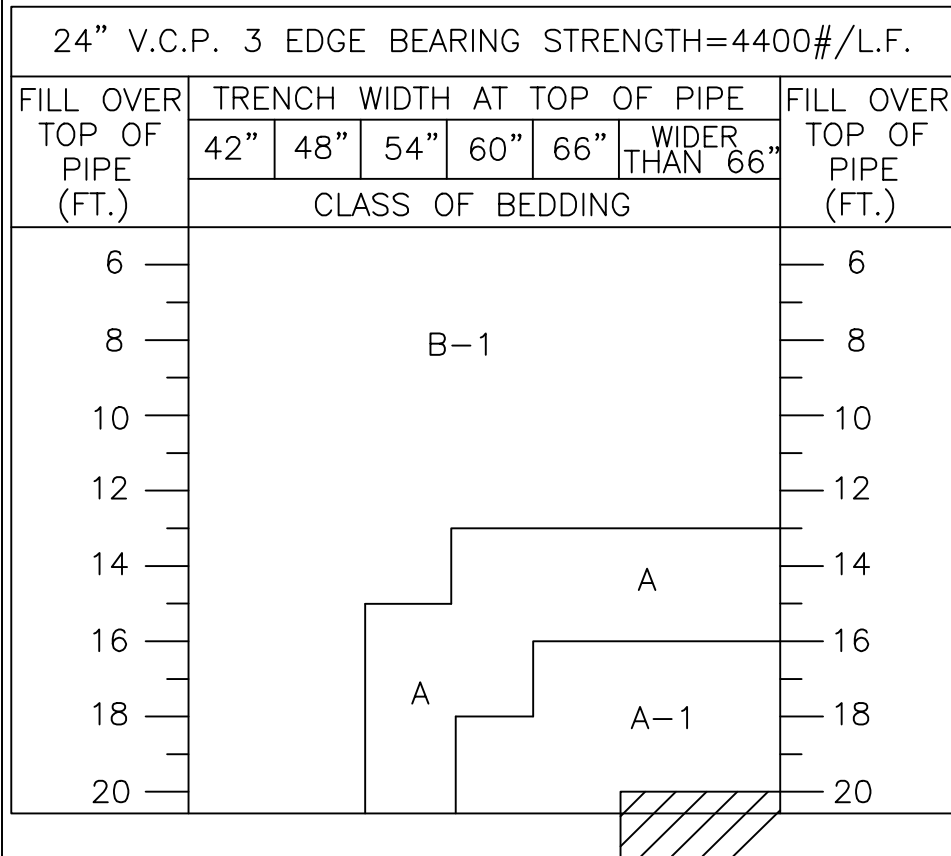
18" & 21" V.C.P. TRENCH LOADING

APPROVED

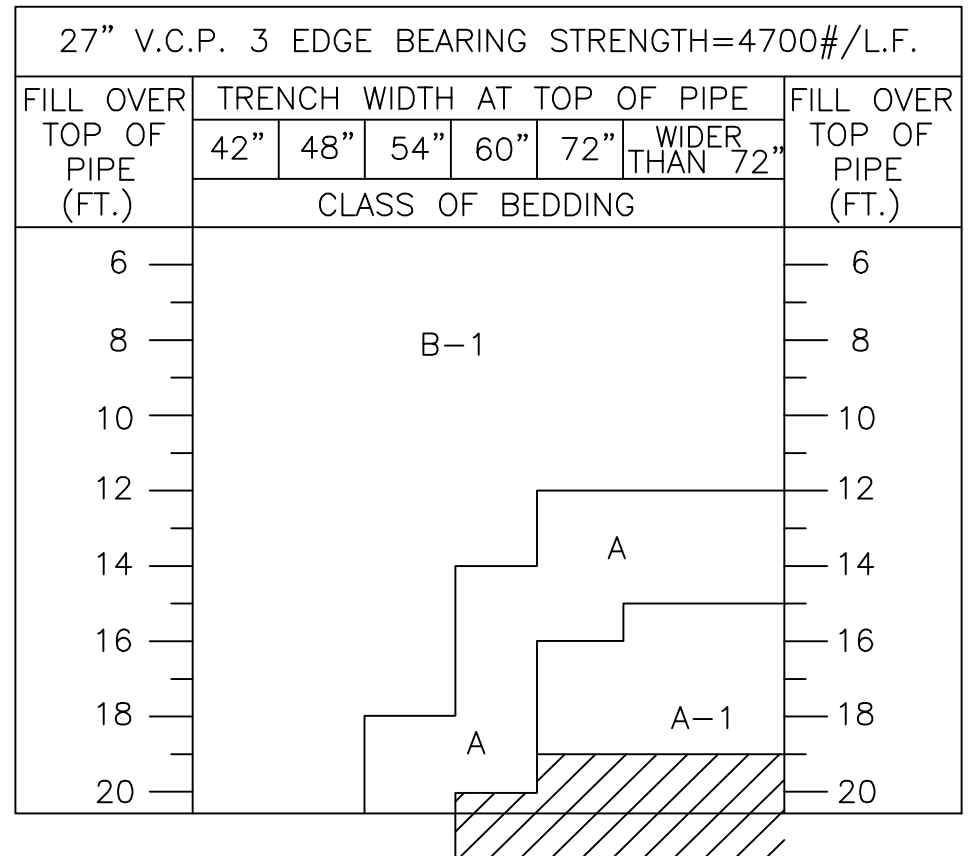
Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

DETAIL NO.
P1123



REQUIRES DESIGN ACTION



SEE DETAIL P1120 FOR BEDDING DETAILS

DETAIL NO.
P1124



City of Phoenix
STANDARD DETAIL

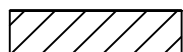
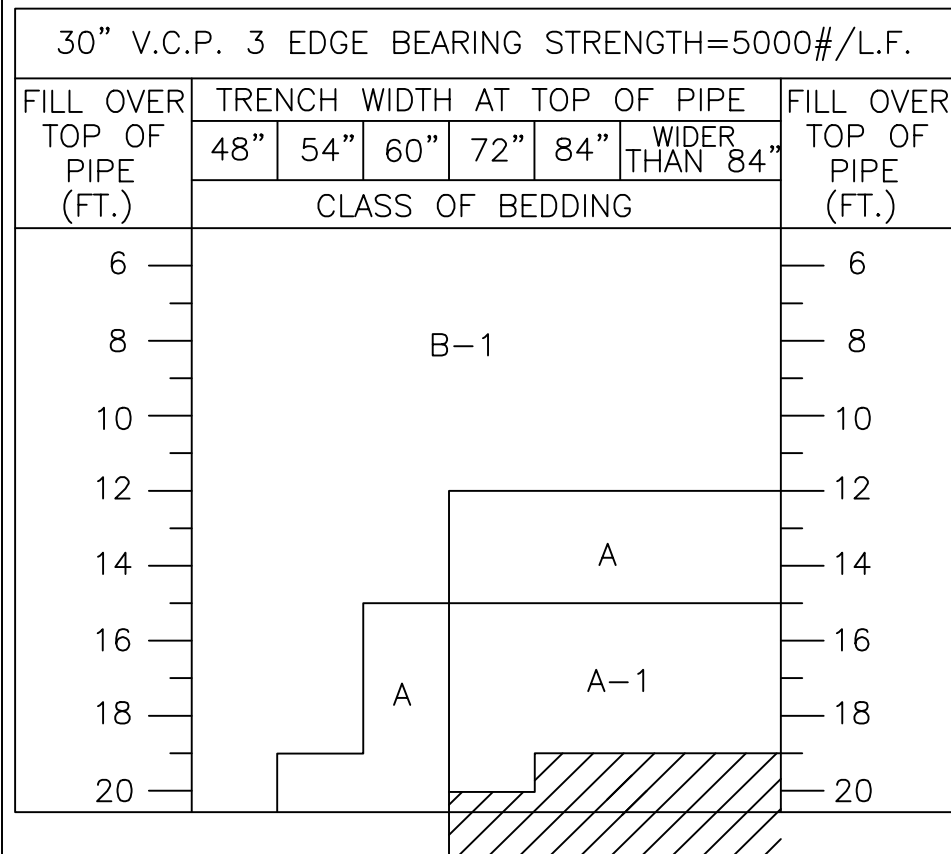
24" & 27" V.C.P. TRENCH LOADING

APPROVED

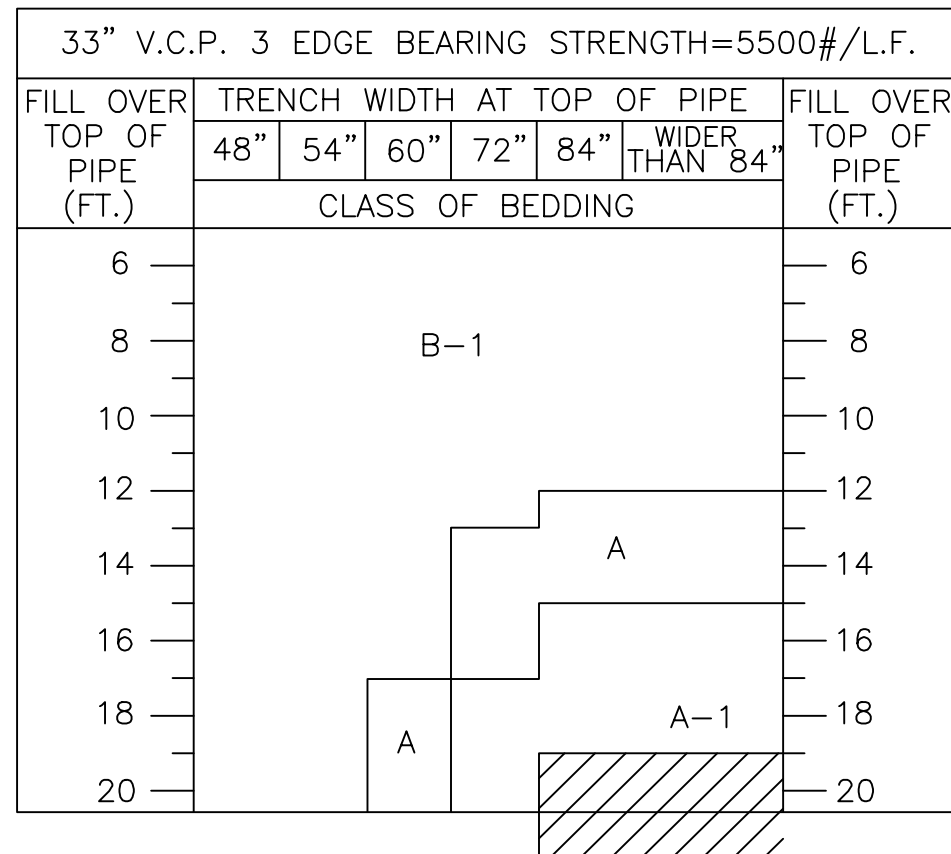
Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

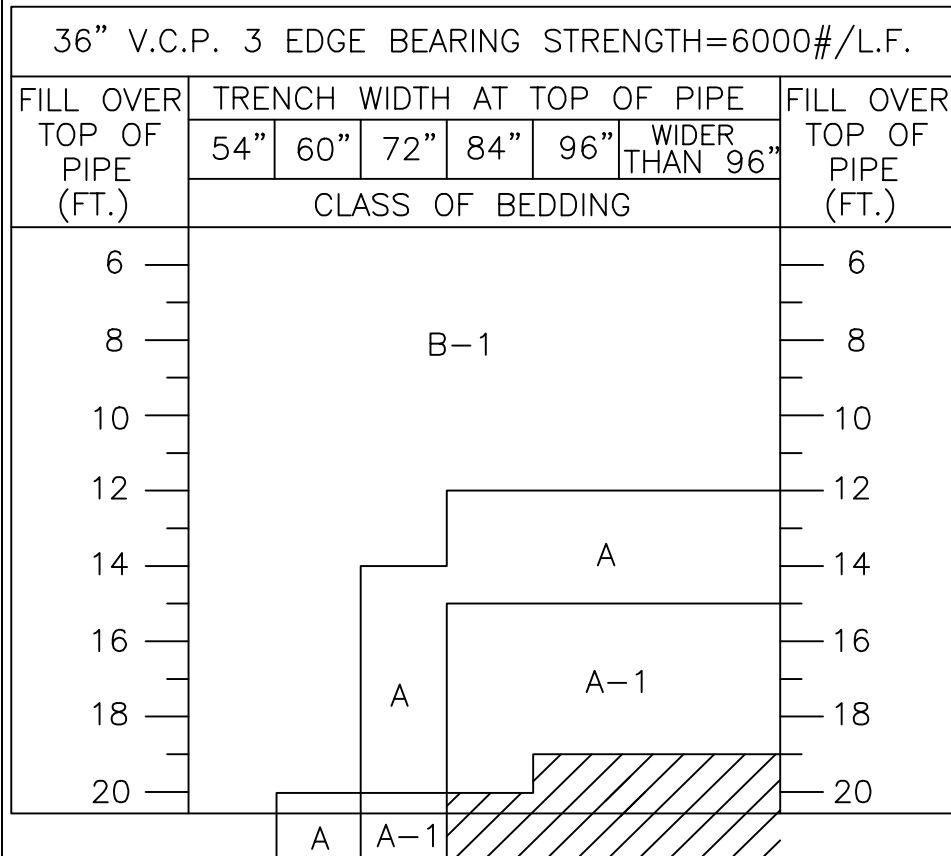
DETAIL NO.
P1124



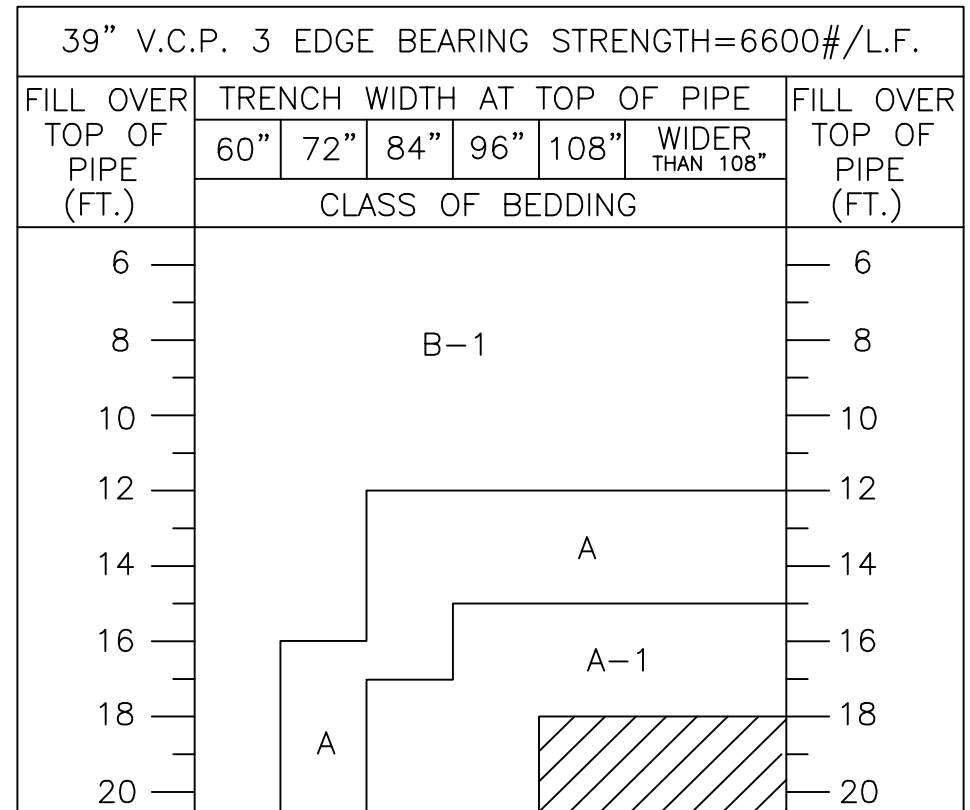
REQUIRES DESIGN ACTION



SEE DETAIL P1120 FOR BEDDING DETAILS



REQUIRES DESIGN ACTION



SEE DETAIL P1120 FOR BEDDING DETAILS

DETAIL NO.
P1126



City of Phoenix
STANDARD DETAIL

36" & 39" V.C.P. TRENCH LOADING

APPROVED

Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

DETAIL NO.
P1126

ALLOWABLE V.C.P. TRENCH LOADING

PIPE SIZE (INCHES)	V.C.P. THREE EDGE BEARING STRENGTH MIN.	ALLOWABLE TRENCH WIDTH PER CLASS OF BEDDING SOIL WT.=130#/CU.FT. SAFETY FACTOR=1.5		
		CLASS A-1 L.F.=3.4	CLASS A L.F.=2.8	*CLASS B-1 L.F.=2.2
42	7000	15867	13067	10267

SEE DETAIL P1120 FOR BEDDING DETAILS



REQUIRES DESIGN ACTION

42" V.C.P. 3 EDGE BEARING STRENGTH=7000#/L.F.

FILL OVER TOP OF PIPE (FT.)	TRENCH WIDTH AT TOP OF PIPE						FILL OVER TOP OF PIPE (FT.)
	60"	72"	84"	96"	108"	WIDER THAN 108"	
6	B-1						6
8							8
10							10
12							12
14	A						14
16							16
18	A-1						18
20							20

DETAIL NO.
P1127



City of Phoenix
STANDARD DETAIL

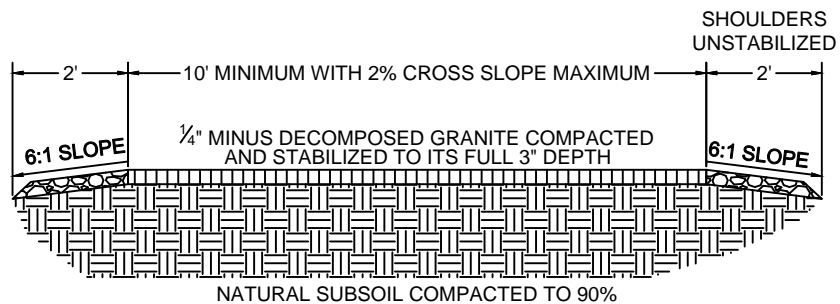
42" V.C.P. TRENCH LOADING

APPROVED

Kenny W. Hain
CITY ENGINEER

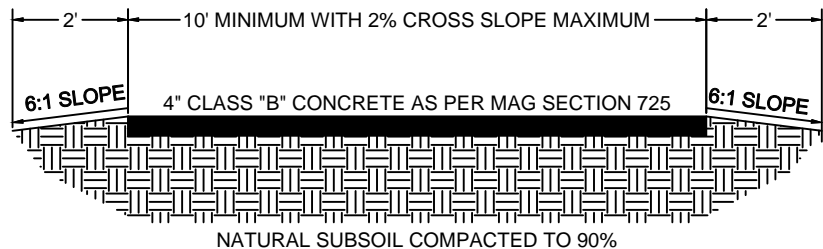
7/9/92
DATE

DETAIL NO.
P1127



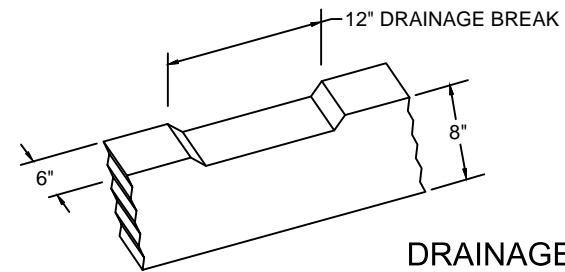
NOT TO SCALE

MULTI-USE TRAIL IN DECOMPOSED GRANITE



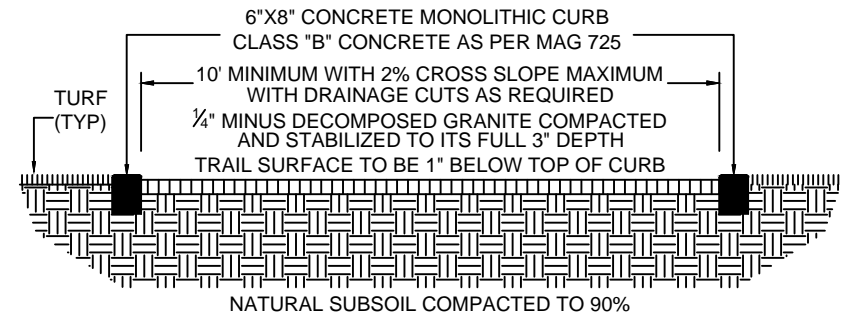
NOT TO SCALE

SHARED USE PATH



NOTCH 1" DEEP WITH 45° CUT (TYP.) AS NEEDED TO PROVIDE DRAINAGE

DRAINAGE CUT



NOT TO SCALE

MULTI-USE TRAIL IN TURF

NOTES:

1. NO RUNNING SLOPE SHALL EXCEED 5%. IF RUNNING SLOPE EXCEEDS 5%, TRAIL MUST CONFORM TO AMERICANS WITH DISABILITIES ACT GUIDELINES.
2. TRAILS WILL NOT EXCEED 8% SLOPES, SLOPES 5-8% NOT TO EXCEED 30' DISTANCE WITHOUT 5' LANDING. REFER TO U.S. DEPARTMENT OF JUSTICE WEBSITE FOR MORE INFORMATION.
3. SHARED-USE PATH WILL FOLLOW P1230 SIDEWALK DETAILS & SPECIFICATIONS FOR CONCRETE SIDEWALK.
4. MULTI-USE TRAIL TO BE LOCATED WITH AN EXCLUSIVE MINIMUM 30' PUBLIC MULTI-USE TRAIL EASEMENT THAT MAY INCLUDE A PUE.
6. SHARED-USE PATH TO BE LOCATED WITHIN A 20' PUBLIC SIDEWALK EASEMENT.
7. MULTI-USE TRAILS AND SHARED-USE PATHS LOCATED WITHIN OR ADJACENT TO OPEN SPACE OR WASH CORRIDORS WILL BE LOCATED WITHIN A MINIMUM 25' PUBLIC TRAIL EASEMENT.

DETAIL NO.
P1130



City of Phoenix
STANDARD DETAIL

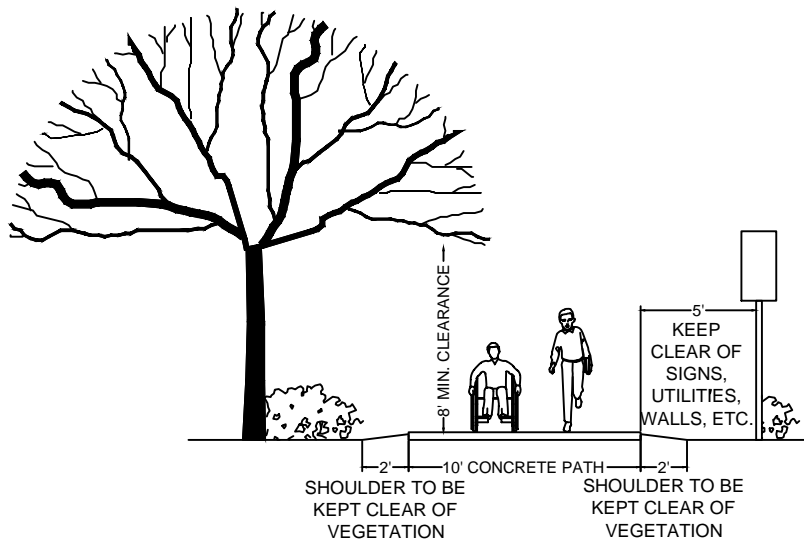
MULTI-USE TRAILS
AND SHARED-USE PATHS

APPROVED

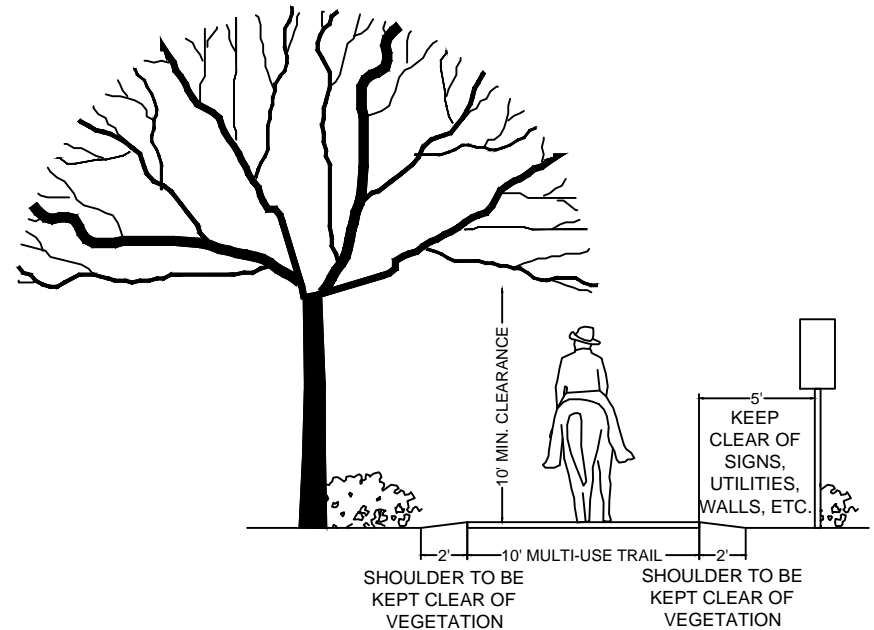
[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

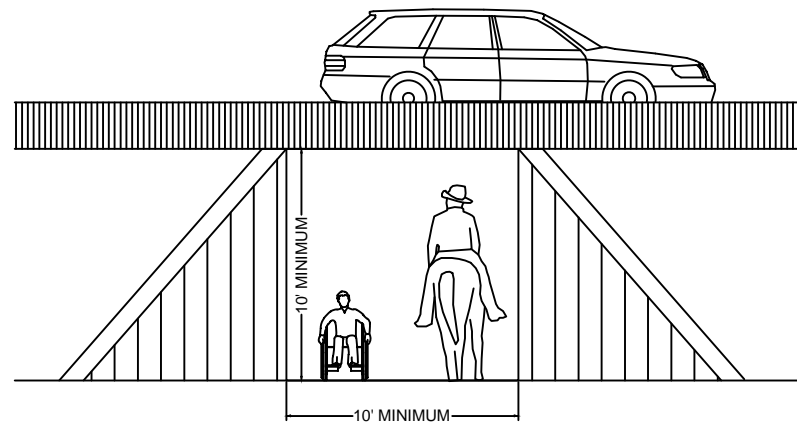
DETAIL NO.
P1130



NOT TO SCALE
SHARED-USE PATHS - OBSTRUCTION CLEARANCES



NOT TO SCALE
MULTI-USE TRAILS - OBSTRUCTION CLEARANCES



NOT TO SCALE
UNDERPASS DIMENSIONS

DETAIL NO.
P1131



City of Phoenix
STANDARD DETAIL

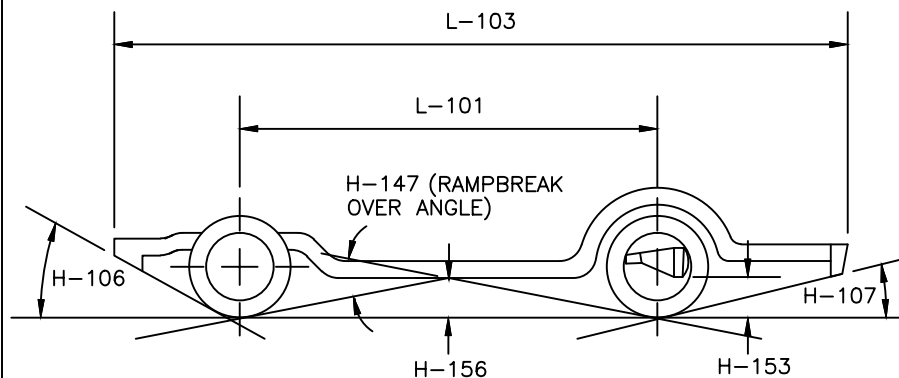
VERTICAL CLEARANCE, MULTI-USE, SHARED-USE,
AND UNDERPASS/BRIDGE CLEARANCE

APPROVED

[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

DETAIL NO.
P1131



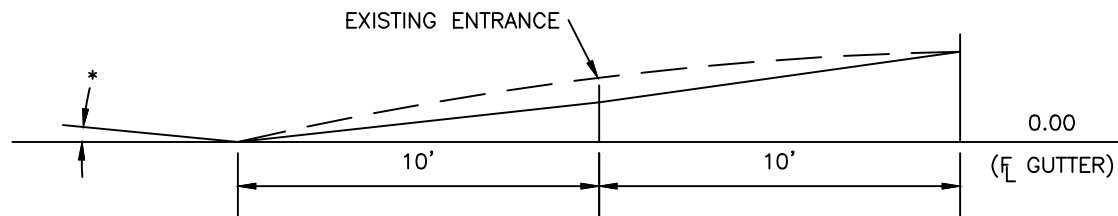
NOTES

1. IF THE SUM OF THE STREET CROWN SLOPE, NORMALLY A NEGATIVE SLOPE OF 1.72' (0.03), AND THE POSITIVE SLOPE IF THE DRIVEWAY IS EQUAL TO OR EXCEEDS THE ANGLE OF DEPARTURE, 8.3' (0.146), THE DRIVEWAY MUST BE REDESIGNED TO A POSITIVE SLOPE OF NOT MORE THAN 6' (0.105).
2. ADDITIONAL INCREASES IN THE POSITIVE SLOPE MAY BE MADE AT TEN (10) FOOT INTERVALS. EACH CHANGE CANNOT EQUAL OR EXCEED THE ANGLE OF DEPARTURE, 8.3' (0.146).
3. CHANGES FROM A POSITIVE SLOPE TO A NEGATIVE SLOPE CANNOT EQUAL OR EXCEED THE BRAKOVER ANGLE OF 5.53' (0.097).
4. WHEN MAKING CHANGE FROM A NEGATIVE SLOPE TO A POSITIVE SLOPE, THE SUM OF THE TWO SLOPES CANNOT EQUAL OR EXCEED THE ANGLE OF DEPARTURE, 8.3' (0.146).

GROUND CLEARANCE DIMENSIONS

H-106 - ANGLE OF APPROACH = 8.6 DEGREES
 H-107 - ANGLE OF DEPARTURE = 8.3 DEGREES
 H-147 - RAMP BRAKOVER ANGLE = 5.53 DEGREES
 H-153 - REAR AXLE TO GROUND = 5.5 INCHES
 H-156 - MINIMUM GROUND CLEARANCE = 3.1 INCHES
 L-101 - WHEELBASE = 9.88 FEET
 L-103 - VEHICLE LENGTH = 18.42 FEET

THESE DIMENSIONS ARE FROM THE 1982 MOTOR VEHICLE MANUFACTURERS ASSOCIATION PUBLICATION. COPIES MAY BE OBTAINED FROM TECHNICAL AFFAIRS DIVISION, MOTOR VEHICLE MANUFACTURERS ASSOCIATION, 300 NEW CENTER BUILDING, DETROIT, MICHIGAN 48202.



* 0.03% MAXIMUM TRANSVERSE SLOPE ALLOWABLE

DETAIL NO.
P1164



City of Phoenix
STANDARD DETAIL

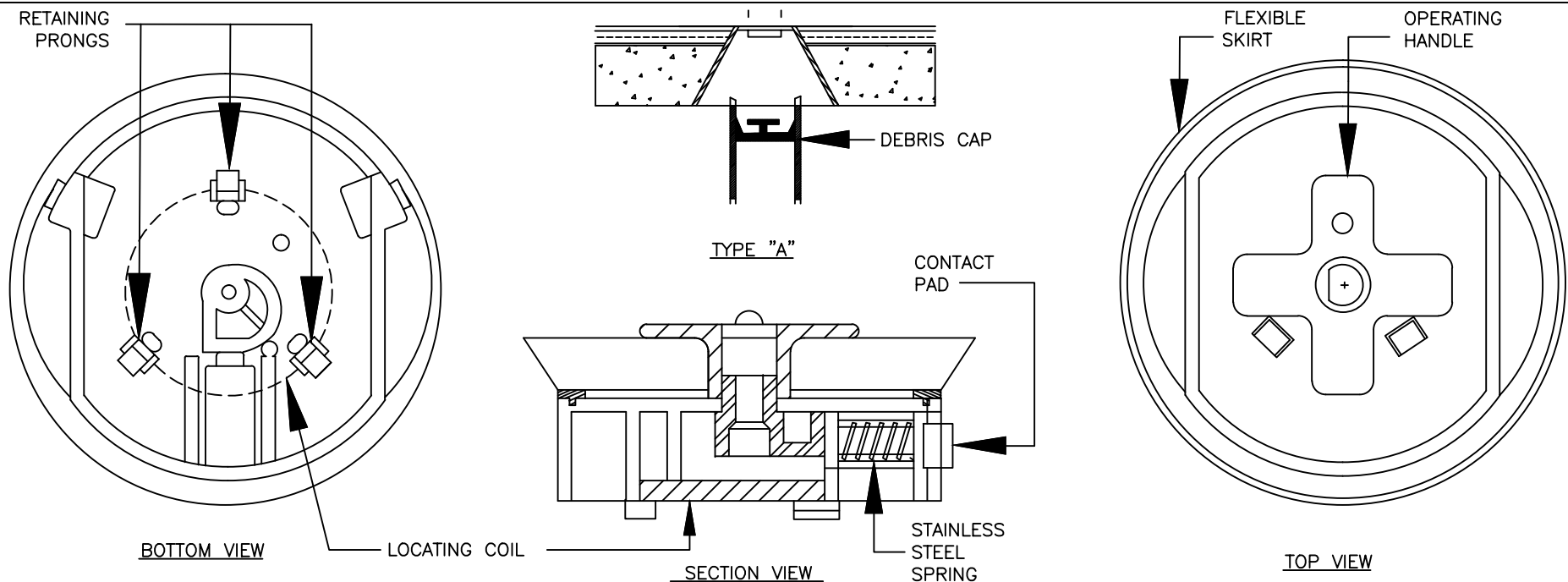
MAXIMUM DRIVEWAYS & ALLEYS SLOPE

APPROVED

Kenny W. Hain
CITY ENGINEER

5/31/94
DATE

DETAIL NO.
P1164



NOTES

1. DEBRIS CAP SHALL BE INSTALLED AS CLOSE UNDER THE CAST IRON COVER WITHOUT INTERFERING WITH COVER OPERATION.
2. FLEXIBLE SKIRT SHALL BE TRIMMED TO PROVIDE A SMOOTH CONTACT WITH THE INTERIOR DIAMETER OF THE PIPE.
3. THE DEBRIS CAP SHALL BE MANUFACTURED BY SW SERVICES, INC., PHOENIX, ARIZONA OR APPROVED EQUAL.
4. THE DEBRIS CAP SHALL BE COMPRISED OF A HOLLOW MEMBER HAVING A CYLINDRICAL OUTER SURFACE, A CLOSURE FOR ONE END AND THREE POINT RESILIENT CONTACT PADS PROJECTING FROM THE OUTER SURFACE. THE CAP SHALL HAVE A FLEXIBLE SKIRT PROVIDING AN OUTWARD SEAL PREVENTING DEBRIS FROM GETTING PAST THE CAP. THE CAP MUST WITHSTAND, WITHOUT SLIPPAGE, A MINIMUM VERTICAL FORCE OF 50 POUNDS, AT A LOADING RATE OF 1.0 IN/MINUTE. THE CAP SHALL BE MOLDED USING GENERAL ELECTRIC ABS #HIM 4500. THE CAP SHALL HAVE RETAINING PRONGS TO RETAIN A STANDARD LOCATING COIL. SCOTCHMARK 4" DISC MARKER 141.7khz BY 3M, OR APPROVED EQUAL.
5. DEBRIS CAPS WITH LOCATOR COILS ARE TO BE INSTALLED ON ANY NEW WATER SERVICES DEPARTMENT CIP PROJECTS, STREET TRANSPORTATION DEPARTMENT CIP PAVING PROJECTS (NEW, REPLACEMENT, AND OVERLAYS) AND PRIVATE DEVELOPMENT PROJECTS IN THE FOLLOWING VALVE BOX LOCATIONS:
 - ALL MAJOR (ARTERIAL) STREETS
 - ANY UNPAVED AREAS
 - ALL EASEMENTS
 - GUTTER LOCATIONS
 - STREETS WITHOUT CURB & GUTTER
 - COUNTY ROADS
 - GATE VALVE LOCATIONS ON WATERLINES GREATER THAN 12" IN DIAMETER
 - ANY OTHER LOCATION INDICATED ON THE PLANS PER THE DESIGNER

DETAIL NO.
P1165



City of Phoenix
STANDARD DETAIL

DEBRIS CAP INSTALLATION

APPROVED

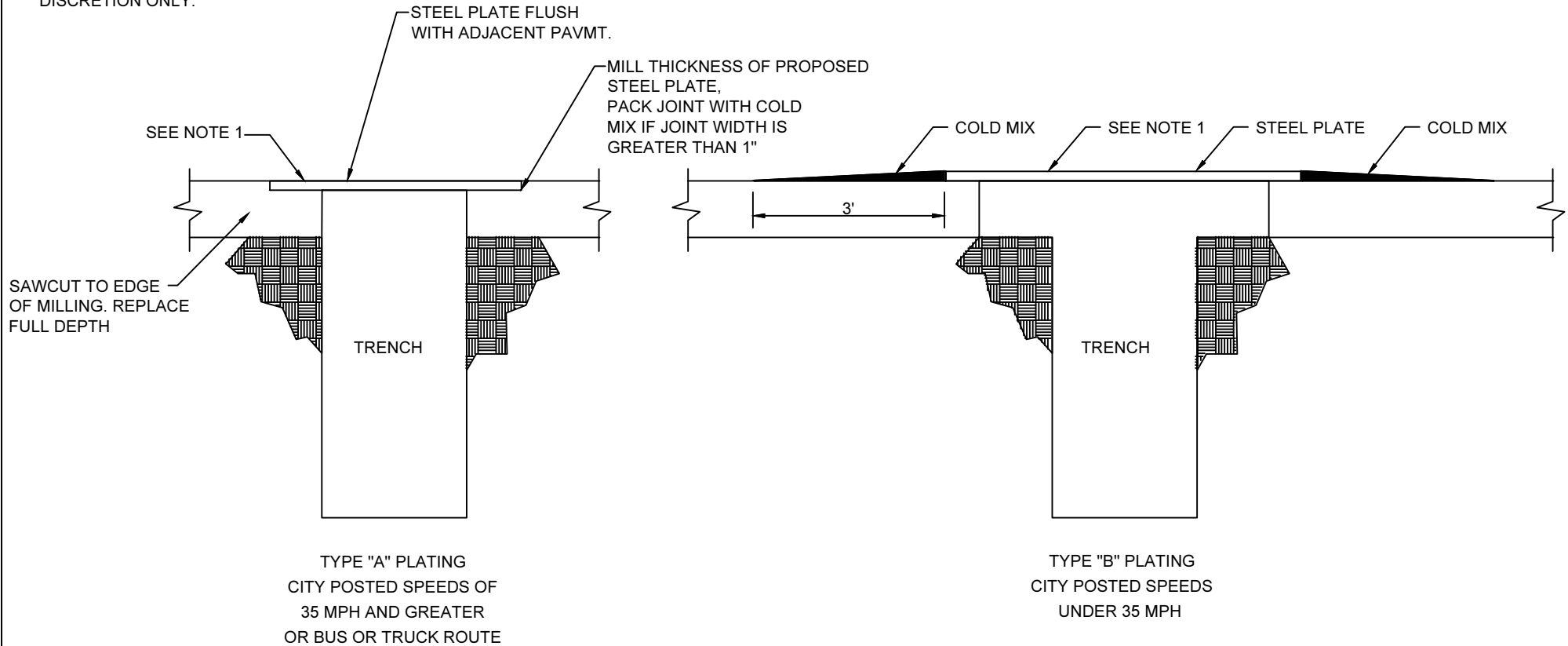
[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

DETAIL NO.
P1165

NOTES:

1. PROVIDE 2' MIN. OVERLAP OF PLATE ON ASPHALT TO ASSURE NO SLIPPAGE OF PLATE AND NO COLLAPSING OF TRENCH.
2. "POSTED SPEED" DOES NOT INCLUDE TEMPORARY CONSTRUCTION SIGNING.
3. METHOD OF ASPHALT REMOVAL OTHER THAN MILLING AT INSPECTOR'S DISCRETION ONLY.



IF TRENCH LENGTH IS LESS THAN 5-FEET AND STEEL PLATES WILL BE IN PLACE LESS THAN 48 HOURS, STEEL PLATES MAY BE PLACED DIRECTLY ON EXISTING ASPHALT WITHOUT MILLING. PROVIDE TEMPORARY ASPHALT TRANSITIONS EXTENDING 3-FEET BEYOND EDGE OF STEEL PLATES.

DETAIL NO.
P1170



City of Phoenix
STANDARD DETAIL

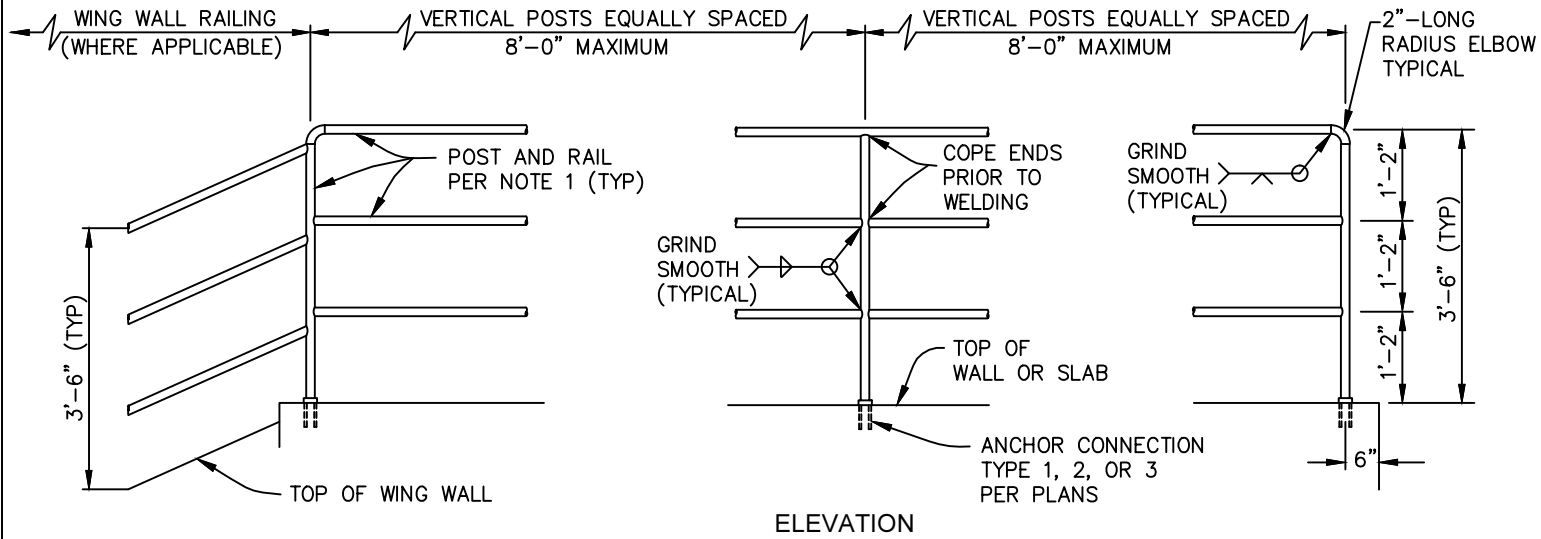
TRENCHING STEEL PLATE

APPROVED

Maria S. Demando
CITY ENGINEER

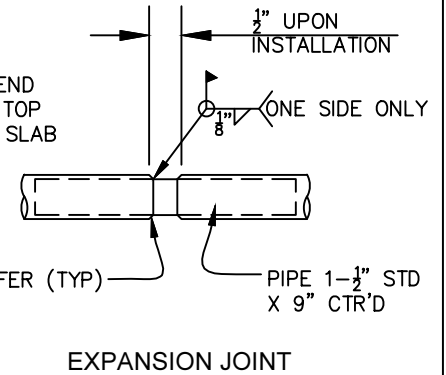
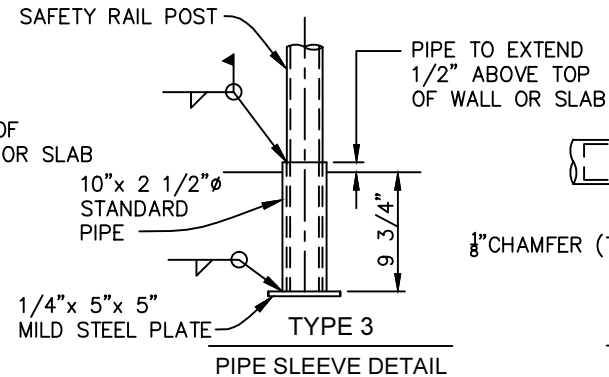
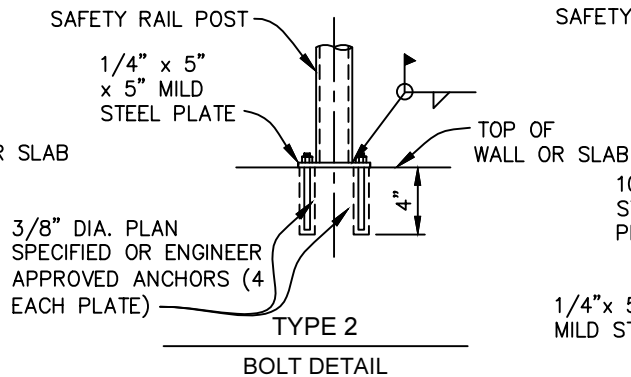
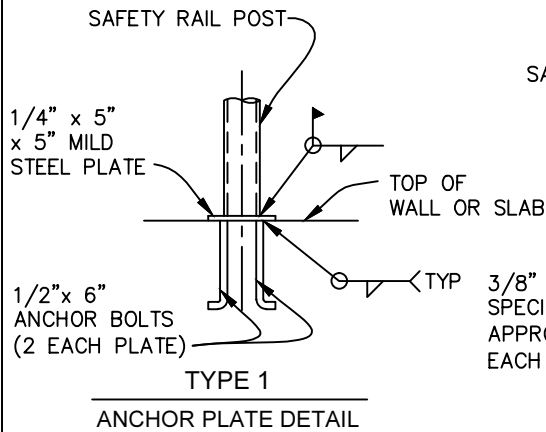
7/9/92
DATE

DETAIL NO.
P1170



CONSTRUCTION NOTES

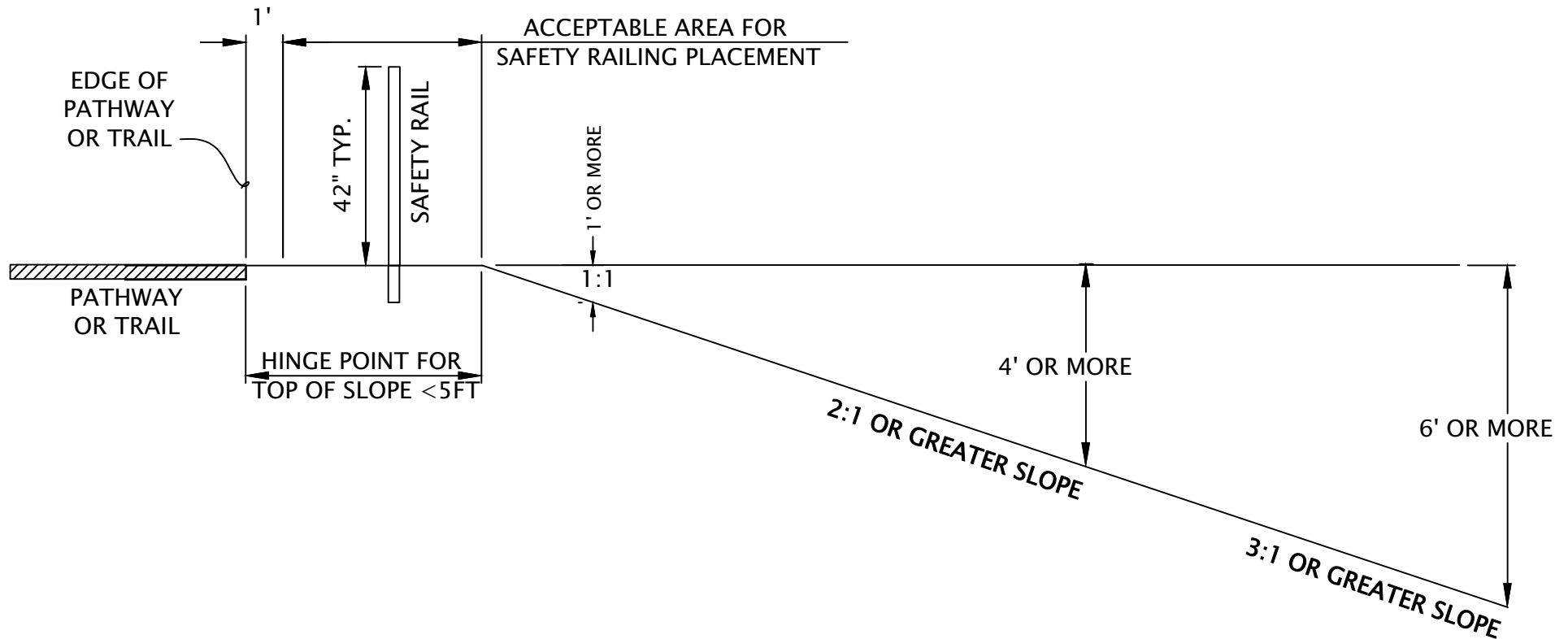
1. PIPE 2 STD (ASTM A53 GRADE B) GALVANIZED PER SECTION 771.
2. PAINT PER SECTION 530 WHERE REQUIRED BY ORDINANCE OR PLANS. COLOR PER PLANS.
3. VERTICAL POSTS TO BE EVENLY SPACED.
4. SAFETY RAILING TO BE PLACED ON ALL HEADWALLS AND AT THE BACK OF SCUPPERS.
5. ANCHORAGE AT SCUPPERS SHALL BE PER MAG STD DETAIL 206-2.
6. EXPANSION JOINT SPACING SHALL NOT EXCEED 40FT AND SHALL BE LOCATED AT STRUCTURE EXPANSION JOINTS, WHICHEVER IS LESS.



NOTES:

1. FOR GROUND INSTALLATION REFER TO MAG STD DETAIL 145.
2. NOT TO BE USED AS A PEDESTRIAN BRIDGE RAIL.

CONDITIONS WHERE SAFETY RAILINGS (DETAIL P1173) ARE REQUIRED (REFER TO SAFETY RAILING MAG DETAIL 145, TYPE 4 FOR ATTACHMENT TO THE GROUND)



NOTE:

1) SAFETY RAILS ARE REQUIRED WHERE THE CONDITIONS WILL EXCEED THE ABOVE DEPICTED LIMITS

NOT TO SCALE

DETAIL NO.
P1174



City of Phoenix
STANDARD DETAIL

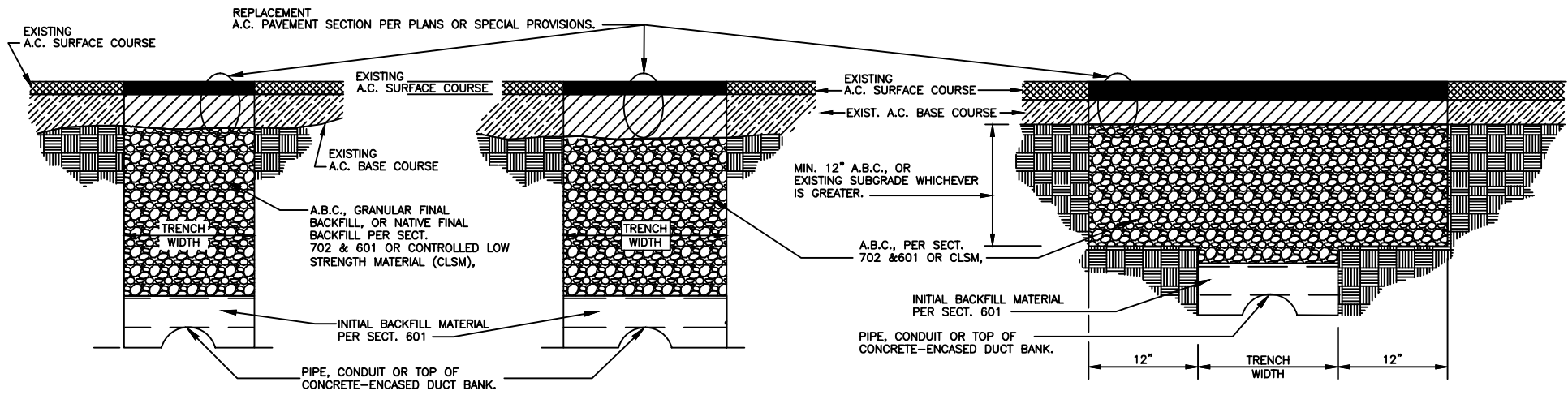
CONDITIONS WHERE SAFETY
RAILINGS ARE REQUIRED

APPROVED

[Signature]
CITY ENGINEER

12/10/2012
DATE

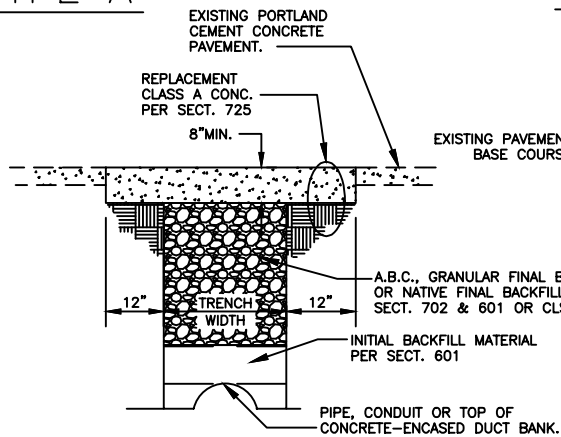
DETAIL NO.
P1174



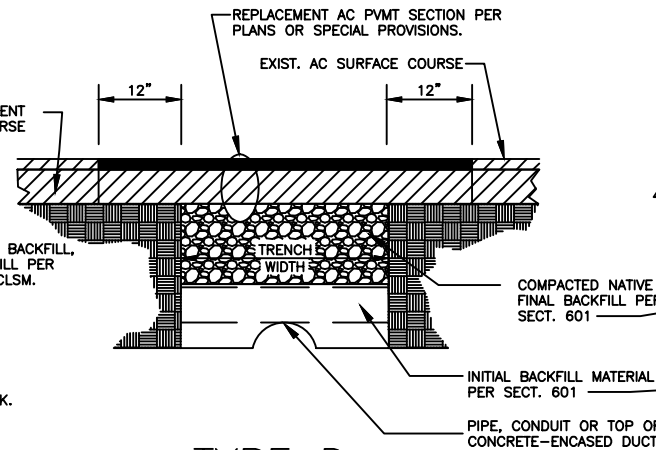
TYPE A

TYPE B

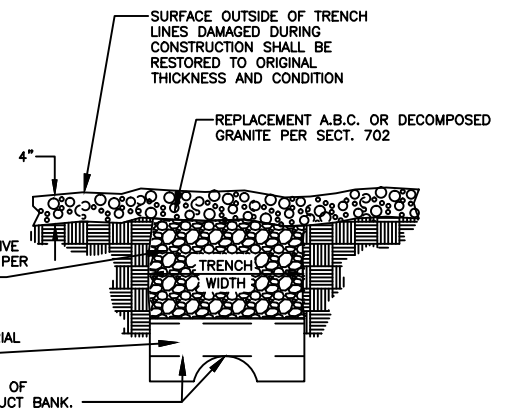
TYPE B-"T" TOP



TYPE C



TYPE D



TYPE E

NOTES:

1. INITIAL BACKFILL PER SECTION 601 FOR ALL TRENCH TYPES.
2. REFER TO SECTION 336.3 FOR FINAL BACKFILL & SURFACE REPLACEMENT TYPES REQ'D BASED ON TRENCH ORIENTATION IN STREETS.
3. TRENCH WIDTH PER SECTION 336 & 601.
4. EXPOSED WATER SERVICE PIPES THAT CROSS TRENCHES TO BE BACKFILLED WITH CLSM SHALL BE WRAPPED WITH MIN. 3/4" THICK CLOSED CELL FOAM INSULATION PRIOR TO PLACEMENT OF CLSM.
5. FOR TRENCHES UP TO 24" WIDE, CLSM MAY BE USED UP TO THE REPLACEMENT PAVEMENT SUBGRADE LEVEL. FOR TRENCHES BETWEEN 24" AND 6' WIDE, CLSM SHALL ONLY BE PLACED IN THE TOP 24" OF TRENCH. FOR TRENCHES WIDER THAN 6', CLSM FINAL BACKFILL SHALL NOT BE USED, UNLESS APPROVED BY THE ENGINEER.

DETAIL NO.
P1200



City of Phoenix
STANDARD DETAIL

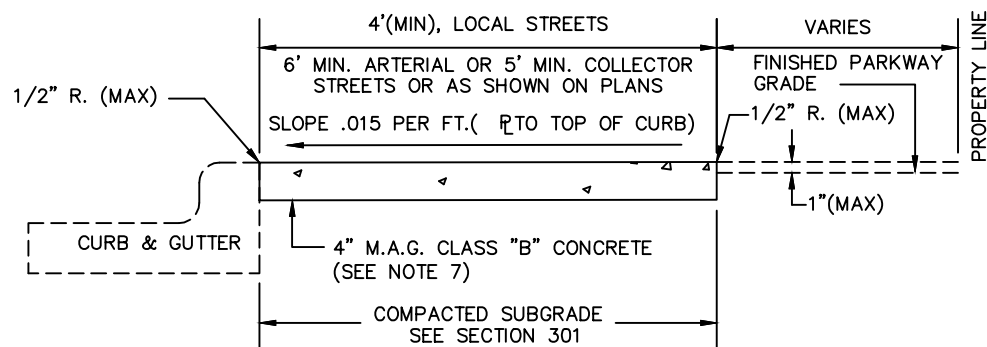
TRENCH BACKFILL
& SURFACE REPLACEMENT

APPROVED

[Signature]
CITY ENGINEER

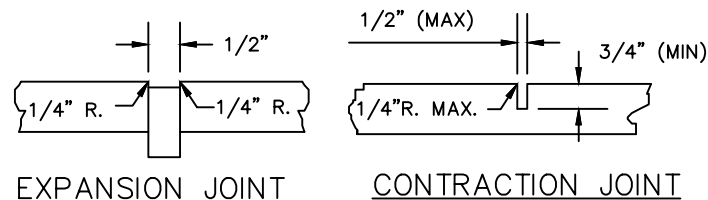
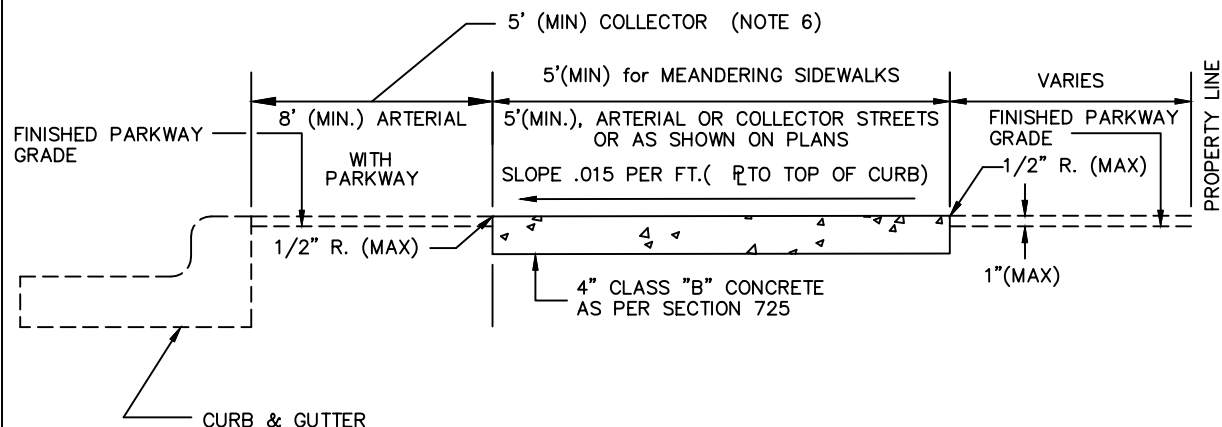
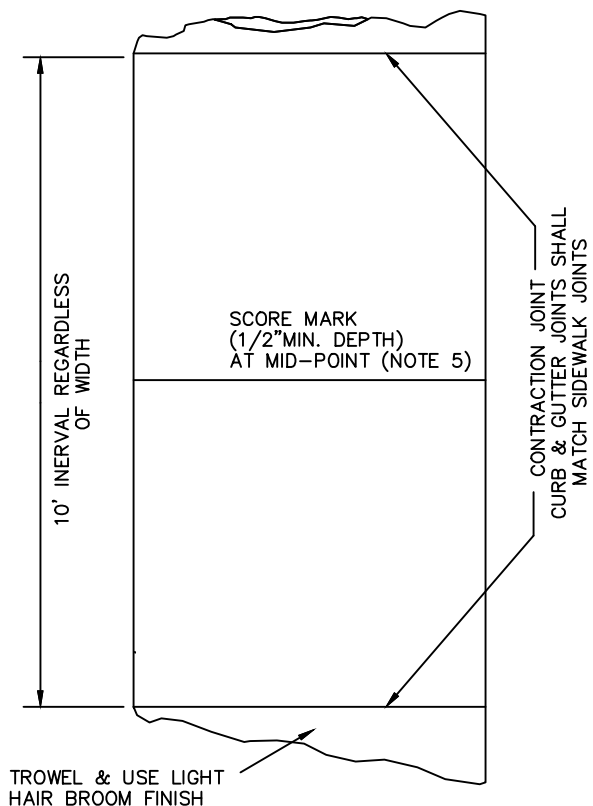
07/01/2015
DATE

DETAIL NO.
P1200



NOTES:

1. SIDEWALK CONSTRUCTION SHALL CONFORM TO SECTION 340.
2. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, A.S.T.M. D-1751.
3. EXPANSION JOINTS SHALL BE INSTALLED PRIOR TO ALL POURS, AT POINTS OF CURVATURE, AT ADJOINING STRUCTURES, AT DRIVEWAYS AND AT A MAXIMUM SPACING OF 50'. THE EXPANSION JOINT MUST PROVIDE FOR COMPLETE SEPARATION OF THE SIDEWALK FROM ADJOINING CONCRETE.
4. THE EXPANSION JOINT MATERIAL SHALL EXTEND FROM 1/4" BELOW THE TOP SURFACE OF THE SIDEWALK TO 1" INTO THE SUBGRADE.
5. WHEN SIDEWALK AND ADJACENT CURB ARE INSTALLED MONOLITHICALLY, THE MID-POINT SCORE LINE MUST EXTEND ACROSS THE CURB & GUTTER.
6. EXCEPTION TO BE APPROVED BY CITY ENGINEER.
7. CONCRETE SHALL BE M.A.G. CLASS "A" IN AREAS WITH CROSSING VEHICULAR TRAFFIC.



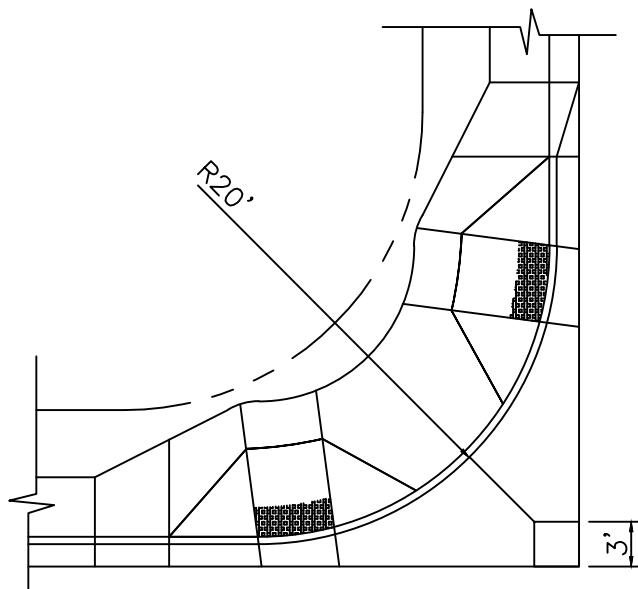
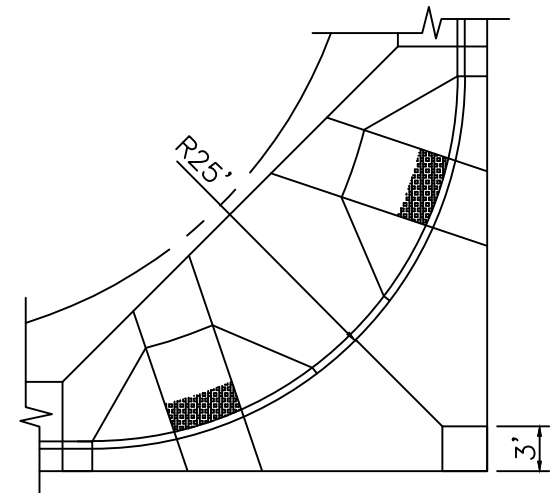
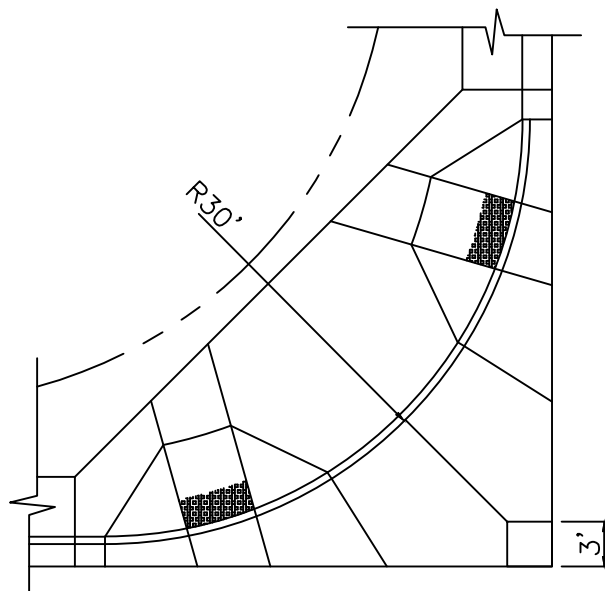
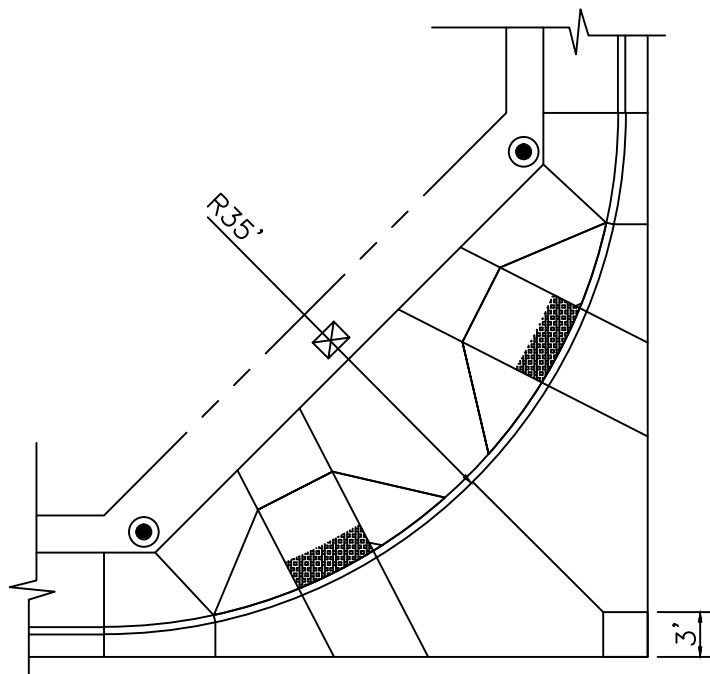
DETAIL NO.
P1230



SIDEWALKS

APPROVED
[Signature]
CITY ENGINEER
07/01/2015
DATE

DETAIL NO.
P1230



NOTES:

1. CONSTRUCT THE CONTRACTION JOINTS AS SHOWN ON CONCRETE APRON FOR THE RADIUS REQUIRED.
2. WHEN PLANS CALL FOR A CLASS "A" CONCRETE VALLEY GUTTER THE CONTRACTION JOINTS SHALL BE SPACED SYMMETRICAL WITH AT LEAST ONE JOINT EVERY 10 FEET.
3. WHEN PLANS CALL FOR A 7' VALLEY GUTTER, MAKE A 7' SQUARE INSTEAD OF A 3' SQUARE.

DETAIL NO.
P1231



City of Phoenix
STANDARD DETAIL

APRON JOINTS

APPROVED

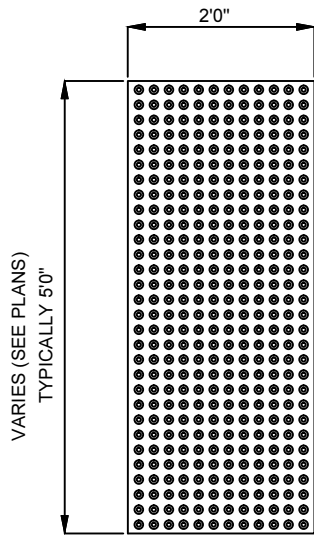
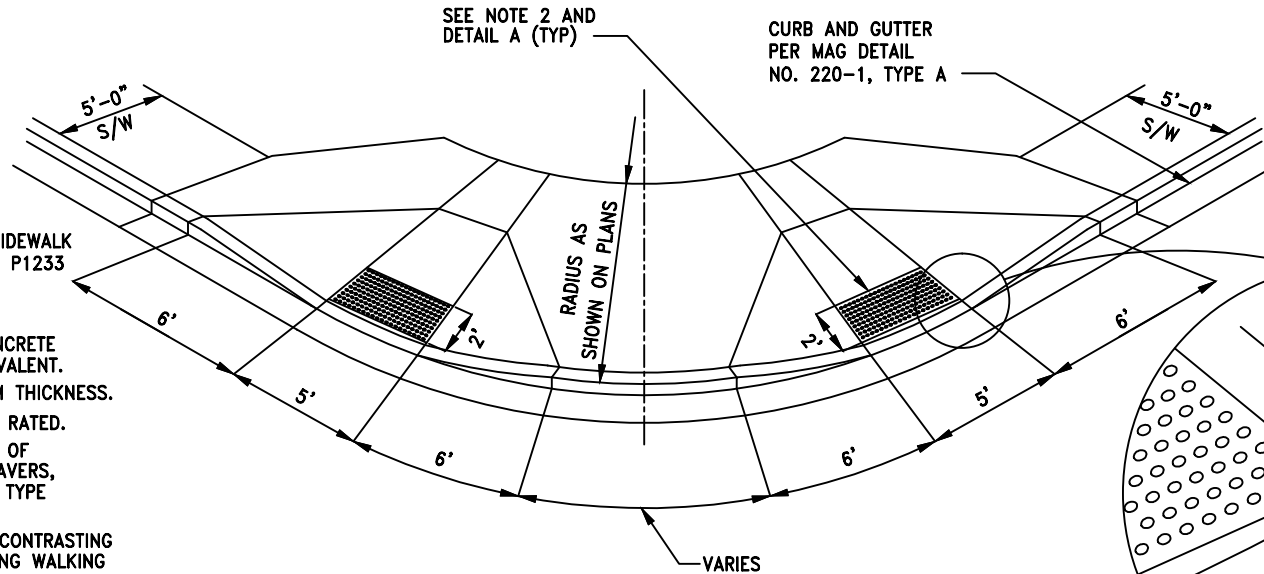
[Signature]
CITY ENGINEER

07/01/2015
DATE

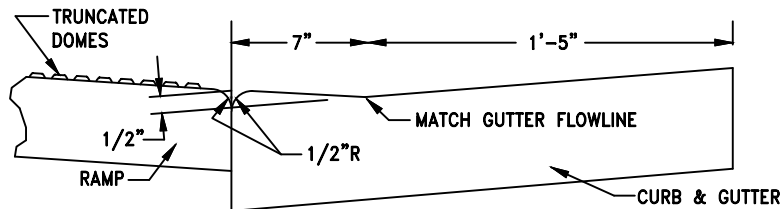
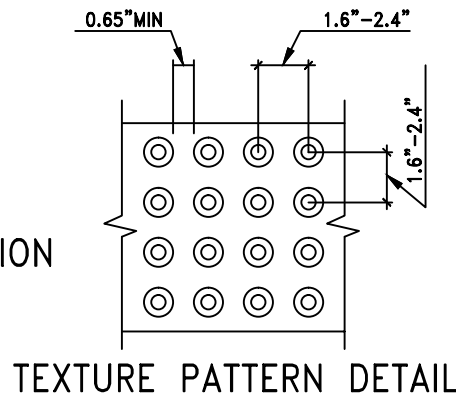
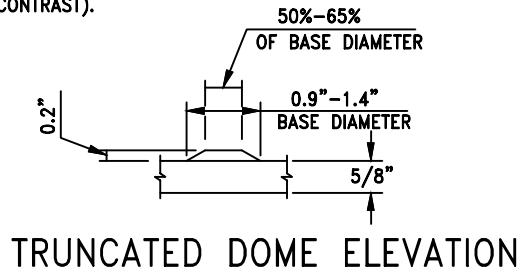
DETAIL NO.
P1231

NOTES:

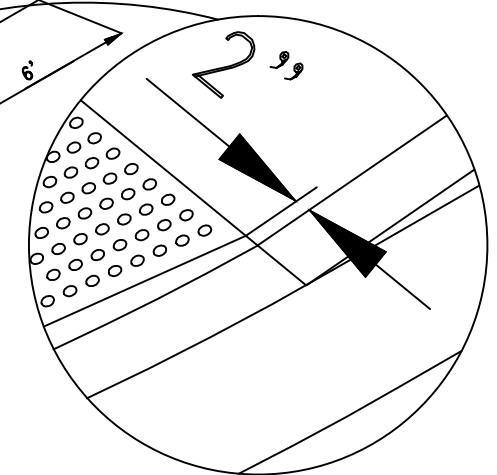
1. CONSTRUCTION DETAILS FOR ALL SIDEWALK RAMP ARE PRESENTED IN DETAILS P1233 THROUGH P1241-3.
2. DETECTABLE WARNING STRIP:
 - 2.1 SHALL BE OF CONCRETE, CONCRETE POLYMER OR APPROVED EQUIVALENT.
 - 2.2 SHALL HAVE A 5/8" MINIMUM THICKNESS.
 - 2.3 SHALL BE 8000 PSI MINIMUM RATED.
 - 2.4 SHALL NOT BE CONSTRUCTED OF ASPHALT PAVEMENT, BRICK PAVERS, STAMPED CONCRETE, OR ANY TYPE OF GLUE-DOWN MATERIAL.
 - 2.5 DOME AREA SHALL BE OF A CONTRASTING COLOR FROM THE SURROUNDING WALKING AREAS. FOR EXAMPLE, DARK ON LIGHT OR LIGHT ON DARK (MINIMUM OF 70% CONTRAST).



DETECTABLE WARNING STRIP



DETAIL A (NTS)



ICC / ANSI A117.1-2003
705.5 TRUNCATED DOMES

DETECTABLE WARNING SURFACES SHALL HAVE TRUNCATED DOMES COMPLYING WITH SECTION 705.5 OF THE ICC/ANSI A117.1-2003, PROVIDED BELOW.

705.5.1 SIZE. TRUNCATED DOMES SHALL HAVE A BASE DIAMETER OF 0.9 INCH (23mm) MINIMUM TO 1.4 INCH (36mm) MAXIMUM, AND A TOP DIAMETER OF 50 PERCENT MINIMUM TO 65 PERCENT MAXIMUM OF THE BASE DIAMETER.

705.5.2 HEIGHT. TRUNCATED DOMES SHALL HAVE A HEIGHT OF 0.2 INCH (5.1mm).

705.5.3 SPACING. TRUNCATED DOMES SHALL HAVE A CENTER-TO-CENTER SPACING OF 1.6 INCHES (41mm) MINIMUM TO 2.4 INCHES (61mm) MAXIMUM, AND A BASE-TO-BASE SPACING OF 0.65 INCH (16.5mm) MINIMUM, MEASURED BETWEEN THE MOST ADJACENT DOMES ON THE GRID.

705.5.4 ALIGNMENT. TRUNCATED DOMES SHALL BE ALIGNED IN A SQUARE GRID PATTERN.

DETAIL NO.
P1232



City of Phoenix
STANDARD DETAIL

TRUNCATED DOMES DETAIL

APPROVED

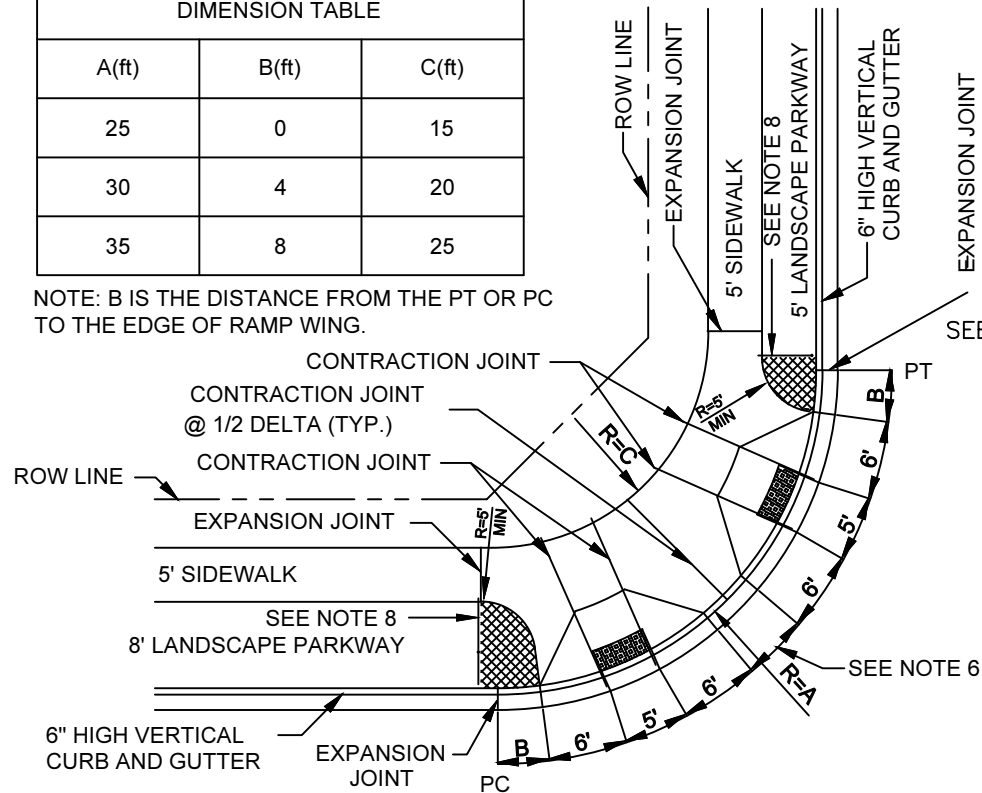
[Signature]
CITY ENGINEER

07/01/2015
DATE

DETAIL NO.
P1232

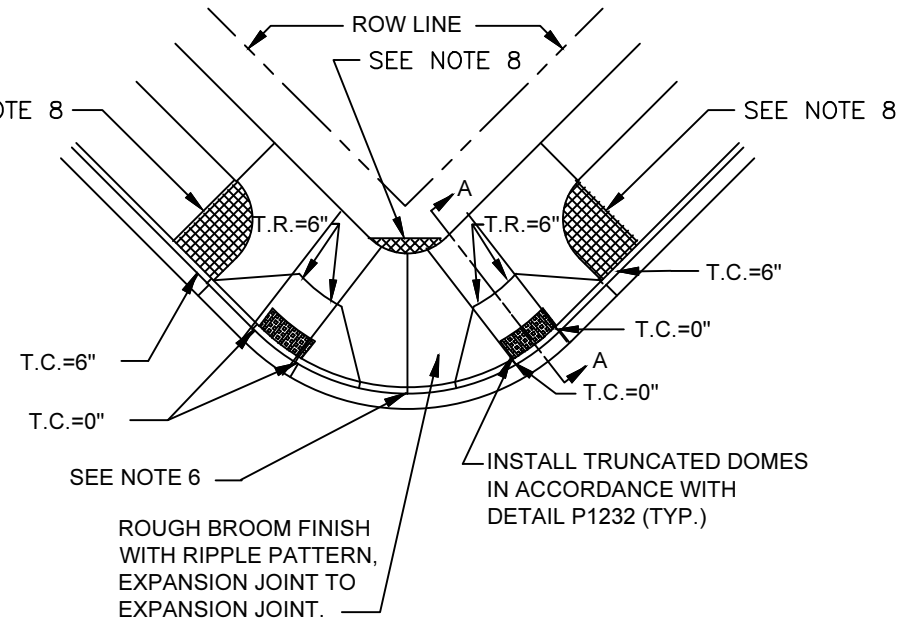
DIMENSION TABLE		
A(ft)	B(ft)	C(ft)
25	0	15
30	4	20
35	8	25

NOTE: B IS THE DISTANCE FROM THE PT OR PC TO THE EDGE OF RAMP WING.

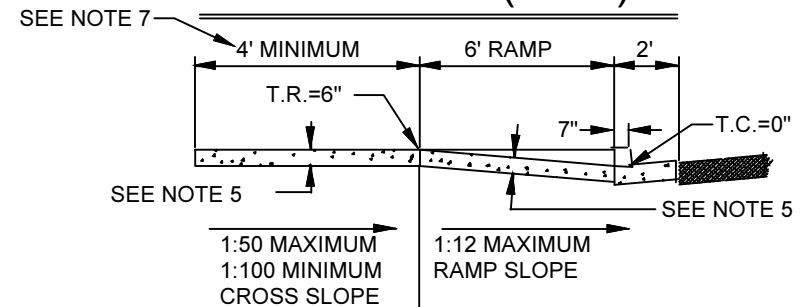


NOTES:

- CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION=0".
- CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
- RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
- EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
- 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
- REDUCE CURB HEIGHT BY 1" MAXIMUM IN ORDER TO ACCOMMODATE A 12" SEPARATION BETWEEN RAMPS.
- MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.
- ADDITIONAL SIDEWALK PER NOTE 2 & 5 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.

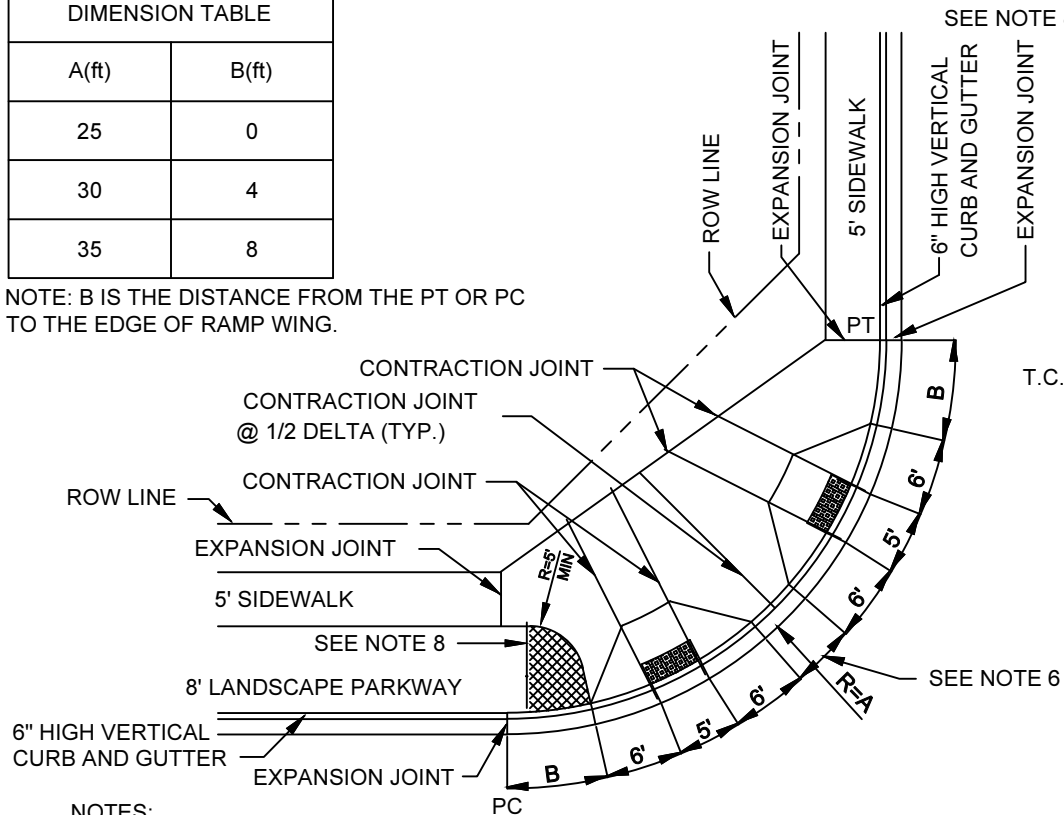


SECTION A-A (TYP.)



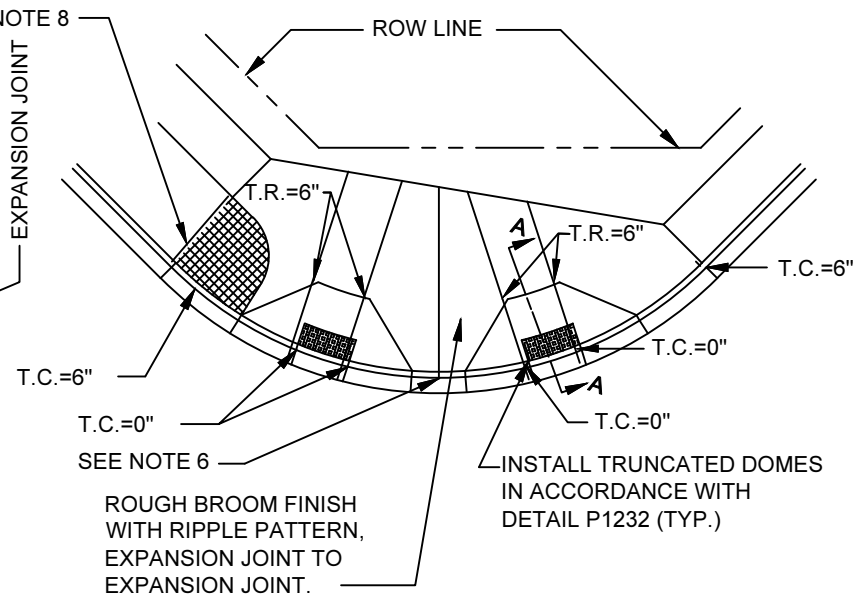
DIMENSION TABLE	
A(ft)	B(ft)
25	0
30	4
35	8

NOTE: B IS THE DISTANCE FROM THE PT OR PC TO THE EDGE OF RAMP WING.

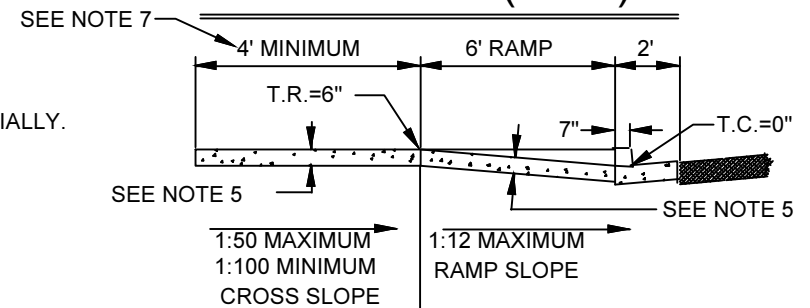


NOTES:

1. CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION=0".
2. CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
3. RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
4. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
5. 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
6. REDUCE CURB HEIGHT BY 1" MAXIMUM IN ORDER TO ACCOMMODATE A 12" SEPARATION BETWEEN RAMPS.
7. MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.
8. ADDITIONAL SIDEWALK PER NOTE 2 & 5 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.



SECTION A-A (TYP.)



DETAIL NO.
P1235



City of Phoenix
STANDARD DETAIL

CURB RAMP DETAIL – 25', 30', & 35' RADII
8' LANDSCAPE PLANTER, ONE SIDE

APPROVED

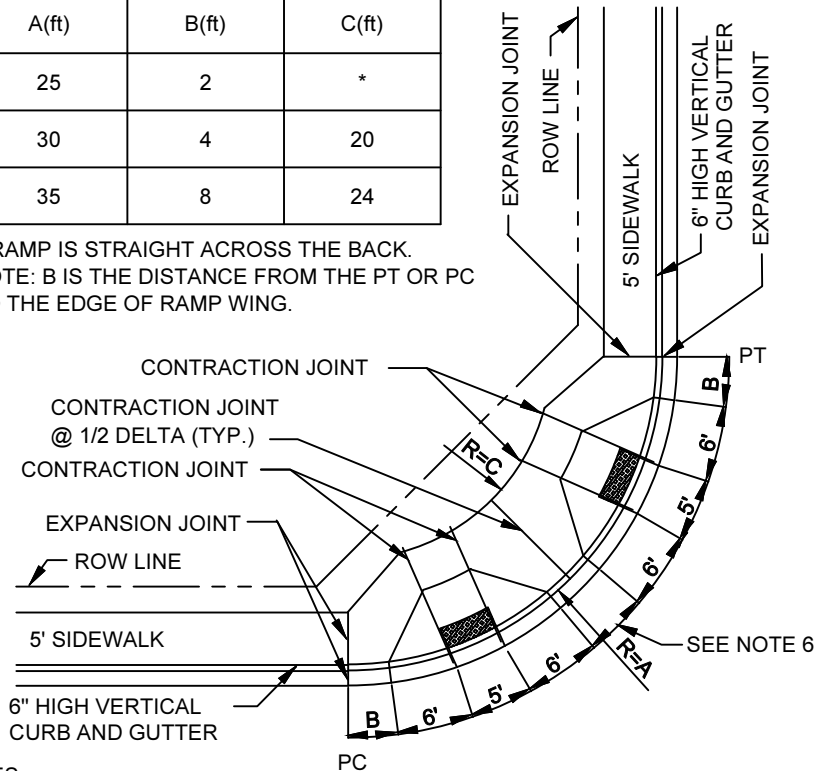
[Signature]
CITY ENGINEER

07/01/2015
DATE

DETAIL NO.
P1235

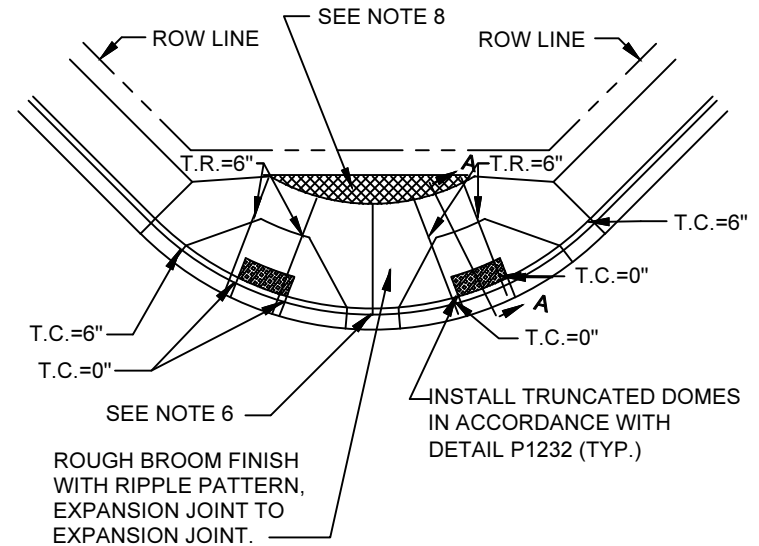
DIMENSION TABLE		
A(ft)	B(ft)	C(ft)
25	2	*
30	4	20
35	8	24

* RAMP IS STRAIGHT ACROSS THE BACK.
NOTE: B IS THE DISTANCE FROM THE PT OR PC TO THE EDGE OF RAMP WING.

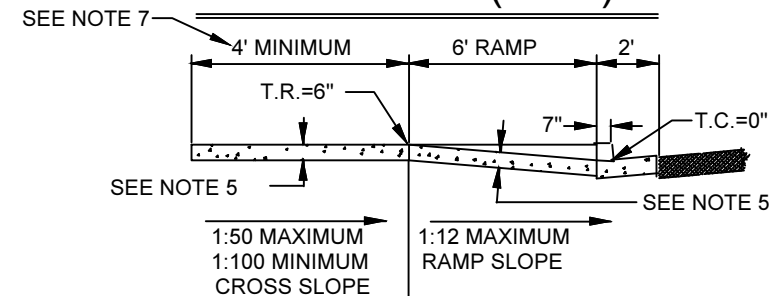


NOTES:

1. CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION=0".
2. CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
3. RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
4. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
5. 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
6. REDUCE CURB HEIGHT BY 1" MAXIMUM IN ORDER TO ACCOMMODATE A 12" SEPARATION BETWEEN RAMPS.
7. MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.
8. ADDITIONAL SIDEWALK PER NOTE 2 & 5 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.



SECTION A-A (TYP.)



DETAIL NO.
P1236



City of Phoenix
STANDARD DETAIL

CURB RAMP DETAIL – 25', 30', & 35' RADII
NO LANDSCAPE PLANTERS

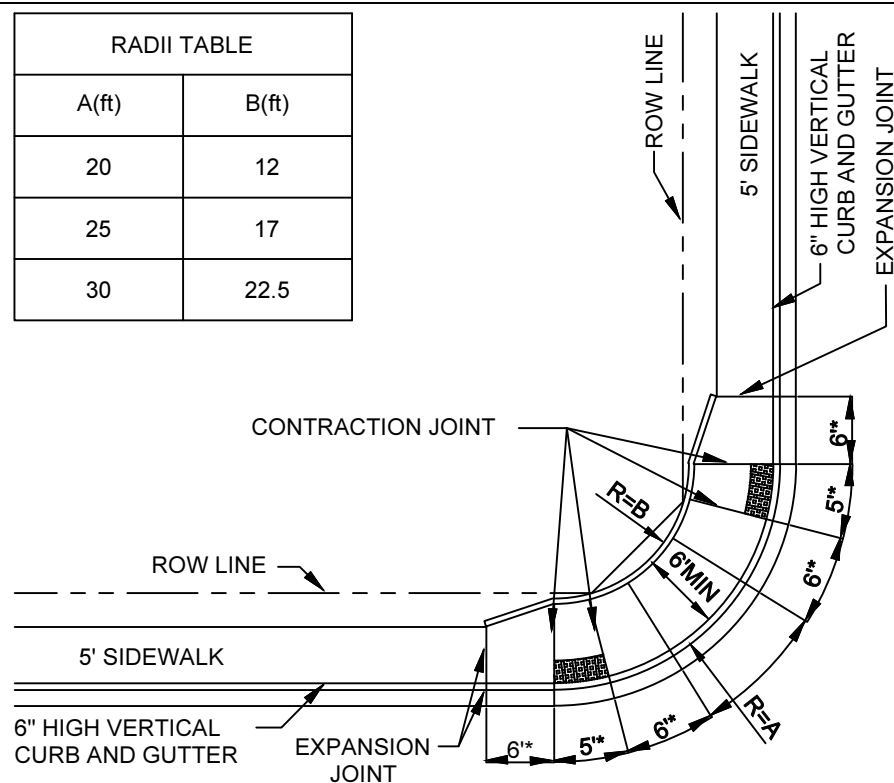
APPROVED

[Signature]
CITY ENGINEER

07/01/2015
DATE

DETAIL NO.
P1236

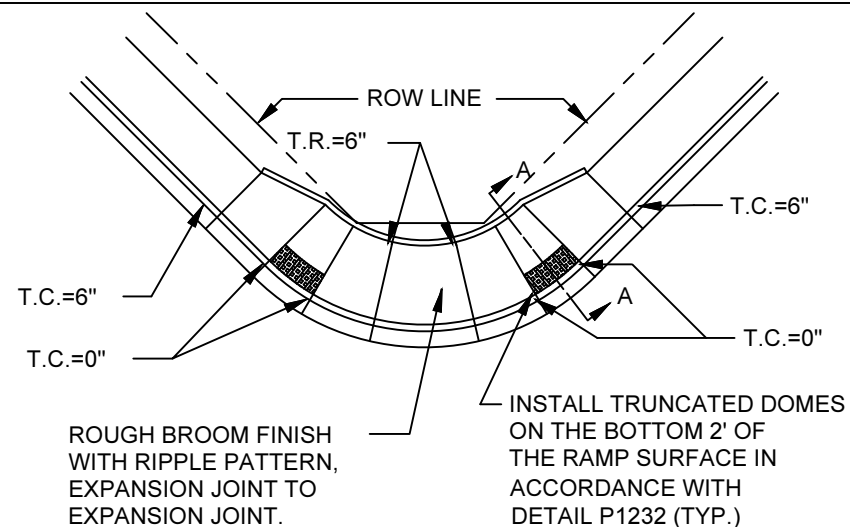
RADII TABLE	
A(ft)	B(ft)
20	12
25	17
30	22.5



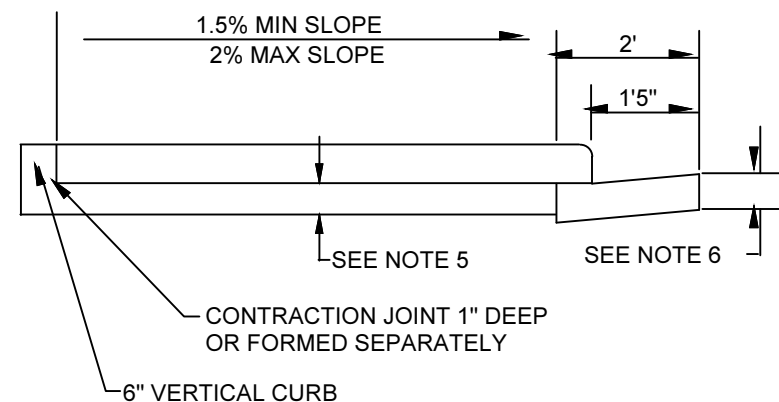
* MINIMUM WIDTH

NOTES:

1. CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADially. GUTTER ELEVATION=0".
2. CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
3. RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
4. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
5. 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
6. 9" CURB ON MAJOR AND COLLECTOR STREETS AND 6" CURB ON LOCAL STREETS.



SECTION A-A (TYP.)



DETAIL NO.
P1237



City of Phoenix
STANDARD DETAIL

CURB RAMP DETAIL – ALL RADIUS CURB RETURNS,
LIMITED RIGHT OF WAY

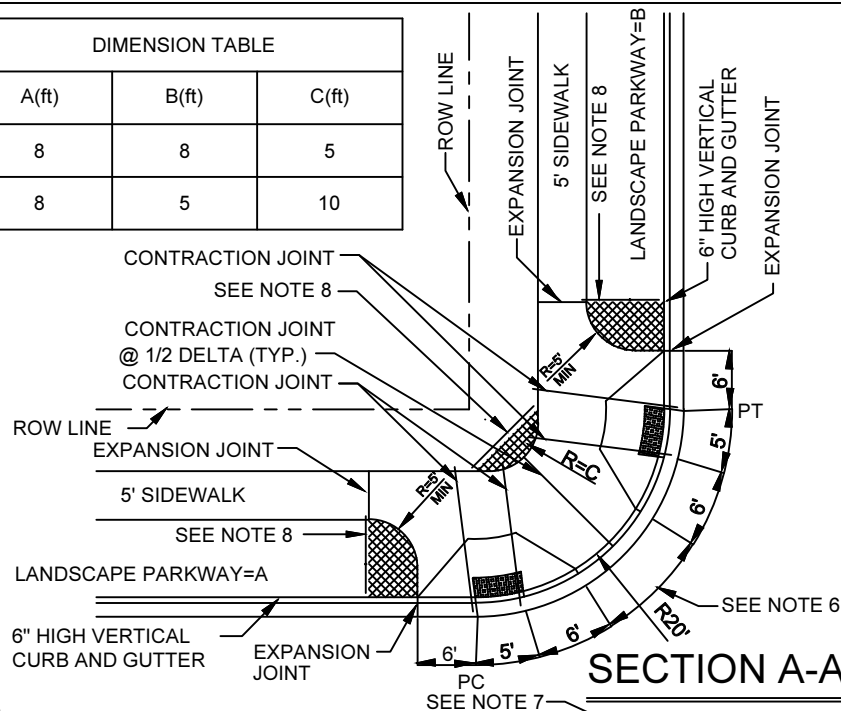
APPROVED

[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

DETAIL NO.
P1237

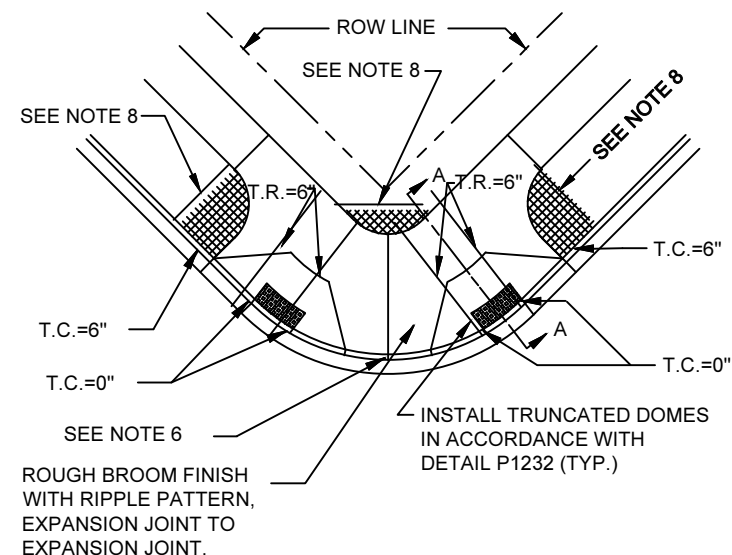
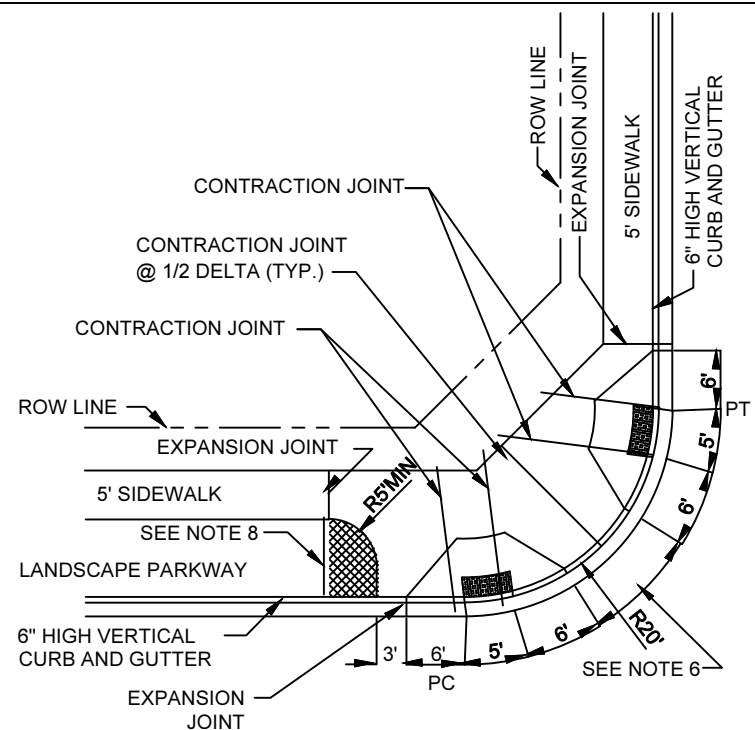
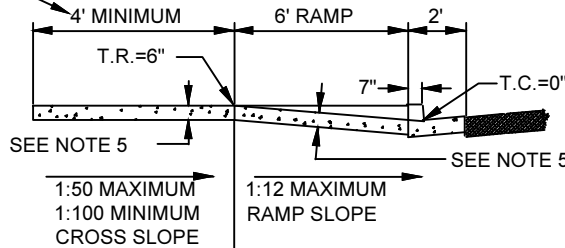
DIMENSION TABLE		
A(ft)	B(ft)	C(ft)
8	8	5
8	5	10

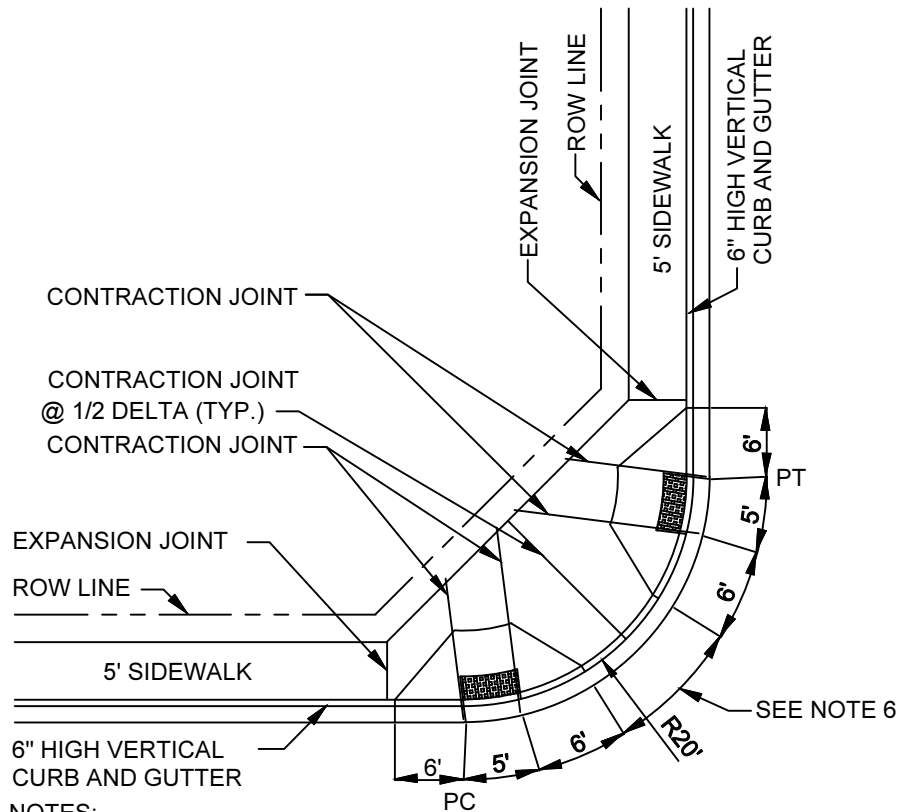


SECTION A-A (TYP.)

NOTES:

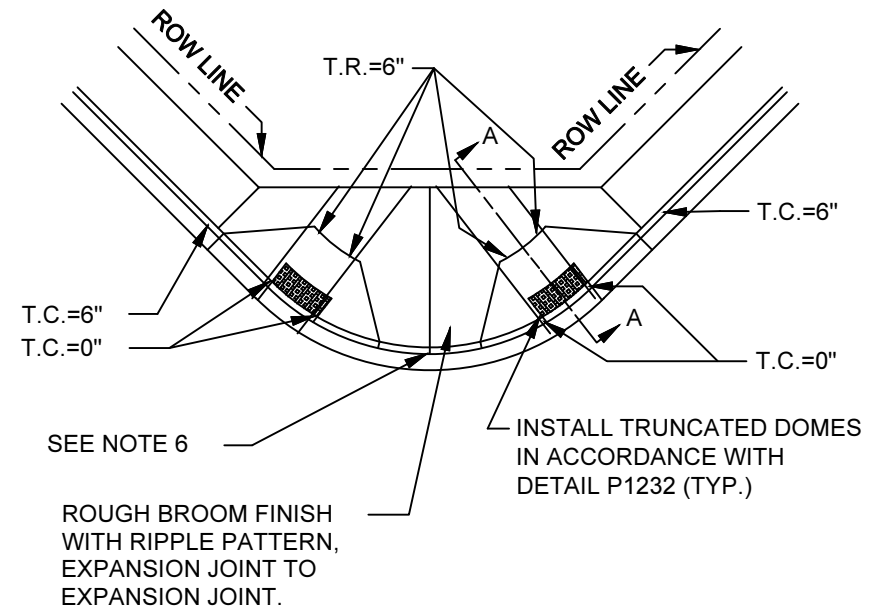
1. CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALY. GUTTER ELEVATION=0".
2. CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
3. RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
4. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
5. 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
6. REDUCE CURB HEIGHT BY 1" MAXIMUM IN ORDER TO ACCOMMODATE A 12" SEPARATION BETWEEN RAMPS.
7. MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.
8. ADDITIONAL SIDEWALK PER NOTE 2 & 5 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.



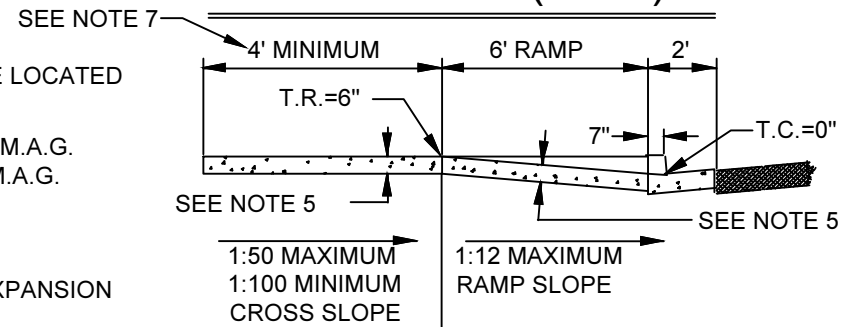


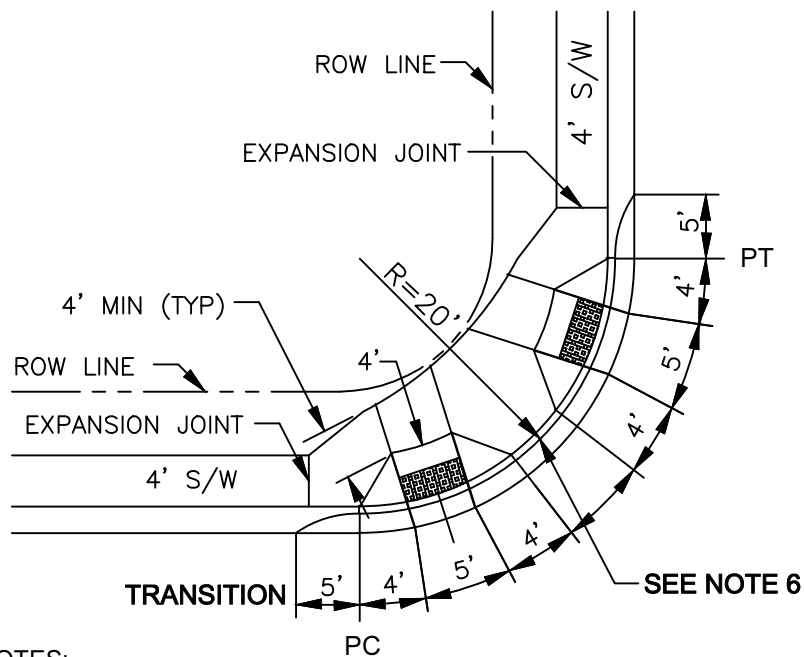
NOTES:

1. CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALY. GUTTER ELEVATION=0".
2. CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
3. RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
4. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
5. 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
6. REDUCE CURB HEIGHT BY 1" MAXIMUM IN ORDER TO ACCOMMODATE A 12" SEPARATION BETWEEN RAMPS.
7. MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING



SECTION A-A (TYP.)

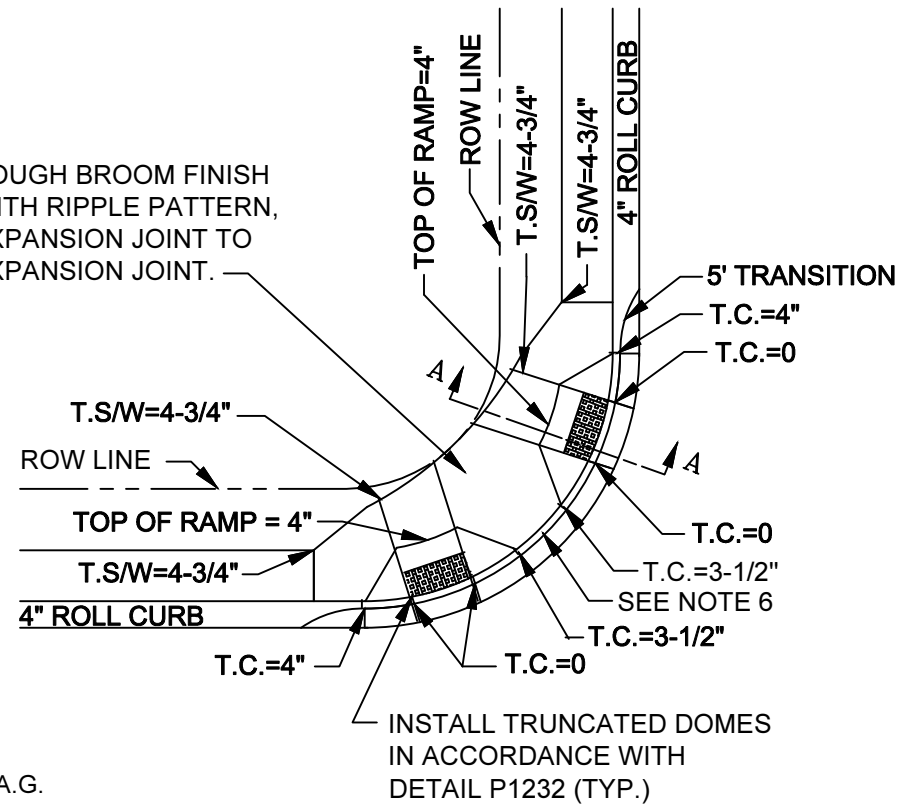




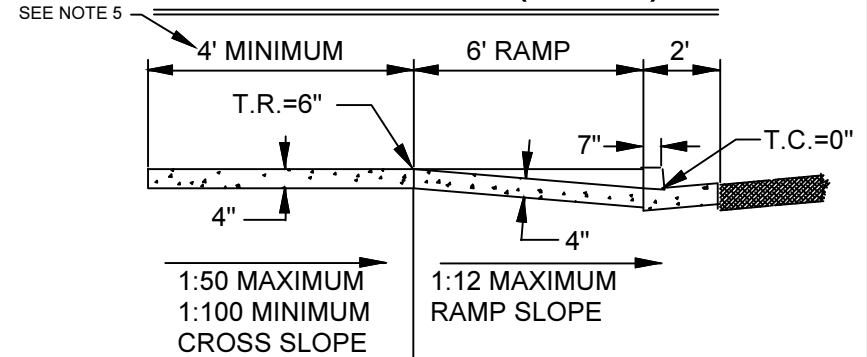
NOTES:

1. CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION=0".
2. CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
3. RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
4. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
5. 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
6. REDUCE CURB HEIGHT BY 1" MAXIMUM IN ORDER TO ACCOMMODATE A 12" SEPARATION BETWEEN RAMPS.
7. MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.

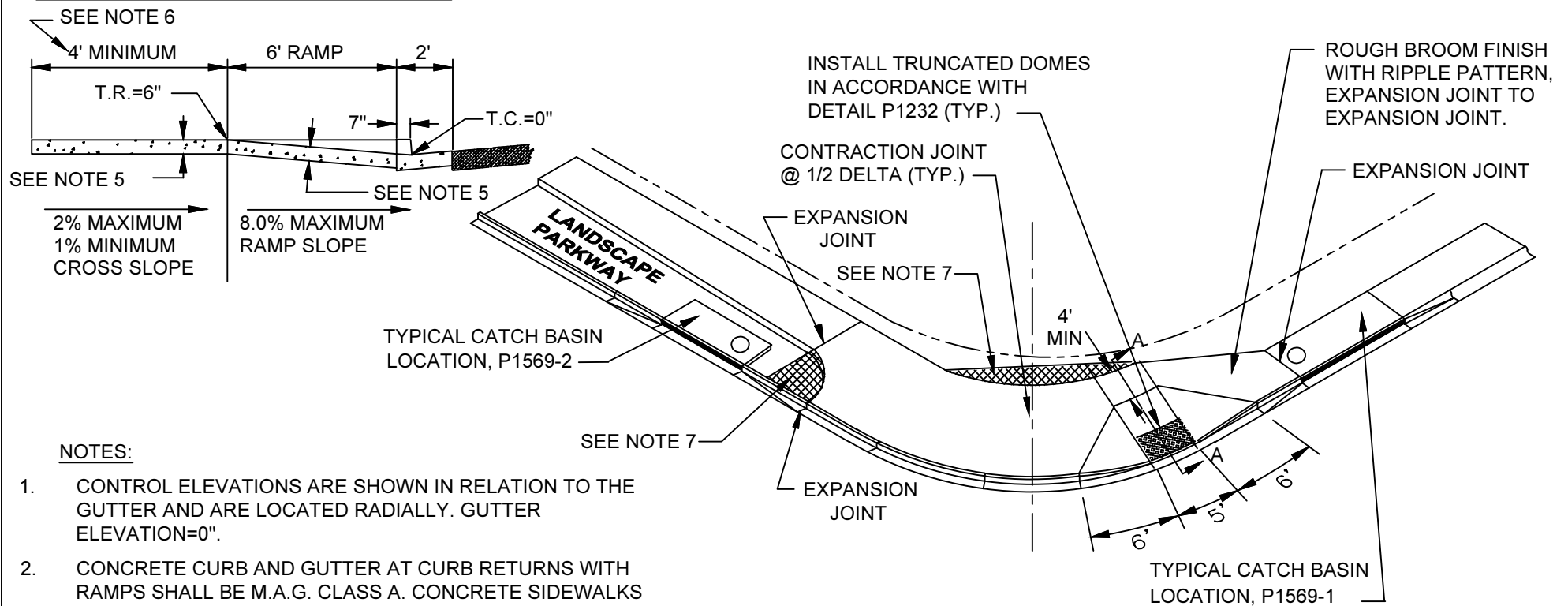
ROUGH BROOM FINISH
WITH RIPPLE PATTERN,
EXPANSION JOINT TO
EXPANSION JOINT.



SECTION A-A (TYP.)



SECTION A-A (TYP.)



NOTES:

1. CONTROL ELEVATIONS ARE SHOWN IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEVATION=0".
2. CONCRETE CURB AND GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A. CONCRETE SIDEWALKS AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
3. RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONTRACTION JOINT.
4. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751
5. 9" THICK LANDING, RAMPS, AND CURBS FROM EXPANSION JOINT TO EXPANSION JOINT ON MAJOR OR COLLECTOR STREETS. 4" THICK LANDING AND RAMPS ON LOCAL STREETS.
6. MAINTAIN THE PLANE OF THE LANDING ONE FOOT (1ft.) BEYOND THE TOP OF LANDING.
7. ADDITIONAL SIDEWALK PER NOTE 2 & 5 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.

DETAIL NO.
P1240



City of Phoenix
STANDARD DETAIL

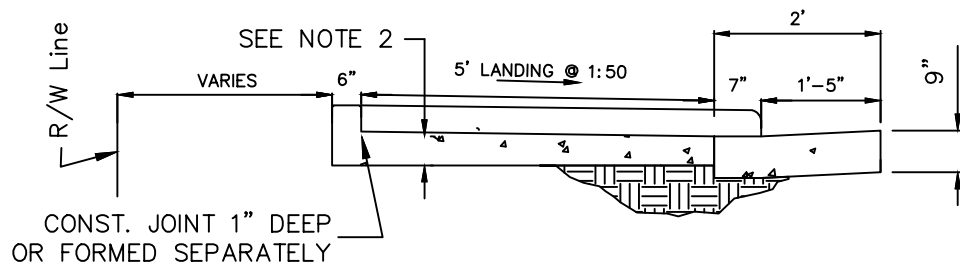
SINGLE CURB RAMP DETAIL
ALL RADIUS CURB RETURNS

APPROVED

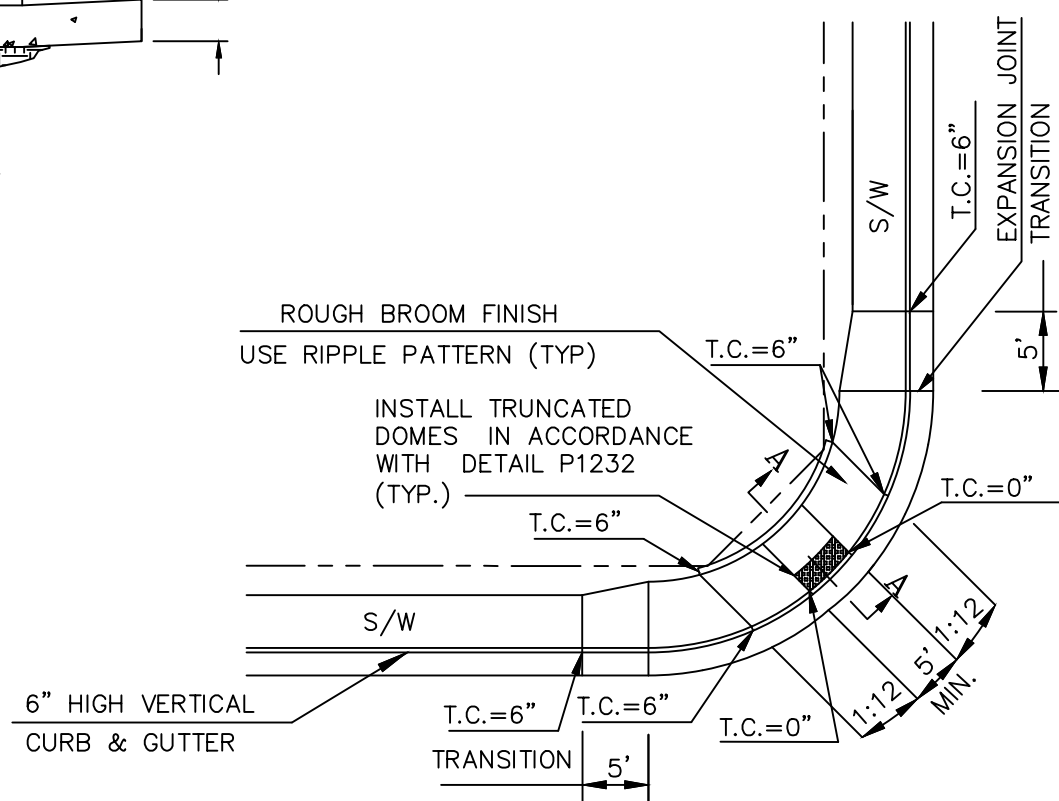
[Signature]
CITY ENGINEER

07/01/2015
DATE

DETAIL NO.
P1240

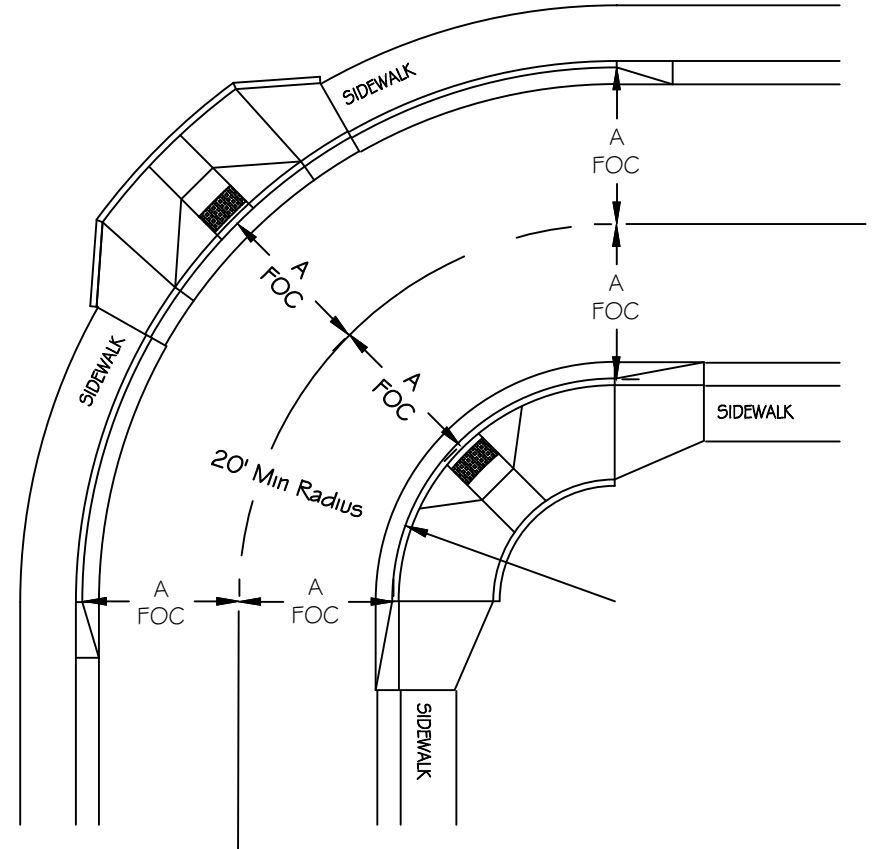
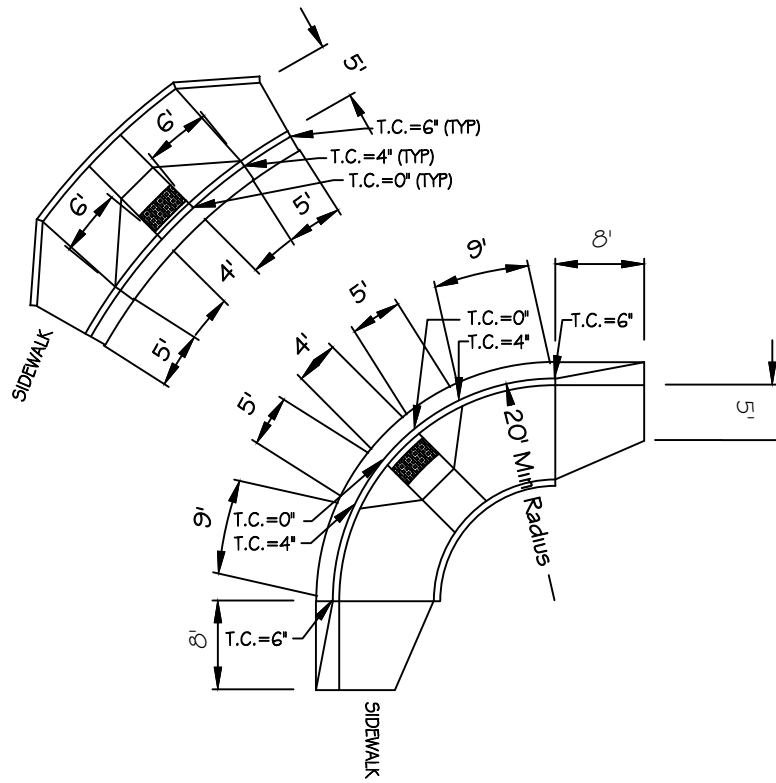


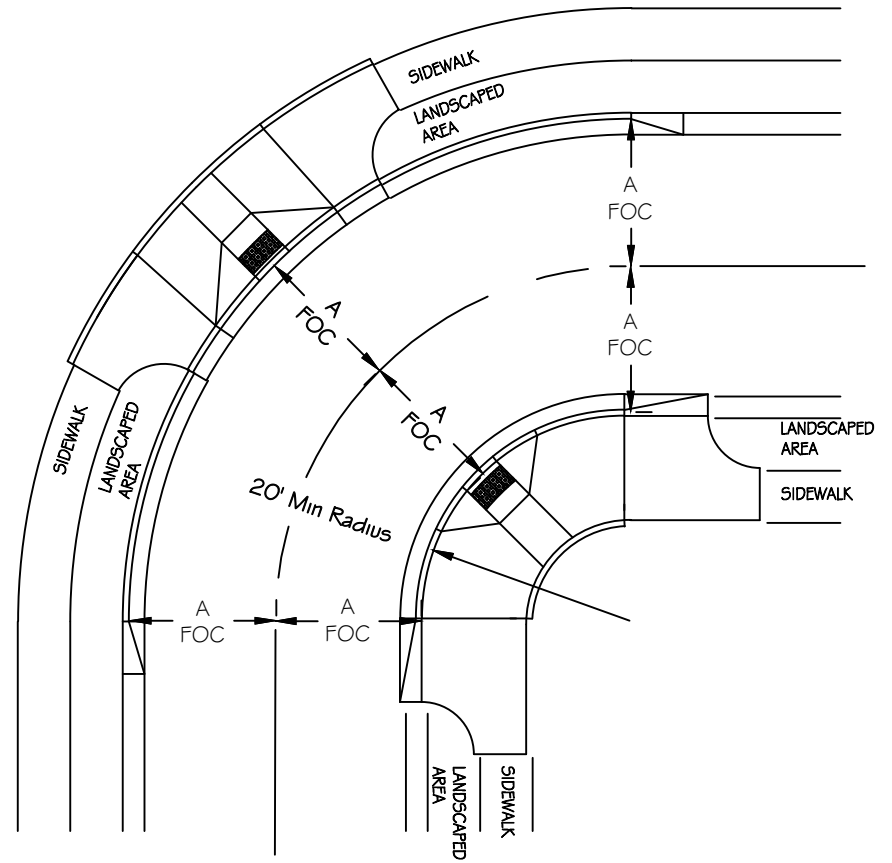
SECTION A-A

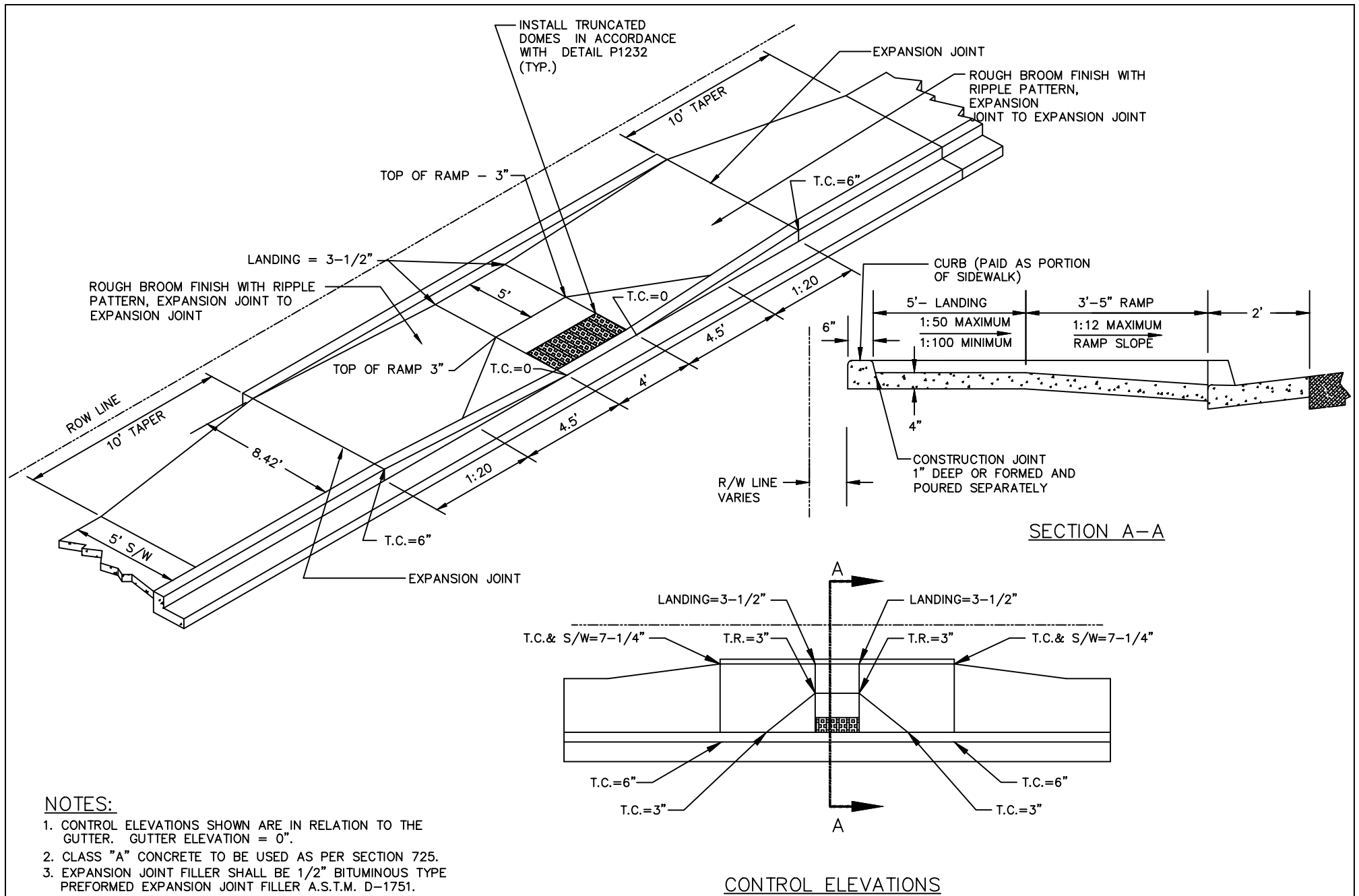


NOTES:

- 1) CONCRETE CURB & GUTTER AT CURB RETURNS WITH RAMPS SHALL BE M.A.G. CLASS A.
CONCRETE SIDEWALK AND RAMPS AT CURB RETURNS SHALL BE M.A.G. CLASS A.
- 2) 9" LANDING AND RAMPS ON MAJOR OR COLLECTOR STREETS
AND 4" LANDING AND RAMPS ON LOCAL STREETS.







DETAIL NO.
P1241-1



City of Phoenix
STANDARD DETAIL

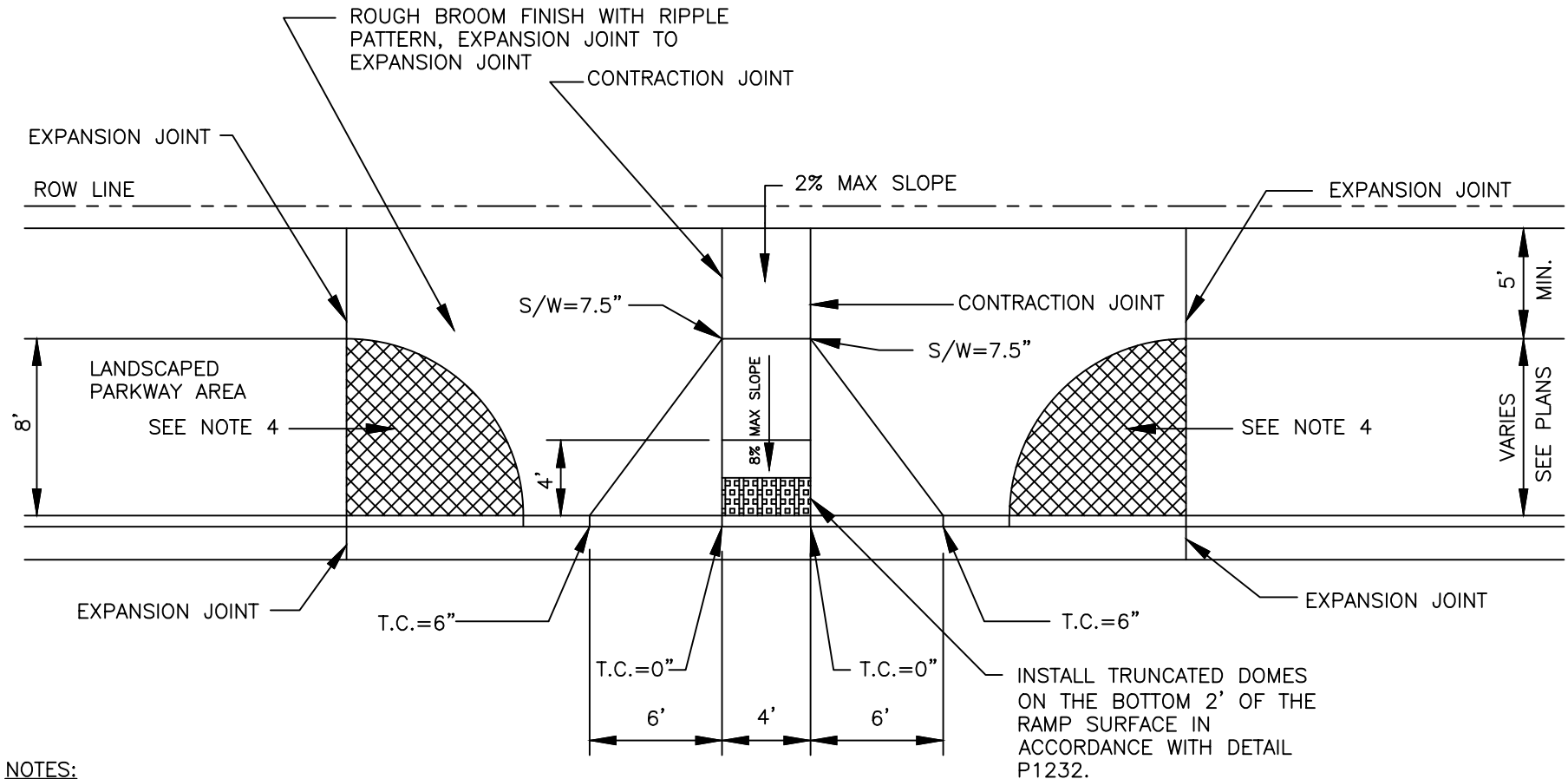
CURB RAMP DETAIL (MID BLOCK)

APPROVED

[Signature]
CITY ENGINEER

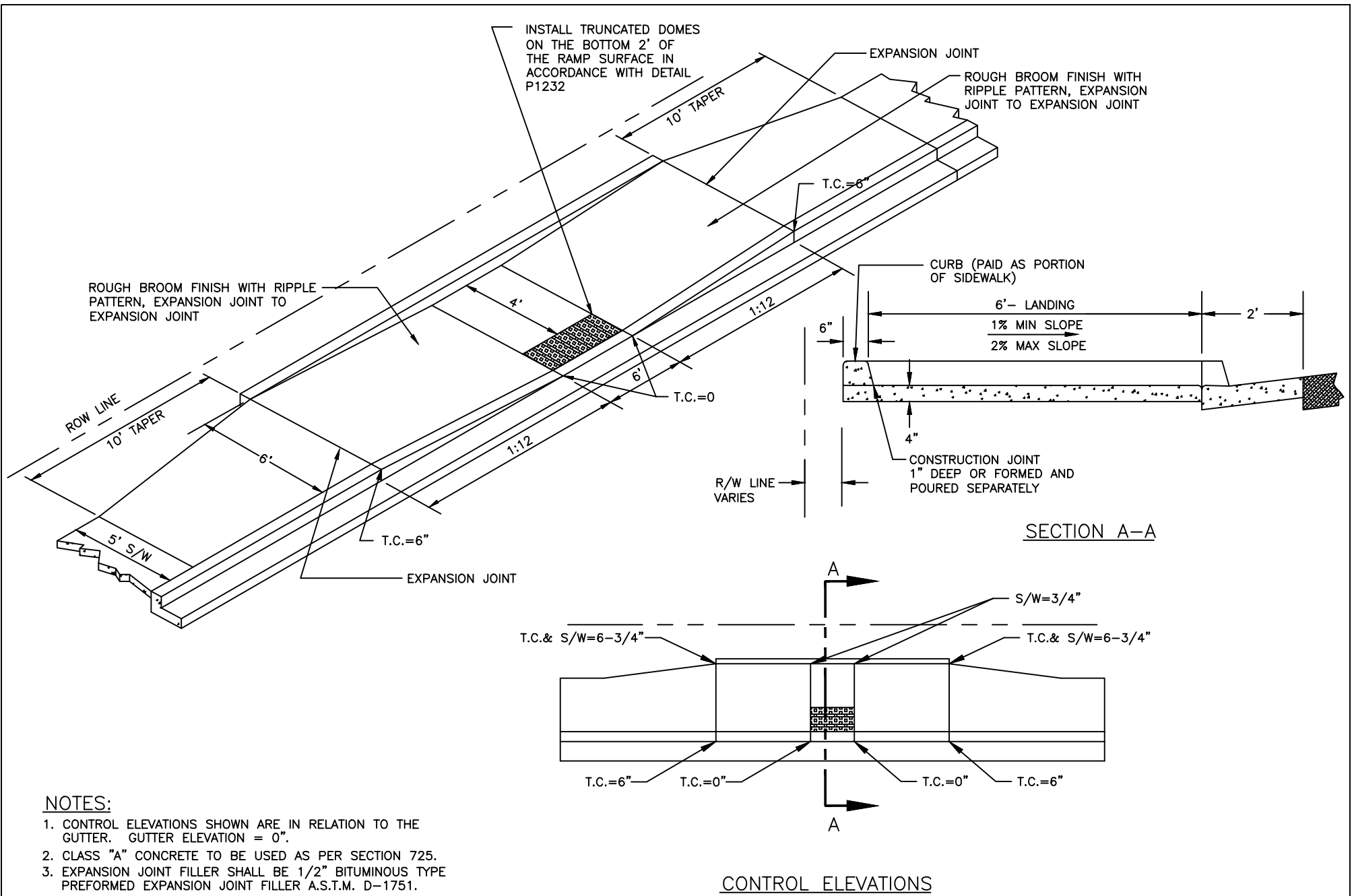
12/10/2012
DATE

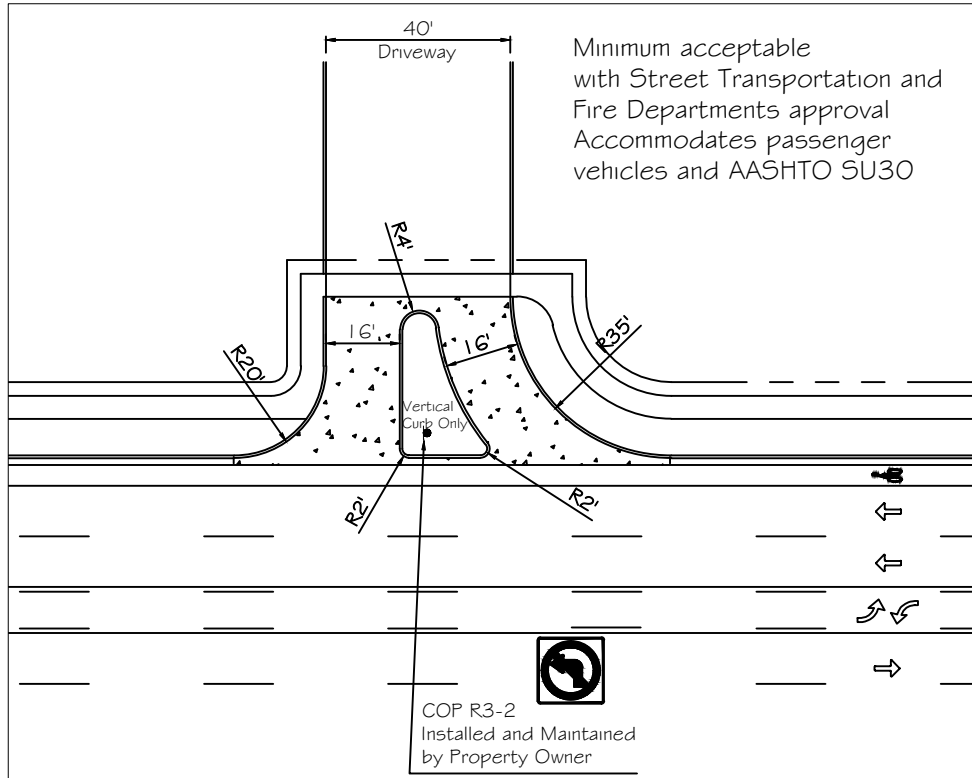
DETAIL NO.
P1241-1



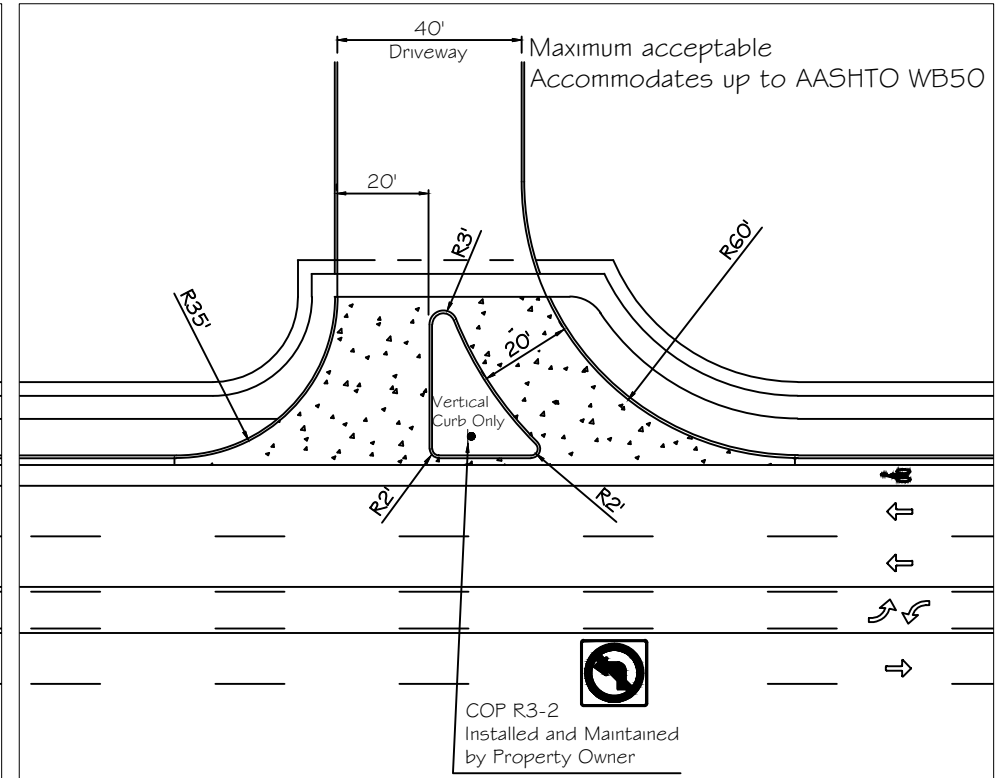
NOTES:

1. CONTROL ELEVATIONS SHOWN ARE IN RELATION TO THE GUTTER. GUTTER ELEVATION = 0".
2. CLASS "A" CONCRETE TO BE USED AS PER SECTION 725.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751.
4. ADDITIONAL SIDEWALK PER NOTE 2 WHEN SIGNAL POLES ARE LOCATED IN THESE AREAS.

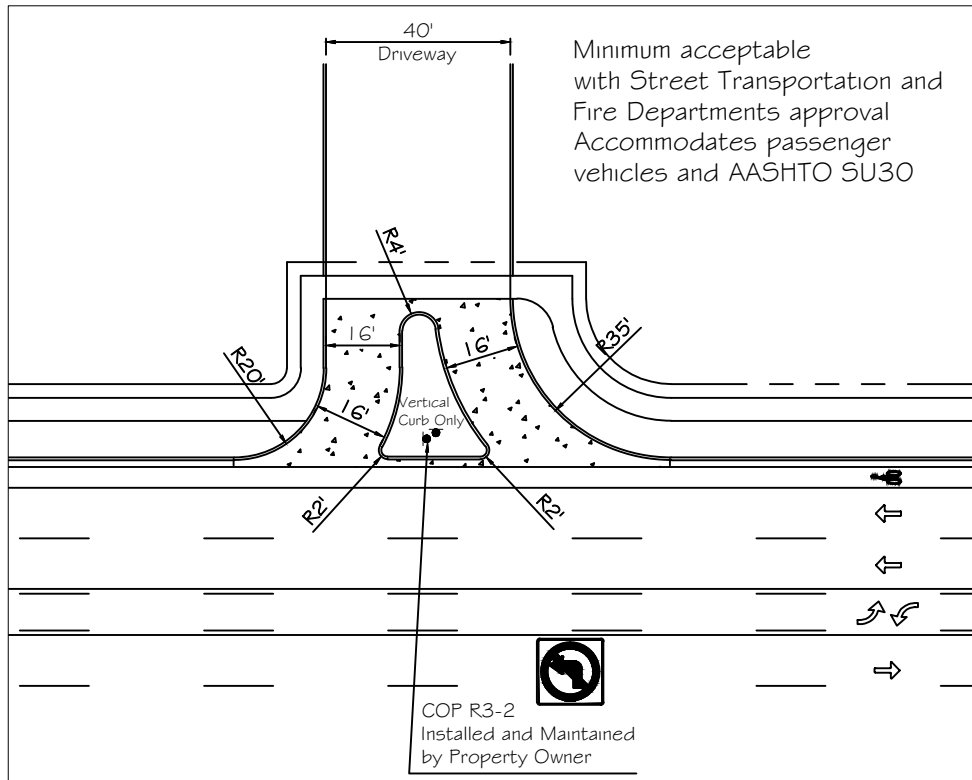




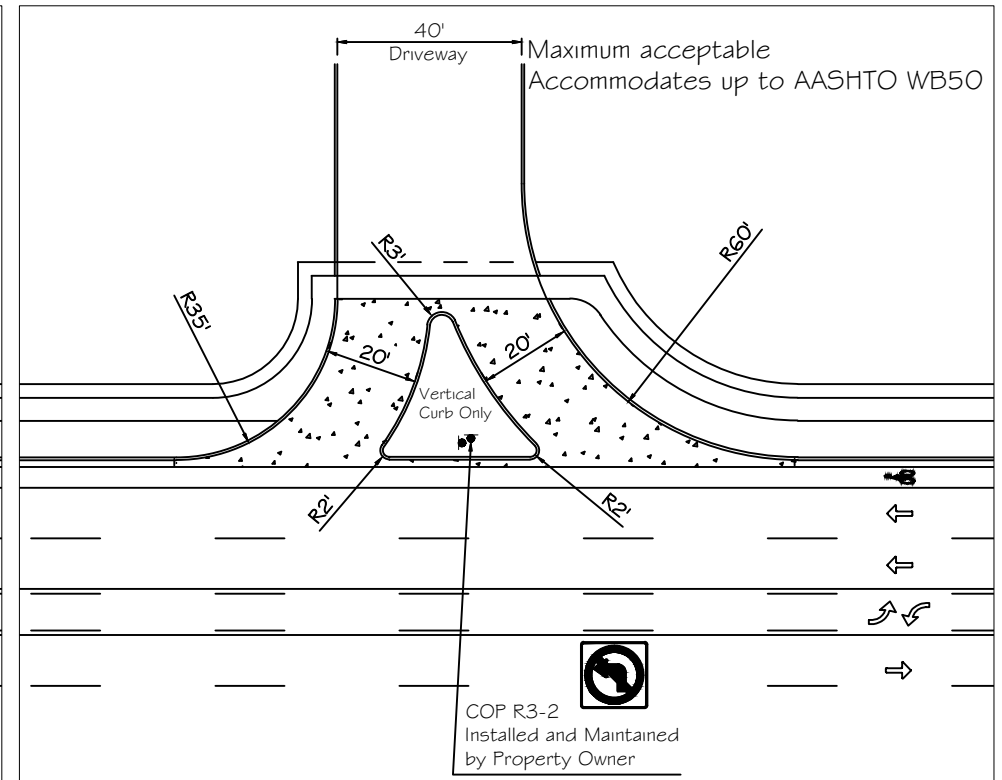
WITHOUT DECELERATION LANE
PREVENTS LEFT TURN IN
35' RETURN



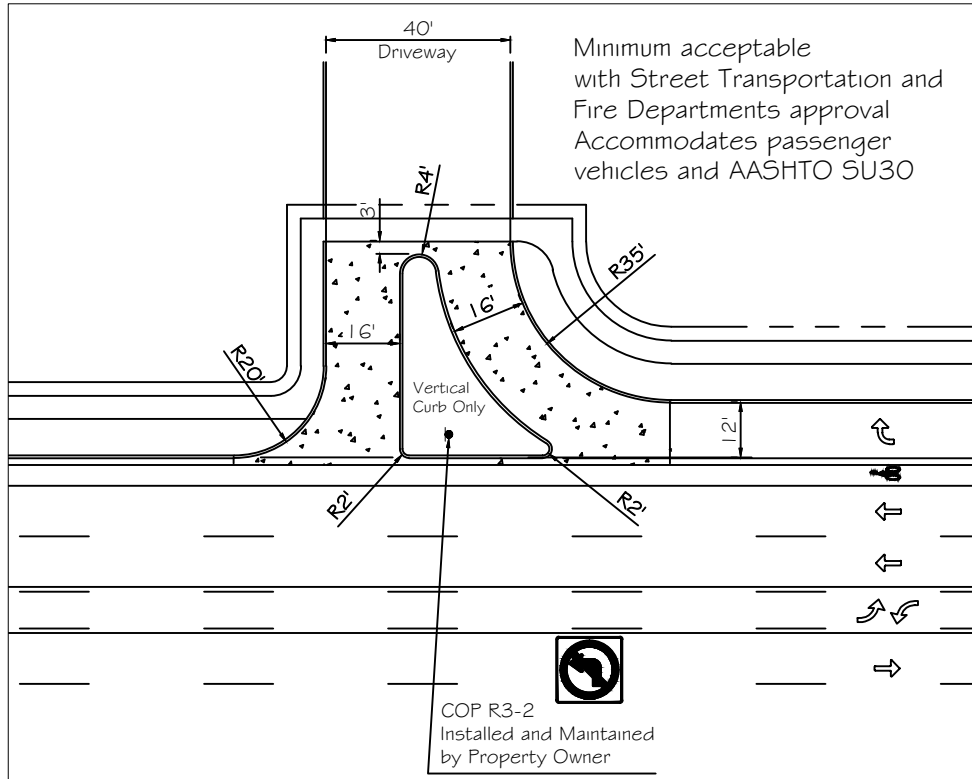
WITHOUT DECELERATION LANE
PREVENTS LEFT TURN IN
60' RETURN



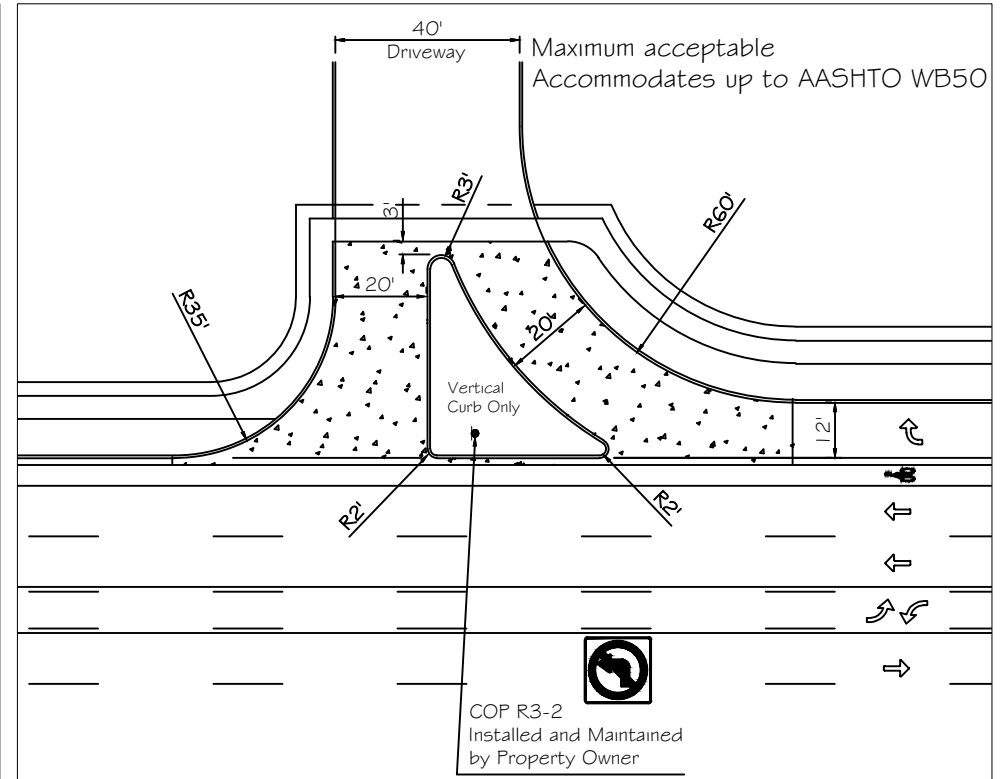
WITHOUT DECELERATION LANE
PREVENTS LEFT TURN IN/OUT
35' RETURN



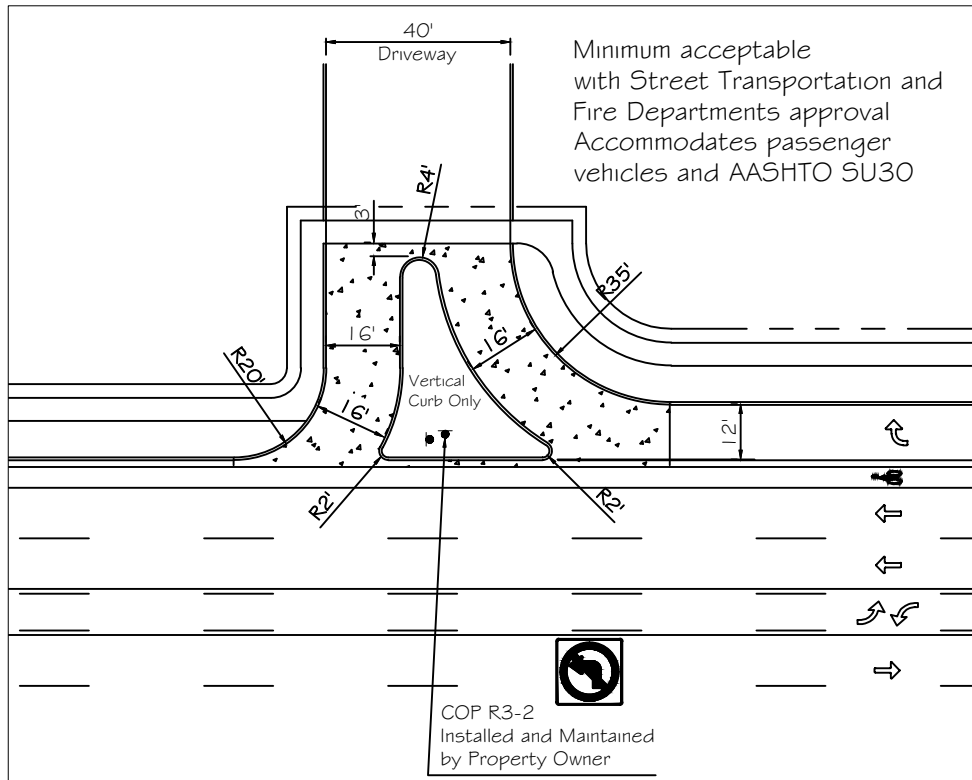
WITHOUT DECELERATION LANE
PREVENTS LEFT TURN IN/OUT
60' RETURN



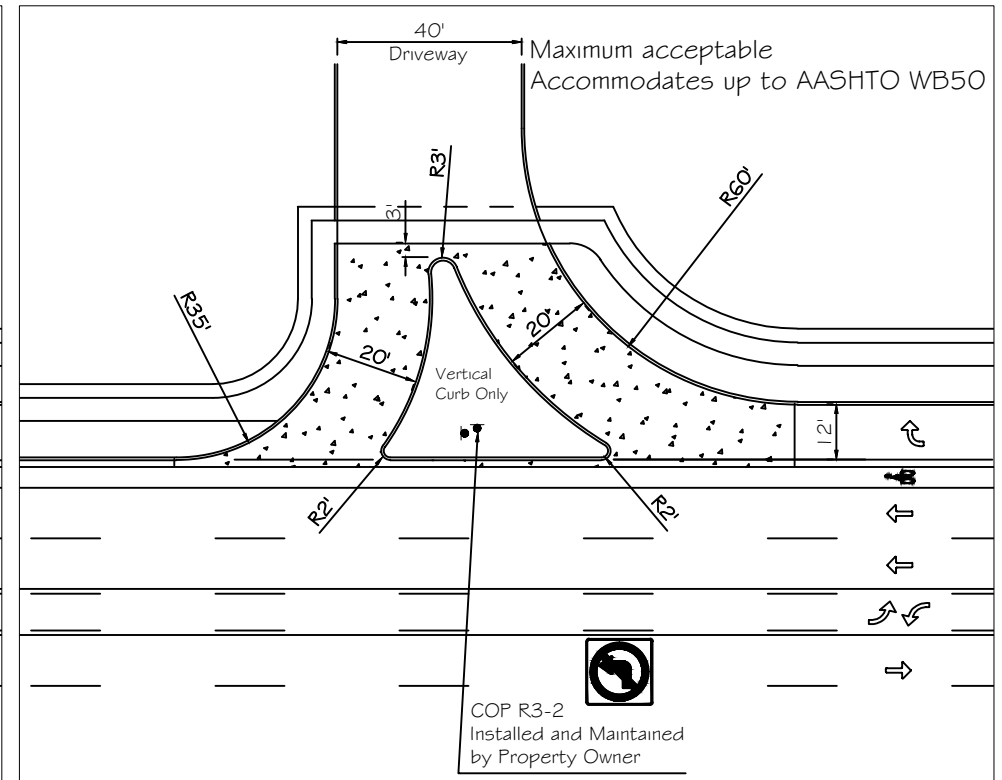
WITH DECELERATION LANE
PREVENTS LEFT TURN IN
35' RETURN



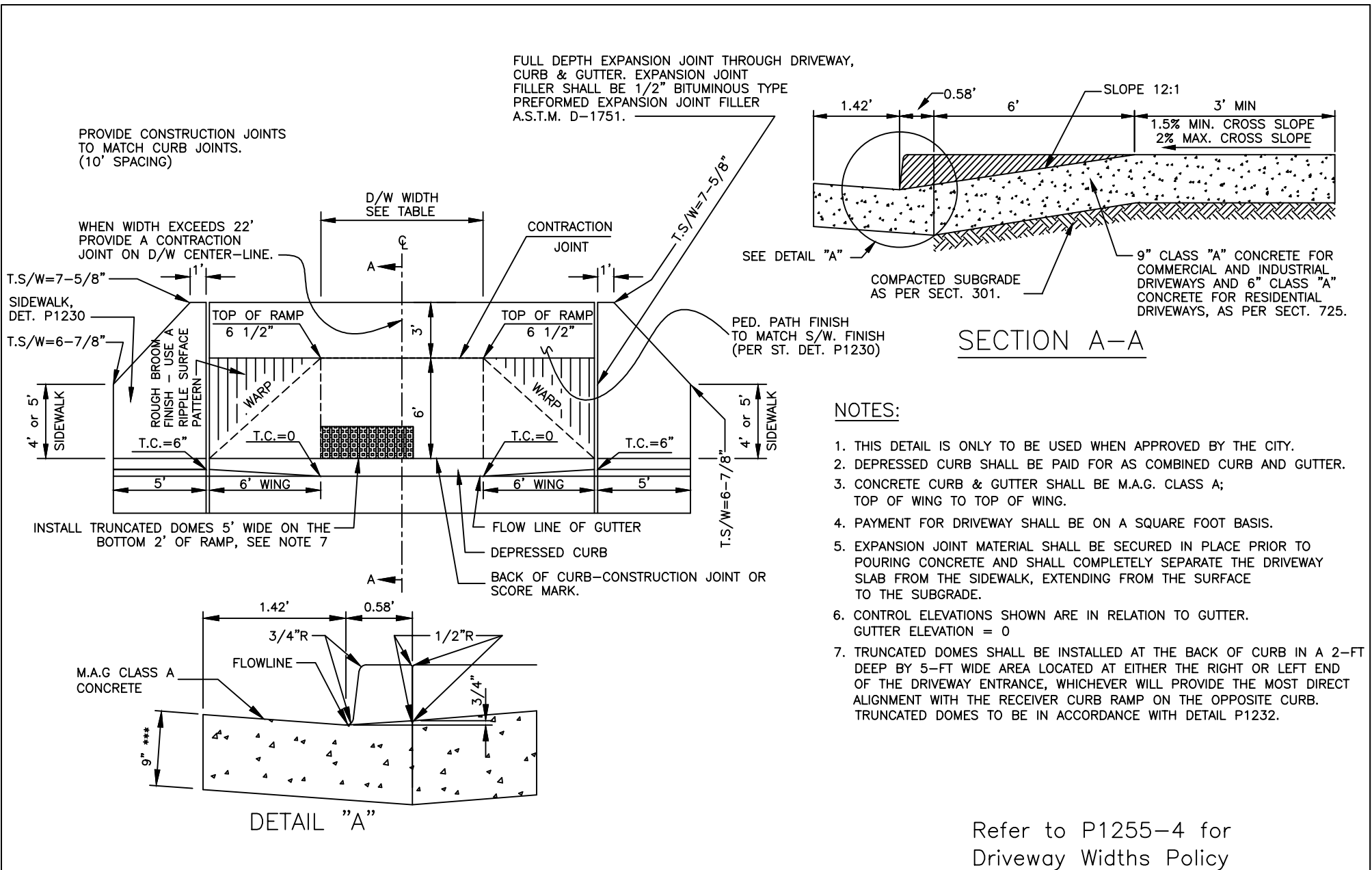
WITH DECELERATION LANE
PREVENTS LEFT TURN IN
60' RETURN



WITH DECELERATION LANE
PREVENTS LEFT TURN IN/OUT
35' RETURN



WITH DECELERATION LANE
PREVENTS LEFT TURN IN/OUT
60' RETURN



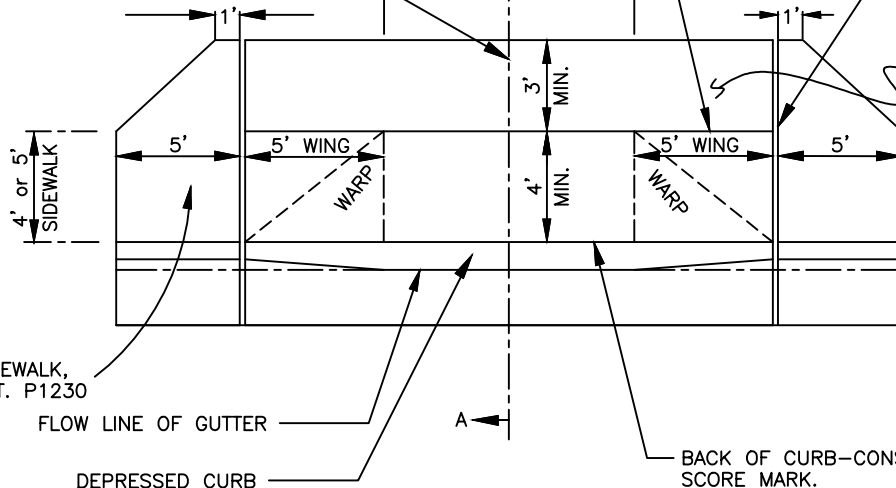
PROVIDE CONSTRUCTION JOINTS
TO MATCH CURB JOINTS.
(10' SPACING)

FULL DEPTH EXPANSION JOINT THROUGH DRIVEWAY,
CURB & GUTTER. EXPANSION JOINT
FILLER SHALL BE 1/2" BITUMINOUS TYPE
PREFORMED EXPANSION JOINT FILLER
A.S.T.M. D-1751.

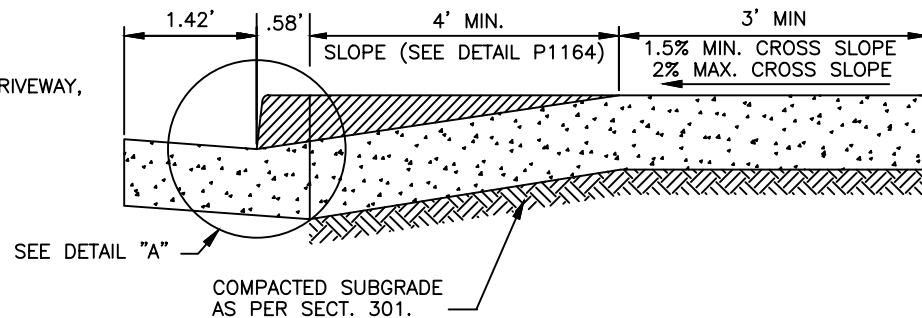
WHEN WIDTH EXCEEDS 22'
PROVIDE A CONTRACTION
JOINT ON D/W CENTER-LINE.

D/W WIDTH
SEE TABLE

CONTRACTION JOINT



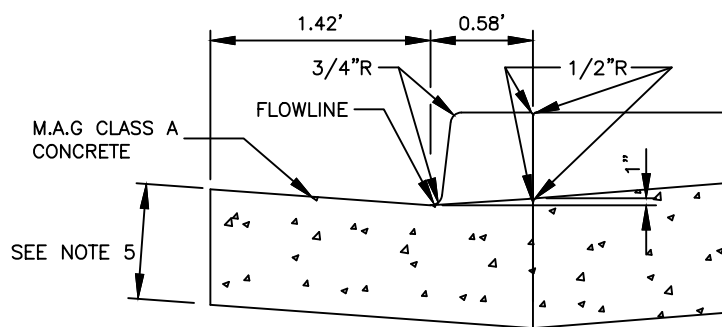
PED. PATH
TO MATCH S/W. FINISH
PER ST. DET. P1230



SECTION A-A

NOTES

1. DEPRESSED CURB SHALL BE PAID FOR AS COMBINED CURB AND GUTTER.
2. CONCRETE CURB & GUTTER SHALL BE M.A.G. CLASS A;
TOP OF WING TO TOP OF WING.
2. PAYMENT FOR DRIVEWAY SHALL BE ON A SQUARE FOOT BASIS.
3. EXPANSION JOINT MATERIAL SHALL BE SECURED IN PLACE PRIOR TO
POURING CONCRETE AND SHALL COMPLETELY SEPARATE THE DRIVEWAY
SLAB FROM THE SIDEWALK, EXTENDING FROM THE SURFACE
TO THE SUBGRADE.
4. WHEN DRIVEWAY IS CONSTRUCTED AT A "T" INTERSECTION AND IS USED AS
A RAMP, USE DETAIL P1244.
5. 9" CLASS "A" CONCRETE FOR COMMERCIAL AND INDUSTRIAL DRIVEWAYS AND
6" CLASS "A" CONCRETE FOR RESIDENTIAL DRIVEWAYS, AS PER SECT. 725.



DETAIL "A"

Refer to P1255-4 for
Driveway Widths Policy

DETAIL NO.
P1255-1



City of Phoenix
STANDARD DETAIL

DRIVEWAY ENTRANCE - TYPE I
(SIDEWALK ADJACENT TO CURB)

APPROVED

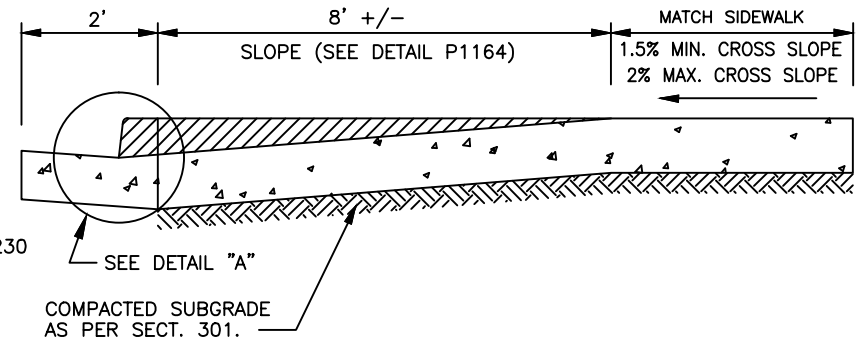
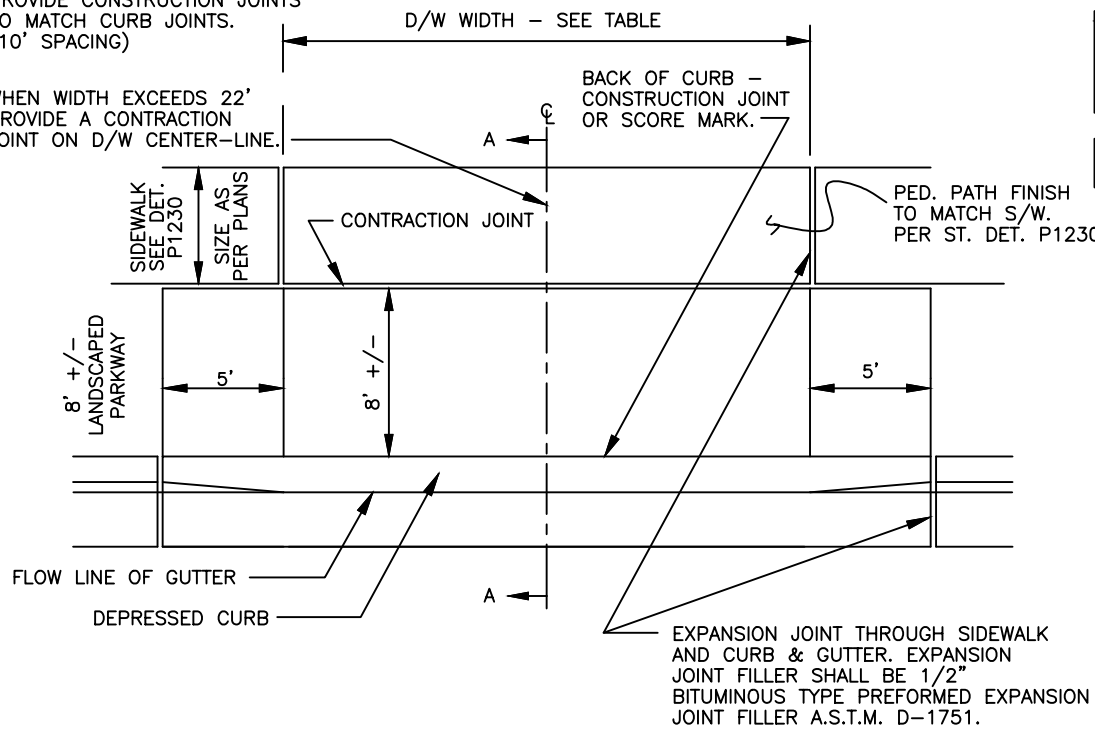
[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

DETAIL NO.
P1255-1

PROVIDE CONSTRUCTION JOINTS
TO MATCH CURB JOINTS.
(10' SPACING)

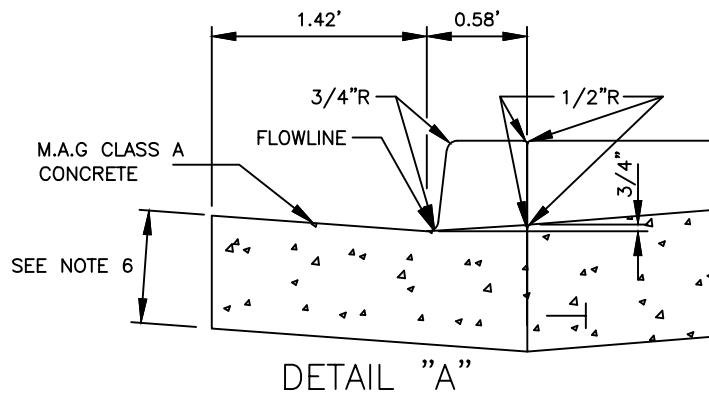
WHEN WIDTH EXCEEDS 22'
PROVIDE A CONTRACTION
JOINT ON D/W CENTER-LINE.



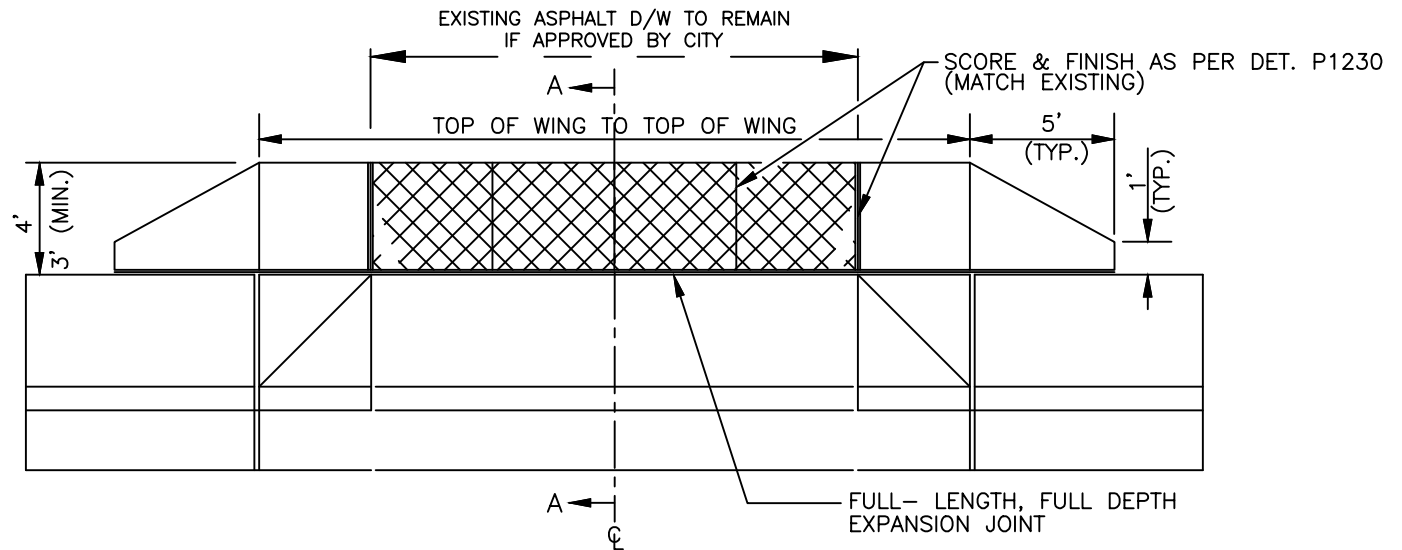
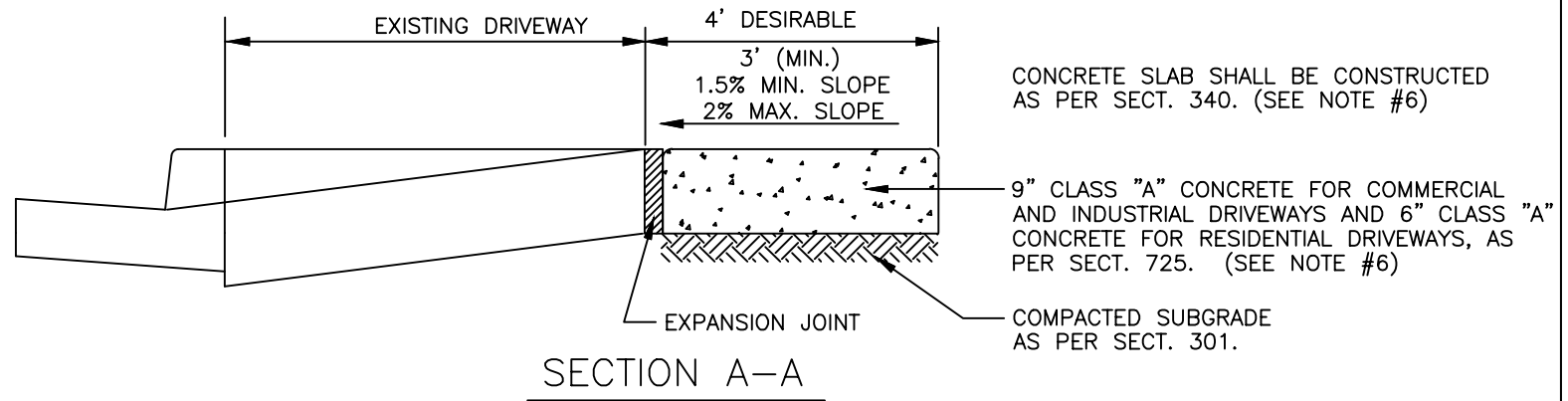
SECTION A-A

NOTES


1. DEPRESSED CURB SHALL BE PAID FOR AS COMBINED CURB AND GUTTER.
2. CONCRETE CURB & GUTTER SHALL BE M.A.G. CLASS A; TOP OF WING TO TOP OF WING.
3. PAYMENT FOR DRIVEWAY SHALL BE ON A SQUARE FOOT BASIS.
4. EXPANSION JOINT MATERIAL SHALL BE SECURED IN PLACE PRIOR TO POURING CONCRETE AND SHALL COMPLETELY SEPARATE THE DRIVEWAY SLAB FROM THE SIDEWALK, EXTENDING FROM THE SURFACE TO THE SUBGRADE.
5. WHEN DRIVEWAY IS CONSTRUCTED AT A "T" INTERSECTION AND IS USED AS A RAMP, THE SLOPE OF THE DRIVEWAY SHALL BE A MAX OF 12:1, AND WILL HAVE TRUNCATED DOMES INSTALLED AT THE BACK OF CURB IN A 2-FT DEEP BY 5-FT WIDE AREA LOCATED AT EITHER THE RIGHT OR LEFT END OF THE DRIVEWAY ENTRANCE, WHICHEVER WILL PROVIDE THE MOST DIRECT ALIGNMENT WITH THE RECEIVER CURB RAMP ON THE OPPOSITE CURB. TRUNCATED DOMES TO BE IN ACCORDANCE WITH DETAIL P1232.
6. 9" CLASS "A" CONCRETE FOR COMMERCIAL AND INDUSTRIAL DRIVEWAYS AND 6" CLASS "A" CONCRETE FOR RESIDENTIAL DRIVEWAYS, AS PER SECT. 725.



Refer to P1255-4 for
Driveway Widths Policy



NOTES

1. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, A.S.T.M. D-1751.
2. CONTROL & EXPANSION JOINTS SHALL ALIGN WITH EXISTING JOINTS IN DRIVEWAY.
3. CONCRETE SHALL BE CLASS "A", SECT. 725.
4. EXPANSION JOINT MATERIAL SHALL BE SECURED IN PLACE PRIOR TO POURING CONCRETE AND SHALL COMPLETELY SEPARATE THE DRIVEWAY SLAB FROM THE SIDEWALK, EXTENDING FROM THE SURFACE TO THE SUBGRADE.
5. EXPANSION JOINT MATERIAL SHALL BE USED WHEN NEW POURING IS ADJACENT TO EXISTING DRIVEWAY AREA.
6.  INDICATES AREA WHICH MAY REMAIN ASPHALT IF THE CROSS SLOPE & PAVING CONDITIONS MEET ADA STANDARDS.

DRIVEWAY WIDTHS POLICY

	TYPE OF DEVELOPMENT					
STREET CLASSIFICATION	SINGLE FAMILY	MutliFamily/Commercial		GAS STATION	TRUCK FACILITIES	GATES
		<30 spaces	>30 spaces			
ALLEY	16' MINIMUM	20'	20'			
LOCAL RESIDENTIAL	12' ONE CAR 16' ONE CAR – RECOMMENDED	24' – 30'	30'			**
LOCAL COMMERCIAL/INDUSTRIAL		30' – 40' ***	30' – 40' ***	40' ***	40' – 50' ***	**
COLLECTOR RESIDENTIAL	16' MINIMUM	30' ***	30' ***	40' ***		**
COLLECTOR COMMERCIAL/INDUSTRIAL		30' – 40' ***	30' – 50' ***	40' – 50' ***	40' – 50' ***	**
ARTERIAL	DISCOURAGED EXCEPT FOR LARGE LOT–CIRCULAR DRIVES *	30' ***	40' ***	40' – 50' ***	40' – 50' ***	**

* MINIMUM 82' PROPERTY WIDTH

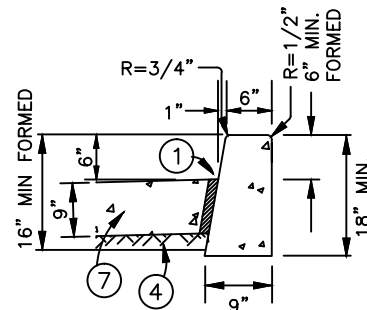
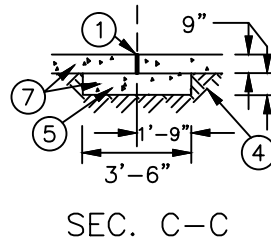
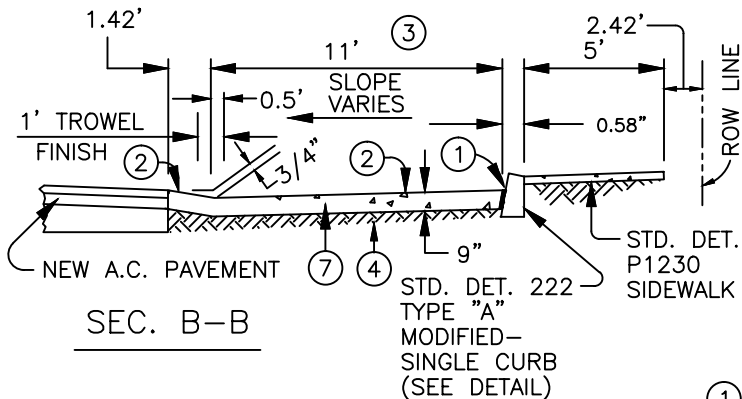
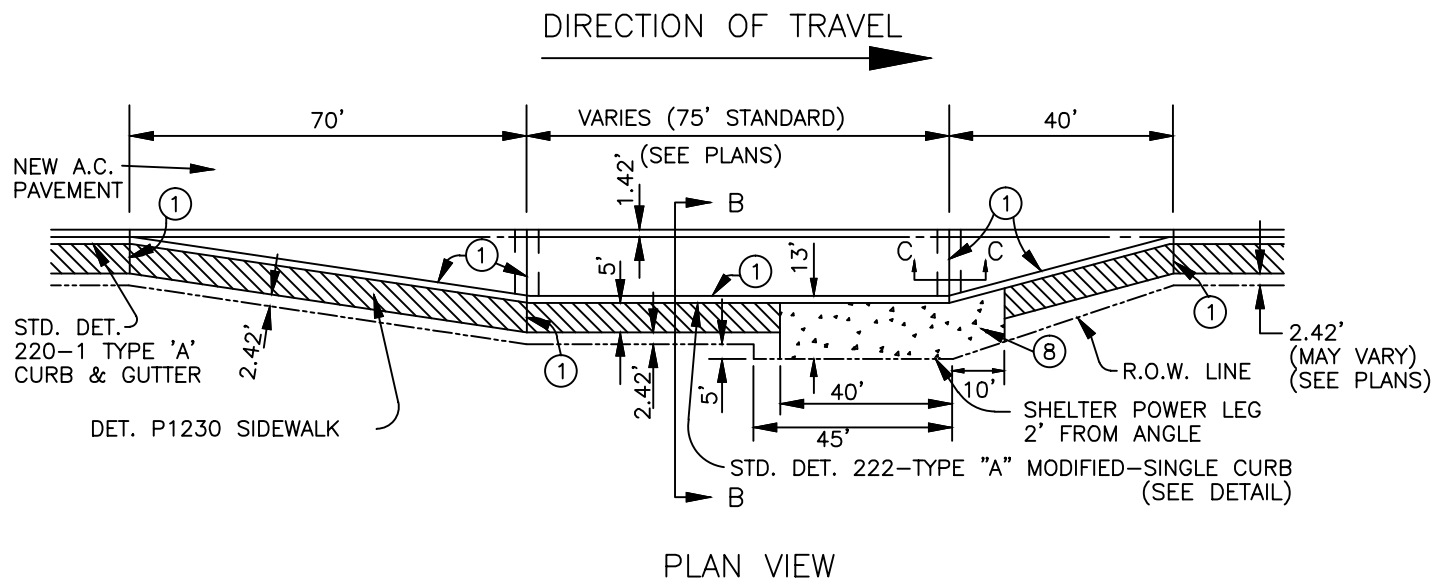
** SEE GATE ACCESS TURNAROUND HANDOUT – DSD

*** MEDIAN –30' MAXIMUM UNLESS THERE IS SIGNIFICANT TRUCK ACCESS – THEN 40'

Local/Collector One Way		Arterial One Way	
In	Out	In	Out
24'	16'	24'	20'

NOTES:

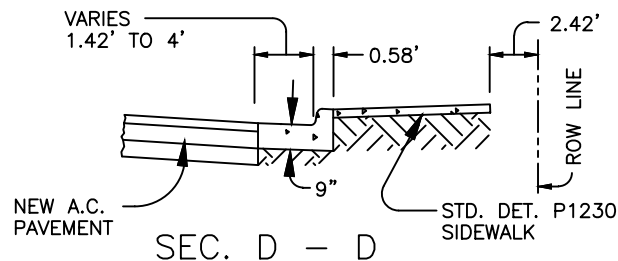
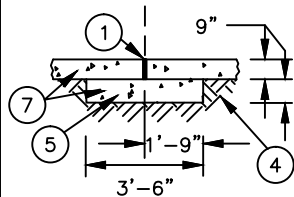
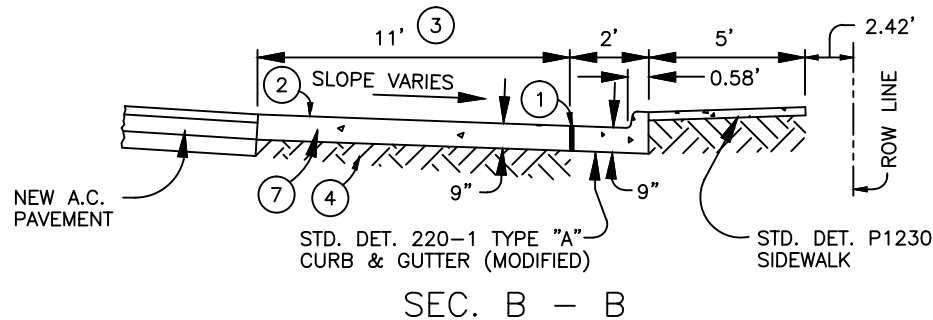
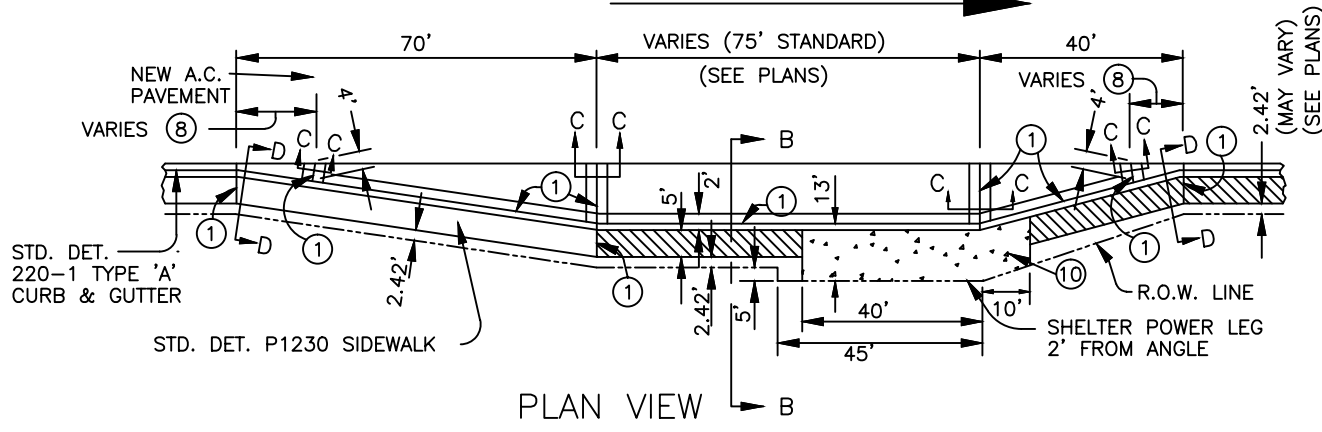
- 1) DRIVEWAYS GREATER THAN 50' ARE NOT PERMITTED BY CITY CODE UNLESS A WAIVER OF THE ORDINANCE IS OBTAINED FROM THE DRIVEWAY HEARING OFFICER OR HIS DESIGNEE.
- 2) DEVIATION FROM THIS POLICY CAN BE DETERMINED BY THE CITY OF PHOENIX TRAFFIC ENGINEER.



NOTES:

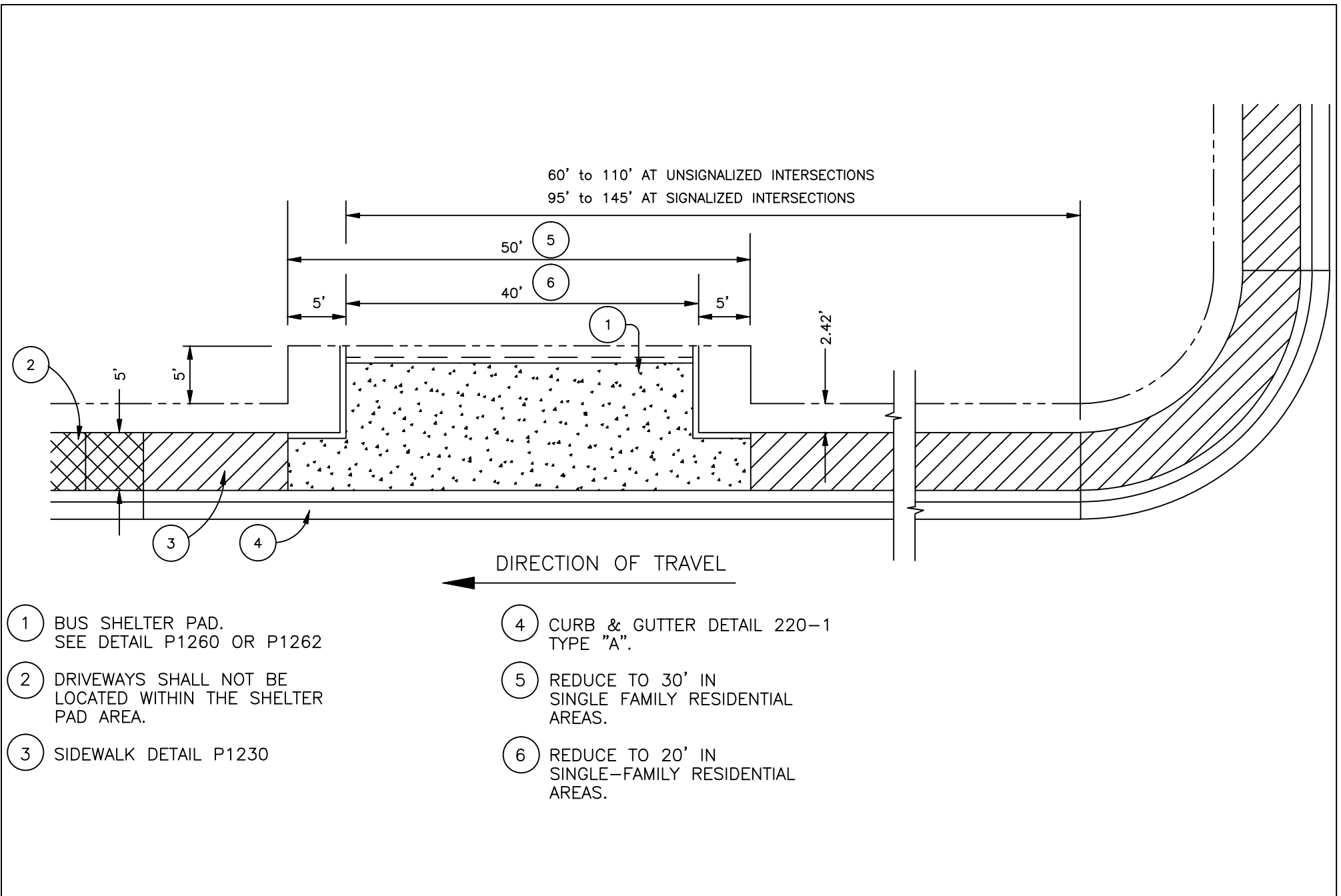
- ① 1/2" BITUMINOUS PREFORMED EXPANSION JOINT FILLER, A.S.T.M. D-1751
- ② CONCRETE BUS BAY PAVEMENT SHALL BE BROOM FINISHED, EXCEPT WHERE OTHERWISE NOTED.
- ③ MAY BE REDUCED TO 10' MINIMUM IF APPROVED BY CITY.
- ④ SUBGRADE PREPARATION PER SPECIFICATIONS.
- ⑤ CONCRETE PAD TO BE POURED SEPARATELY FROM CONCRETE BUS BAY PAVEMENT. (SEE SECTION C-C)
- ⑥ CONTRACTION JOINTS IN THE BUS BAY PAVEMENT SHALL MATCH THOSE IN THE CURB.
- ⑦ CONCRETE SHALL BE CLASS "A" PER M.A.G. SPECS. OR CLASS "S", F'C = 3000 PSI PER A.D.O.T. SPECS.
- ⑧ BUS SHELTER PAD, SEE DETAIL P1261
- ⑨ DRIVEWAYS SHALL NOT BE LOCATED WITHIN THE SHELTER PAD AREA.
- ⑩ CAN BE USED AT INTERSECTIONS WITH TOTAL ROADWAY WIDTHS OF 74' OR LARGER.

DIRECTION OF TRAVEL



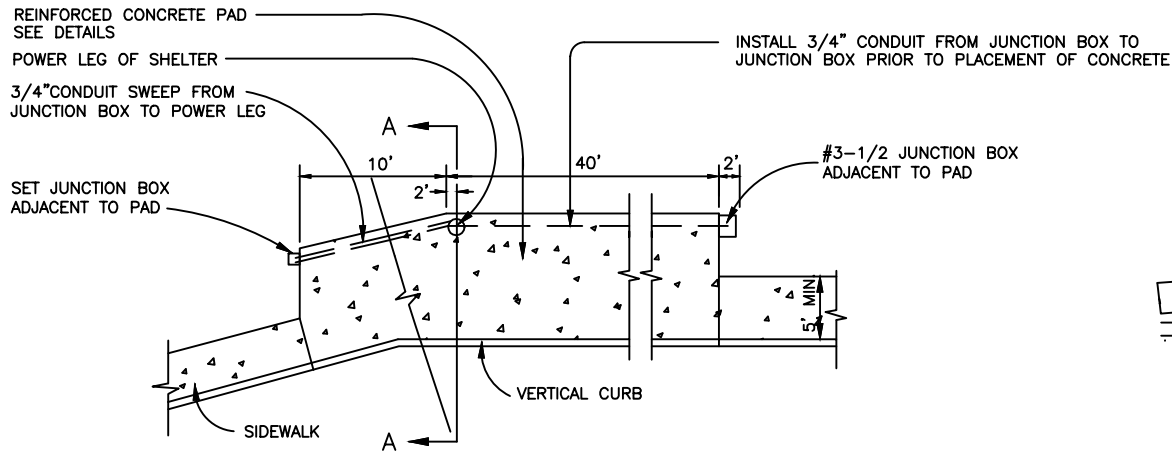
NOTES:

- ① 1/2" BITUMINOUS PREFORMED EXPANSION JOINT FILLER, A.S.T.M. D-1751
- ② CONCRETE BUS BAY PAVEMENT SHALL BE BROOM FINISHED.
- ③ MAY BE REDUCED TO 10' MINIMUM IF APPROVED BY CITY.
- ④ SUBGRADE PREPARATION PER SPECIFICATIONS.
- ⑤ CONCRETE PAD TO BE POURED SEPARATELY FROM CONCRETE BUS BAY PAVEMENT. (SEE SECTION C-C)
- ⑥ CONTRACTION JOINTS IN THE BUS BAY PAVEMENT SHALL MATCH THOSE IN THE CURB.
- ⑦ CONCRETE SHALL BE CLASS "A" PER M.A.G. SPECS. OR CLASS "S", F'C = 3000 PSI PER A.D.O.T. SPECS.
- ⑧ CURB & GUTTER-TO-BUS BAY PAVEMENT-TRANSITION (LENGTH VARIES)
- ⑨ DRIVEWAYS SHALL NOT BE LOCATED WITHIN THE SHELTER PAD AREA.
- ⑩ BUS SHELTER PAD, SEE DETAIL P1261
- ⑪ CAN BE USED AT INTERSECTIONS WITH TOTAL ROADWAY WIDTHS OF 74' OR LARGER.

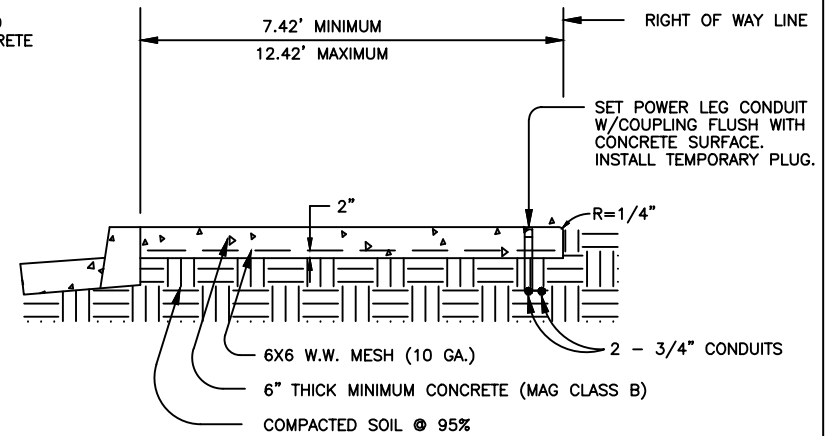




SLEEVE SWEEP & JUNCTION BOX DETAIL



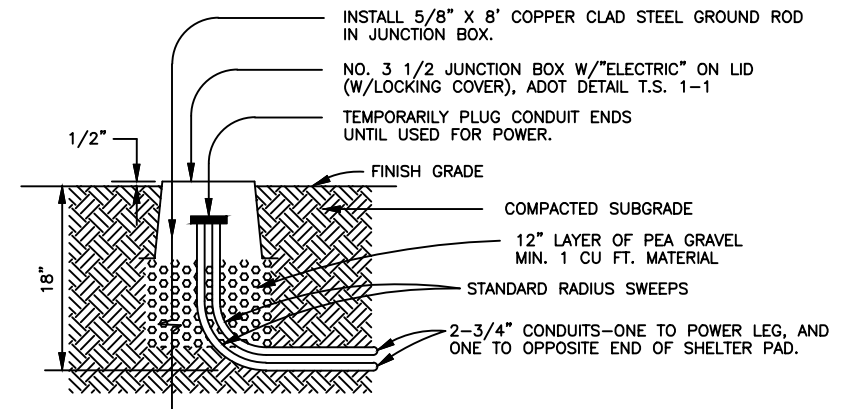
PLAN VIEW



SECTION A - A

NOTES:

1. ACTUAL PLAN LAYOUT MAY VARY. ALL OTHER DETAIL INFORMATION REMAINS THE SAME. SEE PLANS FOR SPECIFIC LOCATIONS AND DIMENSIONS OF BUS SHELTER PAD.
2. ANY SHELTER OR BUS STOP FURNITURE PLACEMENT SHALL BE LOCATED TO PROVIDE A MIN. 5 ft. WIDE CLEAR SIDEWALK.
3. DECORATIVE PAVEMENT OPTIONS MAY INCLUDE EXPOSED AGGREGATE 1/4" (NO LARGER) WITH DESIGN STRENGTH OF 4000 PSI MINIMUM. OTHER OPTIONS INCLUDING COLOR (TO MATCH SURROUNDINGS) AND STAMPING WILL BE CONSIDERED. CONCRETE MIX DESIGN THROUGH THE CITY OF PHOENIX MATERIALS LAB. DECORATIVE OPTIONS TO BE APPROVED BY THE CITY OF PHOENIX. PAVERS ARE NOT TO BE USED.
4. ELECTRICAL CONDUITS AND JUNCTION BOXES SHALL NOT BE REQUIRED UNLESS REQUESTED.
5. ALL CONDUIT SHALL BE P.V.C. SCHEDULE 40, U.L. LISTED.
6. ALL COSTS ASSOCIATED WITH ELECTRICAL AND RELATED ITEMS SHOWN ON THESE DETAILS (CONDUITS, JUNCTION BOXES, GROUND ROD, ETC.) SHALL BE CONSIDERED INCLUDED IN THE COST OF THE PAY ITEM FOR CONCRETE BUS SHELTER PAD.
7. BUS BAY PAVEMENT, CONCRETE PAD, CONCRETE CURB, SINGLE CURB, CURB & GUTTER, SIDEWALKS, & DRIVEWAYS ARE SEPARATE PAY ITEMS.
8. SHELTER PADS AND DRIVEWAYS SHALL BE LOCATED TO PROVIDE MINIMUM INTERSECTION SIGHT DISTANCE IN ACCORDANCE WITH CURRENT AASHTO STANDARDS (CASE IIIA).



SLEEVE SWEEP & JUNCTION BOX DETAIL

DETAIL NO.
P1261



City of Phoenix
STANDARD DETAIL

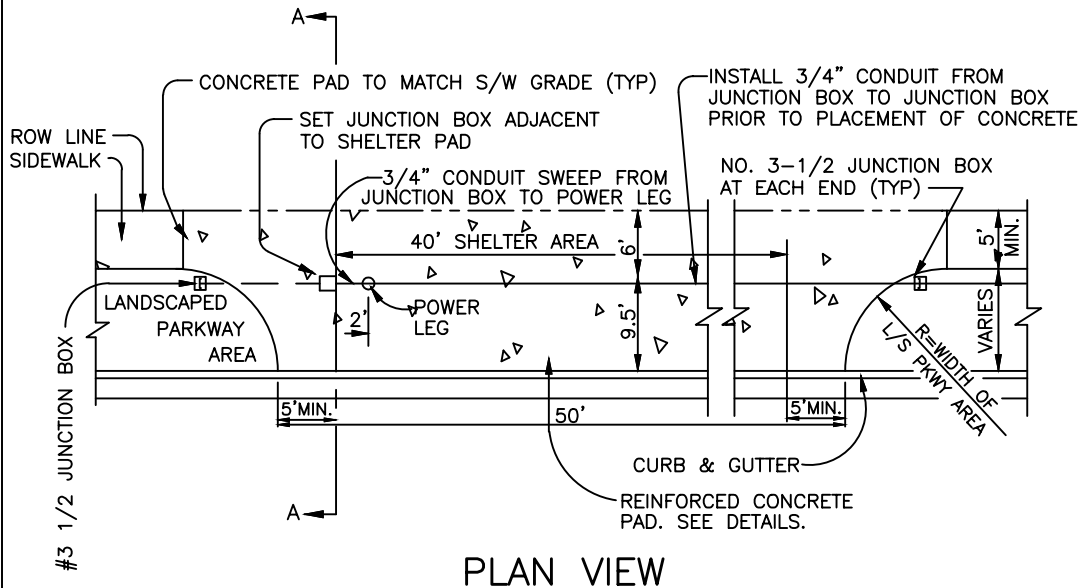
BUS SHELTER/ACCESSORY PAD
BUS BAY

APPROVED

[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

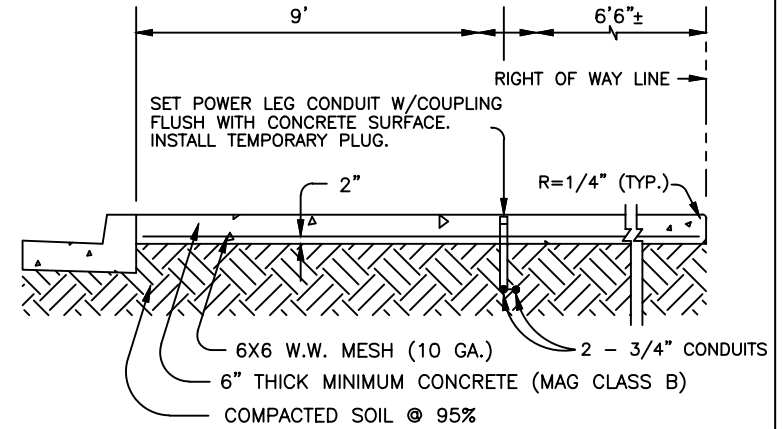
DETAIL NO.
P1261



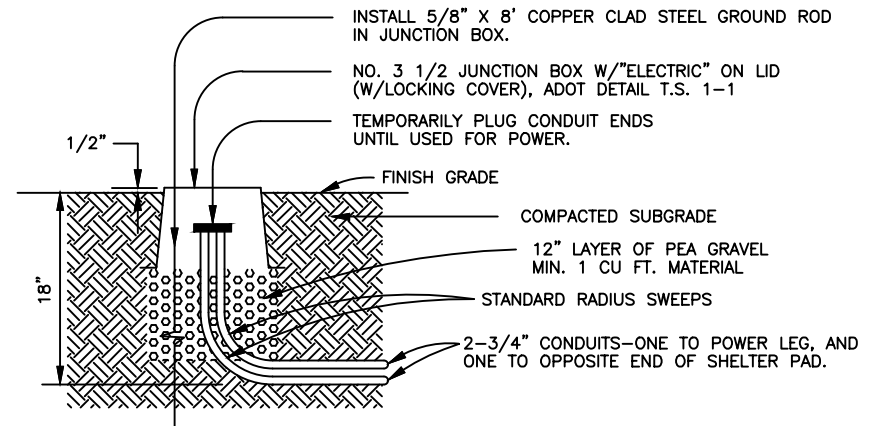
PLAN VIEW

NOTES:

1. ACTUAL PLAN LAYOUT MAY VARY. ALL OTHER DETAIL INFORMATION REMAINS THE SAME. SEE PLANS FOR SPECIFIC LOCATIONS AND DIMENSIONS OF BUS SHELTER PAD.
2. ANY SHELTER OR BUS STOP FURNITURE PLACEMENT SHALL BE LOCATED TO PROVIDE A MIN. 5 ft. WIDE CLEAR SIDEWALK.
3. DECORATIVE PAVEMENT OPTIONS MAY INCLUDE EXPOSED AGGREGATE 1/4" (NO LARGER) WITH DESIGN STRENGTH OF 4000 PSI MINIMUM. OTHER OPTIONS INCLUDING COLOR (TO MATCH SURROUNDINGS) AND STAMPING WILL BE CONSIDERED. CONCRETE MIX DESIGN THROUGH THE CITY OF PHOENIX MATERIALS LAB. DECORATIVE OPTIONS TO BE APPROVED BY THE CITY OF PHOENIX. PAVERS ARE NOT TO BE USED.
4. ELECTRICAL CONDUITS AND JUNCTION BOXES SHALL NOT BE REQUIRED UNLESS REQUESTED.
5. ALL CONDUIT SHALL BE P.V.C. SCHEDULE 40, U.L. LISTED.
6. ALL COSTS ASSOCIATED WITH ELECTRICAL AND RELATED ITEMS SHOWN ON THESE DETAILS (CONDUITS, JUNCTION BOXES, GROUND ROD, ETC.) SHALL BE CONSIDERED INCLUDED IN THE COST OF THE PAY ITEM FOR CONCRETE BUS SHELTER PAD.
7. BUS BAY PAVEMENT, CONCRETE PAD, CONCRETE CURB, SINGLE CURB, CURB & GUTTER, SIDEWALKS, & DRIVEWAYS ARE SEPARATE PAY ITEMS.
8. SHELTER PADS AND DRIVEWAYS SHALL BE LOCATED TO PROVIDE MINIMUM INTERSECTION SIGHT DISTANCE IN ACCORDANCE WITH CURRENT AASHTO STANDARDS (CASE IIIA).



SECTION A - A



SLEEVE SWEEP & JUNCTION BOX DETAIL

DETAIL NO.
P1262



City of Phoenix
STANDARD DETAIL

PARKWAY BUS SHELTER/ACCESSORY PAD

APPROVED

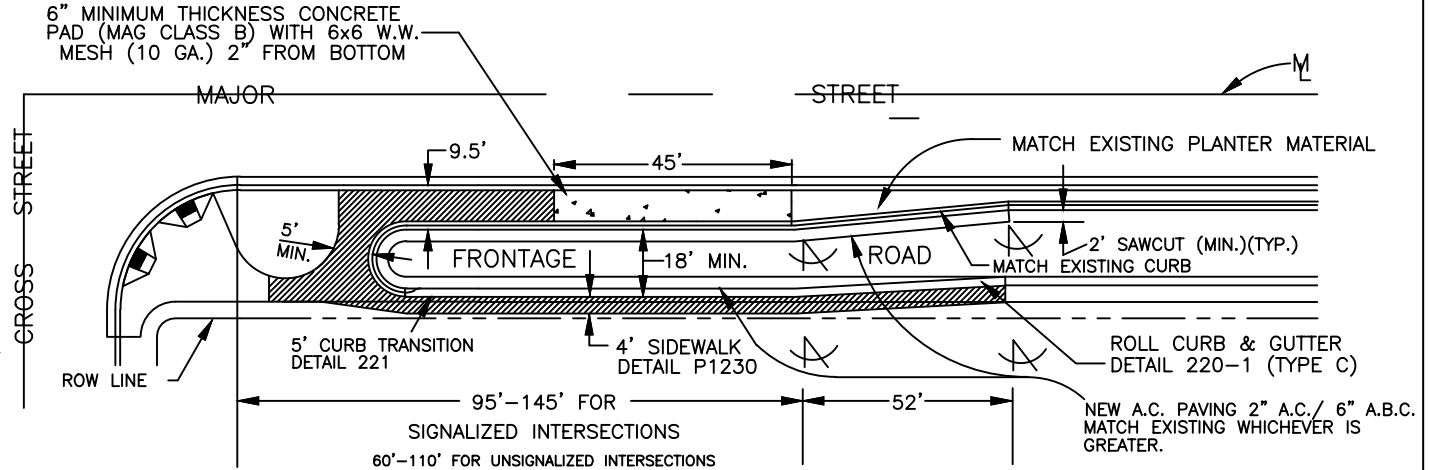
[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

DETAIL NO.
P1262

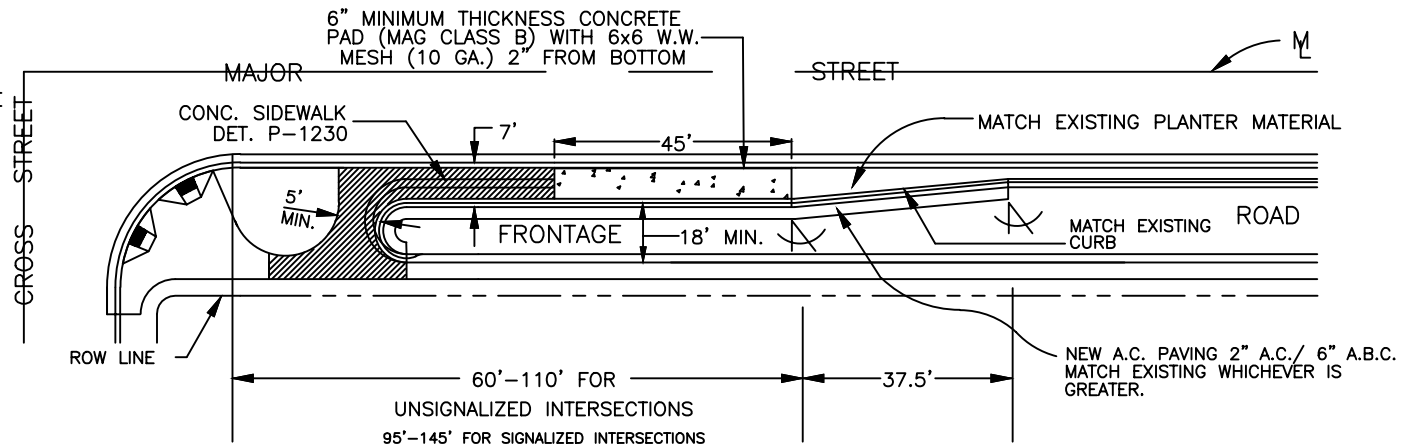
NOTES:

1. ALL DIMENSIONS ARE TO FACE OF CURB.
2. WHEEL CHAIR RAMP AND WING SLOPES SHALL NOT EXCEED 12:1.
3. COORDINATE REMOVAL OF LANDSCAPING WITH STREET TRANSPORTATION DEPARTMENT'S LANDSCAPE ARCHITECT.
4. EXISTING LANDSCAPE IRRIGATION LINES SHALL BE SLEEVED UNDER BUS SHELTER/ACCESSORY PAD. SLEEVE SHALL EXTEND 12" BEYOND EACH SIDE OF PAD.
5. NOTIFY PARKS DEPARTMENT MAINTENANCE DISTRICT IF LANDSCAPE IRRIGATION SYSTEM WILL BE INTERRUPTED FOR MORE THAN 24 HOURS.
6. ALL CONCRETE AND ASPHALT REMOVALS SHALL BE SAW CUT. MIN. 2' ASPHALT REPLACEMENT ADJACENT TO NEW CURBS.
7. SEE DETAIL P1263-1 FOR CROSS SLOPE LIMITS.
8. DECORATIVE PAVEMENT OPTIONS MAY INCLUDE EXPOSED AGGREGATE 1/4" (NO LARGER) WITH DESIGN STRENGTH OF 4000 PSI MINIMUM. OTHER OPTIONS INCLUDING COLOR (TO MATCH SURROUNDINGS) AND STAMPING WILL BE CONSIDERED. CONCRETE MIX DESIGN THROUGH THE CITY OF PHOENIX MATERIALS LAB. DECORATIVE OPTIONS TO BE APPROVED BY THE CITY OF PHOENIX. PAVERS ARE NOT TO BE USED.



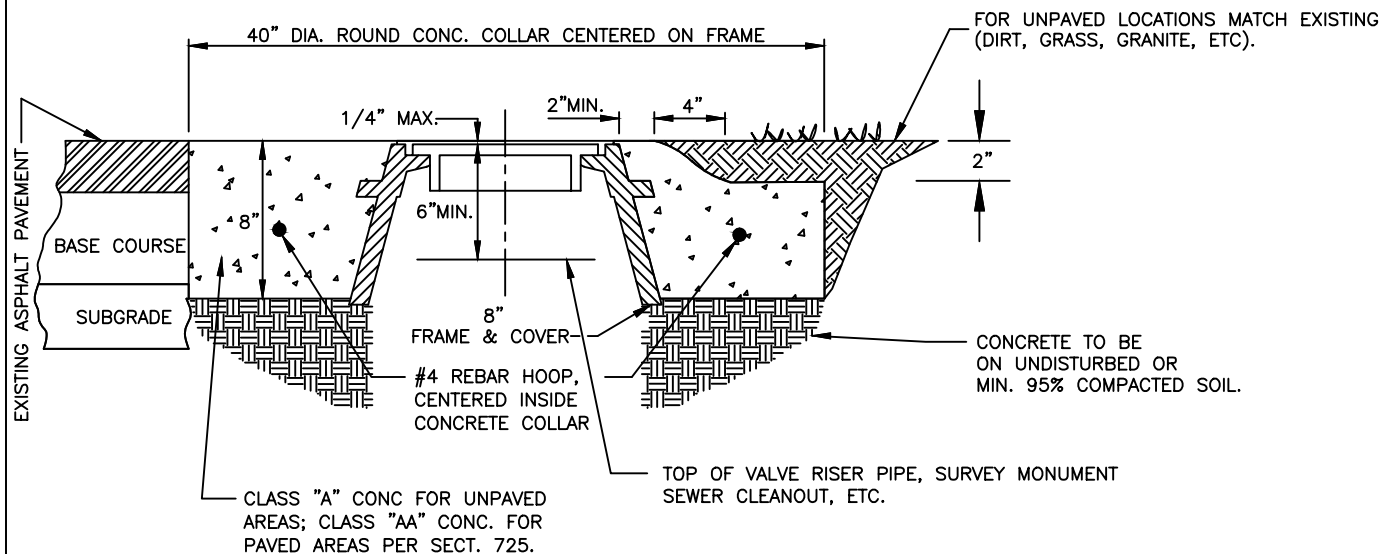
ALTERNATE 2A

NEW CONSTRUCTION FOR HIGH VOLUME BUS STOPS



ALTERNATE 2B

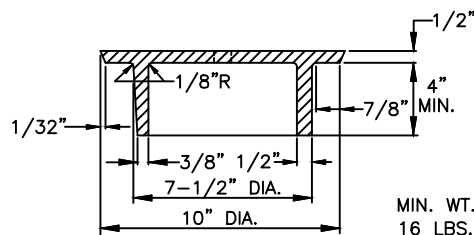
RETROFIT OR NEW CONSTRUCTION FOR LOW VOLUME BUS STOPS.



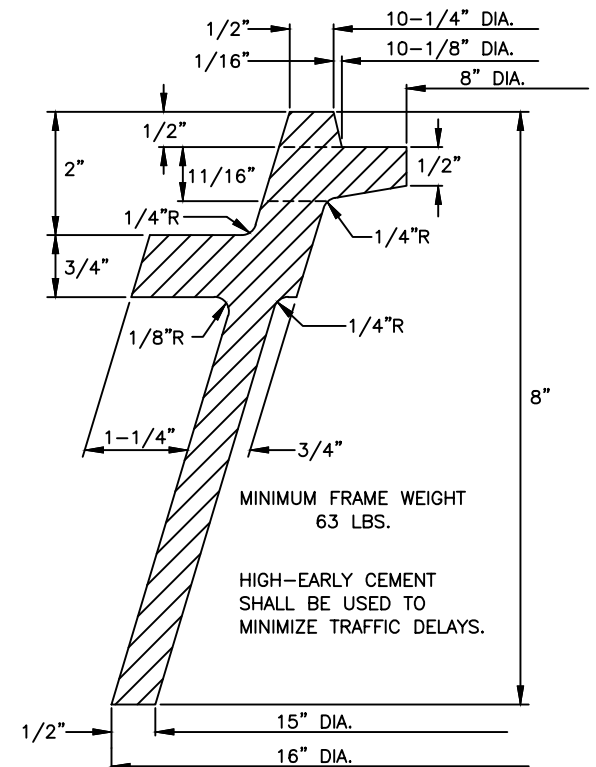
1) IN PAVED MAJOR ARTERIAL STREETS, CONCRETE COLLARS SHALL BE SCORED RADIALLY AT QUARTER-CIRCLE POINTS AND SCORES SHALL BE 1/4" WIDE BY 1/2" DEEP. CONCRETE SURFACE SHALL BE ROUGH BROOM FINISHED. NO TRAFFIC SHALL BE ALLOWED ON COLLARS UNTIL CONCRETE REACHES MINIMUM 2500 PSI ON ALL STREETS.

2) LETTERS ON COVER TO BE AS FOLLOWS: "SEWER", "WATER", OR "SURVEY" AS DIRECTED. TOTAL WIDTH OF WORD "SEWER" OR "WATER" 3-3/4". TOTAL WIDTH OF WORD "SURVEY" 4-1/2". LETTER SIZE 5/8" X 3/4", RAISED 1/16" ABOVE LEVEL OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. CASTINGS TO CONFORM TO SECT. 787.

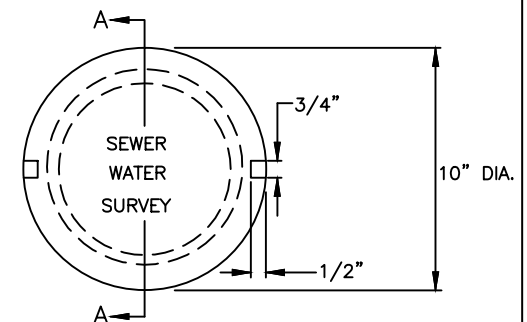
3) COMPACTION TO CONFORM TO SECT. 301 OR 601.



COVER
SECTION A-A



8" C.I. FRAME AND COVER



DETAIL NO.
P1270



City of Phoenix
STANDARD DETAIL

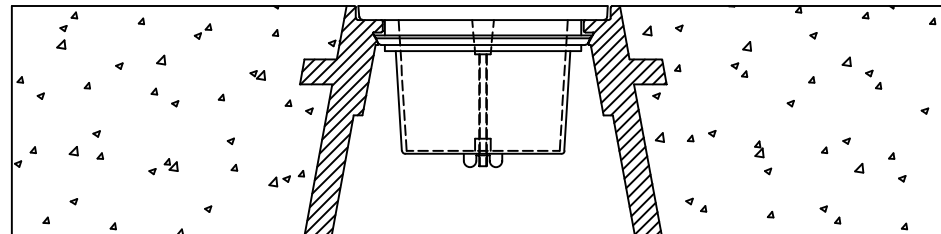
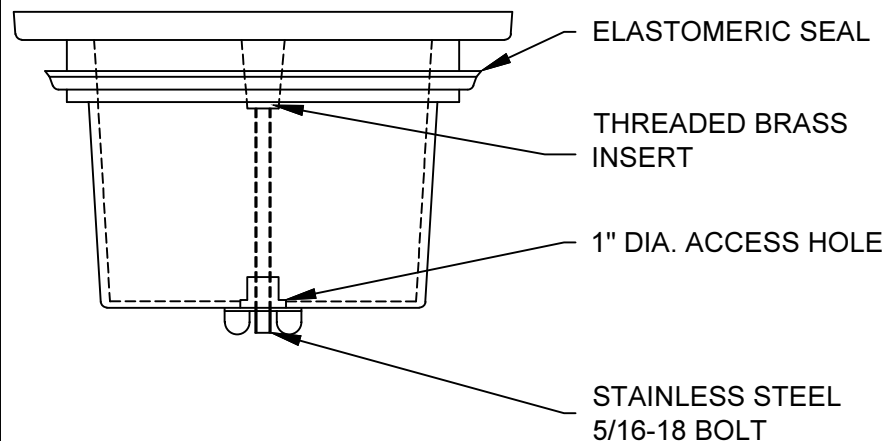
FRAME AND COVER INSTALLATION
AND GRADE ADJUSTMENT

APPROVED

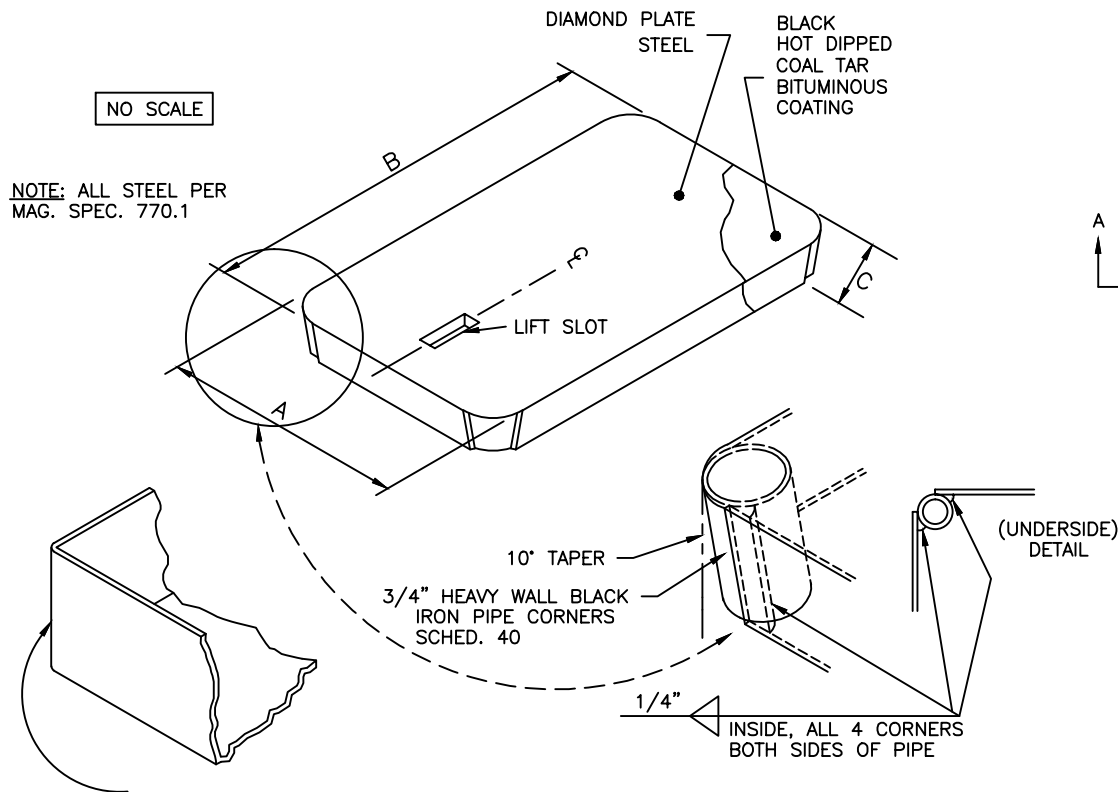
[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

DETAIL NO.
P1270

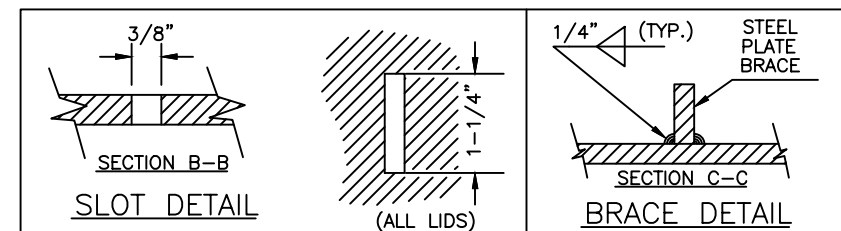
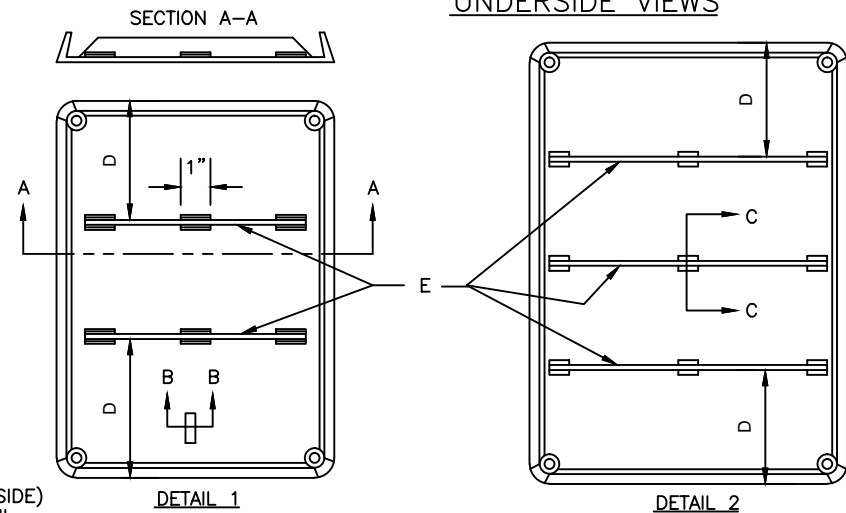


1. BODY OF THE SECURE VALVE BOX LID SHALL BE MOLDED USING AN ABS/POLYCARBONATE ALLOY, AND DISPLAY THE CITY OF PHOENIX LOGO, THE WORDS "CITY OF PHOENIX", AND "WATER".
2. WITH AN ELASTOMERIC SEAL WHICH WHEN PRESSED INTO PLACE BENEATH THE LID-SEAT, EXPANDS TO A DIAMETER GREATER THAN THE OPENING THROUGH WHICH IT WAS PASSED, BUT CAPABLE OF FOLDING BACK DURING LID EXTRACTION.
3. A HOLLOW ENCLOSURE MOLDED USING AN ABS/POLYCARBONATE ALLOY. CAPABLE OF BEING FILLED WITH A GRANULAR MATERIAL, FOR ADDITIONAL WEIGHT IF DESIRED, MUST BE AFFIXED BENEATH THE SURFACE PLATE OF LID, WITH SERIES 3400 STAINLESS STEEL 5/16"-18 BOLT INSERTED INTO THREADED BRASS INSERT MOLDED IN LID.
4. HOLLOW ENCLOSURE TO EXTEND A MINIMUM OF 4" BENEATH THE LID-SEAT, AND BE SECURED BY A STAINLESS STEEL BOLT EXTENDING THROUGH THE ENCLOSURE INTO THREADED BRASS INSERT IN LID.
5. HOLLOW ENCLOSURE MUST HAVE AN ACCESSIBLE OPENING OF AT LEAST 1" DIAMETER FOR FILLING, WHEN REQUIRED.
6. SECURE VALVE BOX LID TO BE AS MANUFACTURED BY SW SERVICES OR EQUAL.
7. SEE DETAIL P1391 FOR ADDITIONAL INFORMATION ON VALVE BOX INSTALLATIONS.



NOTE: ALL STEEL PER
MAG. SPEC. 770.1

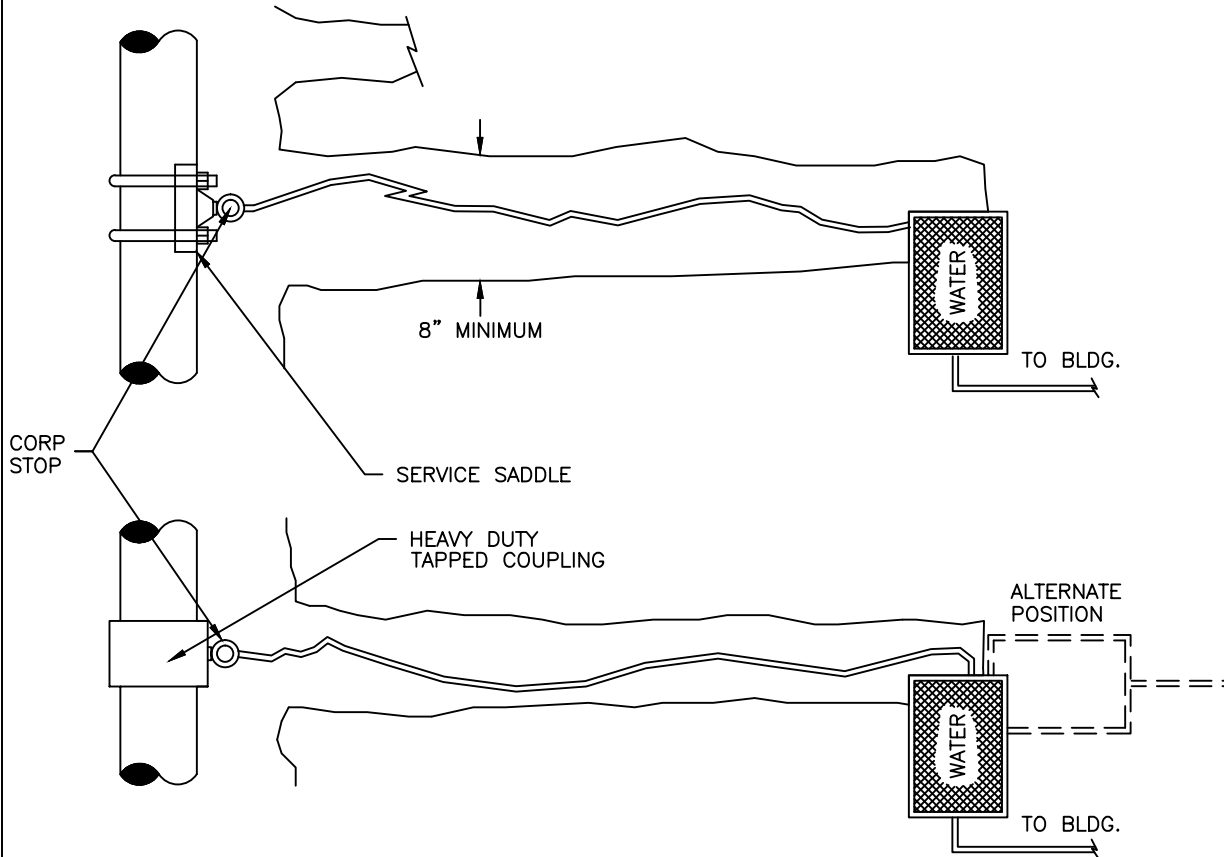
UNDERSIDE VIEWS



*OPTIONAL 3/16" WELD IN LIEU OF IRON PIPE

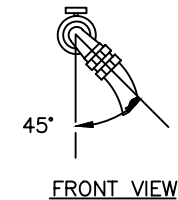
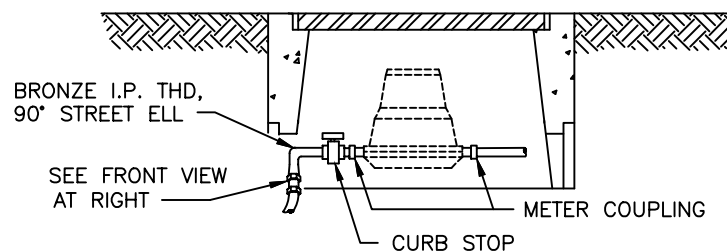
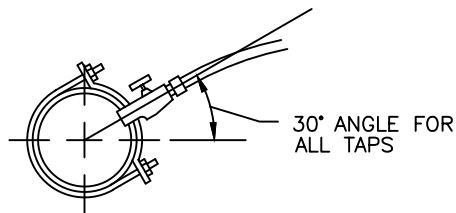
SPECIFICATIONS

NO.	A	B	C	D	E	BRACES	WEIGHT	MATERIAL
1	9"	15-7/8"	1-3/8"	NONE	NONE	NONE	5-1/4 LBS.	14 GAGE
2	14-1/8"	21-3/4"	1-1/2"	6-1/2"	3/16" X 1-1/4" X 13-1/8"	DETAIL 1	12-3/4 LBS.	12 GAGE
3	15-1/4"	26-1/4"	1-1/2"	8-1/4"	3/16" X 1-1/4" X 14-1/4"	DETAIL 1	19-1/4 LBS.	12 GAGE
4	19-1/2"	30"	1-1/2"	7-1/8"	3/16" X 1-1/4" X 18-3/4"	DETAIL 2	33 LBS.	11 GAGE



NOTES:

1. NEW WATER SERVICE TAPS SHALL BE INSTALLED USING AN ALL-BRONZE DOUBLE-STRAP TAPPING SADDLE OR A TAPPED COUPLING.
2. 30" MINIMUM COVER IS REQUIRED FOR SERVICE LINES.
3. WATER SERVICE INCLUDES THE CORP. STOP, SERVICE PIPE, APPURTENANT FITTINGS, CURB STOP, METER BOX & COVER. APPROVED WATER SERVICE COMPONENTS ARE LISTED IN CITY OF PHOENIX SUPPLEMENTS.
4. ONLY AUTHORIZED PERSONNEL OF THE WATER & WASTEWATER DEPT. SHALL INSTALL THE SERVICE CONNECTION FOR ANY EXISTING CITY WATER MAIN SERVING ALL OR PART OF A NEW SUBDIVISION.
5. WATER METER WILL BE INSTALLED BY CITY FORCES.
6. FOR 3/4" THROUGH 2" SERVICE USE COPPER PIPE.
7. FOR WATER METER LOCATION SEE CITY OF PHOENIX DETAIL P1363.



DETAIL NO.
P1342



City of Phoenix
STANDARD DETAIL

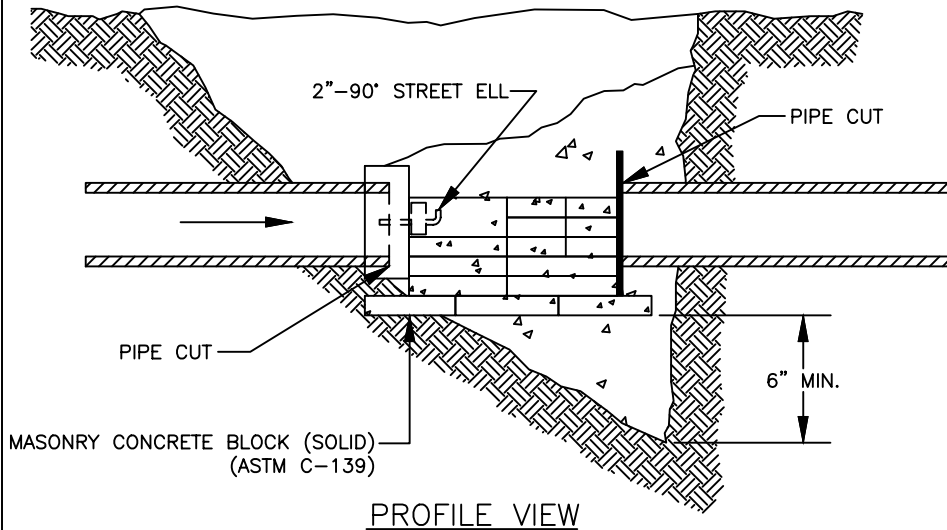
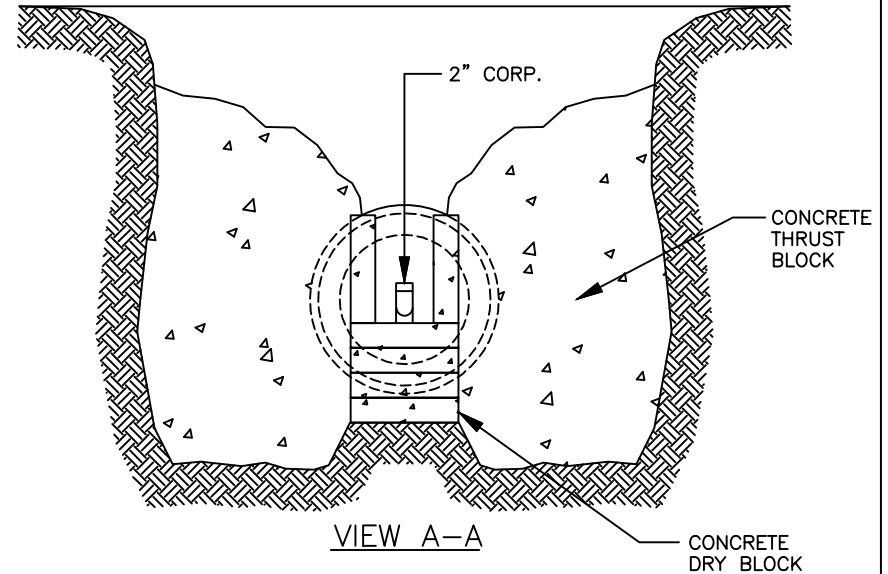
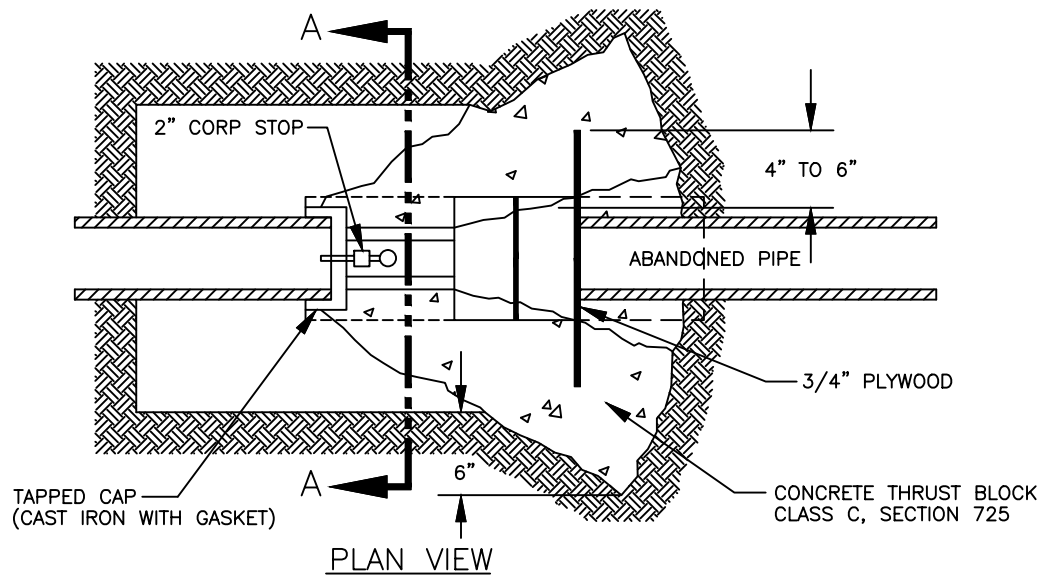
WATER SERVICE CONNECTIONS

APPROVED

[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

DETAIL NO.
P1342



NOTES:

1. CUT AND PLUGS MUST BE ADEQUATELY "DRY BLOCKED".
2. DRY BLOCKS SHALL BE STANDARD SIZE SOLID MASONRY CONCRETE BLOCKS. (ASTM C-139)
3. THE QUANTITY AND ARRANGEMENT OF THE BLOCKING MUST WITHSTAND LINE PRESSURE BY HOLDING THE CAP OR PLUG IN POSITION.
4. DRY BLOCKING SHALL BE PROPERLY SHIMMED TIGHT AND SECURE AGAINST THE CAP BEFORE LINE PRESSURE IS RESTORED.
5. CONCRETE THRUST BLOCKS SHALL NOT BE POURED UNTIL LINE PRESSURE IS RESTORED AND THE CAP OR PLUG IS INSPECTED FOR LEAKAGE.
6. CONCRETE SHALL NOT BE POURED OVER ANY PORTION OF THE ABANDONED PIPE.
7. MINIMUM THRUST BLOCK AREA PER M.A.G. DETAIL 380.
8. WHERE A 4" OR LARGER LINE IS SPECIFIED TO BE ABANDONED, THE CUT AND PLUG SHOULD OCCUR AT THE SUPPLY MAIN TO AVOID CREATING AN UNUSED DEAD END LINE.

DETAIL NO.
P1343



City of Phoenix
STANDARD DETAIL

WATERLINE – CUT AND PLUG
FOR 12" DIA. MAIN AND SMALLER

APPROVED

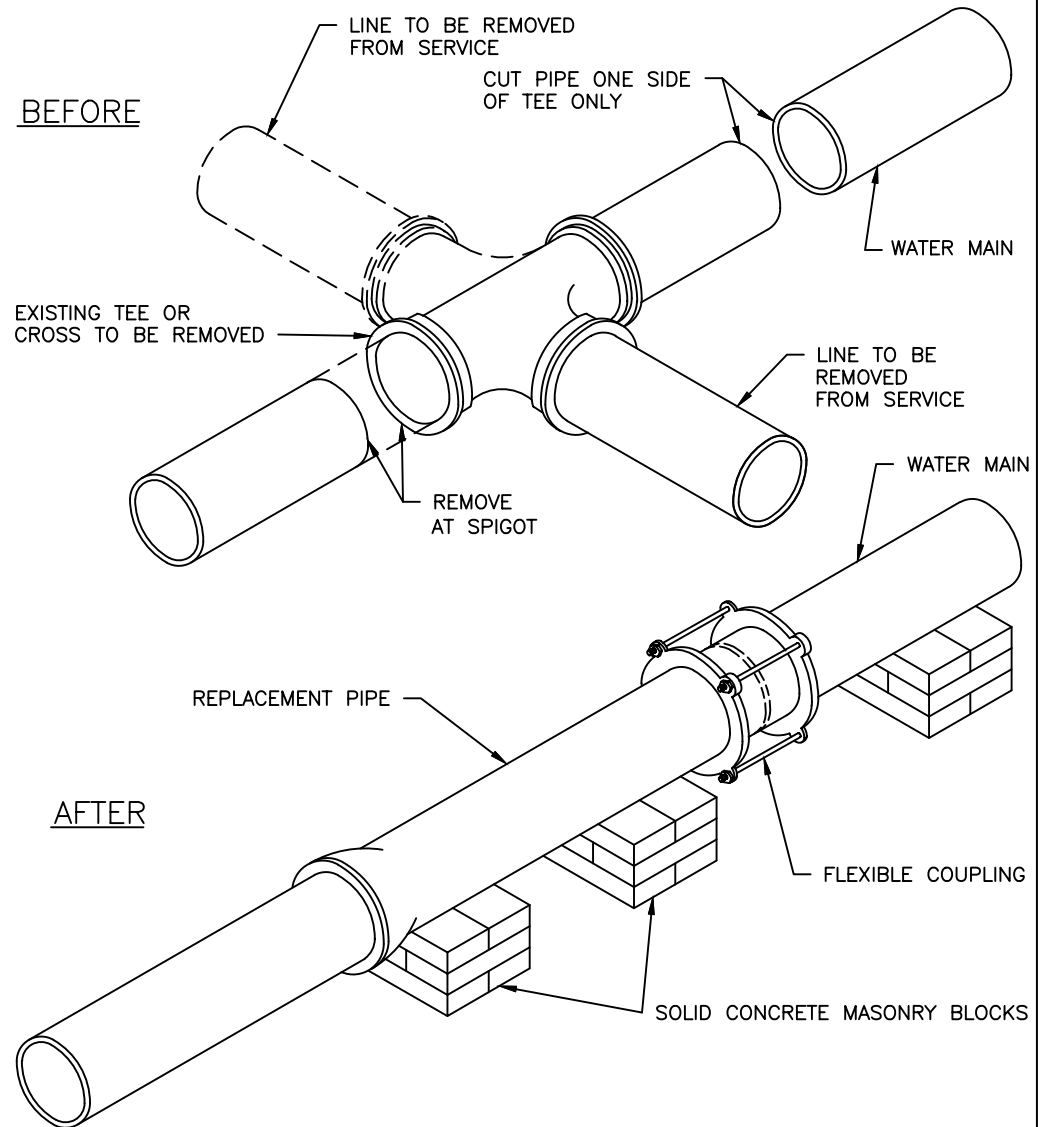
Kenny Whelan
CITY ENGINEER

5/31/94
DATE

DETAIL NO.
P1343

NOTES:

1. REPLACEMENT PIPE MATERIAL SHALL BE IN KIND OR DUCTILE IRON.
2. WHERE POSSIBLE, ONE END OF THE REPLACEMENT PIPE SECTION SHALL CONNECT TO AN EXISTING BELL OR SPIGOT.
3. FLEXIBLE COUPLING SHALL BE THE CAST IRON TYPE AND SPECIFICALLY DESIGNED FOR USE ON THE PIPE SIZE AND MATERIAL(S) BEING CONNECTED. USE OF FULL CIRCLE REPAIR CLAMPS IS PROHIBITED.
4. THE NEW REPLACEMENT PIPE SECTION SHALL BE ADEQUATELY DRY BLOCKED PRIOR TO BACKFILLING.
5. BACKFILLING SHALL NOT BEGIN UNTIL LINE PRESSURE IS RESTORED AND CONNECTIONS INSPECTED FOR LEAKAGE BY WATER DEPARTMENT PERSONNEL.
6. DRY BLOCKS SHALL BE STANDARD SIZE SOLID MASONRY CONCRETE BLOCKS. (ASTM C-139)
7. REPLACEMENT PIPE SHALL BE CLEANED IN ACCORDANCE WITH SECTION 611.1.



DETAIL NO.
P1344



City of Phoenix
STANDARD DETAIL

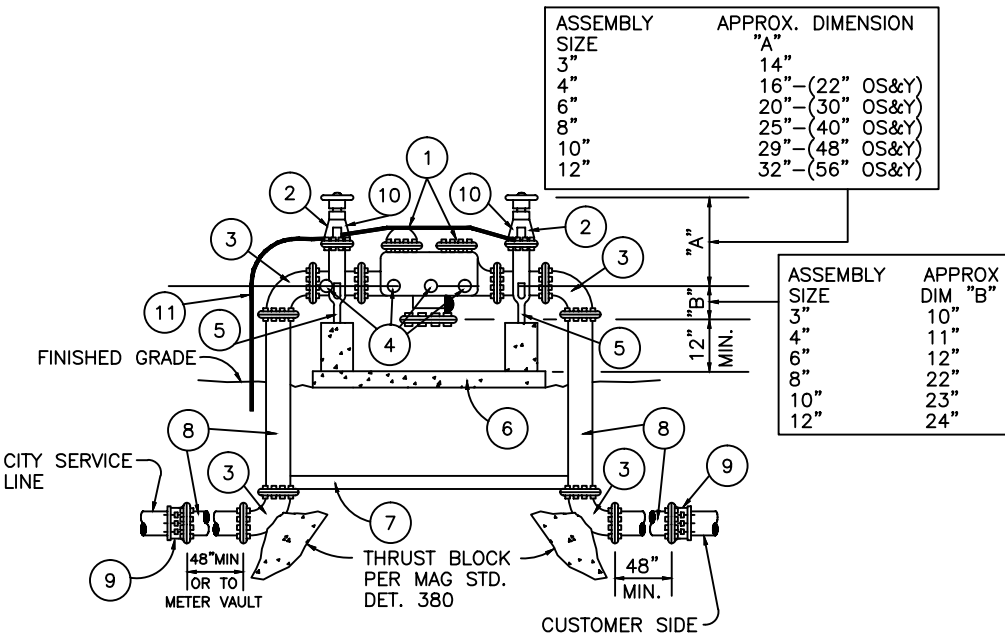
WATERLINE CUT OUT (TEES & CROSSES)
FOR 12" DIA. MAIN AND SMALLER

APPROVED

Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

DETAIL NO.
P1344



REDUCED PRESSURE PRINCIPLE DEVICE

GENERAL NOTES

1. ASSEMBLY SHALL BE APPROVED BY U.S.C. FOUNDATION FOR CROSS CONNECTION AND HYDRAULIC RESEARCH.
2. CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES.
3. FOUR (4) TEST COCKS TO BE INSTALLED PER U.S.C.
4. COPPER FITTINGS SHALL BE CONNECTED WITH LEAD-FREE SOLDER JOINTS.
5. FINISHED GRADE BELOW BACKFLOW PREVENTER SHALL BE 95% COMPACTION.
6. ASSEMBLY MAY BE PAINTED TO BLEND WITH LANDSCAPE SURFACE TREATMENT OR ON-SITE STRUCTURES.
7. THE ASSEMBLY MAY ALSO BE SCREENED WITH SHRUBBERY OR BE ENCLOSED WITHIN A WALL TYPE STRUCTURE. ADEQUATE DRAINAGE FOR SURFACE WATER IS REQUIRED.
8. ANY SCREENING/ENCLOSURE MUST PROVIDE A MINIMUM 18" ACCESS OPENING (UNSECURED GATES ARE ACCEPTABLE) AND SIDE WALLS OR SHRUBBERY MUST BE A MINIMUM OF 24" FROM THE OUTSIDE FACE OF ANY PORTION OF THE BACKFLOW PREVENTION DEVICE.
9. ASSEMBLY MAY BE PROTECTED BY GUARD POSTS (MODIFY P-1359, HYDRANT GUARDS, PHOENIX SUPPLEMENT TO MAG).

LIST OF MATERIALS

- | | |
|---|--|
| <ol style="list-style-type: none"> 1 APPROVED REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION DEVICE. 2 GATE VALVE, RESILIENT SEATED (NON-RISING STEM)(O.S.&Y. REQUIRED ON FIRELINES). 3 90° ELL (FLANGED D.I.P. 3" THROUGH 12"). 4 TEST COCK, RESILIENT SEATED (4 REQUIRED) FIT WITH BRASS PLUG. 5 ADJUSTABLE PIPE SUPPORT PERMANENTLY ATTACHED TO BASE (4" AND LARGER ASSEMBLY ONLY). 6 CONCRETE SUPPORT PAD 4" THICK BY 18" WIDE MINIMUM BENEATH 4" AND LARGER ASSEMBLIES. (CLASS "A" CONCRETE) | <ol style="list-style-type: none"> 7 3"x3"x1/4" STEEL ANGLE. BOLT TO FLANGE, EACH END WITH ONE BOLT. COAT WITH COAL TAR EPOXY (16 MILS) REQUIRED ON 4" AND LARGER ASSEMBLIES. 8 PIPE SPOOL (FLANGED D.I.P. 3" THRU 12"). 9 FLANGED ADAPTER (WHEN REQUIRED). 10 TAMPER SWITCH (ON FIRELINE ONLY, OPTIONAL). 11 ELECTRICAL CONDUIT FOR TAMPER SWITCH. |
|---|--|

DETAIL NO.
P1351



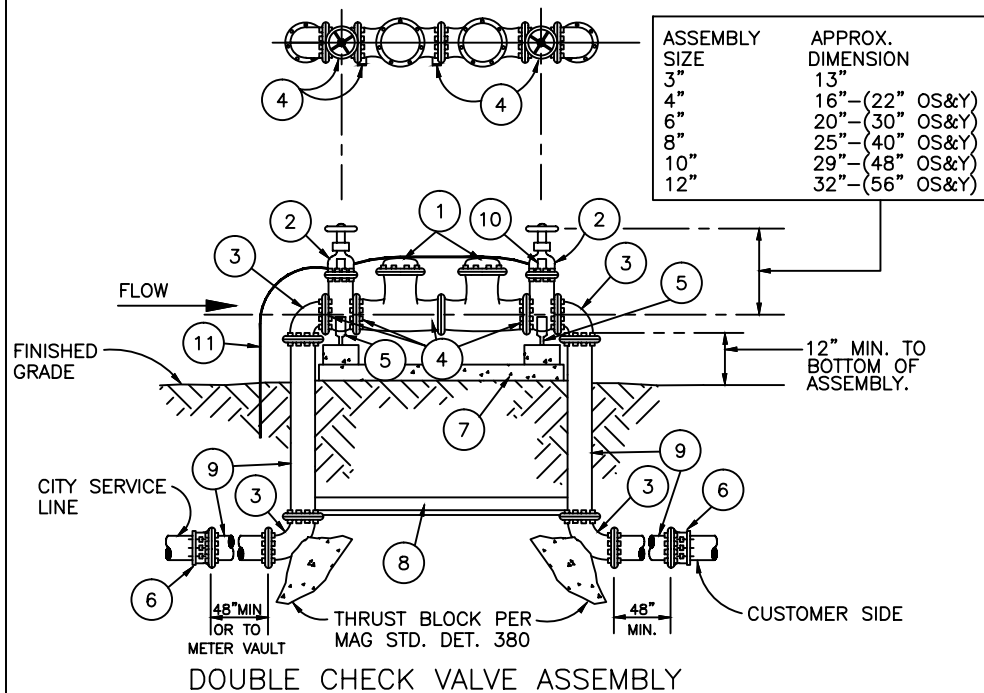
City of Phoenix
STANDARD DETAIL

REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION
ASSEMBLY INSTALLATION - 3" AND OVER

APPROVED

Maria S. Delamando
CITY ENGINEER
6/27/01
DATE

DETAIL NO.
P1351

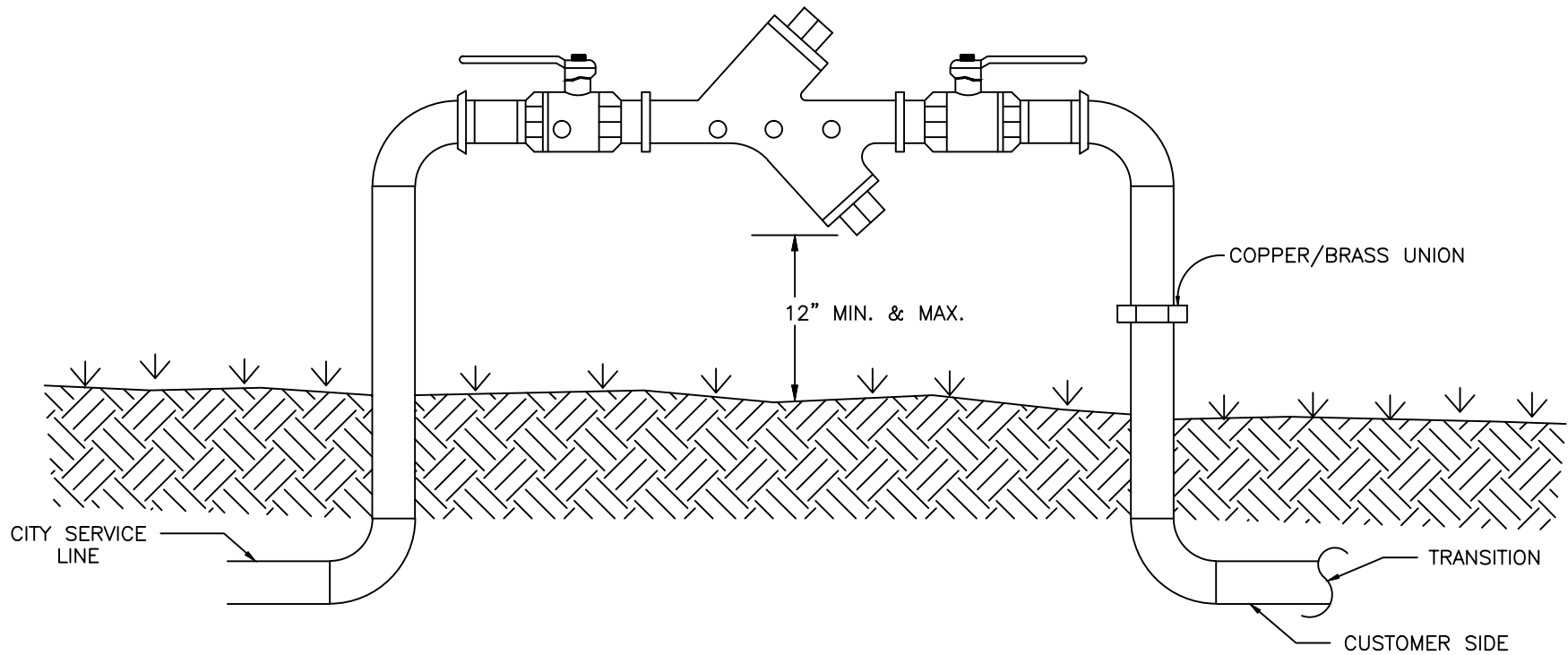


GENERAL NOTES

1. ASSEMBLY SHALL BE APPROVED BY U.S.C. FOUNDATION FOR CROSS CONNECTION AND HYDRAULIC RESEARCH.
2. CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES.
3. FOUR (4) TEST COCKS TO BE INSTALLED PER U.S.C.
4. COPPER FITTINGS SHALL BE CONNECTED WITH LEAD-FREE SOLDER JOINTS.
5. FINISHED GRADE BELOW BACKFLOW PREVENTER SHALL BE 95% COMPACTION.
6. ASSEMBLY MAY BE PAINTED TO BLEND WITH LANDSCAPE SURFACE TREATMENT OR ON-SITE STRUCTURES.
7. THE ASSEMBLY MAY ALSO BE SCREENED WITH SHRUBBERY OR BE ENCLOSED WITHIN A WALL TYPE STRUCTURE. ADEQUATE DRAINAGE FOR SURFACE WATER IS REQUIRED.
8. ANY SCREENING/ENCLOSURE MUST PROVIDE A MINIMUM 18" ACCESS OPENING (UNSECURED GATES ARE ACCEPTABLE) AND SIDE WALLS OR SHRUBBERY MUST BE A MINIMUM OF 24" FROM THE OUTSIDE FACE OF ANY PORTION OF THE BACKFLOW PREVENTION DEVICE.
9. ASSEMBLY MAY BE PROTECTED BY GUARD POSTS (MODIFY P-1359, HYDRANT GUARDS, PHOENIX SUPPLEMENT TO MAG).

LIST OF MATERIALS

- | | |
|--|--|
| <p>① APPROVED DOUBLE CHECK VALVE ASSEMBLY.</p> <p>② GATE VALVE, RESILIENT SEATED (NON-RISING STEM)(O.S.&Y. REQUIRED ON FIRELINE).</p> <p>③ 90° ELL (FLANGED D.I.P. 3" THROUGH 12").</p> <p>④ TEST COCK, RESILIENT SEATED (4 REQUIRED) FIT WITH BRASS PLUG.</p> <p>⑤ ADJUSTABLE PIPE SUPPORT PERMANENTLY ATTACHED TO BASE (4" AND LARGER ASSEMBLY ONLY).</p> <p>⑥ FLANGE ADAPTER (WHEN REQUIRED).</p> | <p>⑦ CONCRETE SUPPORT PAD 4" THICK BY 18" WIDE MINIMUM BENEATH 4" AND LARGER ASSEMBLIES. (CLASS "A" CONC).</p> <p>⑧ 3"x3"x1/4" STEEL ANGLE. BOLT TO FLANGE, EACH END WITH ONE BOLT. COAT WITH COAL TAR EPOXY (16 MILS) REQUIRED ON 4" AND LARGER ASSEMBLIES.</p> <p>⑨ PIPE SPOOL (FLANGED D.I.P. 3" THRU 12").</p> <p>⑩ TAMPER SWITCH (ON FIRELINE ONLY, OPTIONAL).</p> <p>⑪ ELECTRICAL CONDUIT FOR TAMPER SWITCH.</p> |
|--|--|



NOTES:

1. ALL PIPE/FITTINGS TO BE TYPE "K" COPPER.
2. CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES.
3. BACKFLOW PREVENTION ASSEMBLY MUST BE LEVEL AND INSTALLED A MINIMUM AND A MAXIMUM OF 12 INCHES FROM ASSEMBLY BODY TO FINAL GRADE.
4. TEST COCKS, (4) SHALL BE FITTED WITH BRASS PLUGS INSTALLED WITH TEFLON TAPE.
5. SHUTOFF VALVES TO BE RESILIENT BALL TYPE WITH REMOVABLE HANDLES.
6. COMPRESSION TYPE FITTINGS ARE NOT ALLOWED.
7. INSTALL THE BACKFLOW PREVENTION ASSEMBLY IMMEDIATELY DOWNSTREAM OF THE CITY WATER METER.
8. A COPPER/BRASS UNION MUST BE INSTALLED IN THE MIDDLE OF THE DOWNSTREAM RISER.
9. ASSEMBLY SHALL BE APPROVED BY U.S.C. FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH.
10. COPPER FITTINGS SHALL BE CONNECTED WITH LEAD-FREE SOLDER JOINTS.
11. TRANSITION FROM "K" COPPER TO OTHER APPROVED PIPING MATERIALS SHALL BE IN THE HORIZONTAL PIPING A MINIMUM OF 12" BELOW GRADE.

DETAIL NO.
P1353



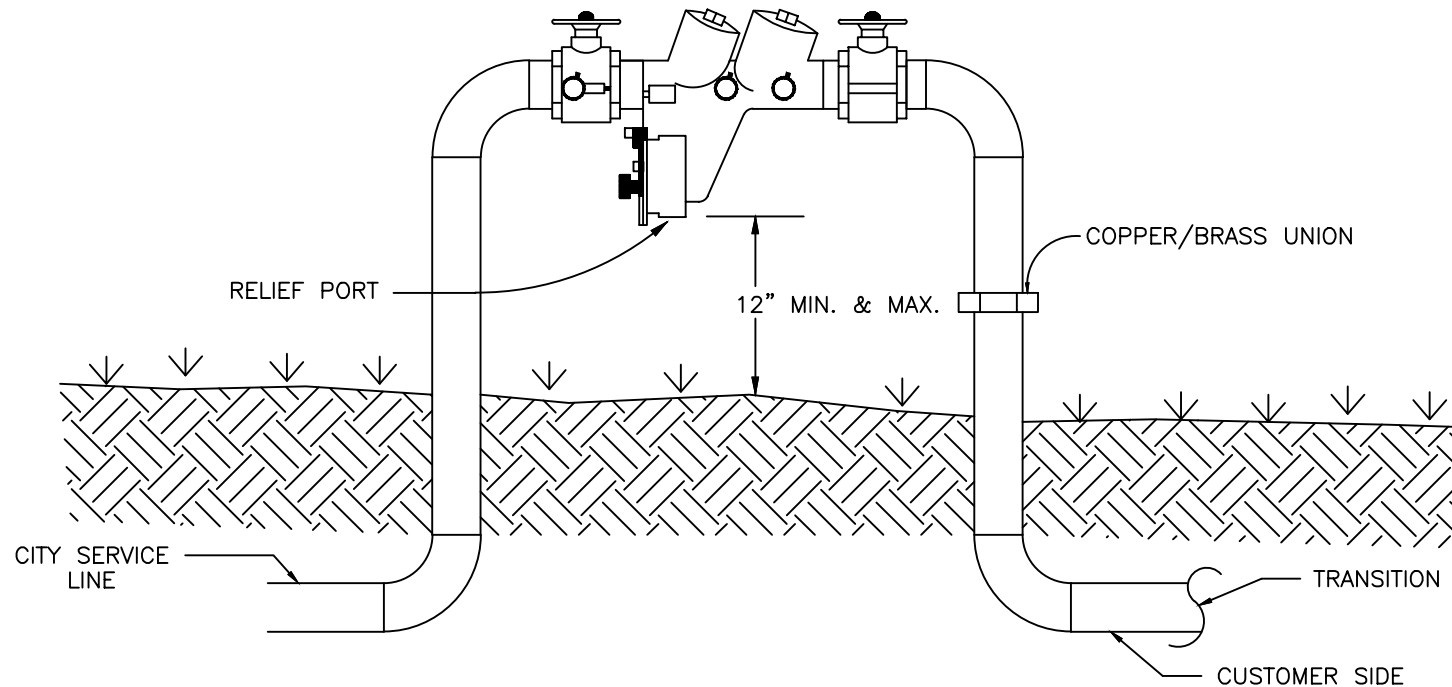
City of Phoenix
STANDARD DETAIL

DOUBLE CHECK VALVE BACKFLOW PREVENTION
ASSEMBLY INSTALLATION - 2 1/2" AND UNDER

APPROVED

Maria S. Delamando
CITY ENGINEER
6/27/01
DATE

DETAIL NO.
P1353



NOTES:

1. ALL PIPE/FITTINGS TO BE TYPE "K" COPPER.
2. ASSEMBLY SHALL BE APPROVED BY U.S.C. FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH.
3. INSTALL BACKFLOW PREVENTION ASSEMBLY WITH RELIEF PORT FACING TOWARD THE GROUND.
4. BACKFLOW PREVENTION ASSEMBLY MUST BE LEVEL AND INSTALLED A MINIMUM AND A MAXIMUM OF 12 INCHES FROM RELIEF PORT TO FINAL GRADE.
5. PAVER CONCRETE BLOCK UNDER RELIEF PORT, SET AT FINAL GRADE.
6. TEST COCKS, (4) SHALL BE FITTED WITH BRASS PLUGS AND INSTALLED WITH TEFLON TAPE.
7. SHUTOFF VALVES TO BE RESILIENT BALL TYPE WITH REMOVABLE HANDLES.
8. COMPRESSION TYPE FITTINGS ARE NOT ALLOWED.
9. INSTALL THE BACKFLOW PREVENTION ASSEMBLY IMMEDIATELY DOWNSTREAM OF THE CITY WATER METER.
10. A COPPER/BRASS UNION MUST BE INSTALLED IN THE MIDDLE OF THE DOWNSTREAM RISER.
11. CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES.
12. COPPER FITTINGS SHALL BE CONNECTED WITH LEAD-FREE SOLDER JOINT.
13. TRANSITION FROM "K" COPPER TO OTHER APPROVED PIPING MATERIAL SHALL BE IN THE HORIZONTAL PIPING A MINIMUM OF 12" BELOW GRADE.

DETAIL NO.
P1354



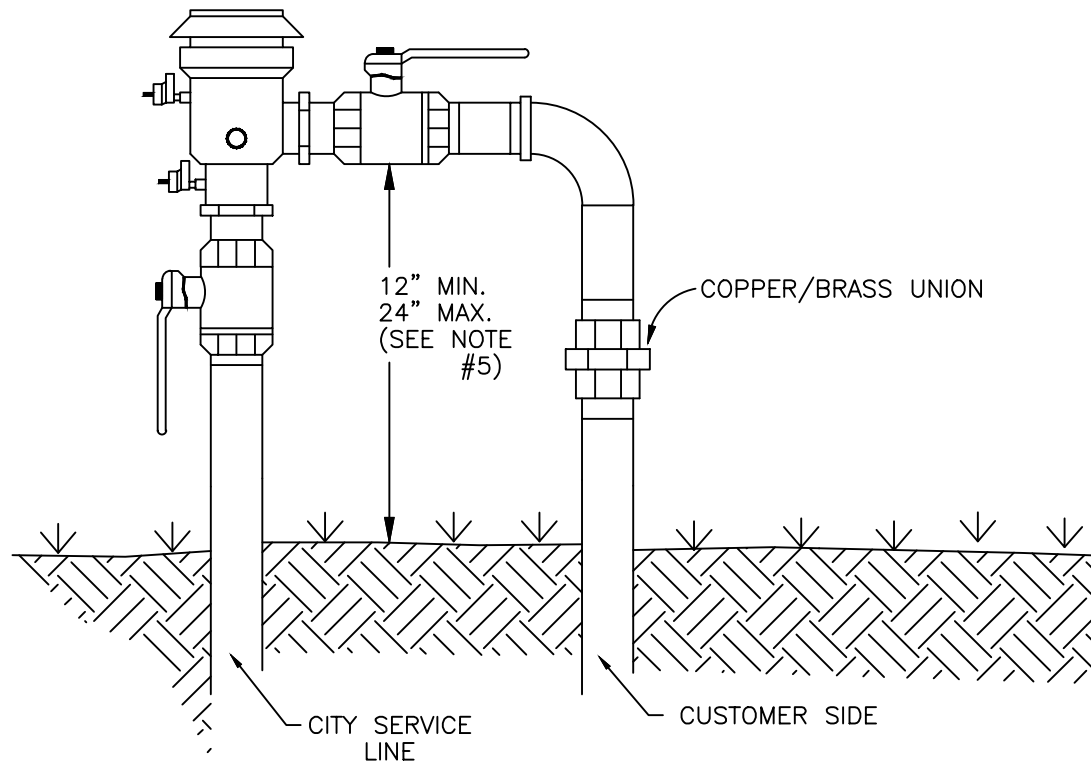
City of Phoenix
STANDARD DETAIL

REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION
ASSEMBLY INSTALLATION - 2 1/2" AND UNDER

APPROVED

Maria S. Delamando
CITY ENGINEER
6/27/01
DATE

DETAIL NO.
P1354



NOTES:

1. CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED PRESSURE VACUUM BREAKER ASSEMBLIES.
2. ASSEMBLY SHALL BE APPROVED BY U.S.C. FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH.
3. TWO (2) TEST COCKS SHALL BE FITTED WITH BRASS PLUGS INSTALLED WITH TEFLON TAPE.
4. SHUTOFF BALL VALVES MUST BE RESILIENT SEATED VALVES AS PER U.S.C..
5. ASSEMBLY MUST BE INSTALLED 12 INCHES ABOVE THE HIGHEST OUTLET ON THE SYSTEM. IF THE DISTANCE EXCEEDS 24 INCHES A REDUCED PRESSURE BACKFLOW PREVENTION ASSEMBLY MUST BE USED.
6. ALL PIPE/FITTINGS TO BE TYPE "K" COPPER.
7. A COPPER/BRASS UNION MUST BE INSTALLED IN THE MIDDLE OF THE DOWNSTREAM RISER.
8. INSTALL THE BACKFLOW PREVENTION ASSEMBLY IMMEDIATELY DOWNSTREAM OF THE CITY WATER METER.
9. COPPER FITTINGS TO BE CONNECTED WITH LEAD-FREE SOLDER JOINTS.
10. TRANSITION FROM "K" COPPER TO OTHER APPROVED PIPING MATERIALS SHALL BE IN THE HORIZONTAL PIPING A MINIMUM OF 12" BELOW GRADE.

DETAIL NO.
P1355



City of Phoenix
STANDARD DETAIL

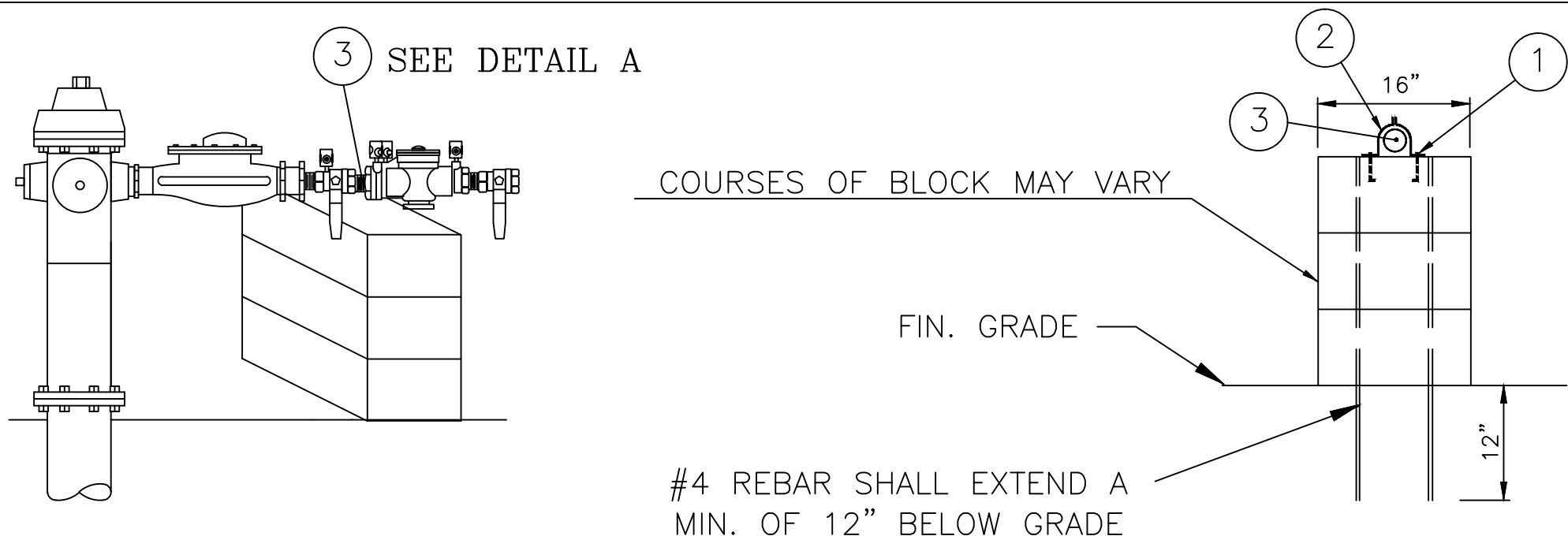
PRESSURE VACUUM BREAKER ASSEMBLY
INSTALLATION - 2" AND UNDER

APPROVED

Maria S. Delamando
CITY ENGINEER

6/27/01
DATE

DETAIL NO.
P1355



Detail A

NOTES:

1. SECURE BACKFLOW ASSEMBLY WITH APPROVED ANCHORS TO 8"X8"X16" TYPE "B" CONCRETE FILLED BLOCK WITH 2 #4 REBARS. ASSEMBLY SHALL BE TESTED BY CERTIFIED BACKFLOW TESTER.
2. 2-PIECE CLAMP WITH APPROVED ANCHORS.
3. BACKFLOW ASSEMBLY FOR USE WITH DETAIL P1354.
4. CONTACT CITY OF PHOENIX DEVELOPMENT SERVICES DEPARTMENT, CROSS-CONNECTION CONTROL FOR A LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES.

DETAIL NO.
P1356



City of Phoenix
STANDARD DETAIL

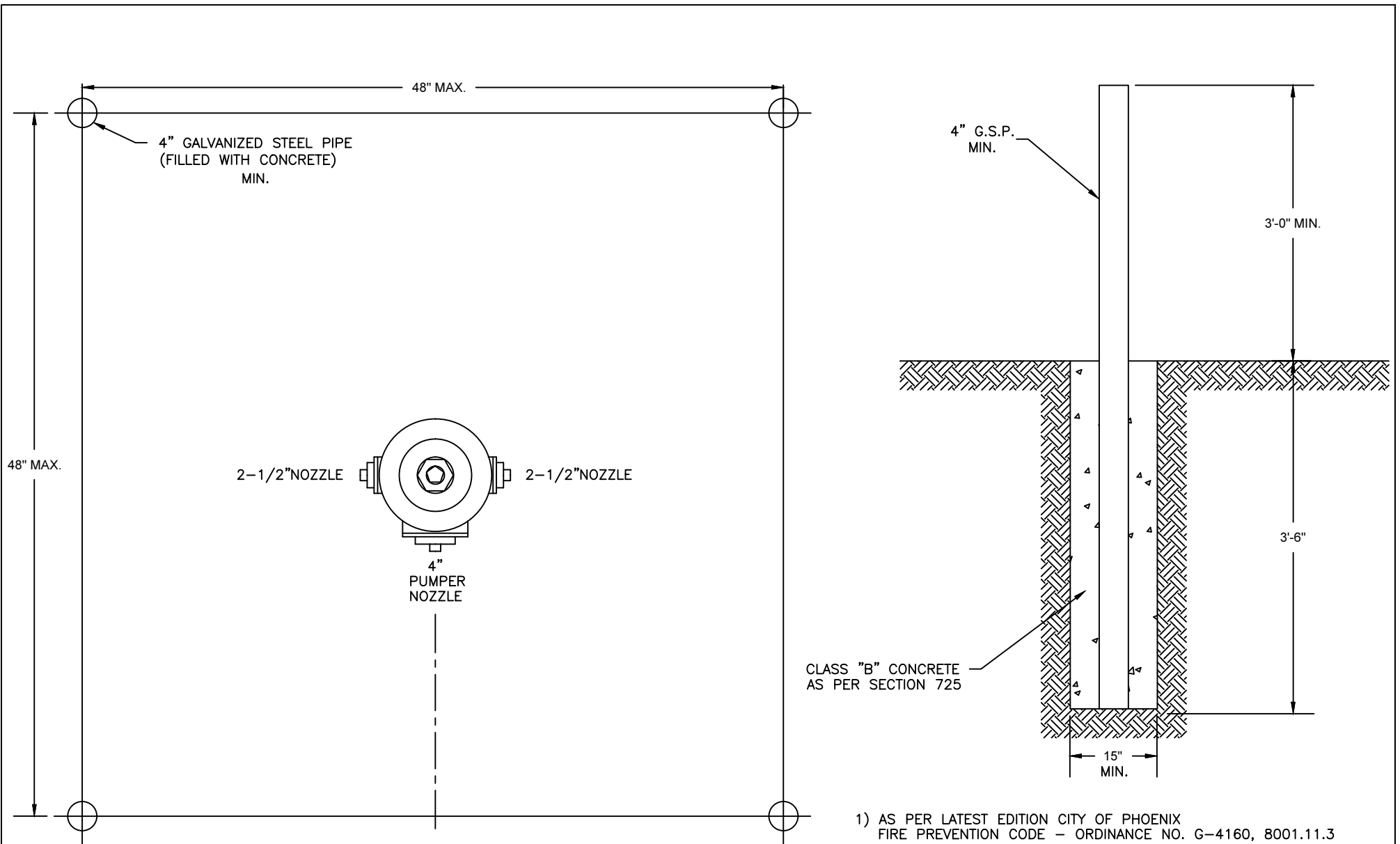
TEMPORARY SUPPORT FOR
FIRE HYDRANT BACKFLOW ASSEMBLY

APPROVED

Maria S. Adame
CITY ENGINEER

6/27/01
DATE

DETAIL NO.
P1356



DETAIL NO.
P1359



City of Phoenix
STANDARD DETAIL

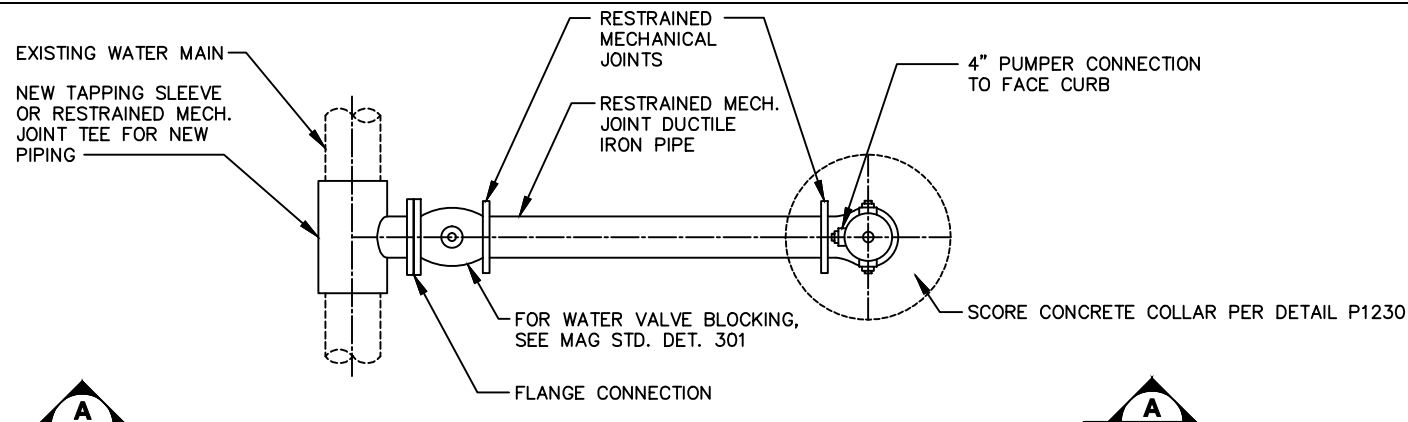
HYDRANT GUARDS

APPROVED

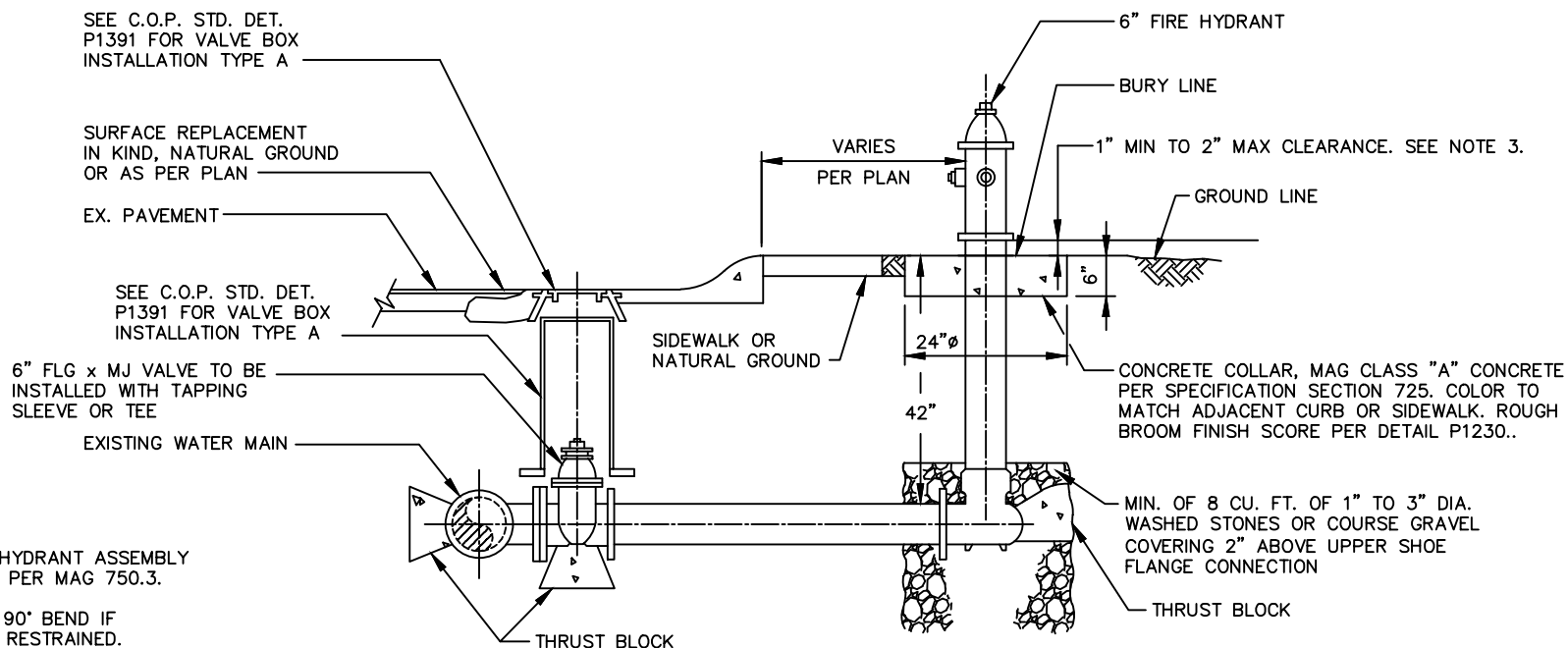
Maria S. Delamando
CITY ENGINEER

6/27/01
DATE

DETAIL NO.
P1359



PLAN VIEW



NOTES:

1. ALL JOINTS IN FIRE HYDRANT ASSEMBLY TO BE RESTRAINED JOINT PER MAG 750.3.
2. REVERSE TAPS AND 90° BEND IF NEEDED SHALL BE FULLY RESTRAINED.
3. FINISHED GRADE IS DEFINED BY ADJACENT NATURAL GROUND, SIDEWALK, PAVEMENT OR CURB. FINISHED GRADE OR NEARBY OBSTRUCTIONS SHALL NOT DENY WRENCH ACCESS TO THE BOTTOM FLANGE BOLTS.

DETAIL NO.
P1360



City of Phoenix
STANDARD DETAIL

FIRE HYDRANT ASSEMBLY

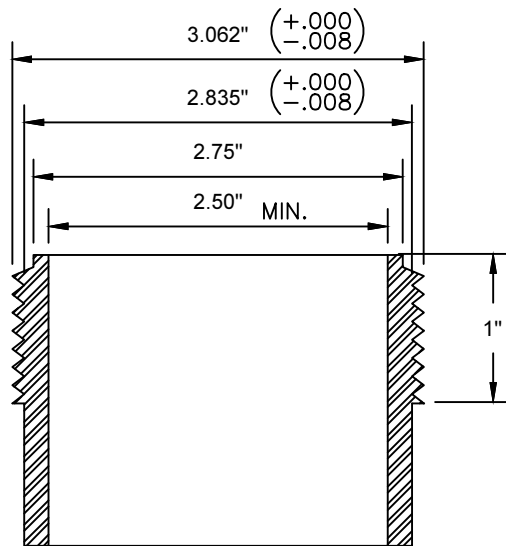
APPROVED

[Signature]
ACTING CITY ENGINEER

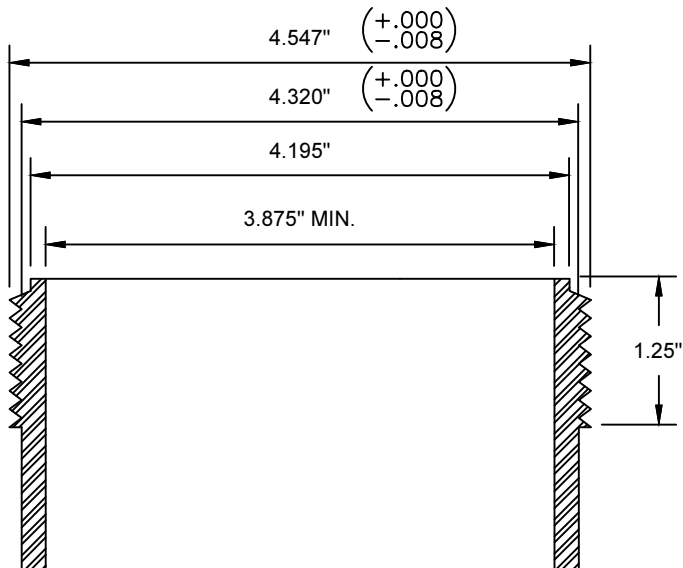
7/31/08
DATE

DETAIL NO.
P1360

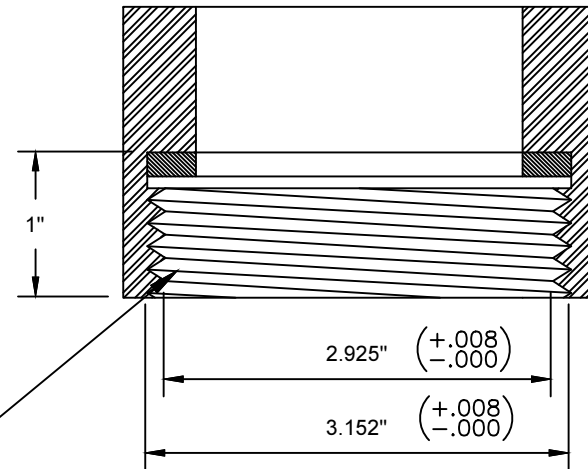
2-1/2" HYDRANT NOZZLE



4" HYDRANT NOZZLE

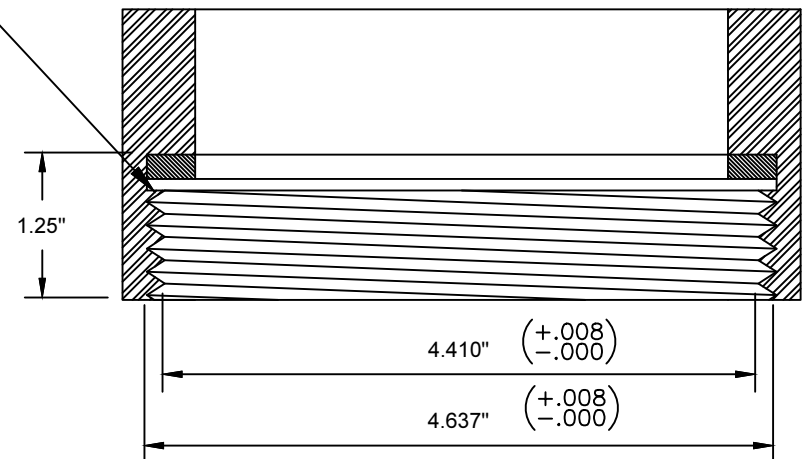


2-1/2" CAP



6 THREADS PER INCH

4" CAP



DETAIL NO.
P1361



City of Phoenix
STANDARD DETAIL

FIRE HYDRANT THREADS
2 1/2" & 4"

APPROVED

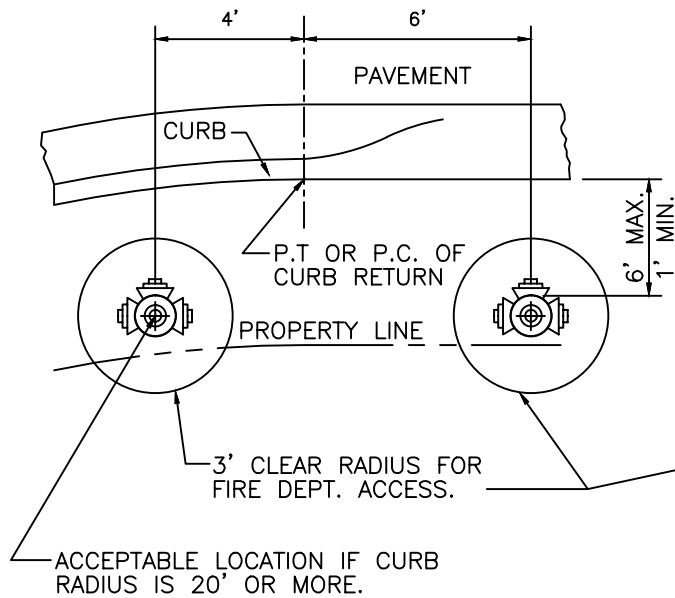
Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

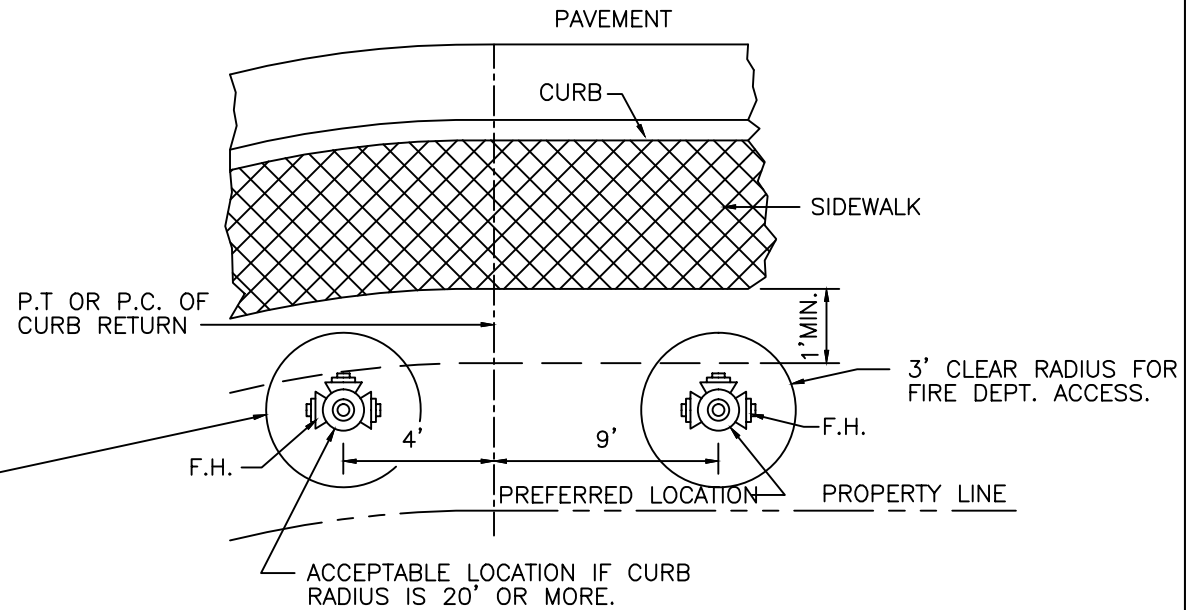
DETAIL NO.
P1361

NOTES:

1. OBSTRUCTIONS SUCH AS UTILITY POLES, STREET SIGNS, IRRIGATION BOXES, FENCES, ETC., MUST NOT BE PLACED BETWEEN CURB AND HYDRANT.
2. DIMENSIONS SHOWN ON CONSTRUCTION DRAWINGS SUPERSEDE LOCATIONS SHOWN HERE.
3. ON LOCATIONS IN MIDBLOCK, THE FIRE HYDRANT WILL BE ALIGNED WITH A PROPERTY LINE.



LANDSCAPE AREA WITH PARKWAY
OR NO SIDEWALK ADJACENT TO CURB



AREA WITH SIDEWALK ADJACENT TO CURB

DETAIL NO.
P1362



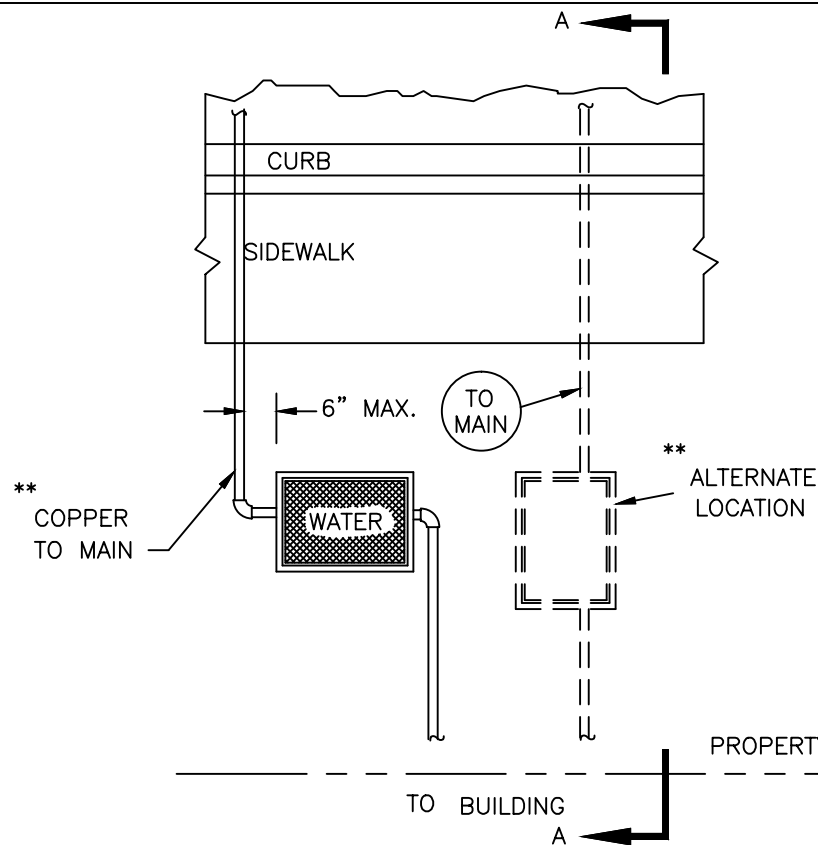
City of Phoenix
STANDARD DETAIL

FIRE HYDRANT LOCATION

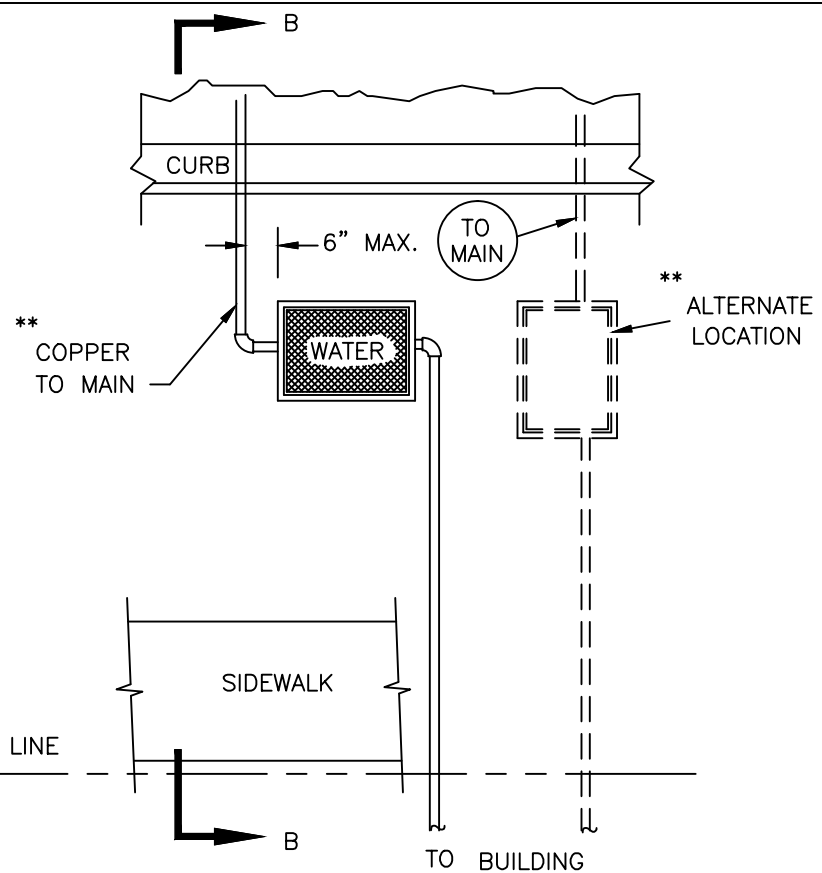
APPROVED

Mano S. Adame
CITY ENGINEER
7/19/04
DATE

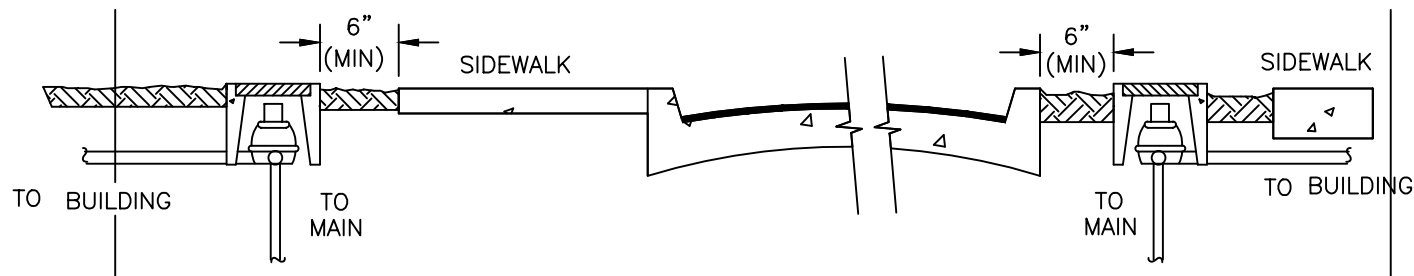
DETAIL NO.
P1362



PLAN VIEW WITH SIDEWALK
ADJACENT TO CURB



PLAN VIEW WITH PARKWAY
OR NO SIDEWALK



SECTION A-A

SECTION B-B

DETAIL NO.
P1363



City of Phoenix
STANDARD DETAIL

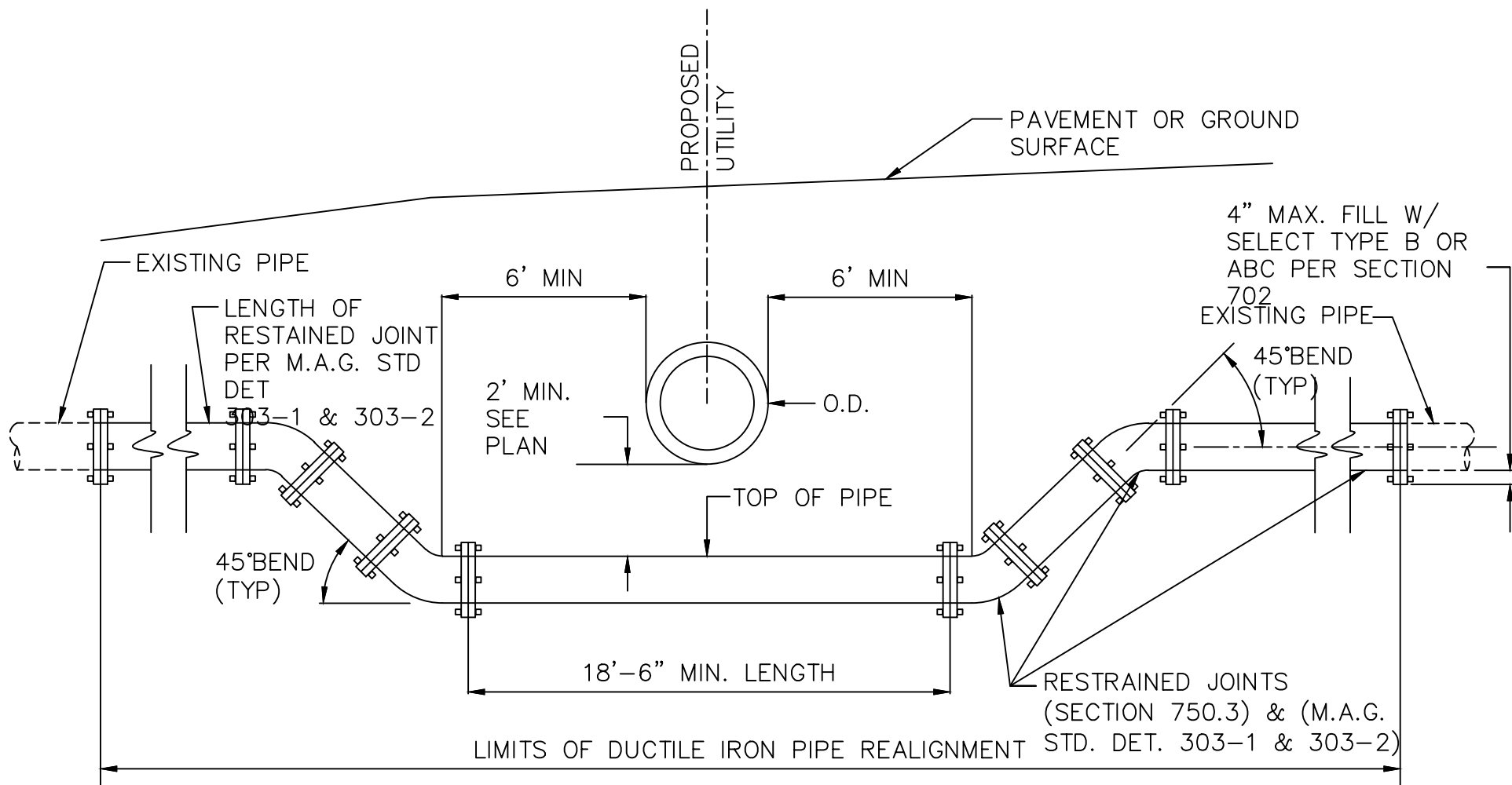
WATER METER LOCATION

APPROVED

Maria S. Delamando
CITY ENGINEER

7/3/00
DATE

DETAIL NO.
P1363



DETAIL NO.
P1370



City of Phoenix
STANDARD DETAIL

VERTICAL REALIGNMENT
OF WATERLINE

APPROVED

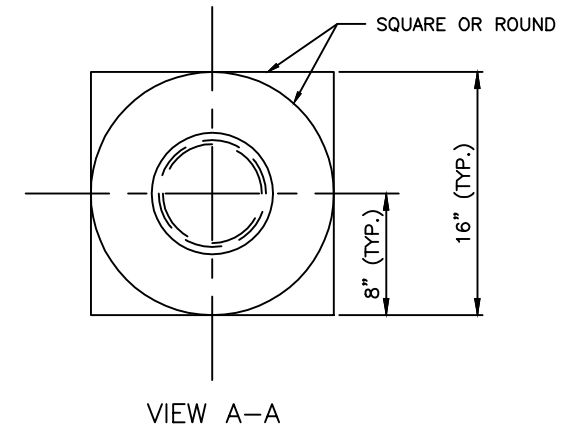
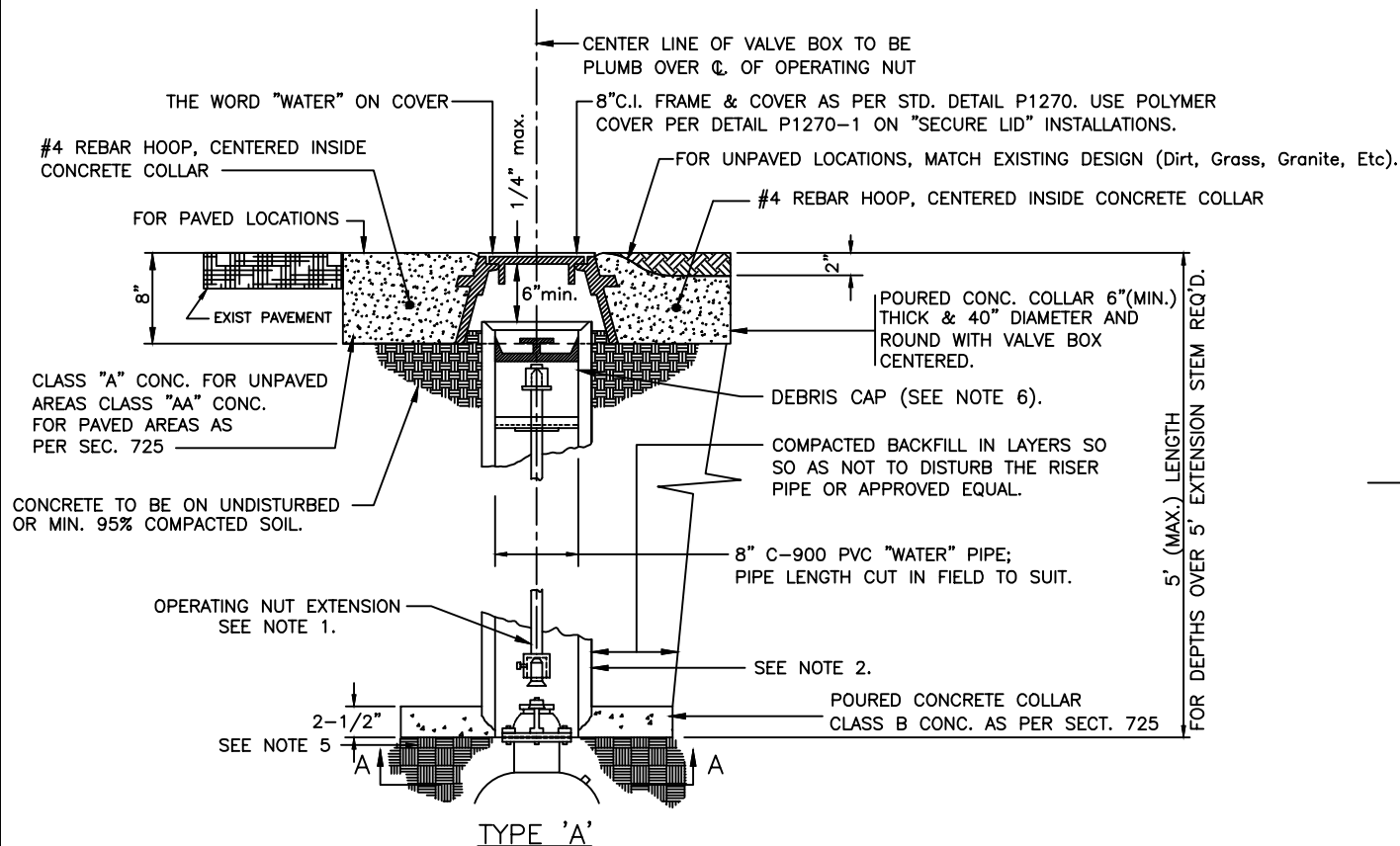
[Signature]
CITY ENGINEER

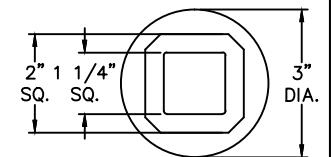
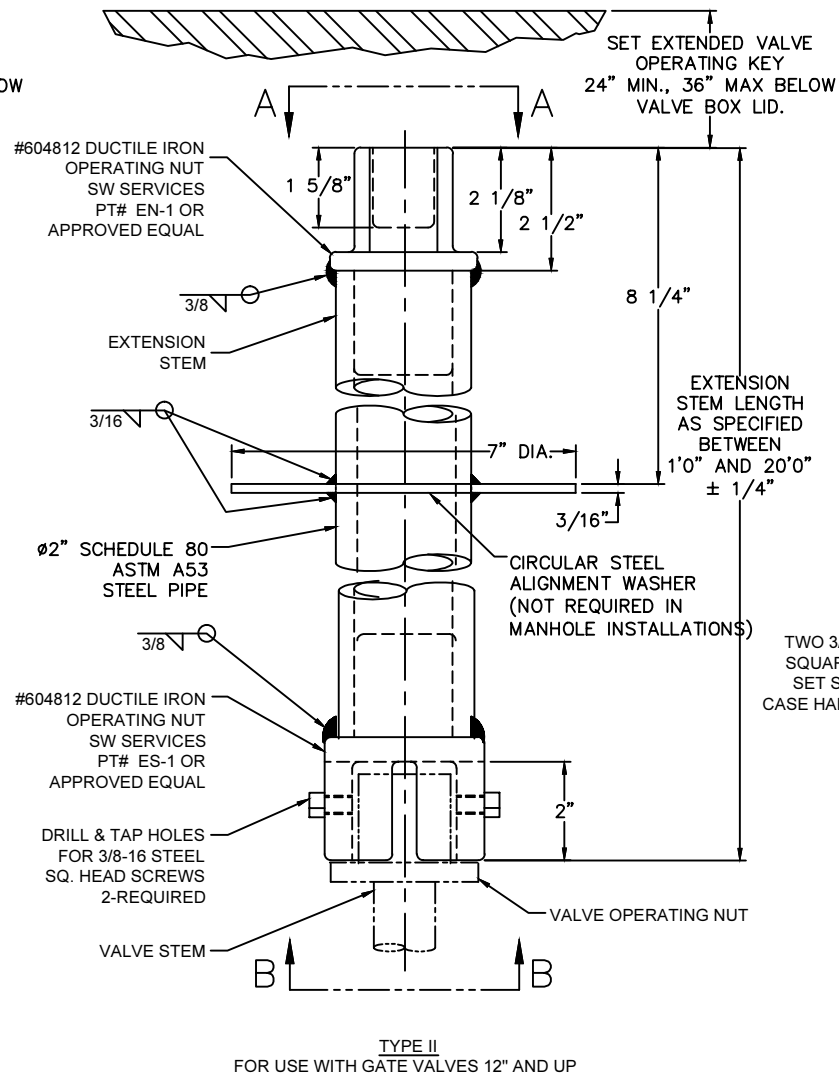
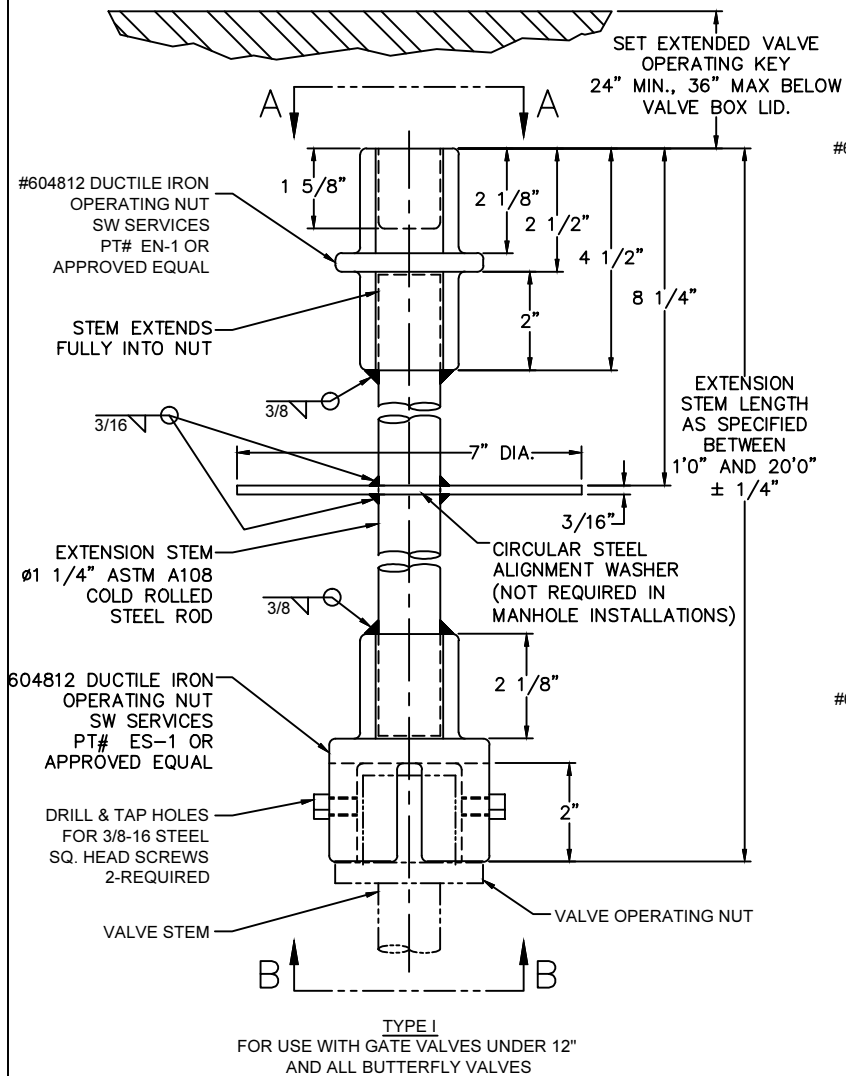
12/10/2012
DATE

DETAIL NO.
P1370

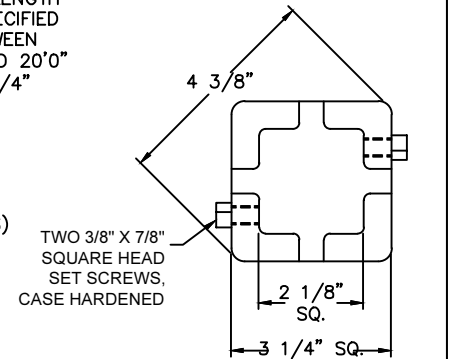
NOTES:

1. VALVE OPERATION NUT EXTENSION: SEE DETAIL P1391-1
EXTENSION TO VALVE STEMS REQUIRED ON ALL VALVES WHERE OPERATING
NUT IS OVER 5' BELOW SURFACE. LENGTH TO FIT EACH INSTALLATION.
2. IF TWO OR MORE JOINTS OF C900 PVC "WATER" PIPE RISER ARE NEEDED, THEY SHALL BE
COUPLED AND GLUED WITH APPROPRIATE PVC GLUE TO FORM A DEBRIS-TIGHT JOINT.
3. VALVE BOX SHALL BE ADJUSTED TO THE FINISH GRADE AFTER PLACING
THE ASPHALTIC CONCRETE SURFACE.
4. USE PARKSON TYLER, APCO, OR EQUAL DEEP SKIRTED COVER LID (4" DEEP OR MORE)
C.I. MIN. T.S. 30,000 P.S.I. USE SECURE POLYMER VALVE BOX LID WITH LID-RETENTION
ELASTOMERIC SEAL PER DETAIL P1270-1 WHERE "SECURE" LIDS ARE SPECIFIED.
5. GROUND BELOW CONCRETE PAD TO BE COMPACTED TO MIN. 95% OF MAX DENSITY.
6. INSTALL DEBRIS CAP PER DETAIL P1165.





VIEW A-A



VIEW B-B

NOTE:

STEM PAINTING:
ALL STEEL TO HAVE PRIME COAT OF PAINT No. 1-D AND ONE HEAVY APPLICATION "FINISH COAT" OF PAINT No. 9 AS PER SECT. 790

DETAIL NO.
P1391-1



City of Phoenix
STANDARD DETAIL

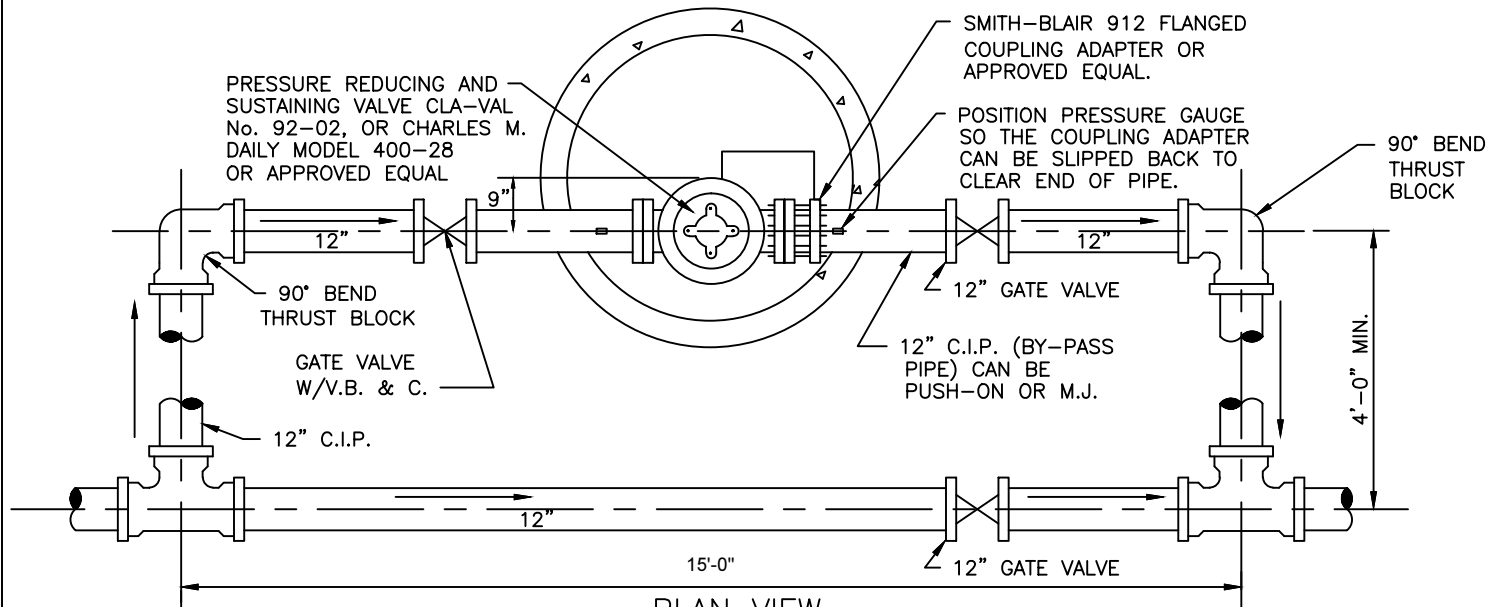
VALVE OPERATING NUT EXTENSION

APPROVED

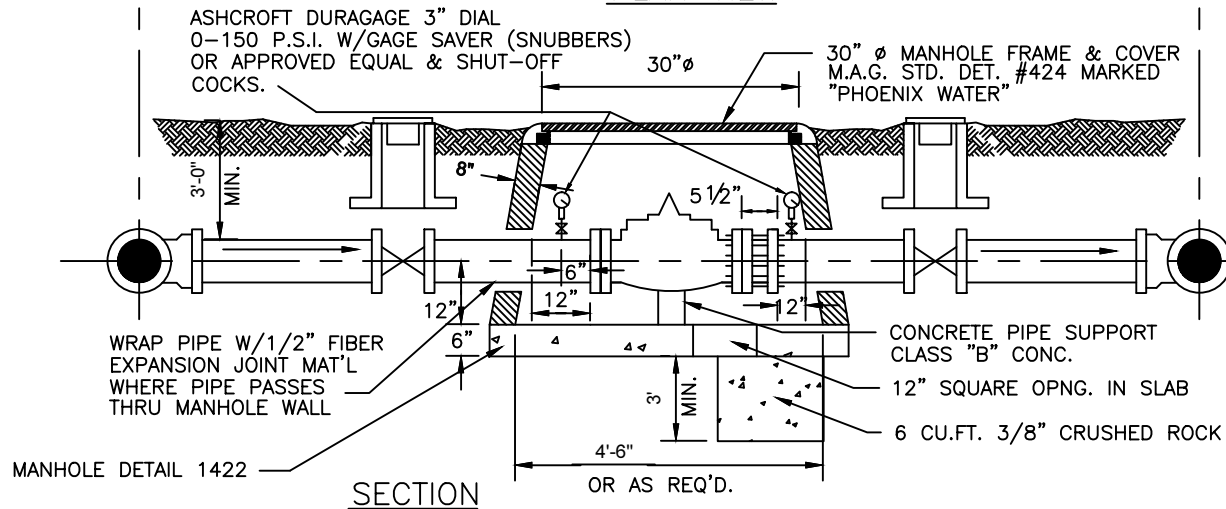
Maria S. Delamando
CITY ENGINEER

6/27/01
DATE

DETAIL NO.
P1391-1



PLAN VIEW



SECTION

NOTES:

1. VALVE SHALL BE IRON BODY, CLASS 125, FLANGED ENDS, HYDRAULICALLY OPERATED, PILOT CONTROLLED, DIAPHRAGM TYPE, GLOVE PATTERNED VALVE. IT SHALL BE TREATED AT 175 P.S.I. MINIMUM PRESSURE.
2. MANUFACTURERS NAME, YEAR OF MANUFACTURE, SIZE OF VALVE AND GUARANTEED WORKING PRESSURE SHALL BE ENGRAVED ON THE VALVE OR ON A NAMEPLATE ATTACHED TO THE VALVE.
3. VALVE SHALL BE OPERATED BY A CONTROL SYSTEM WHICH INCLUDES PILOT CONTROLS FOR PRESSURE REDUCING AND FOR PRESSURE SUSTAINING. BOTH PILOT CONTROLS SHALL BE FIELD ADJUSTABLE FOR ANY PRESSURE IN THE RANGE OF 50-120 P.S.I.

DETAIL NO.
P1394



City of Phoenix
STANDARD DETAIL

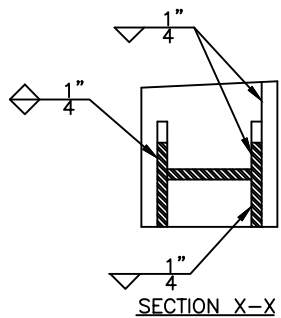
PRESSURE REDUCING & SUSTAINING VALVE

APPROVED

Kenny Whelan
CITY ENGINEER

7/9/92
DATE

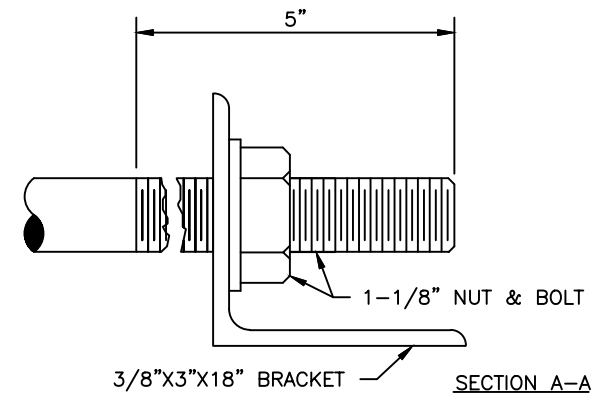
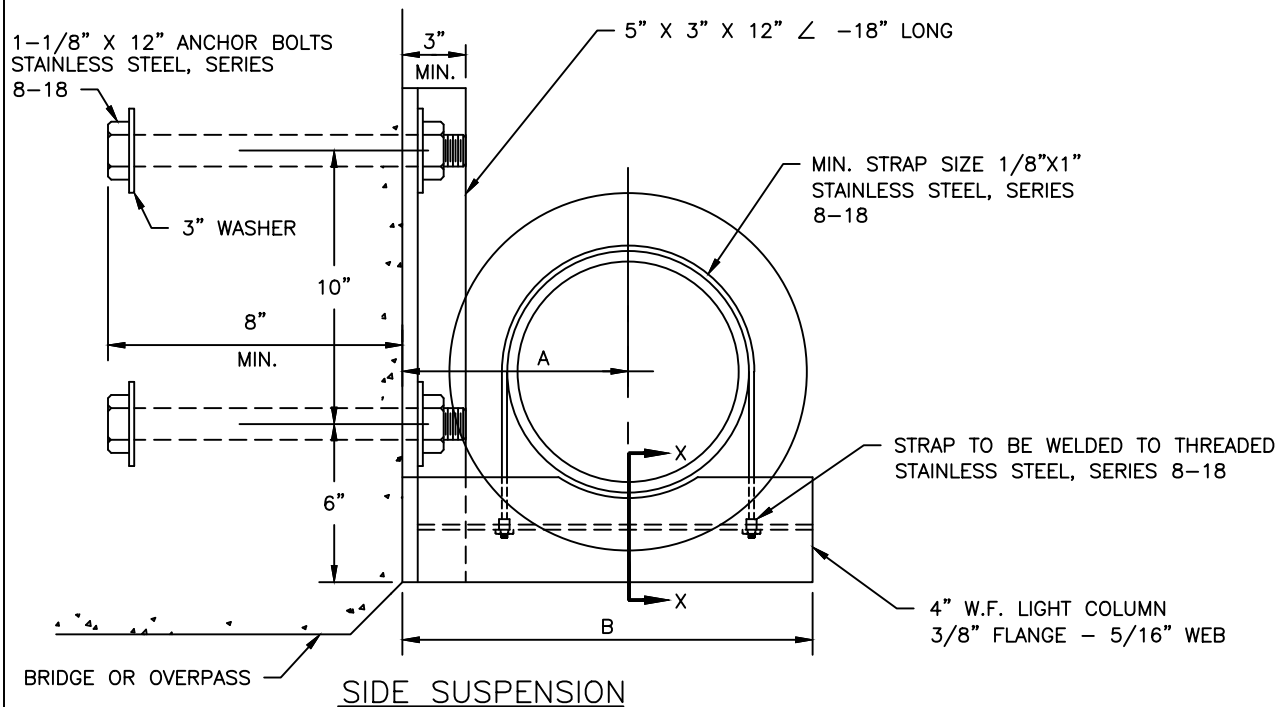
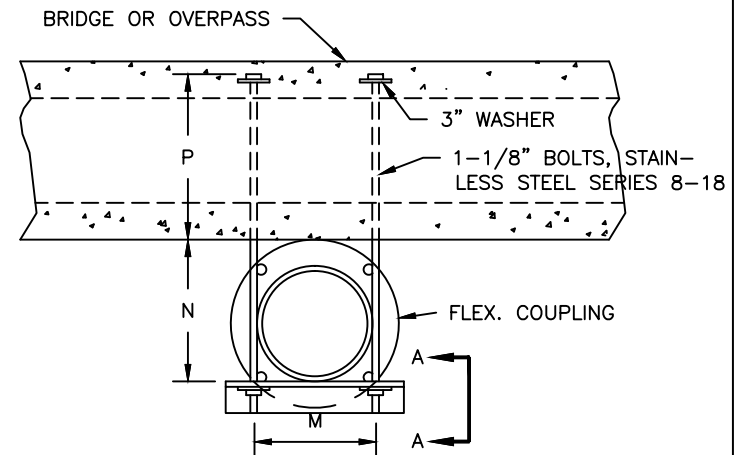
DETAIL NO.
P1394



PIPE SIZE	A	B
8"	8"	15"
10"	9"	17"
12"	10"	19"

NOTES:

1. MINIMUM 2 SUPPORTS PER JOINT OF PIPE.
2. ALL NUTS SHALL BE STAINLESS STEEL SERIES 8-18.
3. ALL BOLTS SHALL HAVE A LOCK WASHER UNDER THE NUT.



PIPE SIZE	M	N	P
8"	10.25"	12"	8"
10"	12.5"	14"	8"
12"	15"	16"	8"

BOTTOM SUSPENSION

DETAIL NO.
P1395



City of Phoenix
STANDARD DETAIL

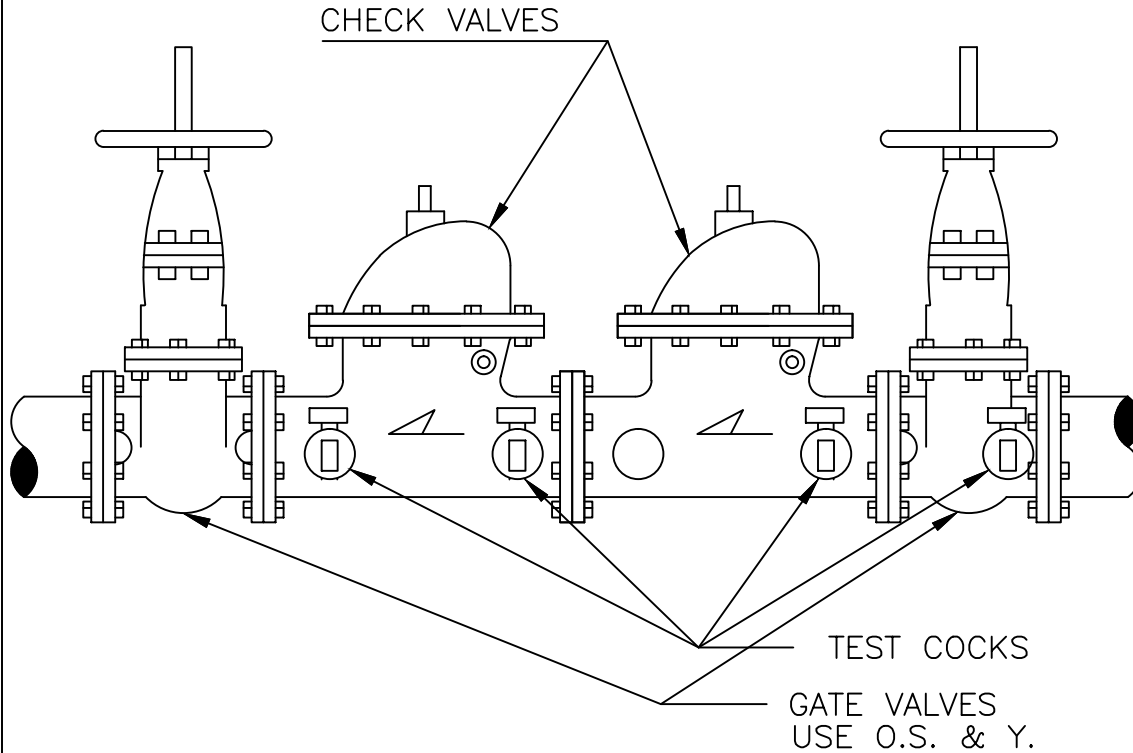
WATER LINE SUSPENSION

APPROVED

Kenny Whitman
CITY ENGINEER

7/9/92
DATE

DETAIL NO.
P1395



NOTES:

1. THE CHECK VALVE SHALL BE LOADED INTERNALLY SO THAT WHEN THE SUPPLY PRESSURE IS 1 P.S.I., AND THE OUTLET PRESSURE IS ATMOSPHERIC, EACH CHECK VALVE WILL BE DRIP-TIGHT IN THE NORMAL DIRECTION OF FLOW.
2. CLAPPER FACING RINGS SHALL BE MOLDED SYNTHETIC RUBBER (SHORE DUROMETER HARDNESS 35-45).
3. ASSEMBLY IS TO MEET A.W.W.A. STANDARD C 506, BACK FLOW PREVENTION DEVICES.
4. PLACEMENT & LOCATION OF DOUBLE CHECK VALVE ASSEMBLY SHALL BE APPROVED BY WATER & WASTEWATER DEPARTMENT.
5. TEST COCKS SHALL HAVE FEMALE ENDS (I.P. THREADS) ON DISCHARGE SIDE.

NOMINAL SIZE OF ASSEMBLY	MINIMUM SIZE TEST COCK
LESS THAN OR EQUAL TO 2"	1/4"
2 1/2" - 4"	1/2"
6" & OVER	3/4"

DETAIL NO.
P1396



City of Phoenix
STANDARD DETAIL

DOUBLE CHECK VALVE ASSEMBLY

APPROVED

Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

DETAIL NO.
P1396



7/8" DIA. VENT
HOLE
1 OPEN
PICKSLOT

OPEN PICKSLOT



7/8" DIA. VENT
HOLE
(2) CONCEALED
PICKSLOTS

CONCEALED PICKSLOT

NOTES:

1. ALL LIDS AND FRAMES TO BE FURNISHED WITH MACHINED HORIZONTAL BEARING SURFACES.
2. MEET H-20 LOAD RATING REQUIREMENTS.
3. WATERTIGHT COVERS SHALL BE FURNISHED WITH T-GASKET IN FRAME OR COVER.
4. ADJUST WORDING TO "PHOENIX WATER," AS NECESSARY.



NO VENT
HOLE
(2) CONCEALED
PICKSLOTS

WATERTIGHT



(4) 1/2" X 2" 5. SEE MAG DETAIL NUMBERS: 423 & 424
HEX-HEAD FOR ADDITIONAL REQUIREMENT.
S.S. BOLTS &
WASHERS
NO VENT
HOLE
(2) CONCEALED
PICKSLOTS

BOLTDOWN WATERTIGHT

DETAIL NO.
P1424



City of Phoenix
STANDARD DETAIL

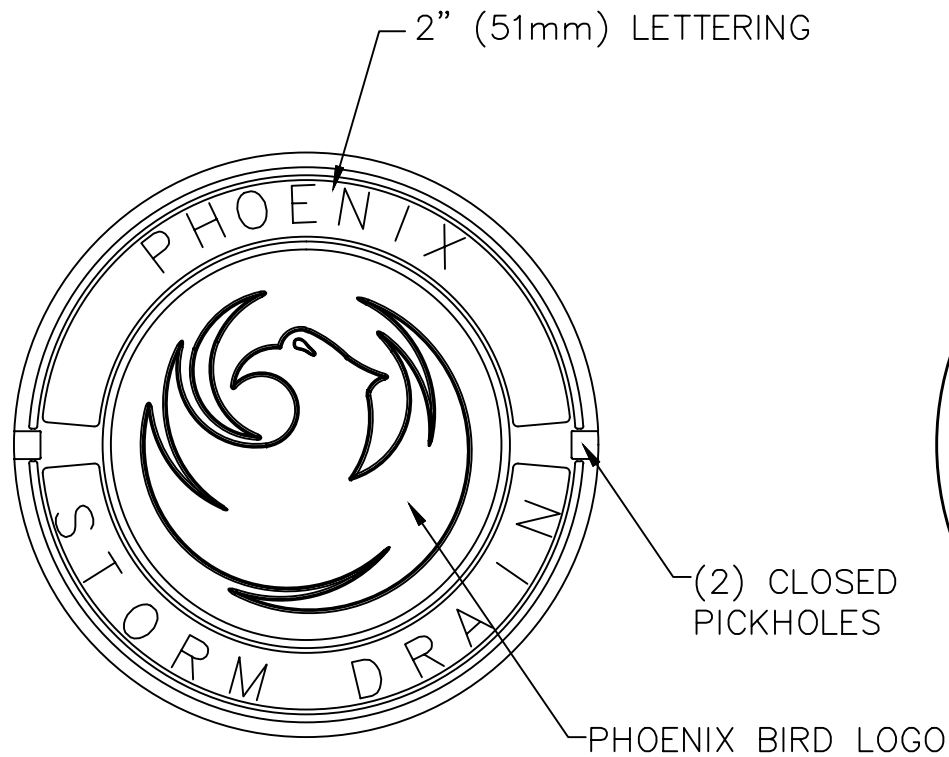
24" & 30" MANHOLE COVERS

APPROVED

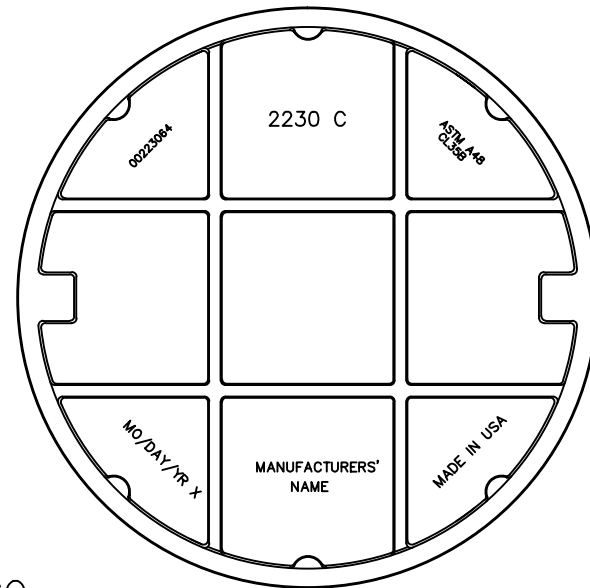
[Signature]
CITY ENGINEER

12/10/2012
DATE

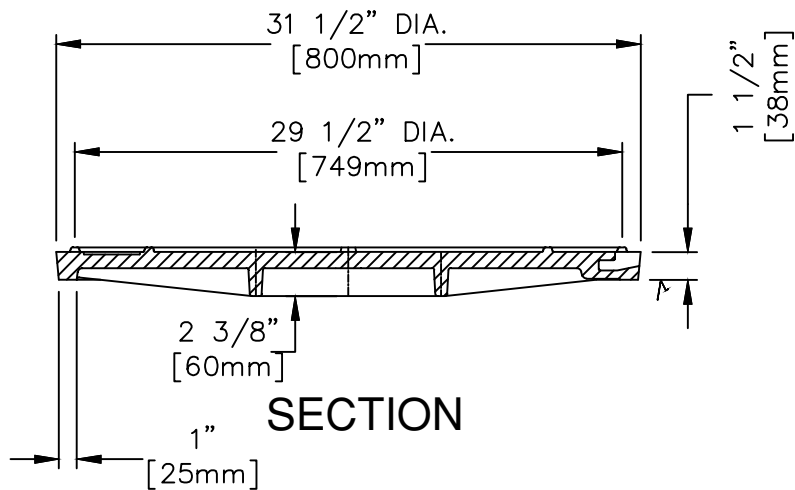
DETAIL NO.
P1424



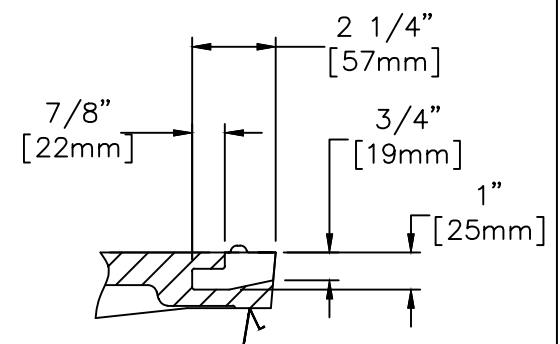
PLAN VIEW



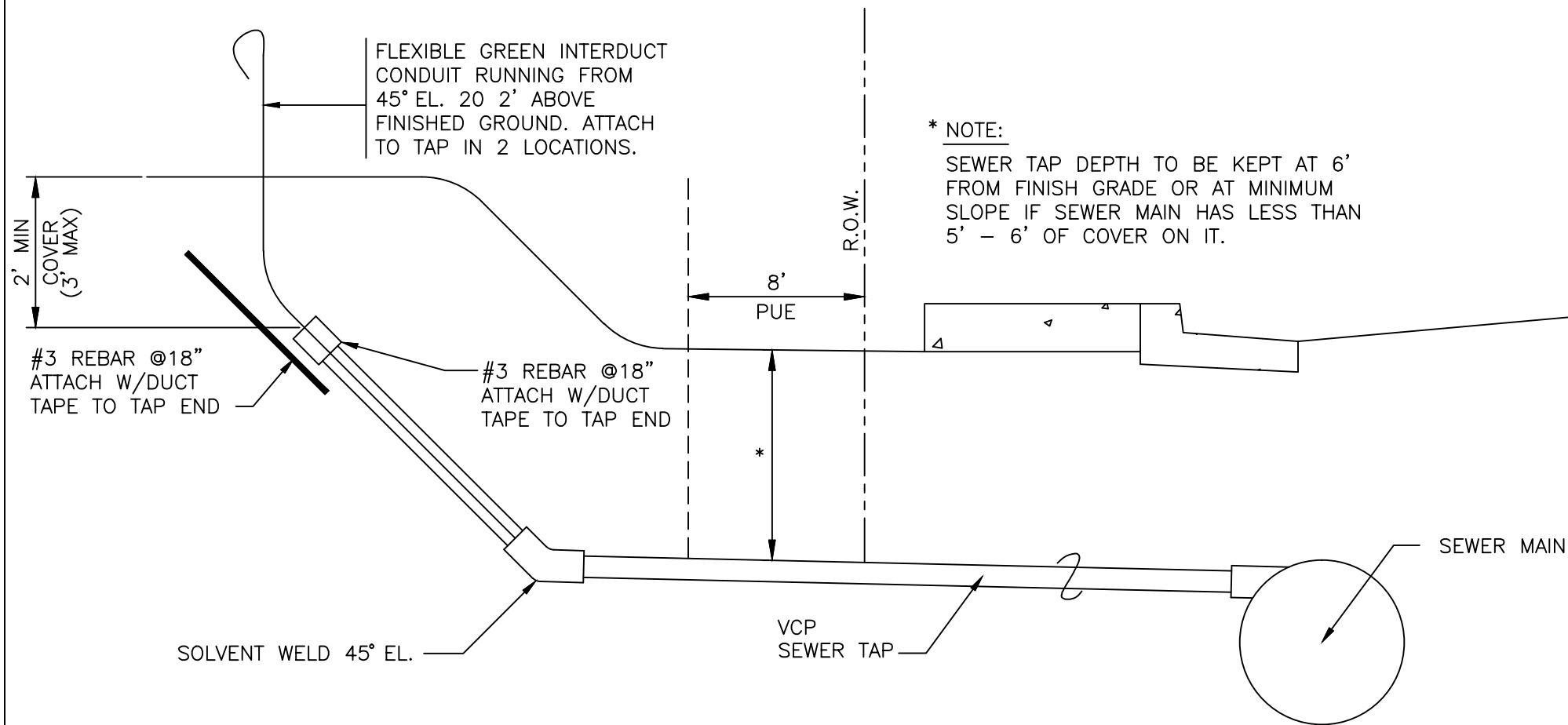
BOTTOM VIEW



NOTES:
Surface of Manhole Cover
to be machined.



PICKHOLE DETAIL



DETAIL NO.
P1431



City of Phoenix
STANDARD DETAIL

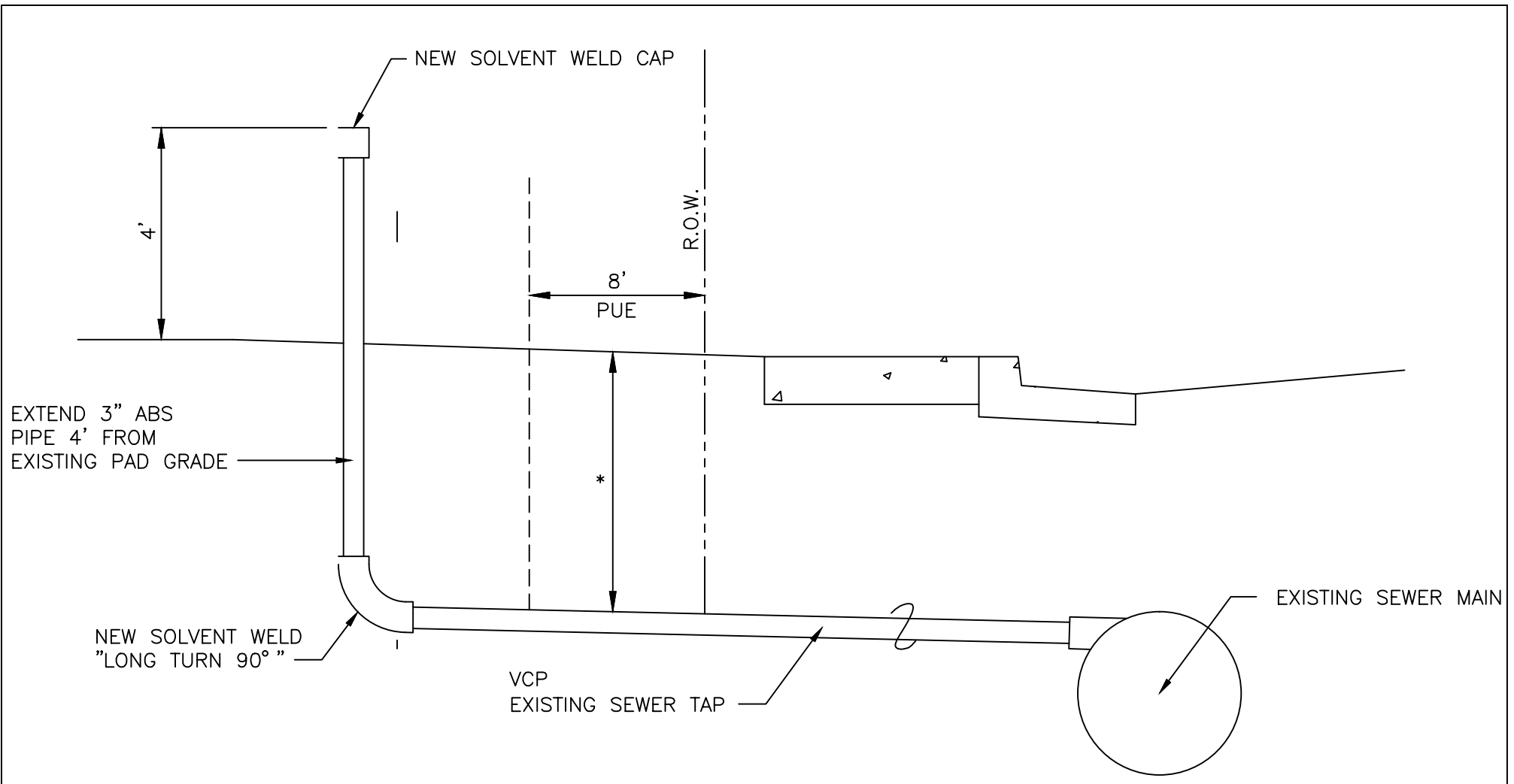
SEWER TAP DEPTH & MARKING

APPROVED

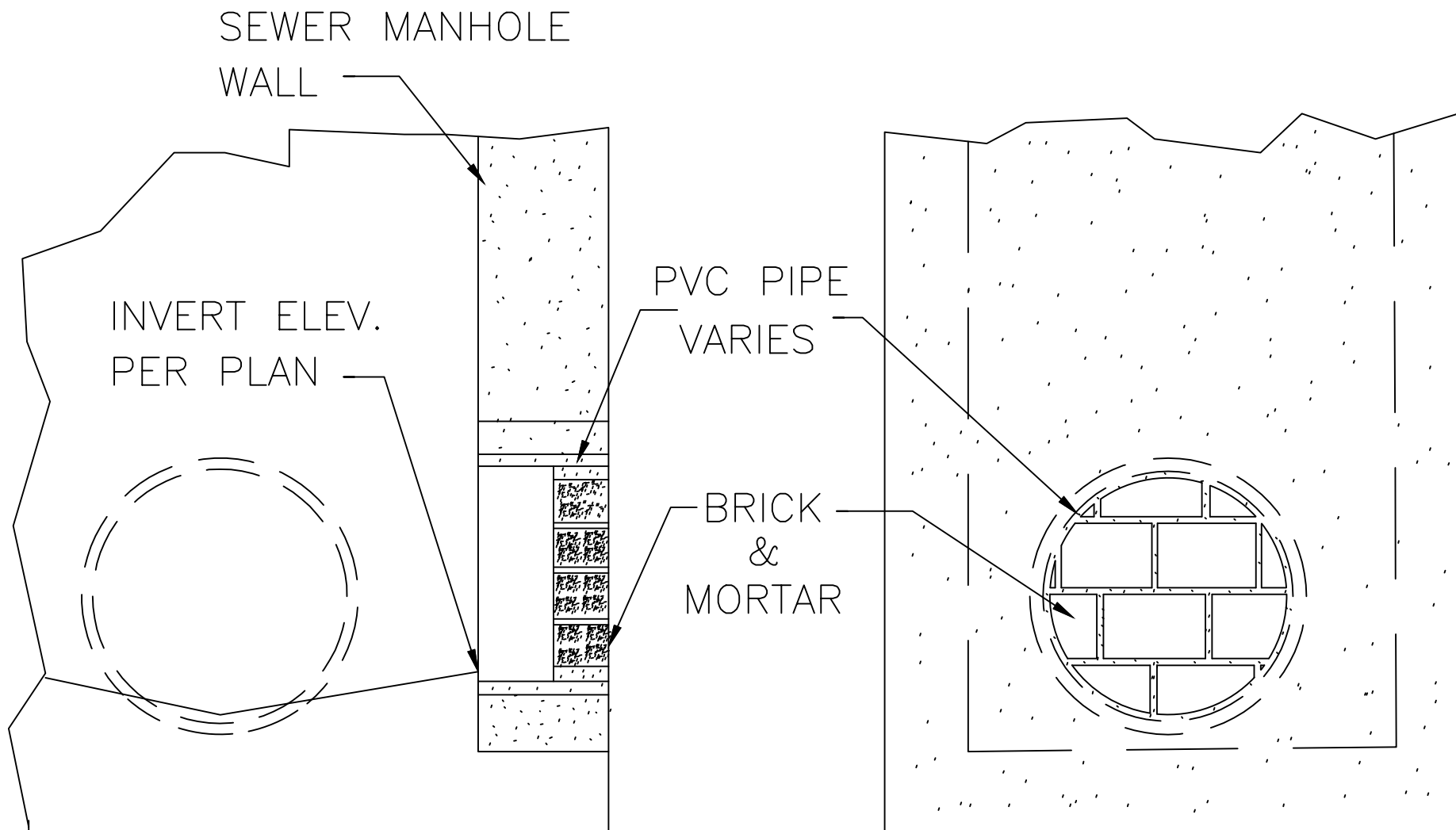
Michael J. Connell
FOR CITY ENGINEER

8/6/99
DATE

DETAIL NO.
P1431



* NOTE:
 HOME SEWER LINE WOULD
 TIE INTO NEW VERTICAL 3" ABS PIPE
 APPROXIMATELY 2' - 3' BELOW
 PAD GRADE. CLEAN OUT CAP WOULD
 ALSO BE PROVIDED AT TOP OF
 VERTICAL PIPE. (NEW PERMIT REQUIRED)
 APPROXIMATELY 2' - 3' BELOW



NOTE:

- 1) FOR FUTURE VCP or DUCTILE IRON PIPE INSTALLATION.
- 2) THE PVC DIAMETER SHALL BE THE NEXT SIZE LARGER (2" MINIMUM) THAN THE PROPOSED FUTURE PIPE CONNECTION.

DETAIL NO.
P1435



City of Phoenix
STANDARD DETAIL

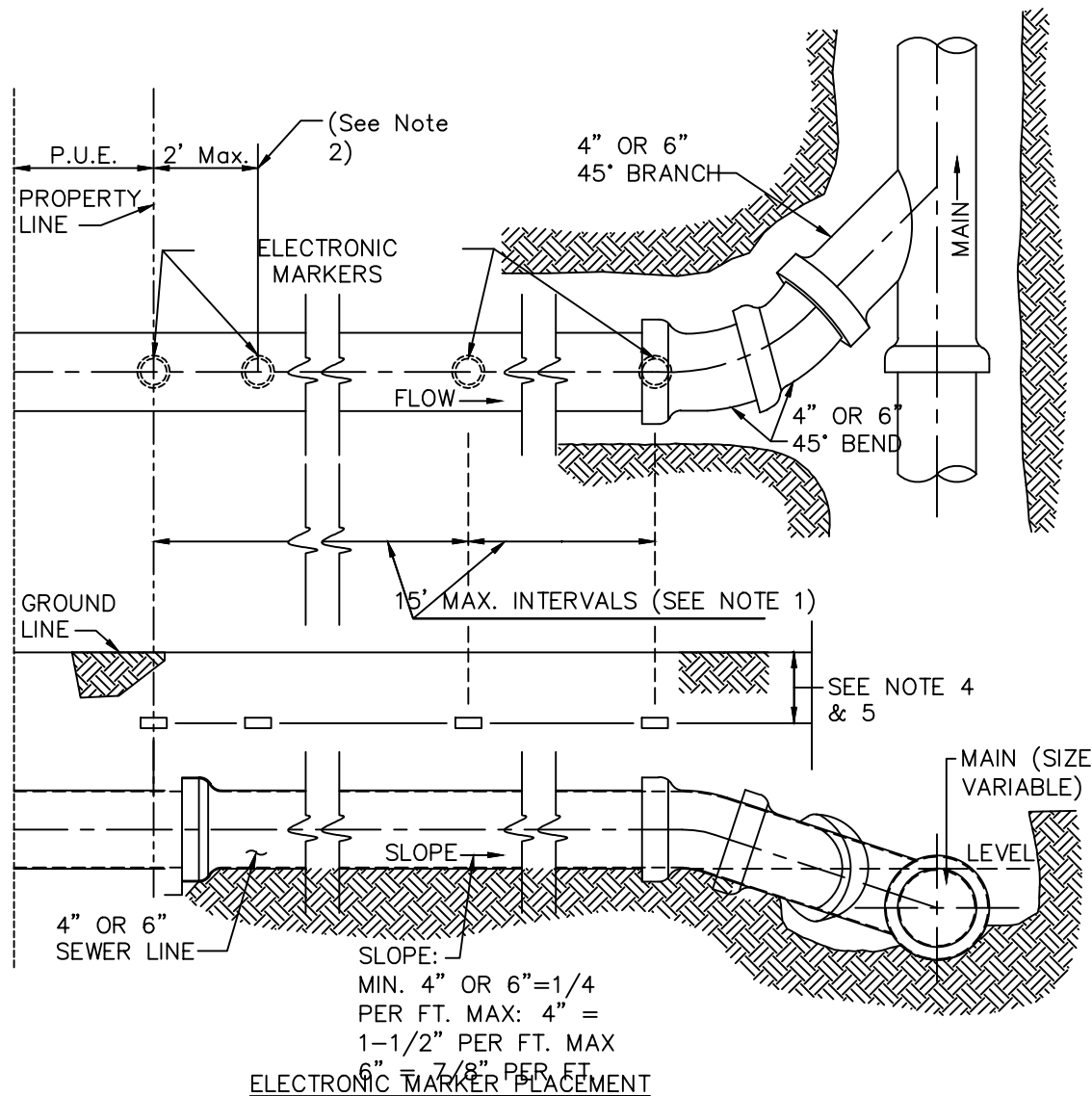
SANITARY SEWER
MANHOLE KNOCKOUT

APPROVED

Maria S. Delamando
CITY ENGINEER

7/19/04
DATE

DETAIL NO.
P1435



NOTES:

1. Electronic markers shall be installed at the tap, at the property line and at all changes in horizontal direction, if any, over all building connection sewers. Additional markers shall be installed as necessary so that maximum spacing between markers shall not exceed 15 feet.
2. Markers at property line may be installed at up to 2 feet from property line into right-of-way if a fence or other obstruction is anticipated to be constructed on property line.
3. Markers shall be 3M 1253 Full Range (potty seats) capable of detection at up to 8 feet of bury, or equal.
4. Markers shall be installed in a horizontal position centered over the sewer with a 6-inch cushion of soil between pipe and marker when building sewer is 8 feet or less in depth to finish grade.
5. If building connection sewer has over 8 feet of cover, marker shall be positioned over center of sewer and buried at 7 to 8 feet of depth from finish grade.
6. Backfill material within 6-inches of any marker shall sand or well graded material with a maximum aggregate size of 1-inch.
7. Construct building connection sewer at minimum slope if cover will be less than 5 feet at the property line.
8. Aside from wye connection at tap, vertical adjustments of the building connection are not allowed in the right-of-way.
9. All fittings shall be installed in accordance with ASTM D-2321. The Contractor may vary from the drawing to use the appropriate wyes and bends to ensure no misalignment of the pipe and fittings. Joints deflections shall not exceed more than one half of manufacturer's recommendations.
10. End of building connection sewer at property line shall be sealed and marked with 2"x 4" stake extending a minimum of 2 feet above finish grade. The top six inches of the stake shall be painted green.
11. A curb stamp shall be provided per MAG Detail 440-4.

DETAIL NO.
P1440



City of Phoenix
STANDARD DETAIL

SEWER BUILDING CONNECTION
& ELECTRONIC MARKERS

APPROVED

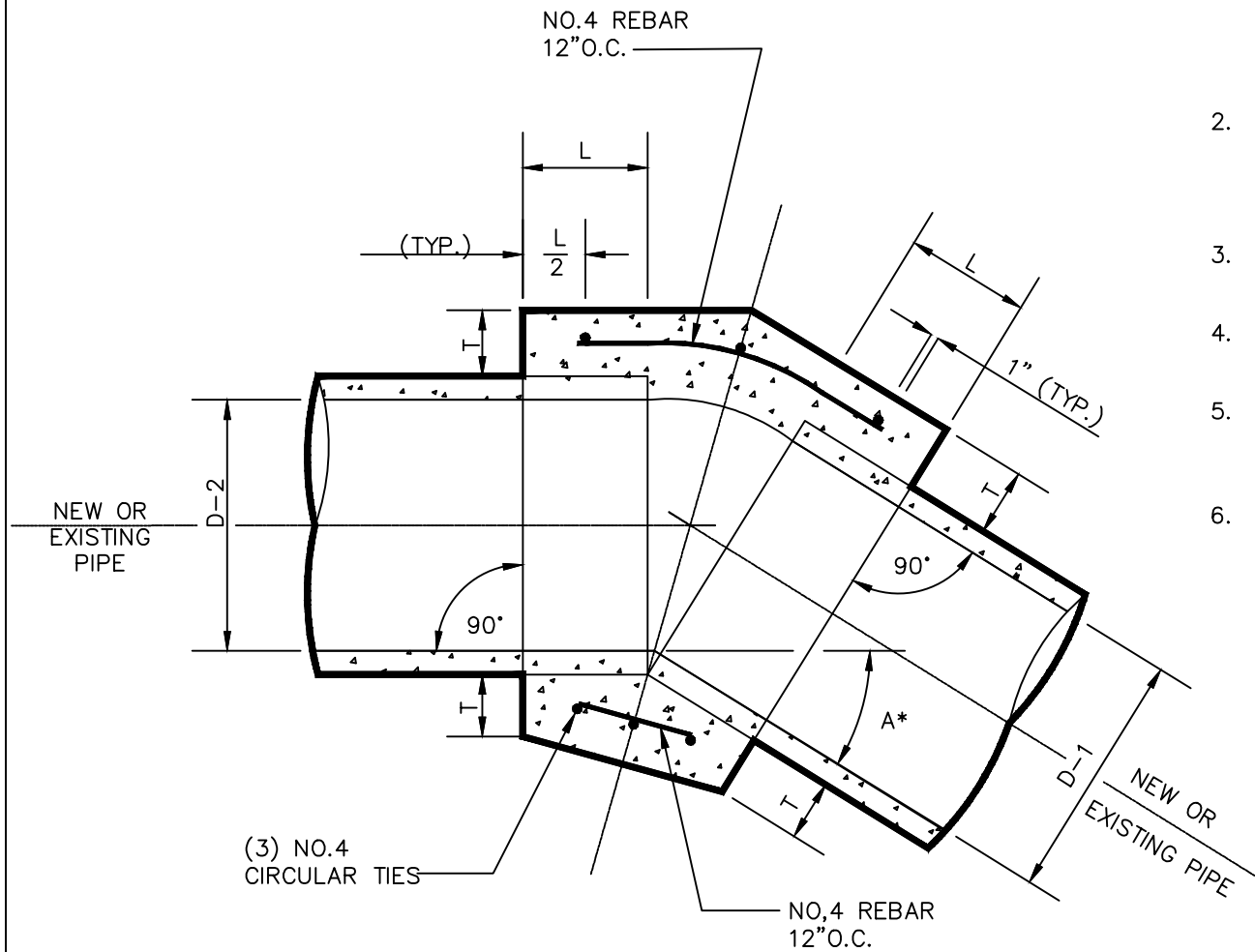
[Signature]
CITY ENGINEER

12/10/2012
DATE

DETAIL NO.
P1440

NOTES:

1. A CONCRETE COLLAR IS REQUIRED WHERE PIPES OF DIFFERENT DIAMETERS OR MATERIALS ARE JOINED, OR WHERE THE CHANGE IN ALIGNMENT OR GRADE EXCEEDS THAT ALLOWED FOR, ON ORDINARY JOINTS.
2. WHERE PIPES OF DIFFERENT DIAMETERS ARE JOINED WITH A CONCRETE COLLAR, L AND T SHOULD BE THOSE OF THE LARGER PIPE, D-D-1, OR D-2 WHICHEVER IS GREATER.
3. FOR PIPE SIZES NOT LISTED AND LESS THAN 66" USE NEXT SIZE LARGER.
4. THE DIAMETER OF THE CIRCULAR TIES SHALL BE OUTSIDE DIAMETER OF PIPE + T.
5. FIELD CLOSURES OF PIPE OF THE SAME DIAMETER AND WITHOUT CHANGE IN GRADE OR ALIGNMENT SHALL BE MADE WITH A CONCRETE COLLAR.
6. CONCRETE SHALL BE CLASS B PER SECT. 725.



* = ANGLE OF DEFLECTION

TABLE		
D	L	T
12"	1.0'	4"
18"	1.0'	5"
24"	1.0'	6"
36"	1.5'	8"
48"	1.5'	10"
57"	1.5'	10"
60"	1.75'	11"
66"	1.75'	11"

DETAIL NO.
P1505



City of Phoenix
STANDARD DETAIL

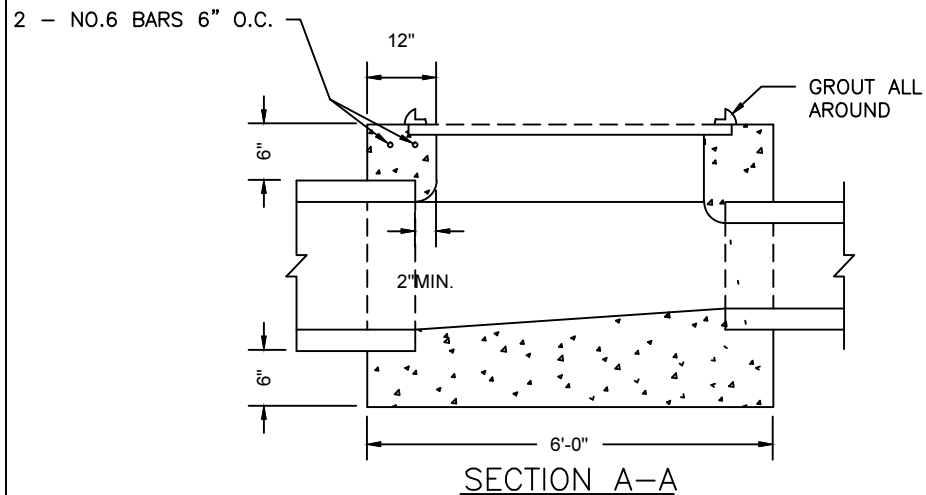
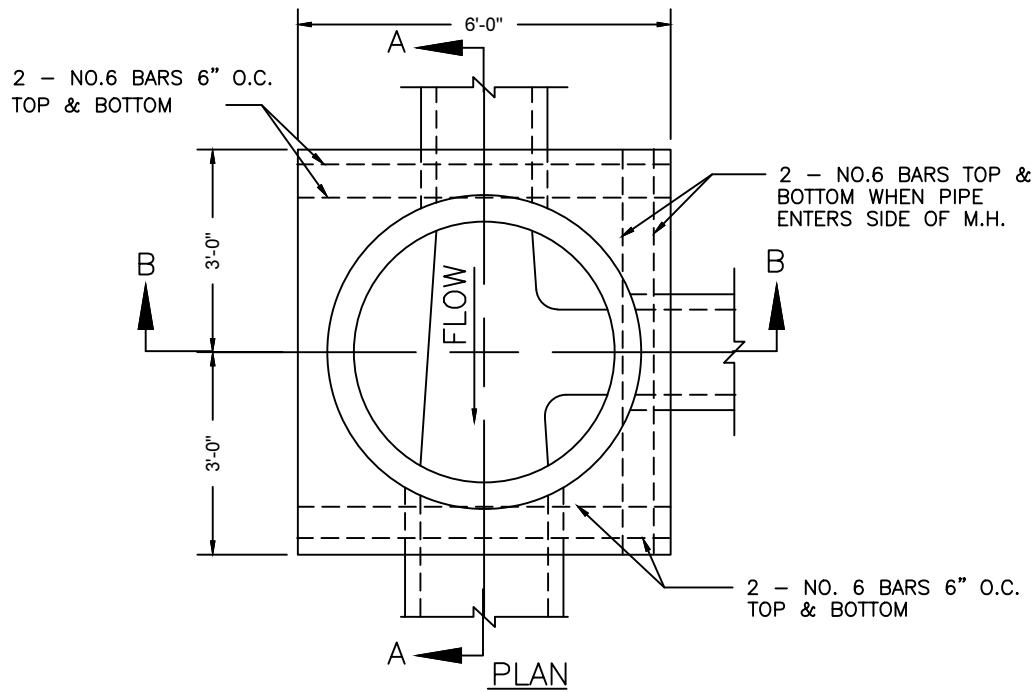
CONCRETE PIPE COLLAR

APPROVED

[Signature]
CITY ENGINEER

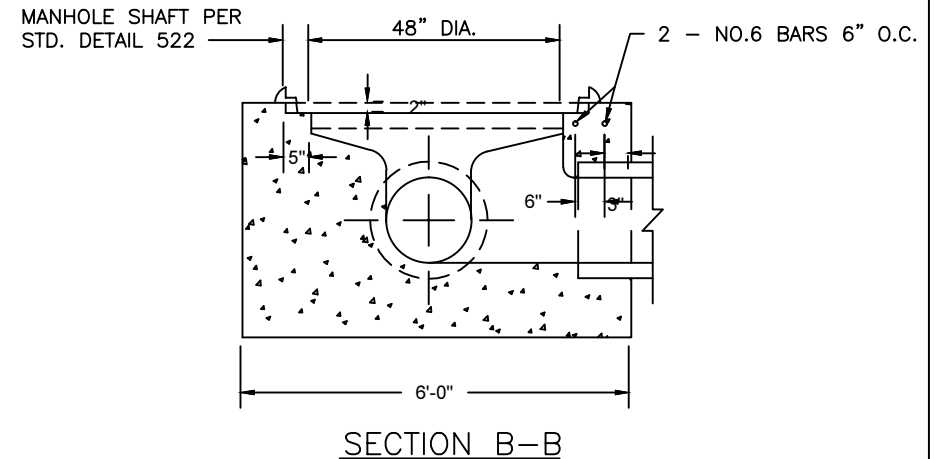
12/10/2012
DATE

DETAIL NO.
P1505



NOTES

1. ALL CONCRETE TO BE CLASS "A" PER SECTION 725.
2. MATCH SPRING LINES OF PIPES ENTERING M.H. UNLESS OTHERWISE NOTED.
3. CUT PIPED TO ALLOW SETTING OF 4' DIA. CYLINDRICAL FORM FROM 6" ABOVE MAIN LINE PIPE TO SPRING LINE. CUT PIPE 2" LARGER THAN FORM TO ALLOW 2" CONC. OVER ENDS OF ALL CUT PIPE.
4. INVERT AND BASE OF M.H. TO BE POURED AND INVERT TO BE SHAPED BY HAND TO MAKE SMOOTH TRANSITION FINISH WITH RUBBER FLOAT.
5. CENTER M.H. ON PIPE JOINT WHERE PIPE CHANGES SIZES.
6. BENCH M.H. BASE TO TOP OF LARGEST PIPE.



DETAIL NO.
P1520



City of Phoenix
STANDARD DETAIL

STORM DRAIN MANHOLE BASE
48" & SMALLER

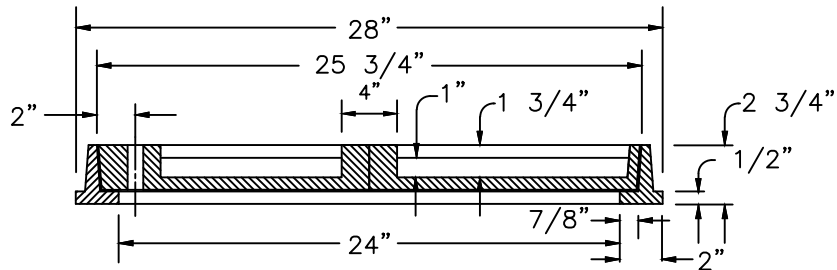
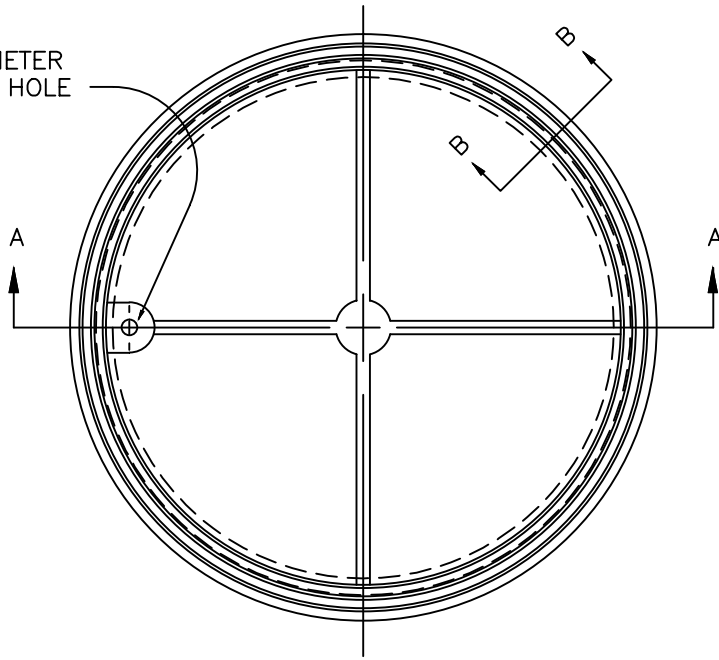
APPROVED

Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

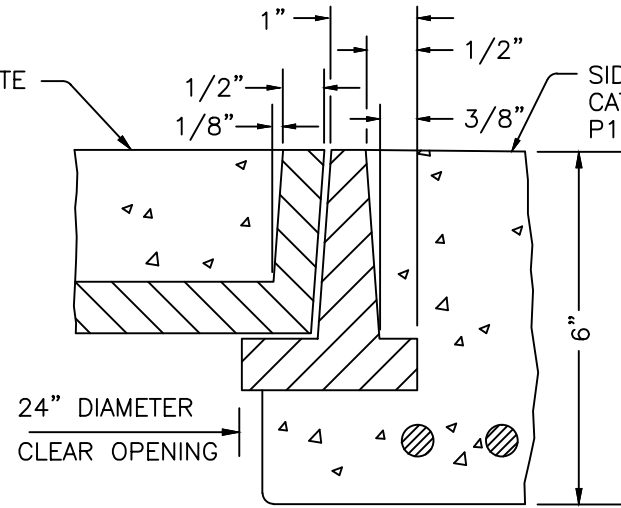
DETAIL NO.
P1520

1" DIAMETER
LIFTING HOLE



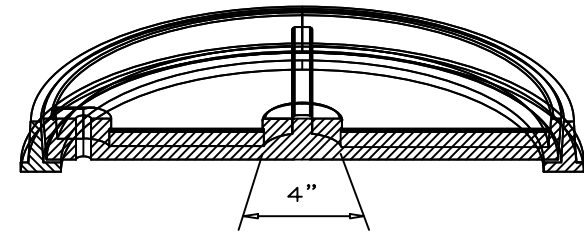
SECTION A - A

CONCRETE
FILLER



SIDEWALK SLAB FOR
CATCH BASIN. SEE
P1569-2 FOR
MODIFICATION
WHEN LOCATED
IN LANDSCAPE
PARKWAY
SECTION.

SECTION B - B



NOTES

1. COVER SHALL BE NON-LOCKING.
2. FRAME AND COVER SHALL BE CAST IRON OR STRUCTURAL STEEL.
3. CATCH BASIN ACCESS FRAME AND COVER IS FOR USE ON NON VEHICULAR TRAFFIC AREAS ONLY.
4. COVER SHALL BE FILLED WITH CONCRETE AND BROOM FINISHED.
5. SMALL VARIATIONS IN DIMENSIONS OR FEATURES OF A MINOR NATURE THAT ARE PART OF THE FOUNDRY'S STANDARD CASTING ARE PERMISSIBLE.

DETAIL NO.
P1561



City of Phoenix
STANDARD DETAIL

FRAME AND COVER
CATCH BASIN ACCESS

APPROVED

[Signature]
ACTING CITY ENGINEER

7/31/08
DATE

DETAIL NO.
P1561

SIZE OF OUTFALL CONDUIT	FRAME ANGLES	SHEAR PIN CLIP ANGLES	SHEAR PINS	ANCHOR BOLTS	HINGE PINS	HINGE ANGLES	HINGE STD. PIPE	HINGE TO FRAME WELDS	ANGLE TO FRAME WELDS	BARRIER BARS PLAIN	NO. OF EQUAL BARRIER BAR SPACES (HORIZ.)	NO. OF EQUAL BARRIER BAR SPACES (VERT.)	H (OUT TO OUT FRAME ANGLES)	W (OUT TO OUT FRAME ANGLES)	A	B
15"	2X2X1/4	4X4X1/4	1-1/8Ø	5/8Ø	1/2"Ø	2X2X1/4	3/4"	1/8	1/8	1/2"Ø	3	5	34"	20"	SINGLE HINGE CENTERED	
18"	2X2X1/4	4X4X1/4	1-1/8Ø	5/8Ø	1/2"Ø	2X2X1/4	3/4"	1/8	1/8	1/2"Ø	3	5	34"	20"	SINGLE HINGE CENTERED	
24"	2X2X1/4	4X4X1/4	1-1/8Ø	5/8Ø	1/2"Ø	2X2X1/4	3/4"	1/8	1/8	1/2"Ø	3	5	34"	20"	SINGLE HINGE CENTERED	
30"	2X2X1/4	4X4X1/4	1-1/8Ø	5/8Ø	1/2"Ø	2X2X1/4	3/4"	1/8	1/8	1/2"Ø	3	5	34"	20"	SINGLE HINGE CENTERED	
36"	2X2X1/4	4X4X1/4	2-1/8Ø	5/8Ø	1/2"Ø	2X2X1/4	3/4"	1/8	1/8	1/2"Ø	5	5	42"	32"	SINGLE HINGE CENTERED	
42"	2X2X1/4	4X4X1/4	2-1/8Ø	5/8Ø	1/2"Ø	2X2X1/4	3/4"	1/8	1/8	1/2"Ø	5	6	42"	32"	2 HINGES 0 0	
48"	3X3X7/16	5X3X1/4	2-1/8Ø	5/8Ø	3/4"Ø	2-1/2X 2-2X1/4	1"	1/8	1/8	1/2"Ø	5	7	47"	38"	3"	1"
54"	3X3X7/16	5X3X1/4	2-1/8Ø	5/8Ø	3/4"Ø	2-1/2X 2-2X1/4	1"	1/8	1/8	1/2"Ø	6	8	54"	44"	5"	3"
60"	3X3X7/16	5X3X1/4	2-1/8Ø	5/8Ø	3/4"Ø	2-1/2X 2-2X1/4	1"	1/8	1/8	1/2"Ø	7	9	60"	50"	9"	4"
66"	3X3X7/16	5X3X1/4	2-1/8Ø	5/8Ø	3/4"Ø	2-1/2X 2-2X1/4	1"	1/8	1/8	1/2"Ø	8	10	66"	56"	11"	6"
72"	4X4X5/8	5X3X1/4	2-3/16Ø	5/8Ø	1"Ø	3X3X3/8	1-1/4"	1/8	1/8	1/2"Ø	9	11	73"	62"	15"	7"
78"	4X4X5/8	5X3X1/4	2-3/16Ø	5/8Ø	1"Ø	3X3X3/8	1-1/4"	1/8	1/8	1/2"Ø	10	11	79"	68"	17"	9"
84"	4X4X5/8	5X3X1/4	2-3/16Ø	5/8Ø	1"Ø	3X3X3/8	1-1/4"	1/8	1/8	1/2"Ø	11	13	86"	74"	21"	10"
90"	4X4X5/8	5X3X1/4	2-3/16Ø	5/8Ø	1"Ø	3X3X3/8	1-1/4"	1/8	1/8	1/2"Ø	12	13	92"	80"	23"	12"
96"	4X4X5/8	5X3X1/4	2-3/16Ø	5/8Ø	1"Ø	3X3X3/8	1-1/4"	1/8	1/8	1/2"Ø	12	14	98"	86"	29"	12"
108"																
120"																

DETAIL NO.
P1562



City of Phoenix
STANDARD DETAIL

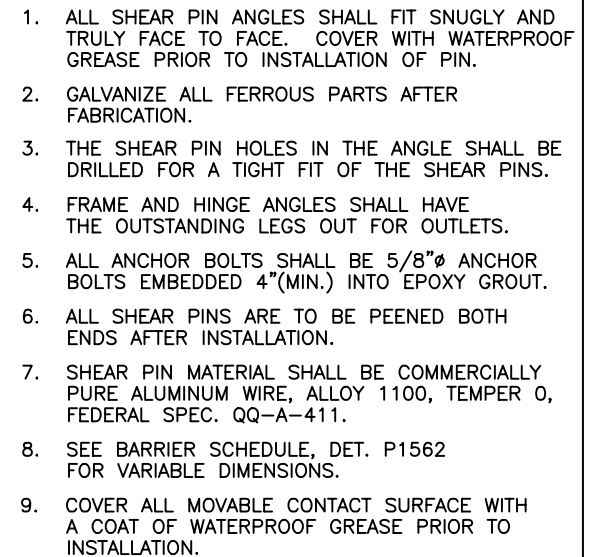
BARRIER SPECIFICATION SCHEDULE

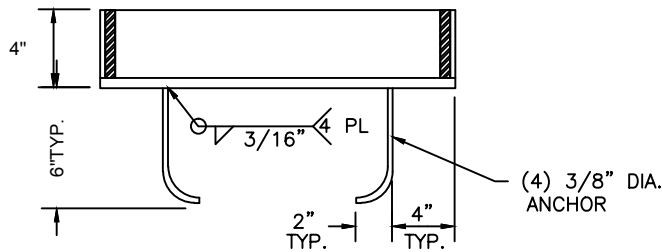
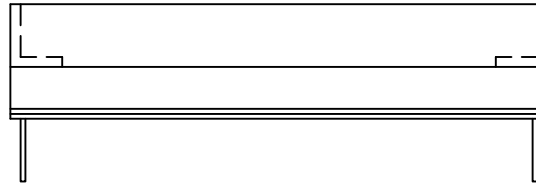
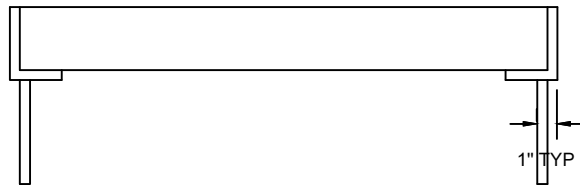
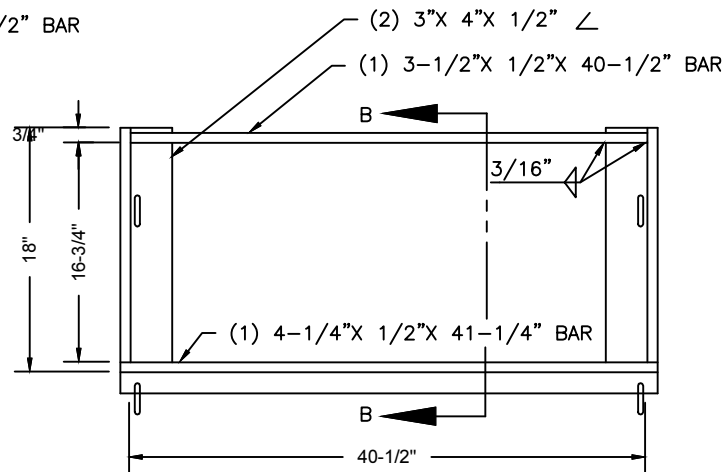
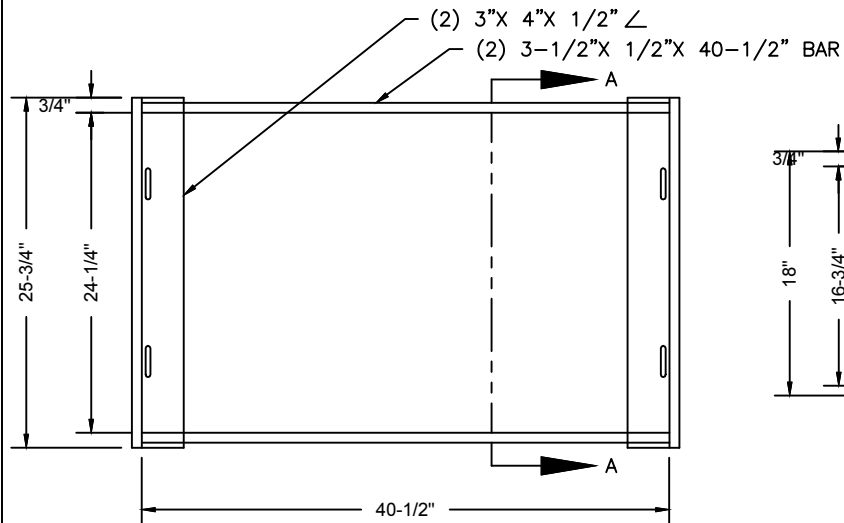
APPROVED

Mano S. Adame
CITY ENGINEER

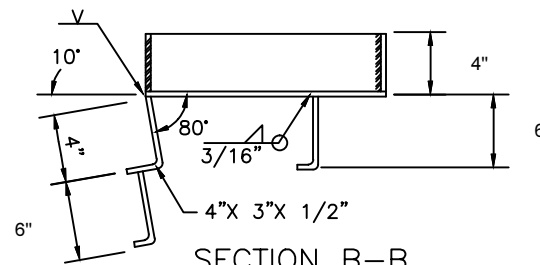
8/8/03
DATE

DETAIL NO.
P1562





SECTION A-A
TYPE 1



SECTION B-B
TYPE 2

NOTES

1. FRAME & FRAME SUPPORT SHALL BE FABRICATED FROM STRUCTURAL STEEL EXCEPT AS NOTED. STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH A.S.T.M. A-36.
2. WELDING SHALL BE IN ACCORDANCE WITH M.A.G. WELDING SPECIFICATIONS.
3. FRAME AND GRATE SHALL BE TESTED FOR ACCURACY OF FIT AND SHALL BE MARKED IN SETS BEFORE DELIVERY.
4. THE COMPLETED ASSEMBLY SHALL BE GIVEN ONE SHOP COAT OF NO. 1 PAINT, AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECTION 790.
5. THE FRAME SHALL BE FABRICATED TO WITHIN $\pm 1/8"$ OF SPECIFIED DIMENSIONS.

DETAIL NO.
P1564



City of Phoenix
STANDARD DETAIL

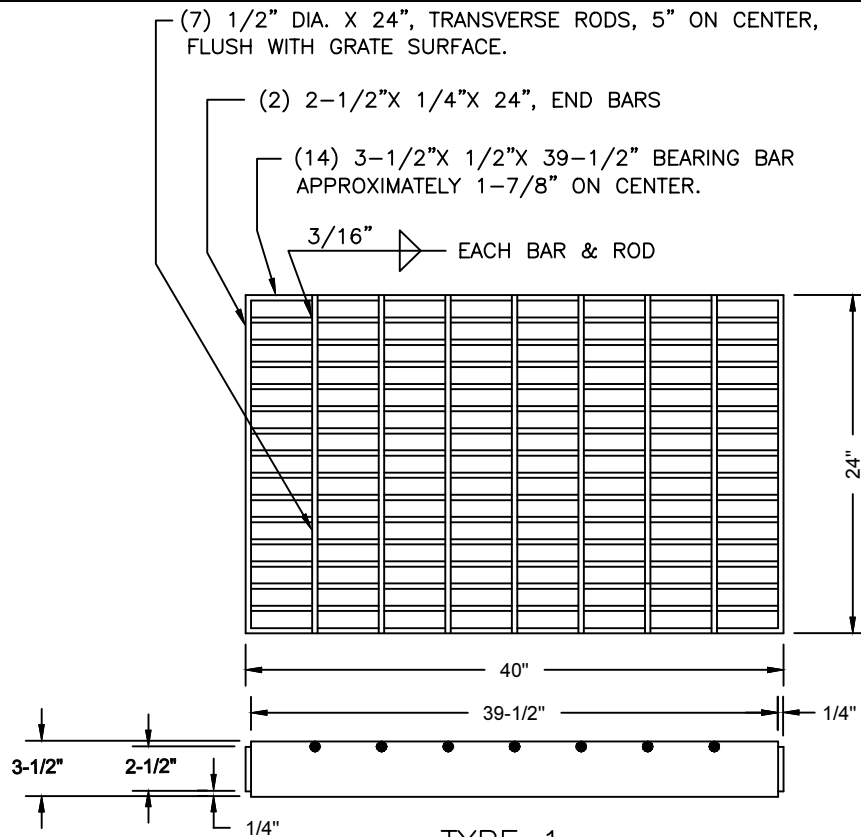
CATCH BASIN GRATE FRAMES

APPROVED

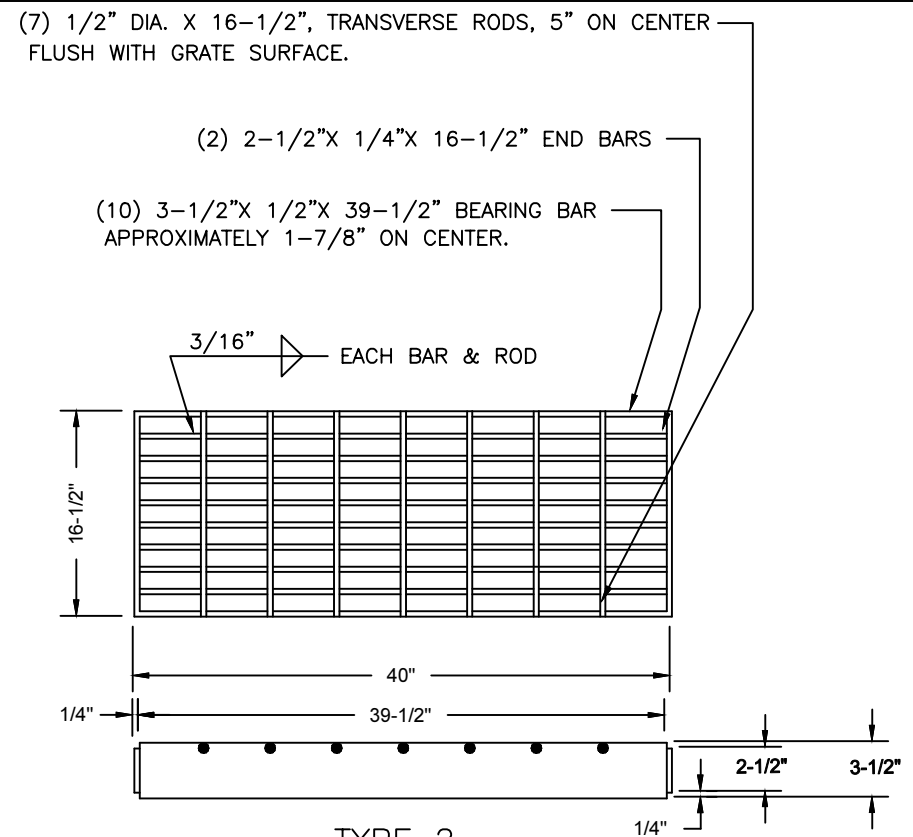
Kenny Whelan
CITY ENGINEER

7/9/92
DATE

DETAIL NO.
P1564



TYPE 1



TYPE 2

NOTES:

1. ALL STEEL SHALL BE IN ACCORDANCE WITH A.S.T.M. A-36.
2. WELDING SHALL BE IN ACCORDANCE WITH A.W.S. SPECIFICATIONS.
3. FRAME AND GRATE SHALL BE TESTED FOR ACCURACY OF FIT AND SHALL BE MARKED IN SETS BEFORE DELIVERY.
4. THE COMPLETED ASSEMBLY SHALL BE GIVEN ONE SHOP COAT OF NO. 1 PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECTION 790.
5. THE GRATE SHALL BE FABRICATED TO WITHIN 1/8" OF SPECIFIED DIMENSIONS.
6. TYPE 1 AND TYPE 2 GRATES, INSTALLED IN GRATE FRAMES PER STANDARD DETAIL P1564, ARE BICYCLE FRIENDLY AND MAY BE USED WITHIN BICYCLE FACILITIES WITH BEARING BARS ORIENTED PARALLEL TO THE DIRECTION OF TRAVEL.
7. TYPE1 AND TYPE 2 GRATES ARE NOT PEDESTRIAN FRIENDLY AND SHALL NOT BE USED IN PEDESTRIAN TRAVELED WAYS.

DETAIL NO.
P1565



City of Phoenix
STANDARD DETAIL

CATCH BASIN GRATES

APPROVED

[Signature]
CITY ENGINEER

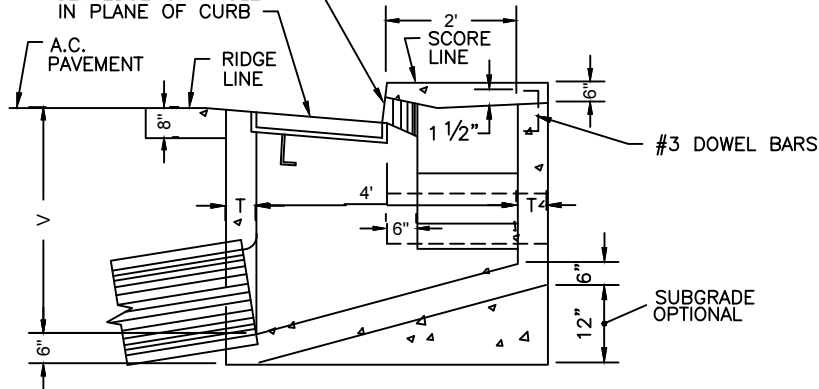
07/01/2015
DATE

DETAIL NO.
P1565

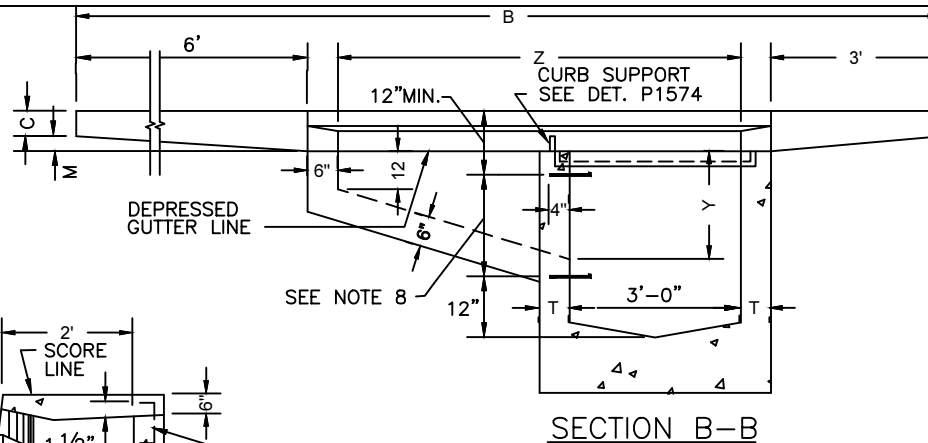
C=6" STD. CURB, M=2"
 C=5" STD. CURB, M=3"
 C=4" STD. CURB, M=4"

FOR INLET OPENING, SEE
 DET. P1574

SET EDGE OF ANGLE
 IN PLANE OF CURB



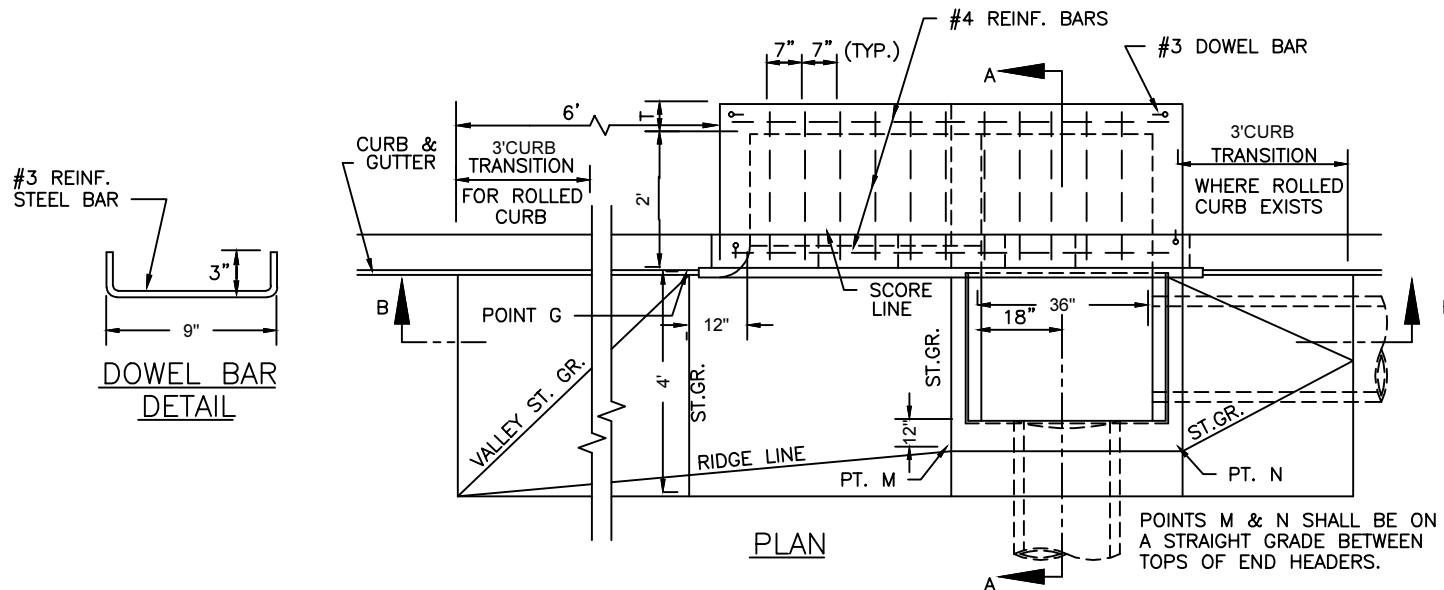
SECTION A-A



SECTION B-B

NOTES:

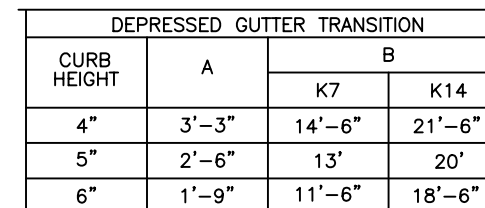
1. DIMENSIONS 'Z' SHALL EQUAL 7' OR 14' TYPES ARE DESIGNATED AS FOLLOWS: TYPE J7, (Z=7', Y=24", B=17') TYPE J14, (Z=14', Y=30", B=24')
2. ALL CONCRETE SHALL BE CLASS 'A'.
3. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPEC. 615.
4. CONNECTOR PIPES MAY BE PLACED IN ANY WALL BENEATH THE GRATE AS PER PLANS.
5. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
6. CONSTRUCTION DRAINS SHALL BE INSTALLED WHEN NOTED. (SEE DET. P1575)
7. DO NOT SPECIFY THIS DETAIL FOR USE IN A MAJOR STREET.
8. THE FRAME SHALL BE DET. P1564, TYPE I AND THE GRATE SHALL BE DET. P1565, TYPE I.
9. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.



PLAN

CATCH BASIN WALL THICKNESS

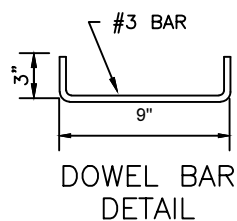
T=6" IF V IS 4' OR LESS
 T=8" IF V IS 4' TO 8'
 IF V EXCEEDS 8' SPECIAL DESIGN IS REQUIRED
 V=4'-0" UNLESS OTHERWISE NOTED



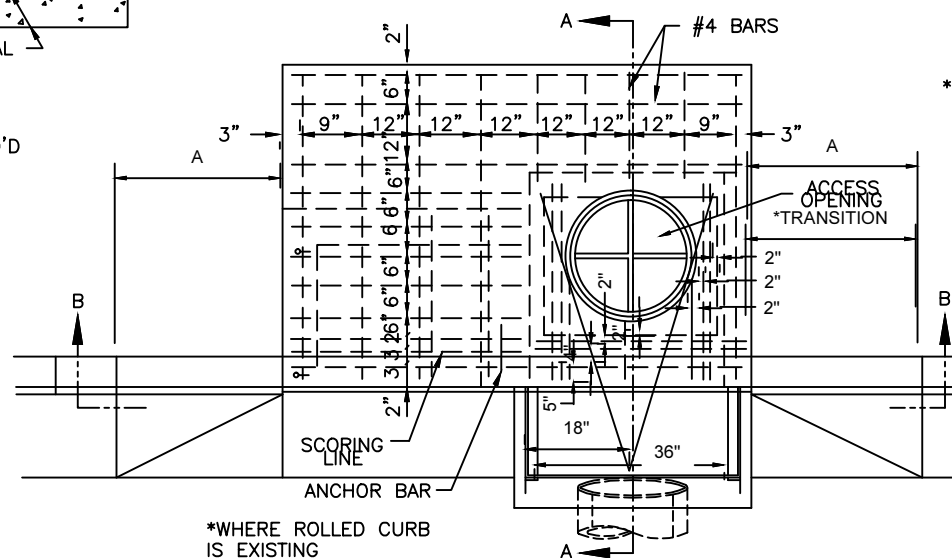
Technical drawing of a curb and gutter cross-section. The drawing shows a gutter with a 6-inch lip, an asphalt concrete (A.C.) layer, and a concrete curb. Dimensions include a 6-inch curb height, a 1'-5 1/2 inch curb width, a 1'-6 inch gutter width, and a 4'-9 inch total width. An inlet opening is shown with a 6-inch width and a 5'-0 inch length. A 1-1/2 inch clear space is required for reinforcement steel. The subgrade is optional.

SECTION A-A

*4'-0" IN LOCATIONS
WHERE 4' S/W IS REQ'D



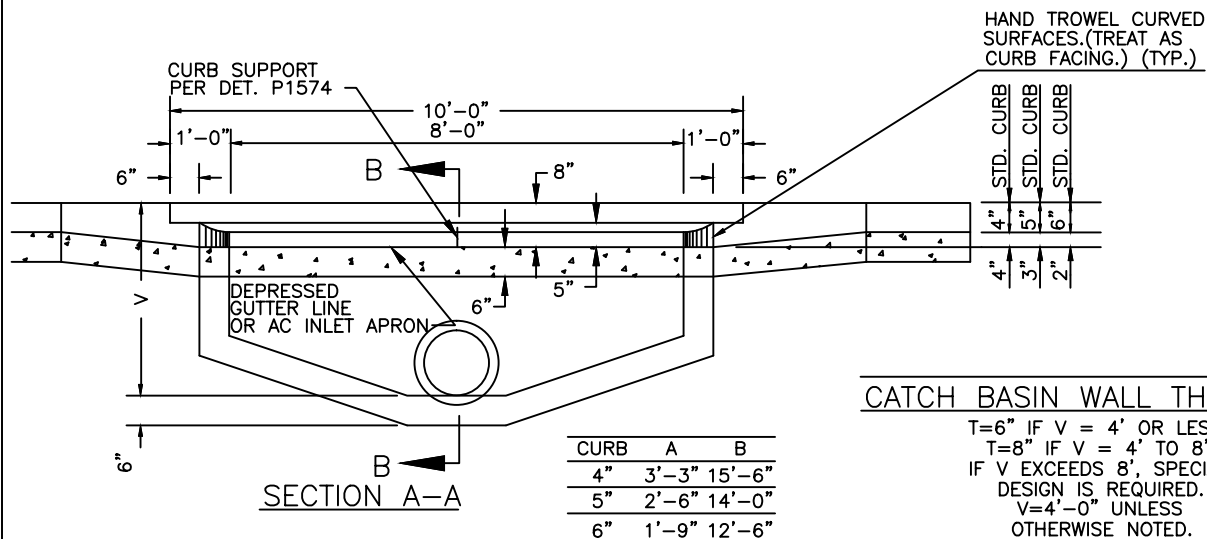
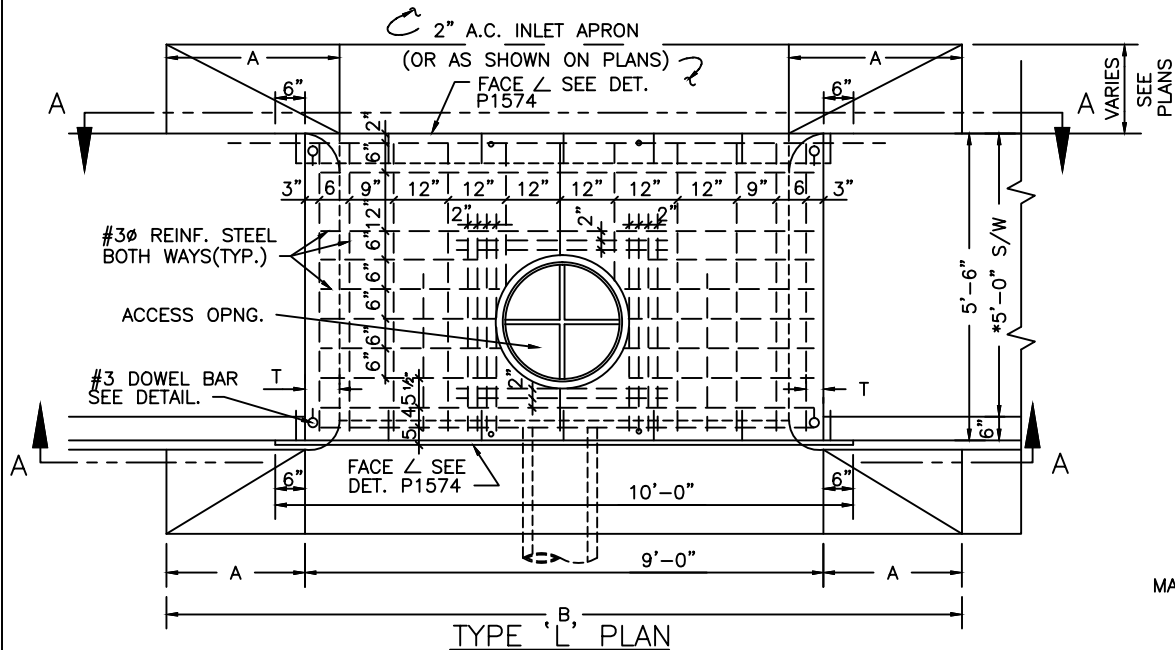
SECTION B-B



1. DIMENSION Z SHALL EQUAL 7' OR 14' TYPES ARE DESIGNATED AS FOLLOWS:
TYPE K7 (Z=7', Y=24")
TYPE K14 (Z=14', Y=30")
2. ALL CONCRETE SHALL BE CLASS 'A'.
3. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
4. CONNECTOR PIPES MAY BE PLACED IN ANY WALL BENEATH THE GRATE AS PER PLANS.
5. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
6. CONSTRUCTION DRAINS SHALL BE INSTALLED WHEN NOTED. (SEE DET. P1575).
7. ACCESS FRAME AND COVER PER DET. P1561.
8. THE FRAME SHALL BE DET. P1564, TYPE 2 AND THE GRATE SHALL BE DET. P1565, TYPE 2.
9. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN. AS DIRECTED BY THE ENGINEER.

CATCH BASIN WALL THICKNESS

T=6" IF V IS 4' OR LESS
T=8" IF V IS 4' TO 10'
IF V EXCEEDS 8' SPECIAL DESIGN IS REQUIRED
V=4'-0" UNLESS OTHERWISE NOTED.



CATCH BASIN WALL THICKNESS

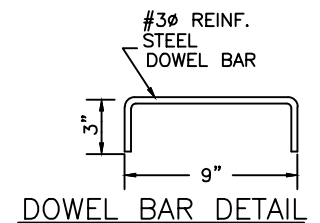
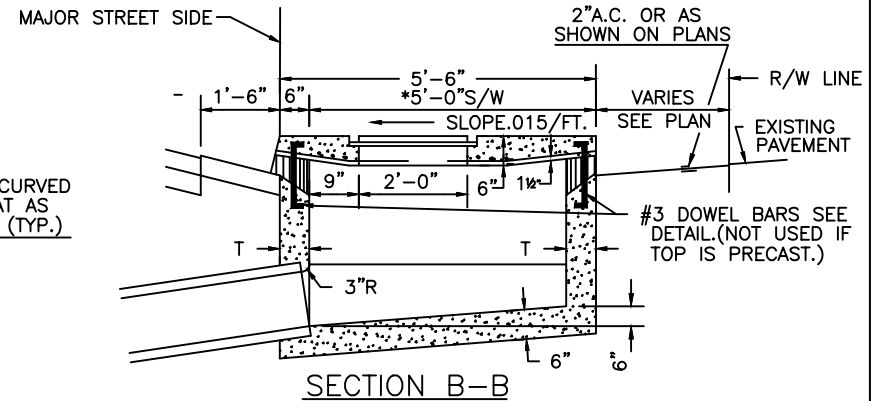
T=6" IF V = 4' OR LESS
T=8" IF V = 4' TO 8'
IF V EXCEEDS 8', SPECIAL DESIGN IS REQUIRED.
V=4'-0" UNLESS OTHERWISE NOTED.

CURB	A	B
4"	3'-3"	15'-6"
5"	2'-6"	14'-0"
6"	1'-9"	12'-6"

NOTES:

1. ALL CONCRETE SHALL BE CLASS 'A'.
2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
3. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLANS.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. CONSTRUCTION DRAINS SHALL BE INSTALLED WHEN SPECIFIED. (SEE DET. P1575.)
6. ACCESS FRAME AND COVER PER DET. P1561.
7. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

* TO BE 4'-0" IN LOCATIONS WHERE 4' S/W IS REQUIRED.



DETAIL NO.
P1568



City of Phoenix
STANDARD DETAIL

CATCH BASIN - TYPE "L"
CURB & PARKWAY OPENING INLET DETAILS

APPROVED

[Signature]
CITY ENGINEER

12/10/2012
DATE

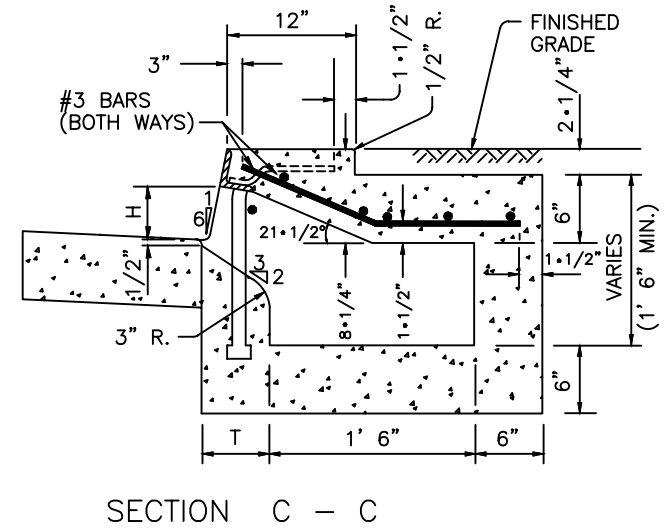
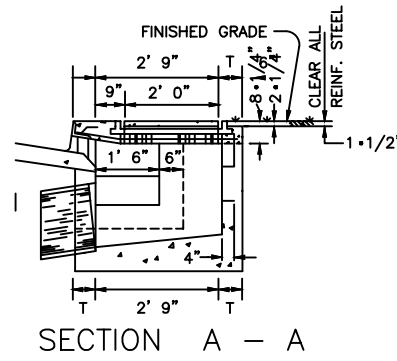
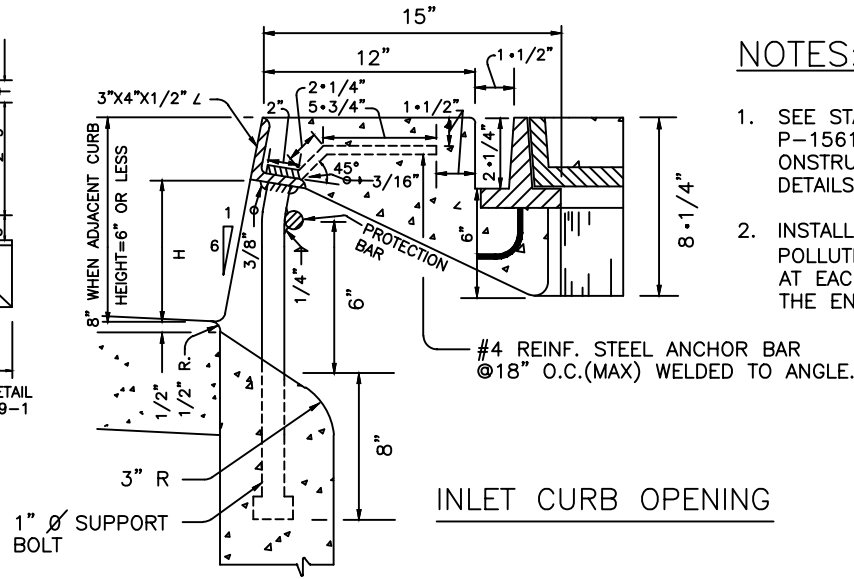
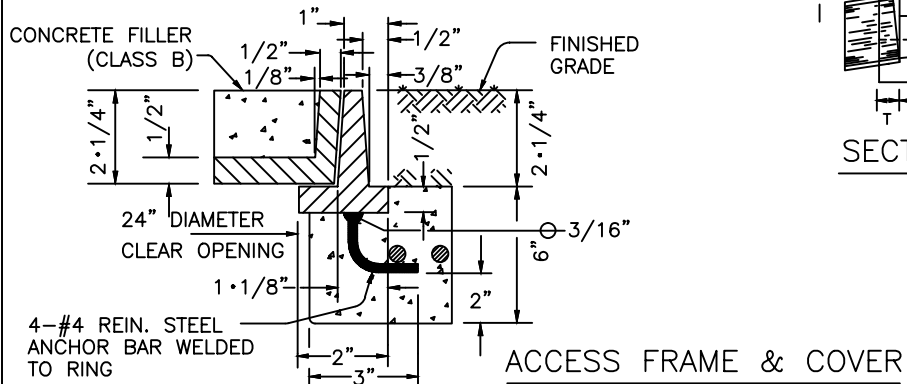
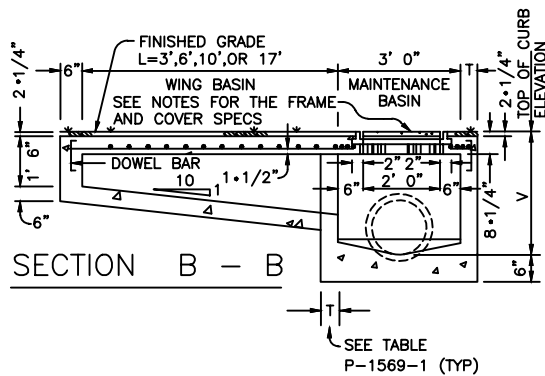
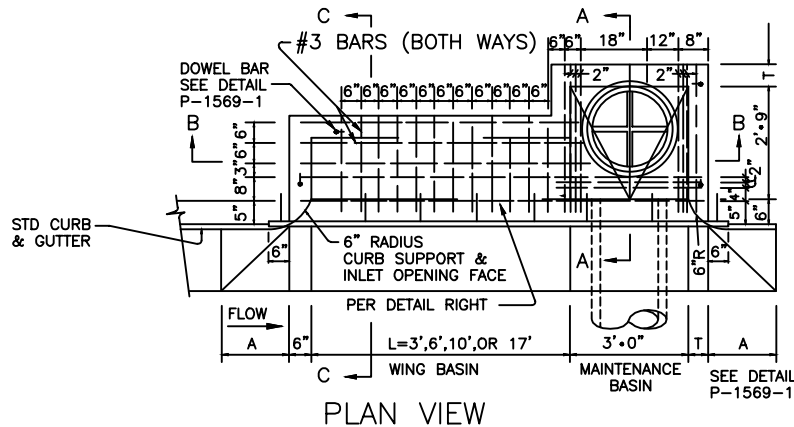
DETAIL NO.
P1568

[illegible][illegible]

DOWEL BAR DETAIL

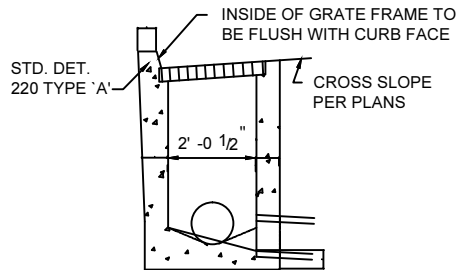
SECTION B - B

- # NOTES
1. TYPES ARE DESIGNATED AS FOLLOWS:
'M'.. NO WING, 'M-1'.. ONE WING,
'M-2'.. TWO WINGS.
 2. ALL CONCRETE SHALL BE CLASS 'A'.
 3. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
 4. CONNECTOR PIPES SHALL BE PLACED IN THE APPROPRIATE WALL OF THE MAINTENANCE BASIN.
 5. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
 6. CONSTRUCTION DRAINS SHALL BE INSTALLED IN WHEN NOTED.
(SEE DET. P-1575.)
 7. LOCATE WING BASIN ON UPSTREAM SIDE OF MAINTENANCE BASIN FOR TYPE M-1. WING BASINS FOR TYPE M-2 SHALL BE BOTH SIDES OF MAINTENANCE BASIN.
 8. ACCESS FRAME AND COVER PER DET. P-1561
 9. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.
- | CATCH BASIN WALL THICKNESS |
|--|
| T = 6" IF V = 4' OR LESS
T = 8" IF V = 4' TO 8'
(IF V EXCEEDS 8', SPECIAL DESIGN IS REQUIRED.) |
| L = 0' UNLESS SPECIFIED ON THE PLANS
V = 4'-0" MIN. UNLESS OTHERWISE NOTED |
- *4'-0" IN LOCATIONS WHERE 4' SIDEWALK IS REQ'D.

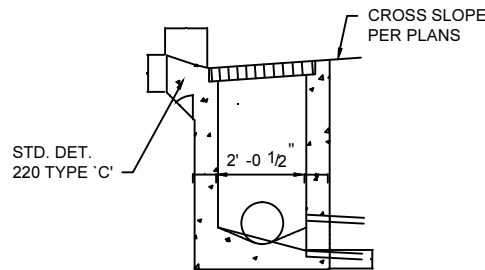


NOTES:

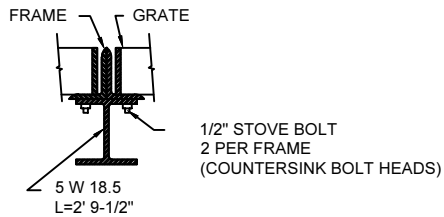
1. SEE STANDARD DETAILS P-1569-1, P-1561, AND P-1574 FOR CONSTRUCTION NOTES AND ADDITIONAL DETAILS.
2. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.



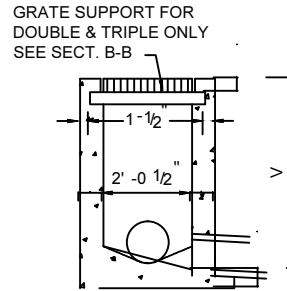
**'N' CATCH BASIN IN
VERTICAL CURB & GUTTER**



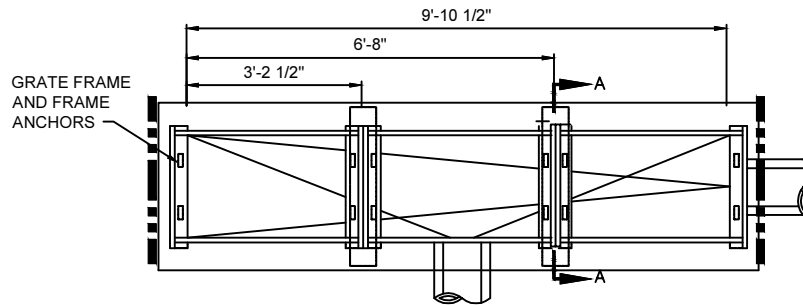
**'N' CATCH BASIN IN
ROLL CURB & GUTTER**



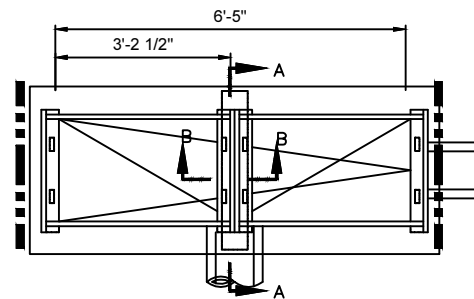
SECTION B-B



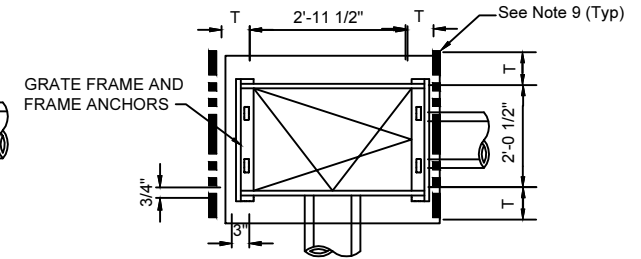
SECTION A-A



TRIPLE CATCH BASIN PLAN



DOUBLE CATCH BASIN PLAN



SINGLE CATCH BASIN PLAN

NOTES:

1. ALL CONCRETE SHALL BE CLASS 'A'.
2. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLAN.
3. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
4. CONSTRUCTION DRAINS SHALL BE INSTALLED WHEN NOTED. (SEE DETAIL P1575)
5. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
6. PLANS SHOULD SPECIFY ELEVATION AND INVERT ELEVATION.
7. THE TYPE 'N' CATCH BASIN MAY BE PREFABRICATED PROVIDING A SHOP DRAWING IS APPROVED BY THE ENGINEER PRIOR TO FABRICATION.
8. THE FRAME SHALL BE DET. P1564, TYPE 1 AND THE GRATE SHALL BE DET. P1565, TYPE 1.
9. EXPANSION JOINT (TYP)
10. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

CATCH BASIN WALL THICKNESS

T=6" IF V = 4' OR LESS
T=8" IF V = 4' TO 8'
(IF V EXCEEDS 8' SPECIAL DESIGN IS REQUIRED)
V=4'-0' UNLESS OTHERWISE NOTED.

DETAIL NO.
P1570



**City of Phoenix
STANDARD DETAIL**

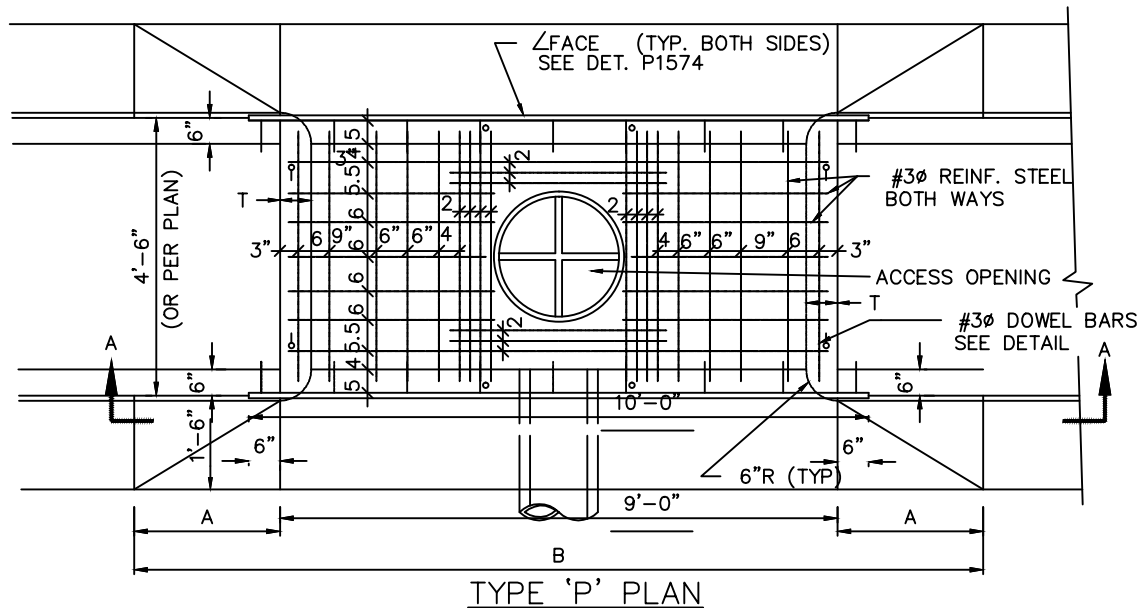
CATCH BASIN
TYPE "N"

APPROVED

[Signature]
CITY ENGINEER

12/10/2012
DATE

DETAIL NO.
P1570

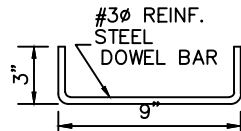
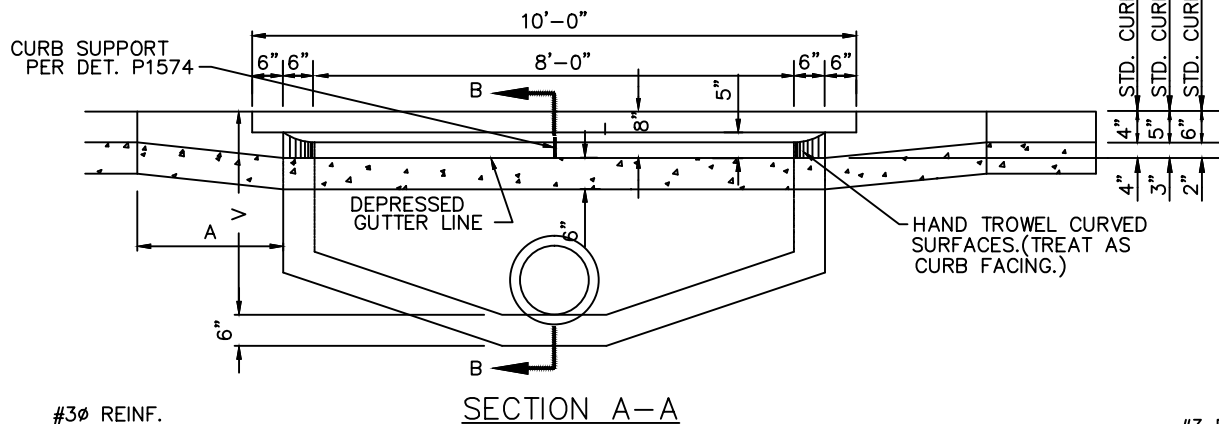


NOTES:

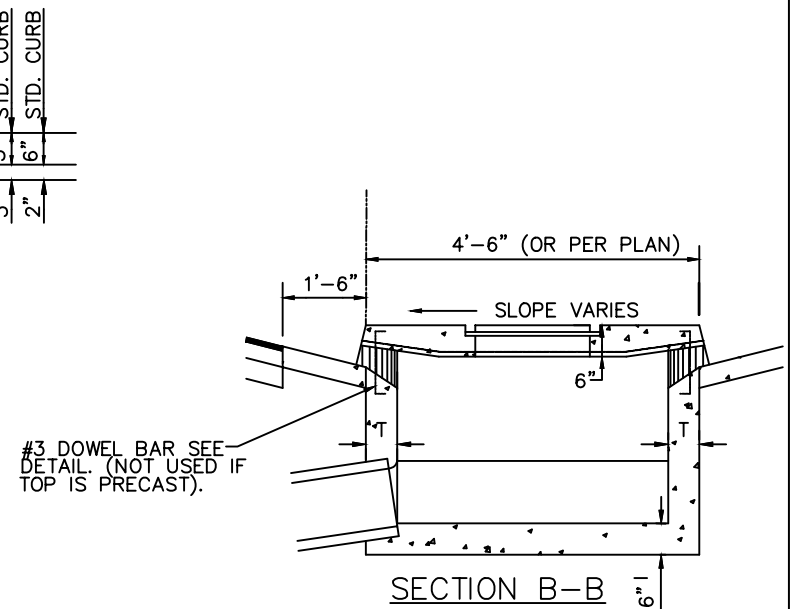
1. ALL CONCRETE SHALL BE CLASS 'A'.
2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
3. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLANS.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. CONSTRUCTION DRAINS SHALL BE INSTALLED IN ALL INLETS BUILT WITH PAVING PROJECTS. (SEE DET. P1575.)
6. ACCESS FRAME AND COVER PER DET. P1561.
7. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

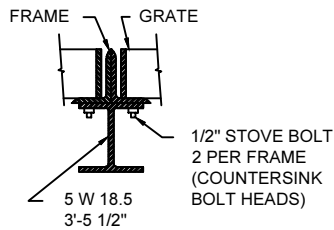
CATCH BASIN WALL THICKNESS

T=6" IF V = 4' OR LESS
 T=8" IF V = 4' TO 8'
 IF V EXCEEDS 8', SPECIAL DESIGN IS REQUIRED.
 V=4'-0" UNLESS OTHERWISE SPECIFIED.

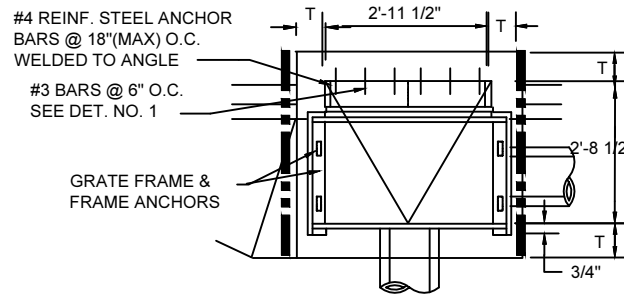


CURB	A	B
4"	3'-3"	15'-6"
5"	2'-6"	14'-0"
6"	1'-9"	12'-6"

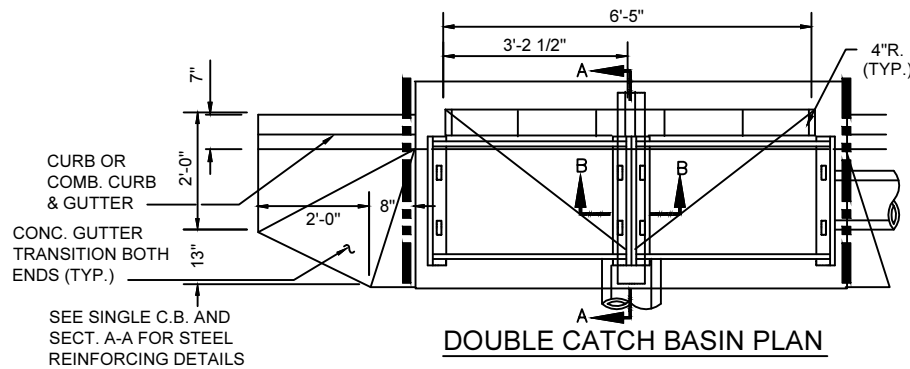




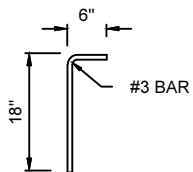
SECTION B-B



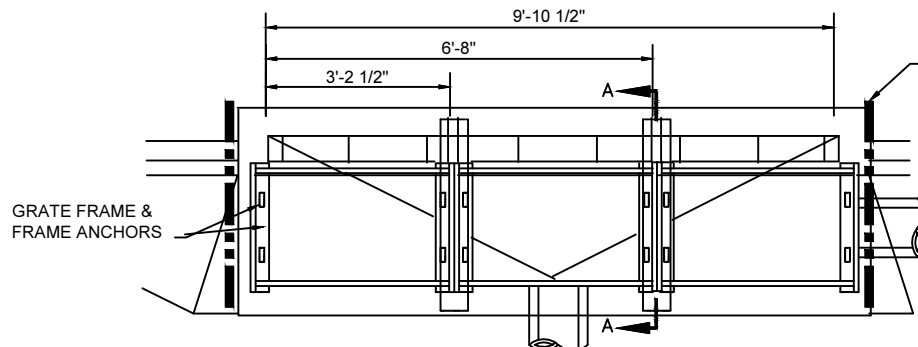
SINGLE CATCH BASIN PLAN



DOUBLE CATCH BASIN PLAN



DETAIL 1

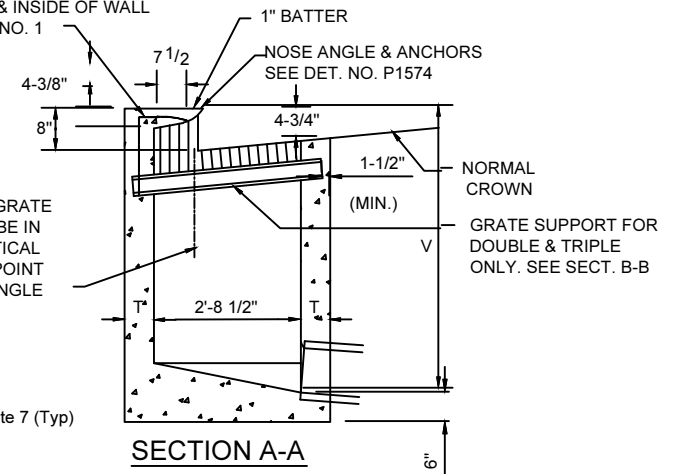


TRIPLE CATCH BASIN PLAN

#3 BARS @ 6" O.C., 1-1/2" CLEAR TO TOP OF NOSE SECTION & INSIDE OF WALL SEE DET. NO. 1

INSIDE OF GRATE FRAME TO BE IN SAME VERTICAL PLANE AS POINT OF NOSE ANGLE

See Note 7 (Typ)



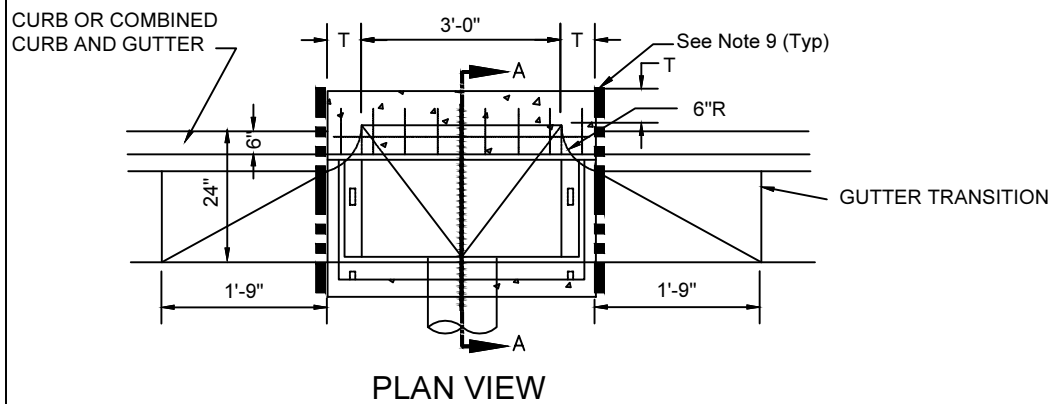
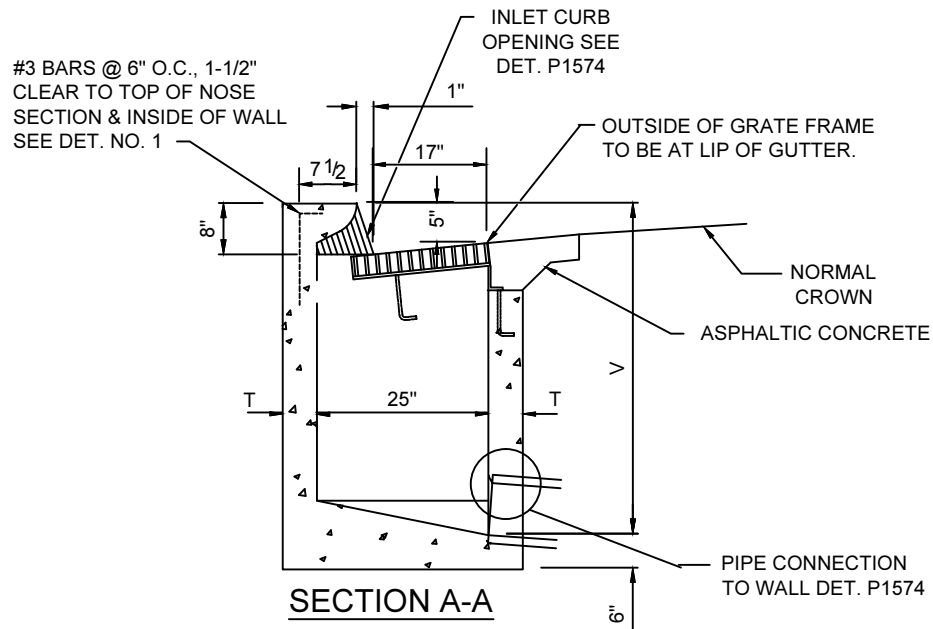
SECTION A-A

NOTES:

1. ALL CONCRETE SHALL BE CLASS 'A'.
2. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLAN.
3. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
4. CONSTRUCTION DRAINS SHALL BE INSTALLED WHEN NOTED. (SEE DETAIL P1575)
5. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
6. THE FRAME SHALL BE DET. P1564, TYPE 1 AND THE GRATE SHALL BE DET. P1565, TYPE 1.
7. EXPANSION JOINT (TYP)
8. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

CATCH BASIN WALL THICKNESS

T=6" IF V = 4' OR LESS
T=8" IF V = 4' TO 8'
IF V EXCEEDS 8' SPECIAL DESIGN IS REQUIRED
V=4'-0' UNLESS OTHERWISE NOTED.

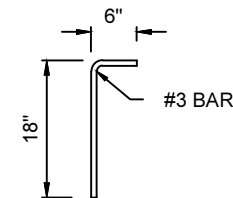


CATCH BASIN WALL THICKNESS

T=6" IF V = 4' OR LESS

T=8" IF V = 4' TO 8'

IF V EXCEEDS 8' SPECIAL DESIGN IS REQUIRED
V=4'-0" UNLESS OTHERWISE NOTED.



DETAIL 1

NOTES:

1. ALL CONCRETE SHALL BE CLASS 'A'.
2. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLAN.
3. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOP FROM ALL DIRECTIONS TO OUTLET.
4. THE CONSTRUCTION DRAINS SHALL BE INSTALLED IN ALL INLETS BUILT WITH PAVING PROJECTS (SEE DET. P1575).
5. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
6. LOCATION OF THE TYPE 'R' CATCH BASIN SHALL BE RESTRICTED TO AREAS WHERE 6" VERTICAL CURB & GUTTER IS EXISTING.
7. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
8. THE FRAME SHALL BE DET. P1564, TYPE 2 AND THE GRATE SHALL BE DET. P1565, TYPE 2.
9. EXPANSION JOINT (TYP)
10. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

DETAIL NO.
P1573



City of Phoenix
STANDARD DETAIL

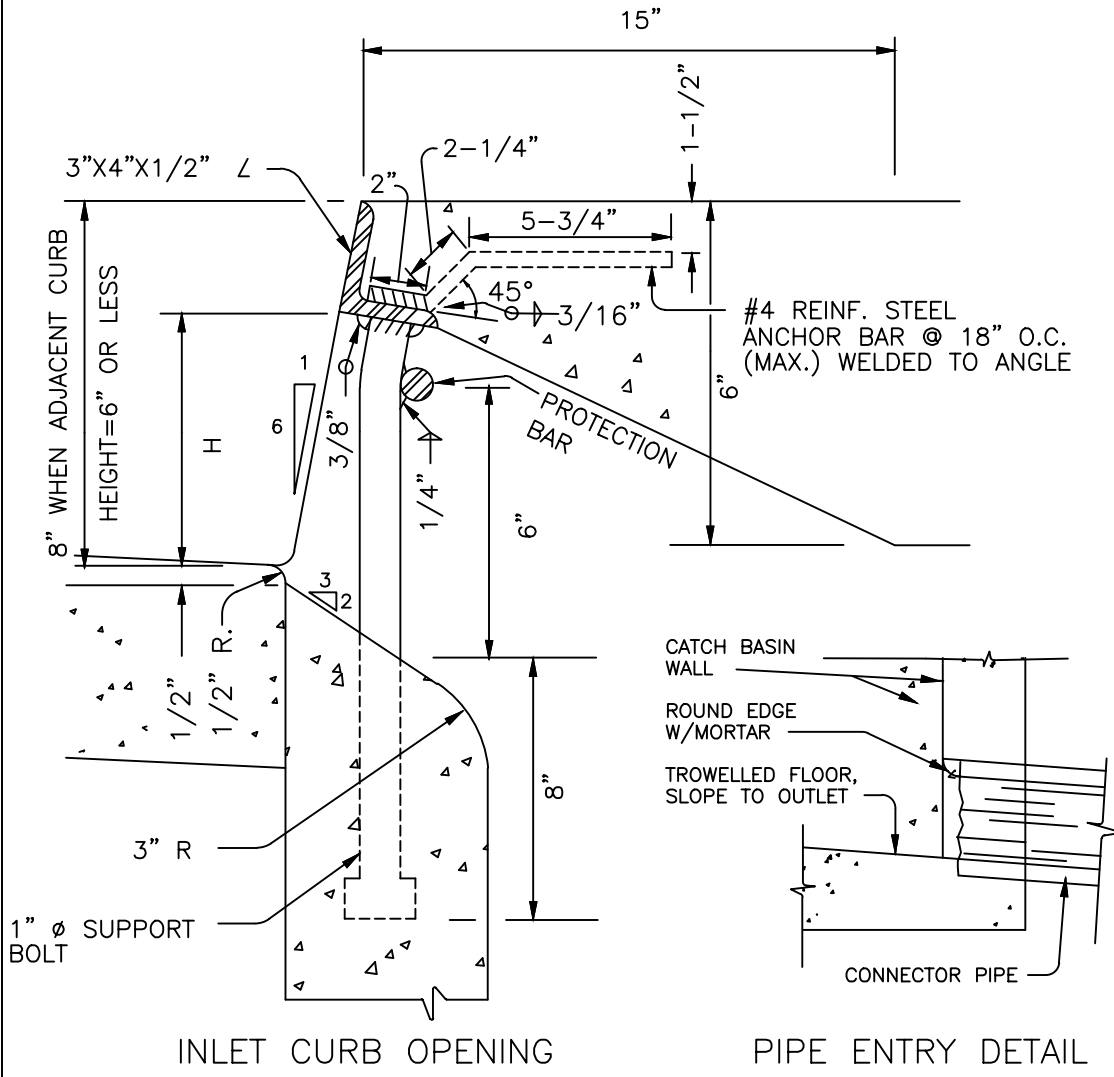
CATCH BASIN
TYPE "R"

APPROVED

[Signature]
CITY ENGINEER

12/10/2012
DATE

DETAIL NO.
P1573



NOTES

1. CURB OPENING HEIGHT 'H' SHALL BE 5" (MINIMUM) UNLESS OTHERWISE SPECIFIED.
2. WHEN CURB OPENING HEIGHT 'H' EXCEEDS 6", INSTALL 1"Ø STEEL PROTECTION BARS. THE PROTECTION BARS SHALL EXTEND THE FULL LENGTH OF THE CURB OPENINGS AND SHALL BE EMBEDDED 3"(MIN.) AT EACH END.
3. INSTALL ADDITIONAL BARS AT 3 1/2" CLEAR SPACING ABOVE FIRST BAR WHEN OPENING EXCEEDS 13".
4. WHEN CURB OPENING LENGTH EXCEEDS 6', INSTALL 1"Ø STEEL SUPPORT BOLTS, SPACED AT NO MORE THAN 5' O.C.
5. ALL EXPOSED METAL HARDWARE SHALL BE GIVEN ONE SHOP COAT OF NO.1 PAINT AND 2 FIELD COATS OF NO.10 PAINT AS PER SECTION 790.
6. ALL METAL UNITS SHALL BE FABRICATED FROM STRUCTURAL STEEL EXCEPT AS NOTED. STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH A.S.T.M. A-36.
7. WELDING SHALL BE IN ACCORDANCE WITH M.A.G. WELDING SPECIFICATIONS.
8. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
9. WHEN CATCH BASIN IS LOCATED WITHIN A LANDSCAPE PARKWAY SECTION, SEE DETAIL P1569-2 FOR INLET MODIFICATIONS.

DETAIL NO.
P1574



City of Phoenix
STANDARD DETAIL

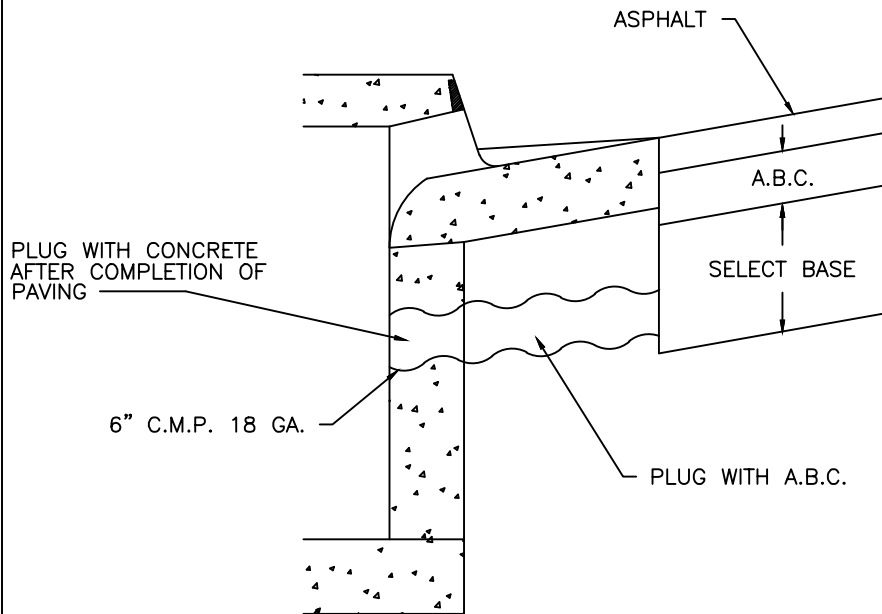
INLET CURB OPENING & PIPE ENTRY DETAIL

APPROVED

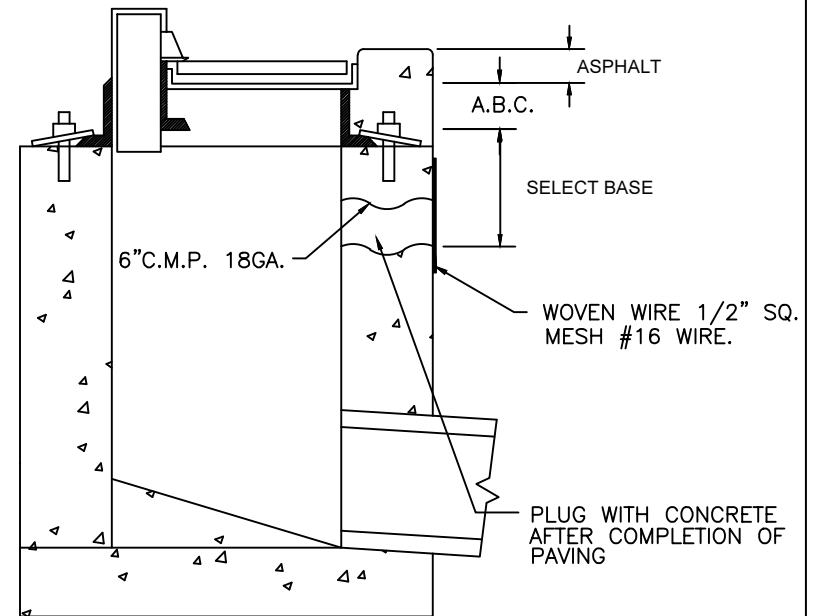
Kenny W. Hain
CITY ENGINEER

7/9/92
DATE

DETAIL NO.
P1574



CURB OPENING INLET



GRATE OPENING INLET

NOTES:

1. CONSTRUCTION DRAINS TO BE INSTALLED IN ALL INLETS BUILT WITH PAVING PROJECTS.
2. SEE PROJECT PLANS FOR INLET DETAILS AND DEPTH OF PAVING.

DETAIL NO.
P1575



City of Phoenix
STANDARD DETAIL

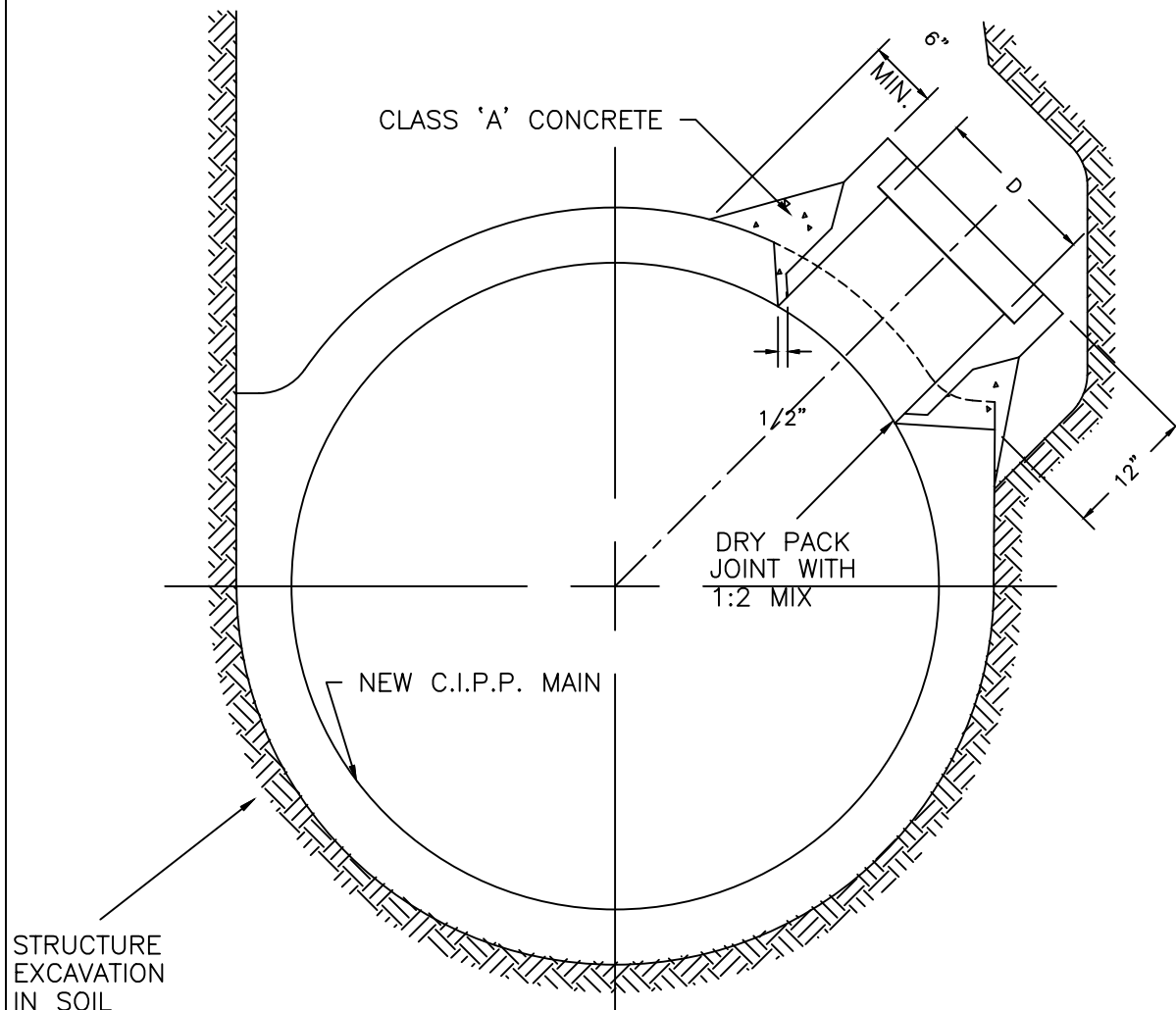
CONSTRUCTION SUB-GRADE DRAIN

APPROVED

Kenny W. Hain
FOR CITY ENGINEER

7/9/92
DATE

DETAIL NO.
P1575



NOTES:

1. "D" SHALL BE 24" OR LESS.
2. PRECAST TEE SHALL BE INSTALLED WHERE THE MAINLINE PIPE IS SMALLER THAN THE MINIMUM OR THE CONNECTING PIPE IS LARGER THAN 24".
3. THE BELL END OF THE PRECAST CONCRETE PIPE SHALL BE INSTALLED AS SHOWN WHILE CONCRETE OF MAINLINE PIPE IS WET.
4. TRENCH WALL TO BE EXCAVATED AS NECESSARY PRIOR TO POURING MAINLINE PIPE TO ACCOMMODATE LATERAL STUB.
5. AXIS OF LATERAL STUB SHALL BE AS PER PLAN AND CROSS-SECTION.
6. THE LATERAL STUB SHALL SATISFY STRENGTH REQUIREMENTS AS SPECIFIED FOR THE LATERAL PIPE.
7. LATERALS FOR FUTURE CONNECTION SHALL BE MARKED. (SEE MAG DETAIL 427)

CONNECTING PIPE SIZE	MINIMUM SIZE MAIN
15"	24"
18"	36"
21"	42"
24"	48"

DETAIL NO.
P1576



City of Phoenix
STANDARD DETAIL

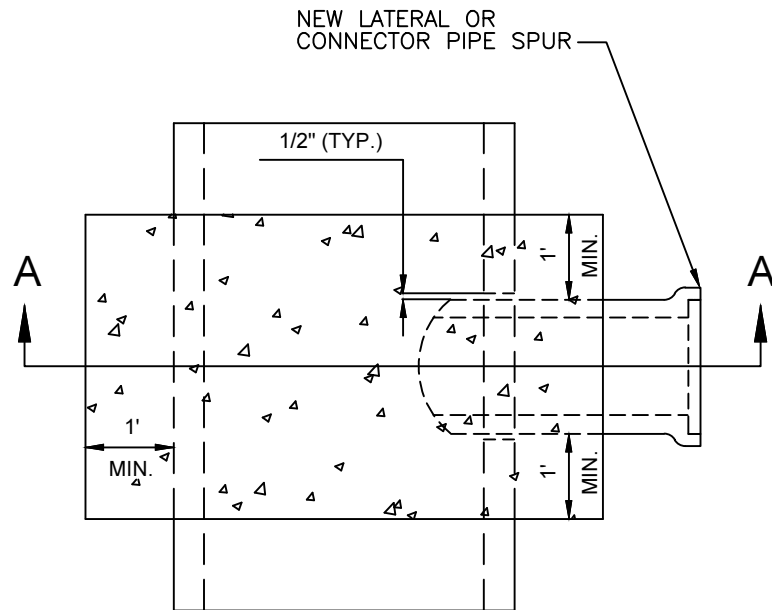
CAST-IN-PLACE PIPE
LATERAL PIPE CONNECTION

APPROVED

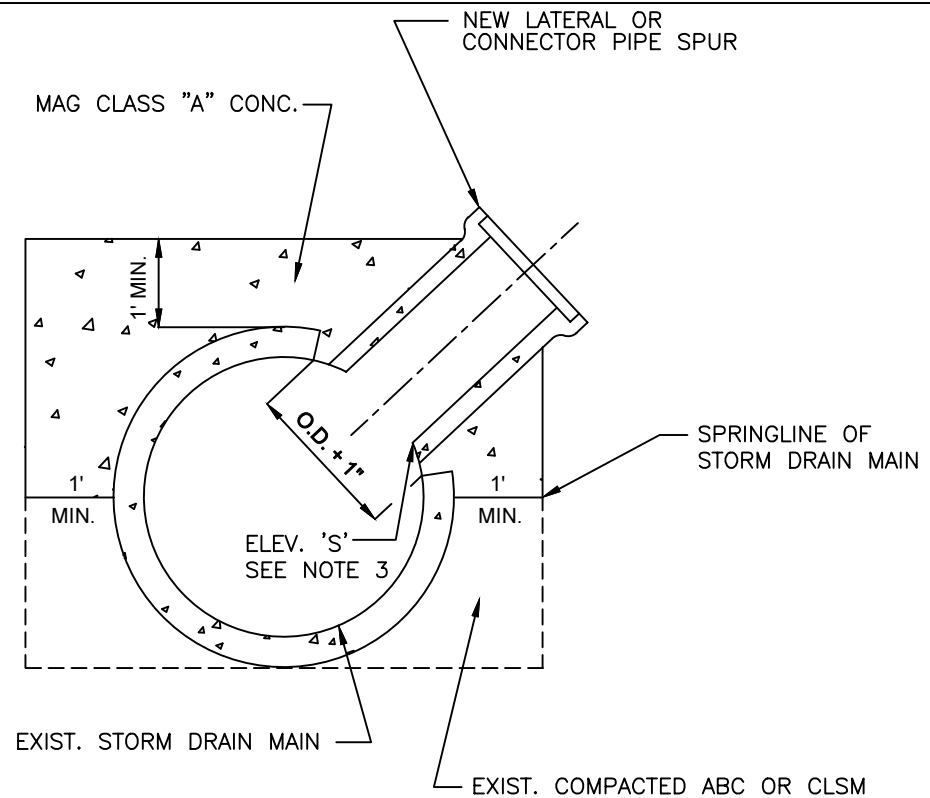
Michael J. Connelley
FOR CITY ENGINEER

8/6/99
DATE

DETAIL NO.
P1576



PLAN VIEW



SECTION A-A

NOTES:

1. THIS DETAIL SHALL BE USED FOR CONNECTING NEW SMALL STORM DRAIN LATERALS OR CATCH BASIN CONNECTOR PIPES TO EXISTING STORM DRAIN MAINS.
2. THIS DETAIL SHALL ONLY BE USED WHEN OUTSIDE DIAMETER OF NEW LATERAL OR CONNECTOR PIPE SPUR IS LESS THAN OR EQUAL TO 1/2 THE INSIDE DIAMETER OF THE EXISTING STORM DRAIN MAIN.
3. THE CONNECTOR PIPE SPUR LINE SHALL BE CONSTRUCTED RADIAL TO THE MAIN, UNLESS OTHERWISE SHOWN BY ELEVATION 'S' AS SHOWN ON PLANS.
4. THE LENGTH OF THE SPUR STUB SHALL BE A MINIMUM OF 18" TO ALLOW FULL, CLEAN PIPE CONNECTION TO THE SPUR JOINT.
5. CONCRETE SHALL BE MAG CLASS "A".

DETAIL NO.
P1577



City of Phoenix
STANDARD DETAIL

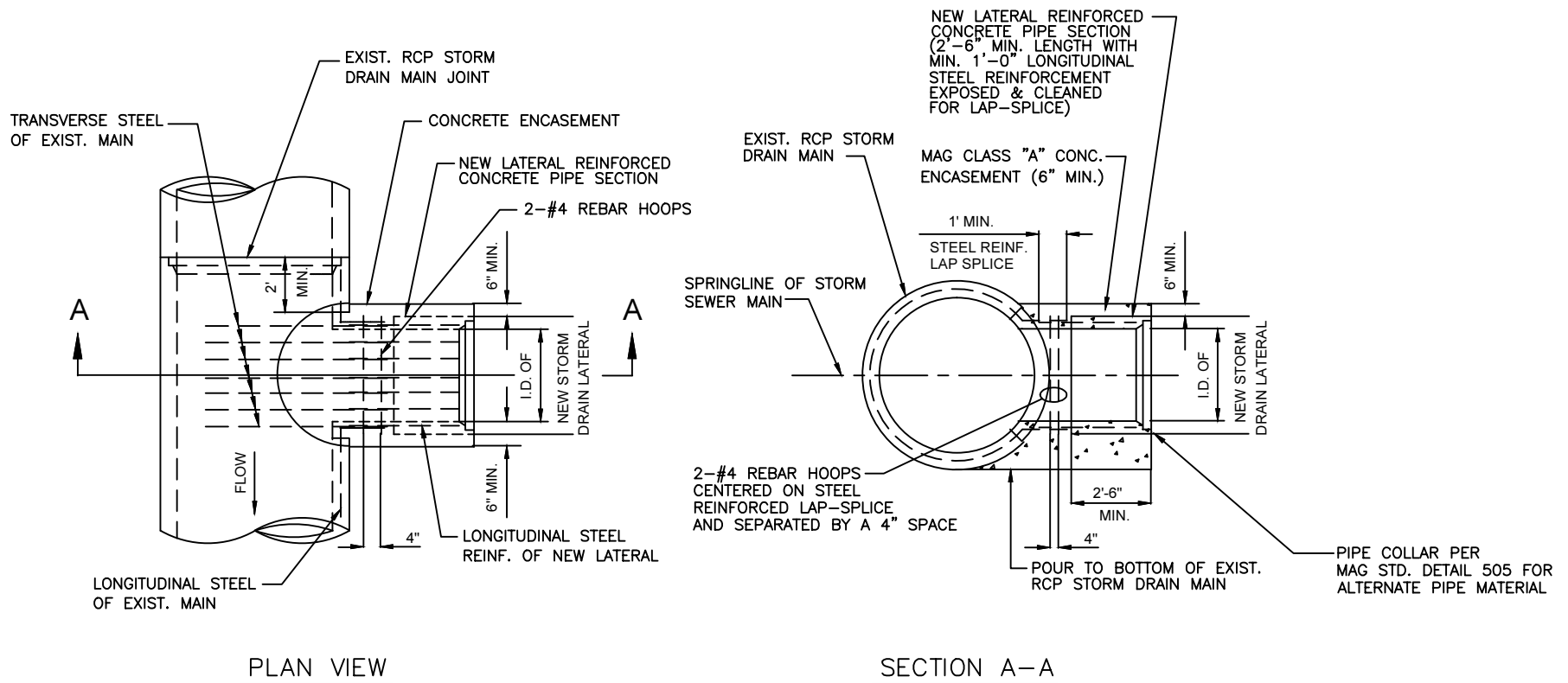
SMALL STORM DRAIN LATERAL OR CATCH BASIN
CONNECTOR PIPE CONNECTION TO EXISTING STORM DRAIN MAIN

APPROVED

[Signature]
CITY ENGINEER

07/01/2015
DATE

DETAIL NO.
P1577



NOTES:

1. THIS DETAIL SHALL BE USED FOR CONNECTING NEW LARGE STORM DRAIN LATERALS OR CATCH BASIN CONNECTOR PIPES TO EXISTING RCP STORM DRAIN MAINS.
2. THIS DETAIL SHALL ONLY BE USED WHEN OUTSIDE DIAMETER OF NEW STORM DRAIN LATERAL OR CONNECTOR PIPE IS GREATER THAN 1/2, BUT LESS THAN THE FULL INSIDE DIAMETER OF THE EXISTING STORM DRAIN MAIN, AND NO OTHER TYPE CONNECTION (SUCH AS A MANHOLE OR SPECIAL JUNCTION STRUCTURE) IS FEASIBLE OR DESIRABLE.
3. THE EXISTING STORM DRAIN MAIN SHALL BE EXPOSED AT THE PROPOSED LOCATION OF NEW CONNECTION. IF NECESSARY, THE LOCATION MAY BE MOVED DOWN STREAM SUCH THAT THE OUTSIDE OF THE NEW OPENING WILL BE A MINIMUM OF 2' FROM THE NEAREST JOINT IN THE EXISTING PIPE MAIN.
4. A CIRCULAR OPENING IN THE EXISTING MAINLINE RCP PIPE SHALL BE CUT TO MATCH THE INSIDE DIAMETER OF THE NEW LATERAL, NORMAL TO THE PIPE SURFACE, WITHOUT DAMAGING STEEL. THE EXPOSED STEEL IN THE CIRCULAR OPENING OF THE EXISTING MAIN SHALL BE CUT TO PROVIDE RELATIVELY EQUAL-LENGTH REINFORCING STUBS AND BENT TO A HORIZONTAL POSITION IN PREPARATION FOR CONNECTION.
5. THE LONGITUDINAL STEEL ON THE END OF THE NEW STORM DRAIN LATERAL STUB SHALL BE PREPARED TO EXPOSE A MINIMUM 1'-0" OF CLEAN STEEL REINFORCEMENT FOR LAP-SPLICING AROUND THE PERIPHERY OF THE NEW STUB. THE EXPOSED STEEL OF THE EXISTING MAIN AND THE NEW STUB SHALL BE LAP-SPLICED A MINIMUM OF 1'-0" AND REINFORCE-TIED WITH 2-#4 REBAR HOOPS.
6. THE NEW STUB AND JOINT SHALL THEN BE ENCASED WITH A MINIMUM OF 6" OF MAG CLASS 'A' CONCRETE. THE ENCASEMENT SHALL EXTEND THE ENTIRE LENGTH OF THE STUB (MIN. 2'-6"). THE SPLICE-JOINT AREA BETWEEN THE PIPES SHALL BE NEATLY FORMED INSIDE TO CREATE A CLEAN, FORMED JOINT.

DETAIL NO.
P1578



City of Phoenix
STANDARD DETAIL

LARGE STORM DRAIN LATERAL OR CATCH BASIN
CONNECTOR PIPE TO EXISTING RCP STORM DRAIN MAIN

APPROVED

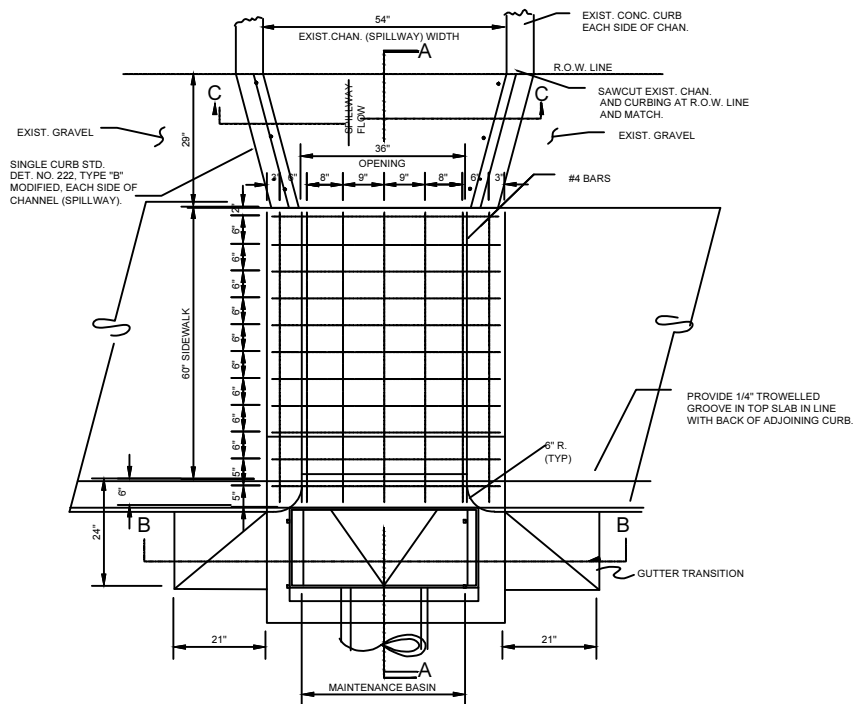
[Signature]
CITY ENGINEER

07/01/2015
DATE

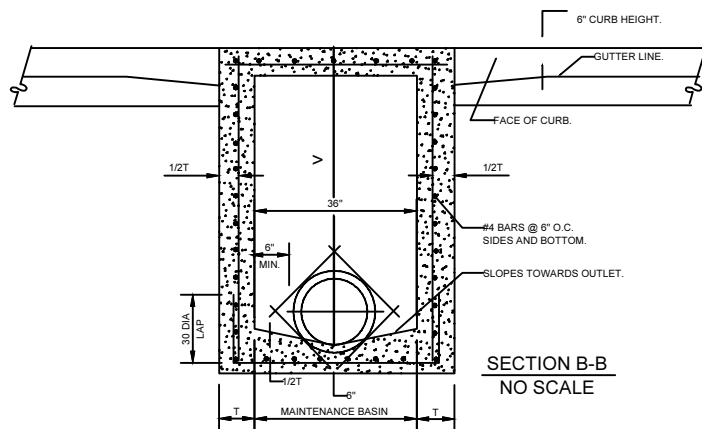
DETAIL NO.
P1578



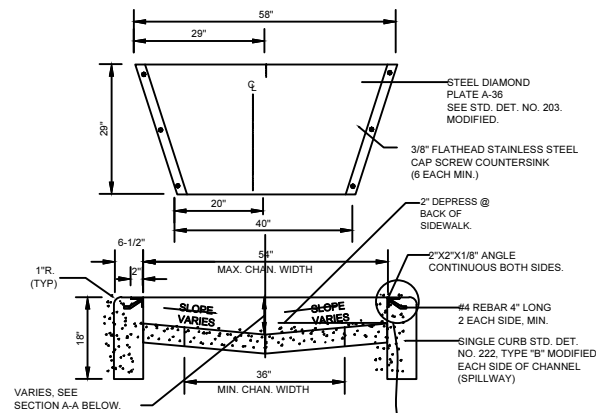
DETAIL NO.
P1581



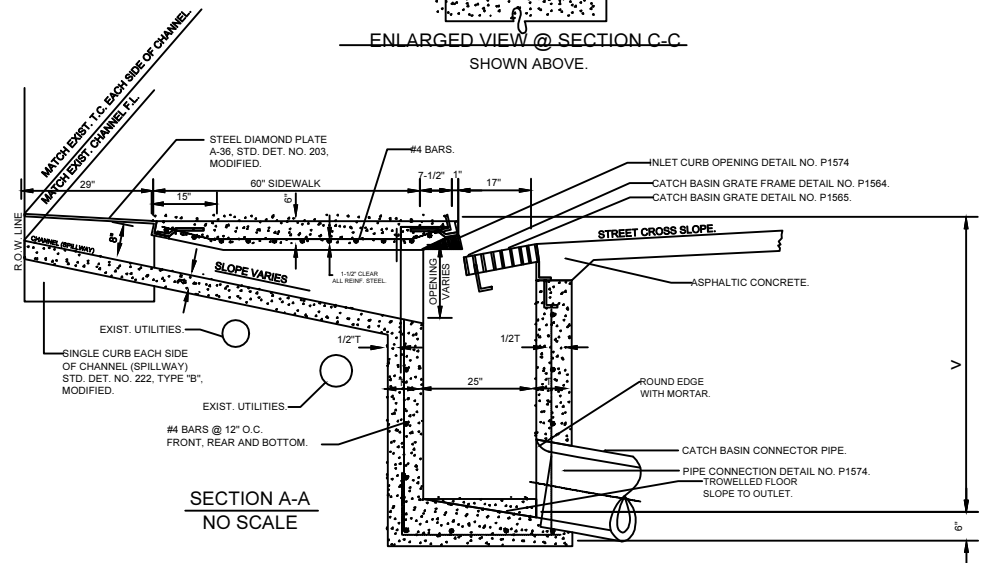
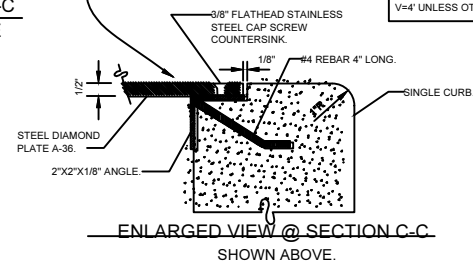
PLAN VIEW
NO SCALE



SECTION B-B
NO SCALE



SECTION C-C
NO SCALE



SECTION A-A
NO SCALE

GENERAL NOTES:

- ALL CONCRETE SHALL BE CLASS "A".
- ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION NO. 615.
- CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLAN.
- FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
- CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
- THE FRAME SHALL BE DETAIL P1564, TYPE 2 AND THE GRATE SHALL BE DETAIL P1565, TYPE 2.
- TYPE IS DESIGNATED AS FOLLOWS: COMBINATION TYPE "L-R" MODIFIED.
- INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

CATCH BASIN WALL THICKNESS & DEPTH	
T=5"	IF V 4' ≤ 8'
T=8"	IF V 4' > 8'
V=4' UNLESS OTHERWISE SPECIFIED.	

DETAIL NO.
P1583



City of Phoenix
STANDARD DETAIL

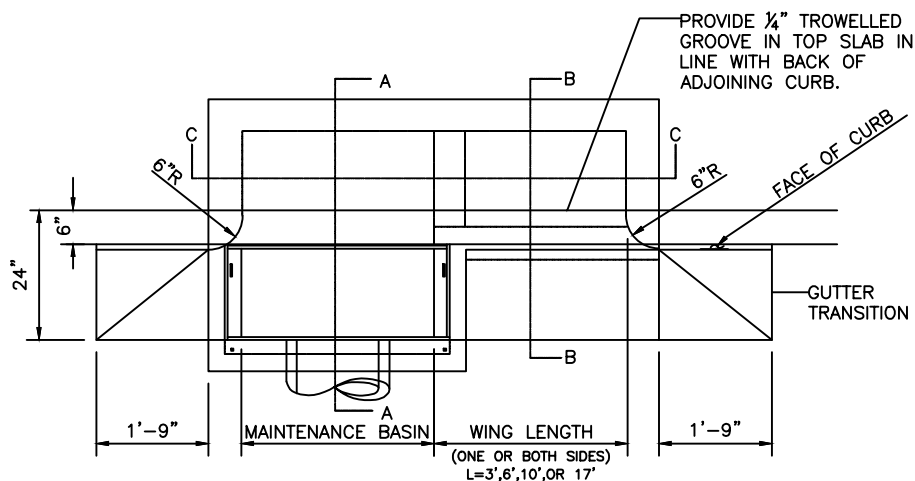
CATCH BASIN – TYPE "L-R" MODIFIED
(WITH REAR INLET)

APPROVED

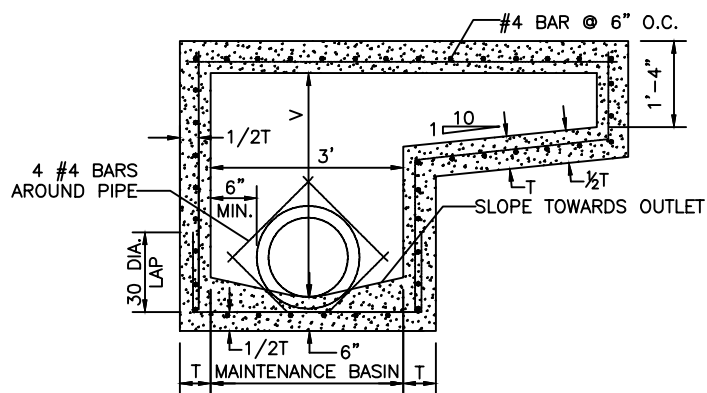
[Signature]
CITY ENGINEER

12/10/2012
DATE

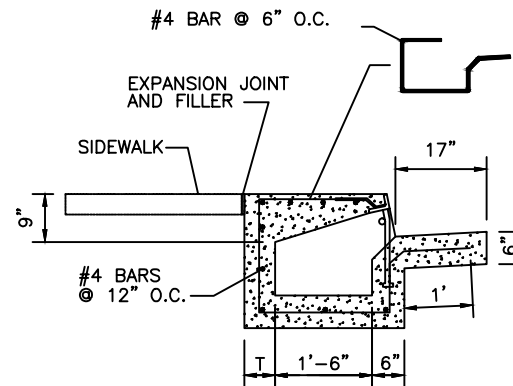
DETAIL NO.
P1583



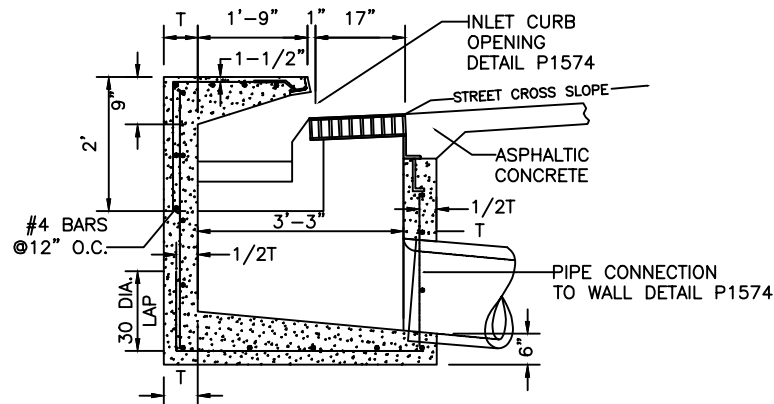
PLAN VIEW



SECTION C-C



SECTION B-B



SECTION A-A

1. ALL CONCRETE SHALL BE CLASS "A".
2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION NO. 615.
3. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLAN.
4. FLOOR BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. CONSTRUCTION DRAINS SHALL BE INSTALLED IN ALL INLETS BUILT WITH PAVING PROJECTS (SEE DETAIL P1575).
6. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
7. THE FRAME SHALL BE DETAIL P1564, TYPE 2 AND THE GRATE SHALL BE DETAIL P1565, TYPE 2.
8. TYPES ARE DESIGNATED AS FOLLOWS:
"R" MODIFIED -- NO WING;
"R-1" MODIFIED -- ONE WING;
"R-2" MODIFIED -- TWO WINGS.
9. INSTALL ONE CITY FURNISHED POLLUTION AWARENESS MARKER (PAM) AT EACH CATCH BASIN, AS DIRECTED BY THE ENGINEER.

CATCH BASIN WALL THICKNESS & DEPTH

T=6" IF V=8' OR LESS.

T=8" IF V=8'-1" TO 16'.

V=4'-0" UNLESS OTHERWISE SPECIFIED.



MARICOPA COUNTY

DEPARTMENT OF TRANSPORTATION

SUPPLEMENT TO THE

MARICOPA ASSOCIATION OF GOVERNMENTS'

UNIFORM STANDARD SPECIFICATIONS

AND DETAILS FOR

PUBLIC WORKS CONSTRUCTION

January 2016

TABLE OF CONTENTS

Authorization Memorandum	vii
Summary of Changes for the 2016 MCDOT Supplement to MAG	viii
SECTION 101 ABBREVIATIONS AND DEFINITIONS	1
SECTION 102 BIDDING REQUIREMENTS AND CONDITIONS	1
SECTION 103 AWARD AND EXECUTION OF CONTRACT	3
SECTION 104 SCOPE OF WORK	3
SECTION 105 CONTROL OF WORK	6
SECTION 106 CONTROL OF MATERIALS	9
SECTION 107 LEGAL REGULATIONS AND RESPONSIBILITY TO PUBLIC	11
SECTION 108 COMMENCEMENT, PROSECUTION AND PROGRESS	20
SECTION 109 MEASUREMENTS AND PAYMENTS	24
SECTION 110 NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION	25
SECTION 111 ENGINEER'S OFFICE FACILITIES	26
SECTION 202 REMOVAL OF STRUCTURES	31
SECTION 205 ROADWAY EXCAVATION	34
SECTION 212 ROADWAY OBLITERATION	34
SECTION 213 DEWATERING	35
SECTION 215 EARTHWORK FOR OPEN CHANNELS	36
SECTION 222 CEMENT STABILIZED ALLUVIUM BANK PROTECTION	36
SECTION 308 LIME SLURRY WITH FLY ASH STABILIZATION	46
SECTION 310 PLACEMENT AND CONSTRUCTION OF AGGREGATE BASE COURSE	51
SECTION 317 ASPHALT MILLING	51
SECTION 321 PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT	52
SECTION 325 PLACEMENT AND CONSTRUCTION OF ASPHALT-RUBBER ASPHALT CONCRETE	53
SECTION 329 TACK COAT	55
SECTION 333 FOG SEAL COATS	55
SECTION 336 PAVEMENT MATCHING AND SURFACE REPLACEMENT	56
SECTION 337 CRACK SEALING	57
SECTION 340 CONCRETE CURB, GUTTER, SIDEWALK, SIDEWALK RAMPS, DRIVEWAY AND ALLEY ENTRANCE	57
SECTION 350 REMOVAL OF EXISTING IMPROVEMENTS	58
SECTION 351 RELOCATION AND ADJUSTMENT OF EXISTING IMPROVEMENTS	59
SECTION 401 TRAFFIC CONTROL	61
SECTION 405 SURVEY MONUMENTS	67
SECTION 415 FLEXIBLE METAL GUARDRAIL	67
SECTION 416 GUARDRAIL END TREATMENTS	68
SECTION 417 CRASH CUSHIONS	71
SECTION 430 LANDSCAPING AND PLANTING	72
SECTION 432 GRAVEL MULCH	76
SECTION 460 REMOVAL OF PAVEMENT MARKINGS AND RAISED PAVEMENT MARKERS	78
SECTION 461 PAINTED PAVEMENT MARKINGS	81
SECTION 462 THERMOPLASTIC PAVEMENT MARKINGS	96
SECTION 463 RAISED PAVEMENT MARKERS	110
SECTION 464 ROADSIDE SIGN SUPPORTS	114
SECTION 465 SIGN PANELS	117
SECTION 470 GENERAL REQUIREMENTS FOR TRAFFIC SIGNAL AND INTERSECTION LIGHTING SYSTEMS	123
SECTION 471 ELECTRICAL UNDERGROUND INSTALLATION	128
SECTION 472 TRAFFIC SIGNAL FOUNDATIONS	133

TABLE OF CONTENTS

SECTION 473 DETECTORS	136
SECTION 474 TRAFFIC SIGNAL POLE INSTALLATION	143
SECTION 475 ELECTRICAL POWER SERVICE AND CONTROLLER CABINET INSTALLATION.....	147
SECTION 476 SIGNAL INDICATIONS AND MOUNTINGS.....	149
SECTION 477 INTERSECTION LIGHTING	154
SECTION 478 ELECTRICAL CONDUCTORS	157
SECTION 480 INTELLIGENT TRANSPORTATION SYSTEM GENERAL REQUIREMENTS	161
SECTION 481 FIBER OPTIC CONDUIT AND PULL BOXES:.....	174
SECTION 482 FIBER OPTIC CABLE AND EQUIPMENT:	186
SECTION 483 CLOSED CIRCUIT TELEVISION.....	201
SECTION 484 DYNAMIC MESSAGE SIGNS.....	205
SECTION 486 COMMUNICATIONS EQUIPMENT	207
SECTION 502 DRILLED SHAFT FOUNDATIONS	228
SECTION 506 PRECAST PRESTRESSED CONCRETE MEMBERS.....	242
SECTION 508 CATTLE GUARD	246
SECTION 601 TRENCH EXCAVATION, BACKFILLING AND COMPACTION.....	247
SECTION 635 CONCRETE LINED IRRIGATION DITCH.....	248
SECTION 702 BASE MATERIALS	249
SECTION 710 ASPHALT CONCRETE	249
SECTION 717 ASPHALT-RUBBER ASPHALT CONCRETE.....	250
SECTION 725 PORTLAND CEMENT CONCRETE	250
SECTION 728 CONTROLLED LOW STRENGTH MATERIAL	250
SECTION 738 HIGH DENSITY POLYETHYLENE PIPE & FITTINGS FOR STORM DRAIN & SANITARY SEWER	251
SECTION 740 POLYPROPYLENE PIPE & FITTINGS FOR STORM DRAIN, IRRIGATION & SANITARY SEWER	251

TABLE OF CONTENTS

Maricopa County Standard Details

<u>Number</u>	<u>Description</u>
2010-1	Residential Speed Hump Without Curb and Gutter
2010-2	Residential Speed Hump With Curb and Gutter
2010-3	Speed Hump Extension
2011	Residential Speed Cushion without Curb and Gutter
2013	Milling for Overlay
2030-A	Sidewalk Ramp Retrofit – Method A
2030-C	Sidewalk Ramp Retrofit – Use Requires Special Approval
2031-A	Sidewalk Ramp Arterial Intersections
2035	Return Type Driveways with Detached Sidewalk
2036	Return Type Driveways with Attached Sidewalk
2054	Street Name Sign Installation Details (4 pages)
2055	Barricade (Portable)
2057	Permanent Road Closure Using Type III Barricades (4 pages)
2058	Square Perforated Tube Sign Post Foundation & Splice Details
2059	U-Channel Post Selection and Installation Details
2060	Offsets, Clearances and Mounting Details for Signs on County Roadways (2 pages)
2061	Sign Blanks – Layouts (23 pages)
2062	Street Sign – Post Caps and Brackets (6 pages)
2066	Mailbox Installation
2067	Mailbox Installation Hardware
2069	Recommended Mailbox Clearances at Intersections
2070	Typical Mailbox Turnout
2801	W-Beam Guard Rail G4(1W) and G4 (2W) Blocked Out Timber Post
2802	Guardrail Installation
2803	W-Beam Guardrail G4 (1S) Blocked Out Steel Post
2805	Guardrail: Tangent W-Beam Terminal Layout with Curb and Gutter
2806	Guardrail: Tangent W-Beam Terminal Layout without Curb and Gutter
2807	Departure End Terminal
2808-1	Nested Guardrail Type 1
2808-2	Nested Guardrail Type 2
2808-3	Nested Guardrail Type 3
2812-1	Thrie Beam Guardrail Transition
2812-2	Bridge Barrier Transition
2812-3	Barrier Details
3001	W Beam Guard Rail G4(1W) and G4 (2W) Blocked Out Timber Post – CHANGED DETAIL NUMBER to Detail 2801
3002	Guardrail Installation – CHANGED DETAIL NUMBER to Detail 2802
3003	W-Beam Guardrail G4 (1S) Blocked Out Steel Post – CHANGED DETAIL NUMBER to Detail 2803
3004	Guardrail Post Installation for Concrete Paved Areas

TABLE OF CONTENTS

<u>Number</u>	<u>Description</u>
---------------	--------------------

3005	End Terminal Layout with Curb and Gutter – CHANGED DETAIL NUMBER to Detail 2805 and revised title
3006	End Terminal Layout without Curb and Gutter – CHANGED DETAIL NUMBER to Detail 2806 and modified title
3007	Departure End Terminal – CHANGED DETAIL NUMBER to Detail 2807
3008-1	Nested Guardrail Type 1 – CHANGED DETAIL NUMBER to Detail 2808-1
3008-2	Nested Guardrail Type 2 – CHANGED DETAIL NUMBER to Detail 2808-2
3008-3	Nested Guardrail Type 3 – CHANGED DETAIL NUMBER to Detail 2808-3
3009	Guardrail Transition 31” to 28”
3010	Bolted Guardrail Anchors (2 pages)
3012-1	Thrie Beam Guardrail Transition – CHANGED DETAIL NUMBER to Detail 2812-1
3012-2	Bridge Barrier Transition – CHANGED DETAIL NUMBER to Detail 2812-2
3012-3	Barrier Details – CHANGED DETAIL NUMBER to Detail 2812-3
3016	Guardrail Measurement
3100	Wood BCT & CRT Posts, Foundation Tube
3101	Midwest Guardrail System Blocked out Timber Post
3102	MGS Guardrail Installation
3103	MGS Blocked Out Steel Post
3105	MGS Tangential Terminal Layout with Curb & Gutter
3108	MGS Long-Span
4701	Traffic Signal Symbols (2 pages)
4711	Traffic Signal Pull Box Detail
4712	Traffic Signal Pull Box Extension
4713	Typical Traffic Signal Pull Box Installation
4716	Typical Traffic Signal Pull Box and Conduit Run Layout
4717	ITS Interconnect Conduit and Pull Box Layout
4720	Signal Pole Foundations (Pole Types A, E, F & PB)
4721	Signal Pole Foundations (Pole Types J, Q, K & R)
4723	'P' Cabinet Foundation
4724	Combination Service Pedestal and Battery Backup Foundation Detail
4725	Anchor Bolt with Hook
4726	Anchor Bolt with Plate
4730	'P' Cabinet
4731-1	'SP' Electrical Service Pedestal & 'BBS' Battery Backup System Cabinet
4731-2	Service Pedestal and Battery Backup Wiring Schematic
4735	Controller Cabinet Wiring Schematic
4737	Luminaire Circuit

TABLE OF CONTENTS

<u>Number</u>	<u>Description</u>
4738	Type 'A' Pole
4739-1	Pole Lower Hand Hole Details
4739-2	Pole Upper Hand Hole Detail
4740	Type 'E' Pole
4741-1	Type 'F' Pole
4741-2	'E' & 'F' Pole Details
4742	Type 'J' Pole
4743	Type 'Q' Pole
4744	'J' & 'Q' Pole Details
4748	Type 'K' Pole
4749-1	Type 'R' Pole
4749-2	'K' & 'R' Pole Details
4750	Type 'PB' Pole
4755	Video Detection Camera Installation
4757	Loop Installation Details
4758	Conduit Stub-Out Detail Without Curb & Gutter
4759	Conduit Stub-Out Detail With Curb & Gutter
4773	Standard Signal Faces
4774	Signal Head Visor
4775	Side Mount (Type XI) Assembly (Vehicle & Pedestrian)
4776	Pole Top (Type III) Mounting Assembly – DELETED
4778-1	Mast Arm Signal Head Mount (Type II)
4778-2	Elevator Plumbizer Detail
4780-1	Metro Street Sign Layout Sheet Installation on Signal Poles
4780-2	Metro Street Sign Layout and Installation on Traffic Signal Poles
4780-3	Metro Street Sign Clamp
4780-4	Metro Street Name Sign Mounted on Type “J” or “K” Signal Poles
4780-5	Oversized Metro Street Name Sign Mounting to Signal Pole Details
4785	Pole Plate
4786	Pole Top Mount Adaptor – DELETED
4788	Elbow
4789	Tee
4791	Ornamental Cap
4792	Side Mounted Terminal Compartment
4793	Terminal Compartment Cover
4794	Type V Mounting Assembly
4795	Type VII Mounting Assembly
4797-1	Type PB Pedestrian Push-Button Mount
4797-2	Pedestrian Push-Button Housing
4797-3	Pedestrian Push-Button Adapter Plate
4797-4	Audible Pedestrian Push Button Station
4798	Underground Combination Power Service / Battery Backup System Layout
4799-1	Color Code - 2, 4 and 7 Conductor Cable
4799-2	Color Code - 20 Conductor Cable

TABLE OF CONTENTS

<u>Number</u>	<u>Description</u>
4801	Typical ITS PVC Conduit Installation
4805-1	ITS Fiber Optic Pull Box Type A
4805-2	ITS Fiber Optic Pull Box Type B
4805-3	ITS Fiber Optic Pull Box Type C
4805-4	ITS Fiber Optic Pull Box Type D
4806-1	ITS Fiber Optic Pull Box Type E
4806-2	ITS Fiber Optic Type E Pull Box Cover Assembly
4810	ITS Conduit and ITS Type A Pull Box Installation
4811	ITS Conduit and Type B, C, D & E Pull Box Installation
4821	Fiber Optic Cable Installed in Type B, C, D & E Pull Box
4825-1	ITS Pedestal Post Top Mounting (G-1)
4825-2	ITS Square Base ('SB') Pole Foundation Detail
4825-3	ITS Square Base 'SB' Pedestal
4825-4	ITS Type 'SB' Pole
4825-5	ITS Pedestal Pole Top Mounting Adapter
4825-6	ITS Type 'G' Cabinet
4827	ITS Post Side Mount (G-2)
4829-1	Service Pedestal
4829-2	Service Pedestal Foundation
4829-3	Service Pedestal Wiring Schematic
4830	CCTV Camera Installation on Signal Pole
4831-1	ITS CCTV Camera Panel Location
4831-2	ITS CCTV Camera Panel Details
4831-3	CCTV Camera Wiring Schematic
4833	Multiservice Radio Installation on Signal Pole
4835	4"X4" Post with Conduit for T1 Demarcation Point




Maricopa County

Department of Transportation

Director's Office
2901 W. Durango Street
Phoenix, AZ 85009
Phone: 602-506-4700
Fax: 602-506-4858
www.mcdot.maricopa.gov

DATE: December 14, 2015

TO: Engineers, Contractors, Consultants and Agency Staff

FROM: Jennifer Toth, P.E. 
Transportation Director/County Engineer

SUBJECT: Maricopa County Department of Transportation Supplement
to the MAG Uniform Standard Specifications and Details for
Public Works Construction

Effective January 1, 2016, work performed within Maricopa County rights-of-way shall comply with the 2016 revision to the MAG Uniform Standard Specifications and Details for Public Works Construction as modified by the Maricopa County Department of Transportation (MCDOT) Supplement dated January 2016. The attached supplement dated January 2016 replaces the MCDOT Supplement dated January 2105 and shall remain in effect until reissued or updated.

Please address specific issues or concerns to the MCDOT Engineering Division:

Robert Herz (602) 506-4760 (email: rherz@mail.maricopa.gov)
Edmund Williams (602) 506-2400 (email: EdmundWilliams@mail.maricopa.gov)

This document is also available on the MCDOT website at <http://www.mcdot.maricopa.gov/technical/home.htm> or for purchase at the Maricopa County Department of Transportation offices located at 2901 West Durango Street, Phoenix, AZ 85009, Customer Service (602) 506-8600.

Enclosure

Summary of Changes for the 2016 MCDOT Supplement to MAG

Below is a summary of changes made for the 2016 MCDOT Supplement to MAG. The changes have been coordinated with MAG Specifications and Details as revised for 2016.

Specification – changes

106.2.1	Added Certificate of Compliance requirements.
106.2.2	Added Certificate of Analysis requirements.
107.15	Revisions include using variable message signs in place of post mounted sign boards and updating the MCDOT Public Information Office phone number. These changes were previously posted in the MCDOT Guideline Special Provisions for inclusion in project special provisions.
310.4	In Table 310-1 delete “or gradation deficiency” from the Type IV Deficiency column.
321.8.2	Added: Longitudinal pavement joints shall maintain a minimum 6 inch clear distance from the edge of any proposed longitudinal stripe.
321.10.3	Requirement added into MAG Specifications, deleted from MCDOT Supplement.
321.13	Revised to coordinate with 2016 changes to the MAG specifications.
325.7.1	Requirements added into MAG Specifications, deleted from MCDOT Supplement.
325.7.2	Added: Longitudinal pavement joints shall maintain a minimum 6 inch clear distance from the edge of any proposed longitudinal stripe.
325.11	MAG Specifications adjusted, deleted from MCDOT Supplement.
336.1	Requirement added into MAG Specifications, deleted from MCDOT Supplement.
336.2.1	Requirement added into MAG Specifications, deleted from MCDOT Supplement.
336.2.2	Requirement added into MAG Specifications, deleted from MCDOT Supplement.
336.2.4.1	Requirement added into MAG Specifications, deleted from MCDOT Supplement.
336.2.4.3	Revised Pavement Repair specifications to provide clarity.
336.3	Adjusted to match revised MAG Specifications.
336.4	Adjusted to match revised MAG Specifications.
415.2	Added: Corten guardrail shall conform to AASHTO M 180, Type IV, Class B with ASTM A588 steel.
416.3.1	Revised to allow the use of a MASH compliant Midwest Guardrail System tangential approach terminal on a 28” high strong post W-beam system when an approved 31” to 28” guardrail transition is installed between the two guardrail systems.
460.3	Deleted the measurement of thermoplastic and painted markings located on surfaces to be removed.

- 461.2.2(B) Added item (6) Heavy Metal Concentration restrictions for glass beads.
- 461.3.2(E) Application rate for glass beads changed to 8 pounds per gallon of paint.
- 461.4 Painted temporary striping required by section 462.3.2(A) is to be measured.
- 462 Adjusted section organization and numbering.
- 462.1 Allows the use of preformed markings for arrows, symbols, and legends when approved by the Engineer.
- 462.2.2 Required alkyd binder and eliminated hydrocarbon binder. Revised the chart showing the hot sprayed thermoplastic components weight percentages. Replaced requirement for 'Lead Chromate Pigment' with 'Yellow Lead-Free Pigment'. Added Color Stability requirements.
- 462.2.3 Drop-on beads revised to be AASHTO M 247 Type 1 and Type 3.
- 462.2.4 Preformed Pavement Markings – a new subsection under MATERIALS.
- 462.3.2 Added requirement to apply painted temporary striping on new asphalt-rubber pavement where thermoplastic striping is required.
- 462.3.3 Application of Preformed Pavement Markings – a new subsection under CONSTRUCTION REQUIREMENTS.
- 462.3.4(D) Adjusted thermoplastic application temperature range. Added application requirements for Type 1 and Type 3 drop-on beads. Revised the required clear distance between longitudinal striping and pavement joints from 12 inches to 6 inches.
- 463.3 Identified placement of raised pavement markers relative to striping.
- 470.6 Added coordination requirements with the MCDOT Traffic Signals Branch Manager prior to modification or disruption of any traffic signal.
- 473 Relocated requirements for Section 485 VIDEO IMAGE DETECTORS into this section.
- 473.2.3 Added material requirements for audible pedestrian push button stations.
- 473.3.2 Removed the reference to a specific pedestrian push button detail.
- 474.5.2 Added: Installation of traffic signal poles shall be scheduled at a time that minimizes disruption of traffic and minimizes exposure of the travelling public to potential harm. Traffic signal pole installation shall occur during nighttime hours unless prevented by local ordinances or regulations or an alternative time is approved by the Engineer.
- 480.1 Deleted paragraph on training for MCDOT staff.
- 480.2.3 Deleted paragraph concerning transformers.
- 480.2.6 Revised to require approval of material and equipment prior to ordering items.
- 480.4 Deleted item 6 requirement from the Warranty Administration Plan. Deleted the requirement to provide an inventory of spare parts.
- 480.6 Deleted TRAINING requirements.
- 481.2.2(B) Revised section title to "Duct Bank - 4 Rigid Conduits" and modified to add PVC conduit.
- 481.2.6 Added requirement to use a conduit termination kit recommended by the fabric innerduct manufacturer when geotextile fabric innerducts are used.
- 481.2.10 Revised section title from "Design Approval Tests (DAT)" to "Product Certification" and also renumbered to 481.2.11 Product Certification.

- 481.2.10 New Pull Tape section added to relocate material requirements to section 481.2 MATERIALS and removed from section 481.3 CONSTRUCTION.
- 481.3.1(C) Revised Detectable Locator Wire from #8 AWG to #14 AWG with a green outer jacket.
- 482.2.1 Fiber optic cable is to be filled with a dry water-blocking material (Super Absorbent Polymer).
- 482.2.1(D) Revised requirements for the ends of branch fiber optic cable to be bare for splicing.
- 482.2.2(C) Add requirements for fiber optic termination units used in traffic signal cabinets.
- 482.3.1(A) Reduced the length of slack fiber optic cable required in Type A and Type B pull boxes.
- 482.3.2(B) Deleted the use of SC type connectors.
- 482.3.2(B) Deleted Field Termination subsection.
- 482.8 The length of branch fiber optic cable attached to patch panels is no longer to be considered as part of the patch panel but is to be measured.
- 483.2.1(B) Added the requirement for H 264 compression for IP Addressable HD Digital Cameras.
- 485 Section 485 VIDEO IMAGE DETECTORS relocated to and merged with Section 473 DETECTORS.
- 486.2.10.2(C) Changed type SC connectors to type LC.
- 601.2.7 Requirement added into MAG Specifications, deleted from MCDOT Supplement.
- 635 Concrete Lined Irrigation Ditch – Limited the use to bottom widths of three feet or less.
- 717.2.1.3 Limited the maximum crumb rubber content in ARB to 24 percent by weight of total binder.
- 727.2 Deleted, the requirements are in the MAG specification.
- 727.3 Deleted, the requirements are in the MAG specification.
- 771 The MCDOT supplemental provisions have been incorporated into the 2016 MAG Specifications and deleted from the MCDOT Supplement.

Details – Revised, New, or Deleted

Deleted MCDOT revision to MAG Detail 145 Safety Rail – MAG Detail revised.

- 2035 Return Type Driveways with Detached Sidewalk – Deleted Table B and all references to residential driveways.
- 2036 Return Type Driveways with Attached Sidewalk – Deleted Table B and all references to residential driveways.
- 2801 W-Beam Guard Rail G4(1W) and G4 (2W) Blocked Out Timber Post – Revised detail number was Detail 3001.
- 2802 Guardrail Installation – Revised Detail number was Detail 3002.
- 2803 W-Beam Guardrail G4 (1S) Blocked Out Steel Post – Revised detail number was Detail 3003.

2805	Guardrail: Tangent W-Beam Terminal Layout with Curb and Gutter – Detail number revised, it was Detail 3005.
2806	Guardrail: Tangent W-Beam Terminal Layout without Curb and Gutter – Detail number revised, it was Detail 3006.
2807	Departure End Terminal – Revised detail number was Detail 3007.
2808-1	Nested Guardrail Type 1 – Revised detail number was Detail 3008-1
2808-2	Nested Guardrail Type 2 – Revised detail number was Detail 3008-2
2808-3	Nested Guardrail Type 3 – Revised detail number was Detail 3008-3
2812-1	Thrie Beam Guardrail Transition – Revised detail number was Detail 3012-1.
2812-2	Bridge Barrier Transition – Revised detail number was Detail 3012-2.
2812-3	Barrier Details – Revised detail number was Detail 3012-3.
3001	W-Beam Guard Rail G4(1W) and G4 (2W) Blocked Out Timber Post – Revised detail number to Detail 2801.
3002	Guardrail Installation – Revised detail number to Detail 2802.
3003	W-Beam Guardrail G4 (1S) Blocked Out Steel Post – Revised detail number to Detail 2803.
3005	End Terminal Layout with Curb and Gutter – Revised detail number and name to Detail 2805 Guardrail: Tangent W-Beam Terminal Layout with Curb & Gutter
3006	End Terminal Layout without Curb and Gutter – Revised detail number and name to Detail 2806 Guardrail: Tangent W-Beam Terminal Layout without Curb & Gutter.
3007	Departure End Terminal – Revised detail number to Detail 2807.
3008-1	Nested Guardrail Type 1 – Revised detail number to Detail 2808-1.
3008-2	Nested Guardrail Type 2 – Revised detail number to Detail 2808-2.
3008-3	Nested Guardrail Type 3 – Revised detail number to Detail 2808-3.
3009	31" to 28" Guardrail Transition – New detail.
3012-1	Thrie Beam Guardrail Transition – Revised detail number to Detail 2812-1.
3012-2	Bridge Barrier Transition – Revised detail number to Detail 2812-2.
3012-3	Barrier Details – Revised detail number to Detail 2812-3.
3016	Guardrail Measurement – Deleted references to specific guardrail approach terminals.
3100	Wood BCT & CRT Posts, Foundation Tube – New detail.
3101	Midwest Guardrail System Blocked out Timber Post – New detail.
3102	MGS Guardrail Installation – New detail.
3103	MGS Blocked Out Steel Post – New detail.
3105	MGS Tangential Terminal Layout with Curb & Gutter – New detail.
3108	MGS Long-Span – New detail.
4723	'P' Cabinet Foundation – Added offset distance between top of foundation and top of cabinet pad.
4755	Video Detection Camera Installation – Mounting location revised.
4773	Standard Signal Faces – Added Type F Modified, D, and E.
4776	Pole Top (Type III) Mounting Assembly – DELETED
4786	Pole Top Mount Adaptor – DELETED

- 4797-1 Type PB Pedestrian Push button Mount – Minor text and drafting adjustments.
- 4797-4 Audible Pedestrian Push Button Station – New detail.

MAG 2016 REVISIONS

New Specifications:

- Section 322: Decorative Asphalt
- Section 608: Horizontal Directional Drilling

Specifications rewritten, or with major updates:

- Section 321: Placement and Construction of Asphalt Concrete Pavement
- Section 336: Pavement Matching and Surfacing Replacement
- Section 342: Interlocking Concrete Paver Installations
- Section 602: Trenchless Installation of Steel Casing
- Section 718: Preservative Seal for Asphalt Concrete

Specifications with minor updates:

- Section 325: Placement and Construction of Asphalt-Rubber Asphalt Concrete Pavement
- Section 334: Preservative Seal for Asphalt Concrete
- Section 345: Adjusting Frames, Covers and Valve Boxes
- Section 601: Trench Excavation, Backfilling and Compaction
- Section 625: Manhole Construction and Drop Sewer Connections
- Section 710: Asphalt Concrete
- Section 717: Asphalt-Rubber Asphalt Concrete
- Section 735: Reinforced Concrete Pipe
- Section 771: Galvanizing
- Section 772: Chain Link Fence

Specifications that have been deleted:

- Section 744: ABS Truss Pipe and Fittings

Details that have been updated:

- Detail 145: Safety Rail
- Detail 200-1: Trench Backfill and Surface Replacement
- Detail 200-2: Trench Backfill and Surface Replacement
- Detail 225: Interlocking Concrete Pavers
- Detail 270: Frame and Cover and Grade Adjustment

MCDOT 2016 Supplement to MAG Uniform Standard Specifications

SECTION 101

ABBREVIATIONS AND DEFINITIONS

101.2 DEFINITIONS AND TERMS:

Add the following:

Certified Laboratory: An AASHTO accredited laboratory, certified in the relevant engineering materials and testing specialty areas(s) referenced in the Contract Documents.

County: The Maricopa County Department of Transportation, acting through its legally constituted officials, officers, or designated employees.

Mailbox: The mail receptacle and its supporting post or structure.

Maximum Density: The maximum dry density of soil obtained from the procedures defined in Section 301.3.

Portland Cement Concrete Pavement: Concrete pavement that complies with specification section 324.

Professional Geologist: A person who has a current registration as a geologist granted by the Arizona State Board of Technical Registration.

The following definition is revised:

Force Account Work: Work performed in accordance with Section 109.5

SECTION 102

BIDDING REQUIREMENTS AND CONDITIONS

102.5 PREPARATION OF PROPOSAL:

Revise the third paragraph of Section 102.5 to read:

102.5.1 Proposal Preparation:

Contractor shall submit the entire construction specifications document intact and shall complete and submit the following documents with its bid:

(A) No Collusion Affidavit - form must be filled out, signed and notarized.

(B) Verification of License - form must be filled out, dated and signed.

(C) Bid Form - appropriate sections of the form must be filled out, addenda listed, if any, and signed.

(D) Bidding Schedule - must include unit costs, amounts per bid item, and total bid amount. Addenda, if any, must be listed. All notations in the bidding schedule must be legible and in pen or ink.

(E) Surety Bond - proposals must be accompanied by a certified check, cashier's check, or a surety bond for an amount equal to ten percent (10%) of the total amount bid.

(F) All addenda issued by the County for the specific project must be included with the bid and noted on the second page of the proposal.

(G) Sub-Contractor Listing

Other forms - execution of the Contract, submittal of the Performance/Payment Bond and the Certificate of Insurance is not required at the time of bid submittal. These documents must be submitted to the County by the successful bidder at time of contract execution.

Contractor may be required to provide proof of satisfactory completion of similar public works projects.

Add the following to Section 102.5:

It shall be the responsibility of the prospective bidder to determine, prior to the submittal of its bid, if any addenda to the project have been issued by Maricopa County. All addenda issued, if not already bound in the Special Provisions, shall be submitted by bidder with its bid and noted in the proposal section. All quantity adjustment, required as a result of the addendum, shall be reflected on the bidding schedule in pen and ink.

Bids which do not reflect the appropriate changes on the bidding schedule, do not have all issued addenda attached and noted in the proposal section of the Contract, will be rejected by the County.

Prospective bidders may call Maricopa County, Office of Procurement Services in order to ascertain if addenda have been issued for this project.

102.6 SUBCONTRACTORS' LIST, add the following:

The Contractor shall submit to the County with the Bid documents a listing of all major Subcontractors and Material Suppliers the Contractor intends to use in the performance of the work specified in this contract. In determining the amount of work assigned to each

Subcontractor, the Contractor shall adhere to the mandates set forth in Section 108.2, Subsection E, of the MAG Uniform Standard Specifications.

SECTION 103

AWARD AND EXECUTION OF CONTRACT

103.6 CONTRACTOR'S INSURANCE:

103.6.1 General, revise the insurance amount for MINIMUM LIMITS OF LIABILITY to be as follows:

General Liability	\$2,000,000	Each Occurrence
	\$2,000,000	Personal & Advertising Injury
	\$4,000,000	General Aggregate
	\$4,000,000	Products/Completed Operations
Automobile Liability	\$2,000,000	Each Occurrence
Workers' Compensation	\$1,000,000	Each Accident
	\$1,000,000	Disease for Each Employee
	\$1,000,000	Disease Policy Limit

SECTION 104

SCOPE OF WORK

104.1 WORK TO BE DONE:

104.1.1 General, add the following:

The work shall be as described in the specifications, as shown on the project plans, and in compliance with permit requirements. Specifications shall be the latest revision of the Maricopa County Association of Governments' Uniform Standard Specifications for Public Works Construction as modified by the Maricopa County Department of Transportation's Supplement to MAG and the project Special Provisions.

104.1.4 Cleanup and Dust Control, add the following:

Contractor shall dispose of excess material or construction debris on an as-needed basis in order to keep the site safe to Contractor's personnel and the general public. Construction debris shall be disposed of only in a manner or in a location approved by

the Engineer. The Contractor shall upon request file with the Engineer the written consent of the owner of any off-site location designated to receive excess material or debris.

Contractor shall be responsible for the safe and clean condition of the site during the entire period the site is under Contractor's care, custody and control.

104.3 VALUE ENGINEERING

Section 104 add the following:

104.3.1 Purpose:

This clause defines a Construction Incentive Change Order Proposal ("CICOP") and establishes the policy and procedure for the application of CICOP's in the Maricopa County construction process.

104.3.2 Definition:

A CICOP is a defined, written proposal for a change order during construction and shall be initiated, developed and identified by Contractor. The CICOP shall result in gross capital savings and a net capital improvement cost reduction, shall not increase the total maintenance cost of the project and shall meet the following requirements:

104.3.2.1 All Time Extensions for the project shall be agreed upon by both parties at the time the CICOP is approved. The County's determination shall be binding upon the Contractor and shall not be subject to challenge.

104.3.2.2 The CICOP shall not alter the initially intended function, quality and safety standards of the project.

104.3.2.3 The CICOP shall not change the overall scope of the work, which would require a re-bidding of the project.

104.3.2.4 The CICOP shall not conflict with any contract provisions regarding proprietary and restrictive specifications for bids in connection with Uniform Standard Specifications and details, or any other applicable specifications.

104.3.2.5 The CICOP shall not cause undue interruption of the contract work schedule.

104.3.2.6 The proposed changes in connection with the CICOP shall comply with all federal, state and local regulations, mandates and permits.

104.3.2.7 If the Contractor wishes to submit a CICOP, he shall submit a preliminary CICOP in writing, which shall address all components required for a final CICOP, in summary form. The County will review the preliminary CICOP and inform the Contractor in writing if the County wishes to implement the CICOP. The Contractor would then be requested to prepare a detailed final CICOP.

104.3.3 Applicability:

All Maricopa County construction contracts.

104.3.4 Content:

The CICOP shall contain pertinent information and support documentation to allow comprehensive review by the appropriate contracting agency. At a minimum, the CICOP shall include the following information:

104.3.4.1 Name and title of individuals associated with the design and preparation of the CICOP.

104.3.4.2 Detailed scope description with sealed plans and specifications. A comparison summary of present design, proposed changes and detailed description of the advantages and disadvantages for each change proposed. The CICOP shall be sealed and signed by a Professional Engineer.

104.3.4.3 Comprehensive procedure and schedule outlining implementation of CICOP, including all required contract amendments and the absolute latest approval date for the CICOP.

104.3.4.4 Estimated cost summary which shall include but not necessarily be limited to the following:

104.3.4.4.1 Project cost with and without CICOP, which shall include the following items:

104.3.4.4.1.1 Quantities of materials and equipment.

104.3.4.4.1.2 Unit prices for materials and equipment.

104.3.4.4.1.3 Hourly rates and total labor hours required for installation.

104.3.4.4.1.4 Overhead and fee percentage of Contractor and all subcontractors of any tier involved in the performance of the work outlined in the CICOP.

104.3.4.4.2 Operations and maintenance cost prior to and after implementation of CICOP.

104.3.4.4.3 Implementation cost of the CICOP not covered in Section 104.3.4.4.1.4, above.

104.3.4.4.4 Contractor's cost of the savings, based on the formula specified below.

104.3.4.4.5 Other pertinent data, as may be required by the County to prepare and execute a change order to the Contract.

104.3.4.4.6 If Contractor fails to notify the County of all required changes for the CICOP during the initial CICOP approval stage, Contractor shall absorb all costs connected with the implementation of changes of which the County was not made aware of. If conditions occur, which could not be foreseen by any prudent Contractor, the County may enter into negotiations with Contractor and make the necessary cost adjustments to the Contract.

104.3.4.4.7 All CICOP's become public record when submitted to the County for review and approval. Propriety information may be protected by Contractor.

104.3.4.4.8 For CICOP's accepted by the County, processing procedure for change orders shall be used.

104.3.4.4.9 If a CICOP is rejected by the County, Contractor may not appeal such a rejection.

104.3.5 Sharing Provisions:

Upon acceptance and implementation of a CICOP, Contractor will share the net capital savings derived from the implementation of the CICOP, in accordance with the formula outlined below:

104.3.5.1 Initial construction cost minus revised construction cost minus CICOP development cost and CICOP implementation cost equals Net Capital Savings.

104.3.5.1.1 The CICOP implementation cost shall include Contractor's actual cost and fee for reviewing and redesigning the CICOP, documented to the satisfaction of the County.

104.3.5.1.2 CICOP development cost shall include Contractor's cost directly associated with the preparation of the CICOP package, documented to the satisfaction of the County.

104.3.5.1.3 CICOP implementation and development costs shall include COUNTY costs for review and approval of the CICOP package.

104.3.5.2 Sharing Formula: Net Capital Savings, calculated in accordance with the formula outlined in Section 104.3.5.1, above, shall be shared with Contractor on an equal 50/50 percentage basis.

SECTION 105

CONTROL OF WORK

105.1 AUTHORITY OF THE ENGINEER, add the following:

The Engineer may adjust design grades or adjust the location of structures (especially drainage structures) prior to construction. Such adjustments are considered minor changes in the work and do not constitute extra work.

105.2 PLANS AND SHOP DRAWINGS, add the following:

Initial submittal for review – five copies, of which one copy will be returned to the Contractor within five working days.

Final submittal for approval – five copies, of which two copies will be returned to the Contractor within five working days.

105.4 COORDINATION OF PLANS AND SPECIFICATIONS:

Section 105.4 is replaced with the following:

Contractor shall perform the work under this Contract in accordance with the intent of the Plans and Specifications and shall not take advantage of any error or omission in the Plans and/or specifications. In the event Contractor discovers an error or omission in the Plans and/or specifications, Contractor shall promptly advise the Engineer of such an error or omission. If Contractor fails to notify the Engineer of an error or omission in the Plans and/or specifications, which Contractor has discovered or should have discovered through the exercise of reasonable diligence, any additional work required as the result of such errors or omissions, shall be compensated by the County on a force account basis and such compensation shall be the exclusive compensation to Contractor for any costs, expenses or damages resulting directly or indirectly from the correction of such errors and omissions.

105.6 COOPERATION WITH UTILITIES, add the following:

Contractor is solely responsible for any damage to existing utilities resulting from Contractor's operations at the site. The use of hand tools to expose a marked facility is required when proposed excavation is within the 2.0-foot tolerance zone of a marked facility, or if uncertainty exists as to the exact location of a facility.

An attempt has been made by the County to identify the location of all underground utilities located within the perimeter of the site and to design the location and elevation of all irrigation and drainage pipes, culverts and structures to avoid interference with existing utilities. It shall be the Contractor's responsibility to cooperate with the appropriate utility companies in order to facilitate requested adjustments of obstructing utilities. (Please refer to the Special Provisions for specific telephone numbers and contact persons of utilities within the project area).

Contractor's installation of conduits, brackets, piping, valve adjustments or other material at the request and for the convenience of the utility shall be paid by the utility unless specifically identified otherwise in the plans or the Special Provisions. Contractor shall make all required arrangements for such construction and payment with the utility. The County will not extend the performance period of the contract to accommodate construction performed for the convenience of the utility.

105.8 CONSTRUCTION STAKES, LINES AND GRADES:

The first paragraph of Section 105.8 of the Uniform Standard Specifications is revised to read:

Maricopa County will furnish one time the necessary survey control for the Contractor's guidance. Staking shall consist of the following:

(A) Right-of-Way lines at 100 ft. intervals for clearing, fencing, and control of Contractor's operations.

(B) Slope stakes shall be offset from the edge of the embankment at 100 ft. intervals.

(C) Blue tops in subgrade at centerline and edge of pavement at 100 ft. intervals except on curves. Contractor shall have all material in place and compacted within 2.5 inches± prior to requesting the survey crew.

(D) Blue tops on aggregate base course at centerline, edge of pavement, and 1/4 points at 50 ft. intervals. Contractor shall have all material in place and compacted within 2.5 inches ± prior to requesting the survey crew.

(E) Catch basin stakes shall be offset at 10 ft. and 15 ft. to the center of the structure with cuts or fills shown to the top of grate.

(F) Grade and line stakes for all structures, pipe lines, culverts, and ditches.

(G) Straddle points for permanent monuments.

105.12 MAINTENANCE DURING CONSTRUCTION, add the following:

The Contractor shall be responsible to protect the construction site, construction activities, and new construction from the detrimental effects of weather, including flooding, until acceptance by the Engineer.

105.15 ACCEPTANCE, add the following:

The Contractor may request an inspection to establish substantial completion when all of the following have occurred:

- All pavement, pavement markings and signing are complete and accepted and traffic can move unimpeded through the project at the posted speed;
- All pedestrian pathways are completed and accepted and pedestrians are not restricted by any construction activity;
- All guardrails, drainage devices, ditches, excavation and embankment have been accepted;
- The only work left for completion is incidental, away from vehicle and pedestrian traffic, and does not affect the safety or convenience of the traveling public.

A notice of substantial completion shall be issued when the Engineer determines after an inspection that all conditions for substantial completion have been met. The decision whether the project is substantially complete is within the sole discretion of the Engineer. The inspection date requested by the Contractor for the substantial completion inspection shall be the date of substantial completion if the Engineer determines the conditions for substantial completion have been met. Liquidated damages shall not be assessed after the substantial completion date.

SECTION 106

CONTROL OF MATERIALS

106.1 SOURCE OF MATERIALS AND QUALITY, add the following:

All materials not specifically noted as provided by the County or other participating agency shall be obtained from commercial sources. Contractor shall pay all royalties or any other charges or expenses incurred in connection with the securing and hauling of the material. Contractor shall provide the Engineer with a list of proposed commercial sources prior to utilization of such sources and shall present satisfactory evidence that the material obtained from the commercial sources meets the specifications of this project.

The Contractor is responsible for providing quality control measures and testing necessary to provide acceptable quality in the production, handling, and placement of all materials. Engineer's testing is for quality assurance and acceptance. The cost of quality control measures and testing shall be included in the unit price of related items.

If the use of borrow material is required during the performance of the work outlined in the Construction Specifications, Contractor shall assure that the borrow material used for the project, if the source is other than that recommended by the County, does not contain any substances which may be harmful to humans, animals, vegetation, ground and surface water, and the environment and which are regulated under the Hazardous Material Transportation Act, the Toxic Substances Control Act, the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

106.2 SAMPLES AND TESTS OF MATERIALS, add the following:

106.2.1 Certificate of Compliance: A Certificate of Compliance shall be submitted on the manufacturer's or supplier's official letterhead, and shall contain the following information:

1. The current name, address, and phone number of the manufacturer or supplier of the material or equipment.
2. A description of the material or equipment supplied.
3. Quantity of material represented by the certificate.
4. Means of material identification, such as label, lot number, or marking.
5. A statement that the material complies in all respects with the requirements of the cited specifications. Certificates shall state the name of the specific cited specifications, such as AASHTO M 320, ASTM C494, or specific table or subsection of the Specifications or Special Provisions.

6. A statement that the individual identified in item seven below has the legal authority to bind the manufacturer or the supplier of the material.
7. The name, title, and signature of the responsible individual. The date of the signature shall also be given.

Each of the first six items specified above shall be completed prior to the signing of the certificate as defined in item seven. No certificate will be accepted that has been altered, added to, or changed in any way after the authorized signature has been affixed to the original certificate. However, notations of a clarifying nature, such as project number, contractor, or quantity shipped are acceptable, provided the basic requirements of the certificate are not affected.

A copy or facsimile reproduction of the original certificate will be acceptable; however, the original certificate shall be made available upon request.

106.2.2 Certificate of Analysis: A Certificate of Analysis shall include all the information required for a Certificate of Compliance and, in addition, shall include the results of all tests required by the specifications.

106.4 TRADE NAMES AND SUBSTITUTES, replace with the following:

Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, the specification or description is intended to establish the type, function and quantity required. Unless the specification or description contains or is followed by words reading that no like equivalent or "or-equal" item or no substitution is permitted, other items of material or equipment of other suppliers may be accepted by the Engineer under the following circumstances:

106.4.1 "Or-Equal":

(A) If in the Engineer's sole discretion an item of material or equipment proposed by the Contractor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by the Engineer as an "or-equal" item, in which case review and approval of the proposed item may, at the Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

(B) Substitute Items: If in the Engineer's opinion an item does not qualify as an "or-equal" item under 106.4.1(A), it will be considered a proposed substitute item. The Contractor shall submit sufficient information, as provided below, to allow the Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. The procedure for review by the Engineer will include the following as supplemented in the Special Provisions and as the Engineer may decide is appropriate under the circumstances. Requests for review of proposed substitute items of material or equipment will not be accepted by the Engineer from anyone other than the Contractor. If the Contractor wishes to furnish or use a substitute item of material or equipment, the Contractor shall first make written application to the Engineer for acceptance thereof, certifying that the proposed substitute will perform adequately the

functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice the Contractor's achievement of completion on time, whether or not acceptance of the substitute for use in the work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with County for work on the project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair and replacement services shall be indicated. The application shall also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other Contractors affected by the resulting change, all of which will be considered by the Engineer in evaluation the proposed substitute. The Engineer may require Contractor to furnish additional data about the proposed substitute.

(C) All data provided by Contractor in support of any proposed "or-equal" or substitute item will be at Contractor's sole expense.

106.4.2 Substitute Construction Methods or Procedures:

If a specific means, method, technique, sequence or procedure of construction is shown or indicated and expressly required by the Contract Documents, Contractor may furnish or use a substitute means, method, technique, sequence or procedure of construction acceptable to the Engineer. Contractor shall submit sufficient information to allow the Engineer at the Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by the Engineer will be similar to that outlined in Section 106.4.1.

106.4.3 Engineers Evaluation:

The Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Sections 106.4.1 and 106.4.2, above. The Engineer will be the sole judge of acceptability. No "or-equal" or substitute shall be ordered, installed or used without the Engineer's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. The County may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute. The Engineer will record time required by the Engineer and the County's consultants in evaluating substitutes proposed or submitted by Contractor pursuant to Sections 106.4.1 and 106.4.2, above and in making changes in the Contract Documents occasioned thereby. Whether or not Engineer accepts a substitute item so proposed or submitted by Contractor, Contractor shall reimburse the County for cost incurred for the evaluation of the proposed substitute item by the Engineers and/or County's consultant.

SECTION 107

LEGAL REGULATIONS AND RESPONSIBILITY TO PUBLIC

107.1 COMPLIANCE WITH LAWS, add the following:

Contractor, in connection with any activity under this Contract, shall not discriminate against any person on the grounds of race, color, religion, sex, national origin, age, disability, political affiliation or belief. Contractor shall include a clause to this effect in all subcontracts. Contractor shall also comply with all applicable provisions of the Americans with Disabilities Act of 1990.

Contractor and its subcontractors and their respective employees, agents, and representatives, when performing the work described in the Construction Specifications, shall comply with all rules and regulations set forth by the County, pertaining to the safety, loss control and environmental regulations, and shall perform the work in compliance with governmental laws and regulations pertaining to occupational health, and environmental protection, including any local sound control and noise level rules, regulations and ordinances which apply to any work performed pursuant to the contract.

Contractor is solely responsible for jobsite ("site") conditions during all phases of construction, beginning with Contractor's mobilization of equipment and/or personnel until the work has been accepted by the Engineer and a certificate of completion has been issued by the County. Contractor's responsibility for the site during the period specified above shall not be limited to Contractor's working hours and shall include but not necessarily be limited to the following:

- * Physical condition of the site;
- * Safety of Contractor's personnel at the site and all other persons entering the site or areas adjacent to the site;
- * Security of Contractor's equipment and material; and
- * Reasonable aesthetic appearance of the site.

| Contractor shall ensure that internal combustion equipment is operated with a muffler of a type recommended by the manufacturer.

| The Contractor shall ensure that contract operations are in compliance with procedures and requirements of the Maricopa County Air Pollution Control Rules and Ordinances with special attention given to the fugitive dust requirements. The Contractor shall pay any penalties imposed upon MCDOT where the violation is a direct result of actions or inactions by the Contractor, the contractor's employees or subcontractors.

107.1.1 SMALL BUSINESS ENTERPRISE PROGRAM (SBE)

It is Maricopa County's policy to endeavor to ensure in every way possible that small business participation firms shall have the opportunity to provide professional services, materials, and contractual services to the County in a nondiscriminatory manner.

107.2 PERMITS, add the following:

It is the Contractor's responsibility to obtain all permits and licenses, pay all fees, charges, and taxes and prepare all required notices for the lawful execution of the work.

Permits for earth moving may be obtained from Air Pollution Control, Maricopa County Department of Environmental Management, 1001 North Central Avenue, Suite 100, Phoenix, Arizona 85004, Telephone Number (602) 506-6010, website <http://www.maricopa.gov/eq/>. A copy of the earthmoving permit and dust control plan shall be submitted to the Engineer prior to commencement of any earthmoving activities.

107.2.1 AZPDES (NPDES) Construction General Permit Requirements:

The Contractor shall comply with the Arizona Pollutant Discharge Elimination System (AZPDES) requirements and conditions administered by the Arizona Department of Environmental Quality (ADEQ). Compliance with AZPDES also includes compliance with the requirements of all municipal separate storm sewer systems (MS4) that are within the project limits. For projects that include Indian Tribal Lands, the Contractor shall also be responsible for compliance with the National Pollutant Discharge Elimination System (NPDES) requirements of the Environmental Protection Agency (EPA).

107.2.1.1 Regulation Compliance: The Contractor, contractor employees, and subcontractors shall not discharge stormwater or non-stormwater from the construction site that is not in compliance with requirements and conditions of the AZPDES Construction General Permit for Arizona (AZCGP) as well as all other applicable federal, state and local laws, ordinances, statutes, rules and regulations pertaining to stormwater discharge and air, ground water and surface water quality.

The Contractor shall be designated as the Operator, having day-to-day operational control of those activities at a project which are necessary to ensure compliance with a Stormwater Pollution Prevention Plan (SWPPP) for the site and other permit conditions. The Contractor is responsible for preparing, in a manner acceptable to the ADEQ and the EPA, all documents required by regulation, which shall include but not necessarily be limited to the following:

- Notice of Intent (NOI).
- Stormwater Pollution Prevention Plan (SWPPP).
- Notice of Termination (NOT).

107.2.1.2 NOI Submittal: The Contractor shall submit a Notice of Intent in accordance with the AZCGP. The Contractor shall identify on the NOI all non-stormwater discharges that are expected to be associated with the project's construction activities as required by the AZCGP.

Preliminary copies of the NOI and the SWPPP shall be available to the County during the pre-construction conference.

The Contractor shall ensure the completed and duly signed NOI form(s) are submitted in a timely manner to prevent a delay to project construction.

The AZPDES form shall be submitted to ADEQ's Phoenix office by certified mail or hand delivered to the address below:

Arizona Department of Environmental Quality
Surface Water Section - Stormwater and General Permits Unit
1110 West Washington Street, 5415A-1
Phoenix, AZ 85007

The form may also be faxed to ADEQ at 602-771-4528 or submitted via "smart NOI" accessible from the ADEQ's website:

<http://www.azdeq.gov/environ/water/permits/stormwater.html>

If the construction is near an impaired or unique water (a.k.a. an Outstanding Arizona Water), the SWPPP shall be submitted with the NOI. Permit activation may require 32 business days or more for construction sites near impaired or unique waters, as well as for construction sites with special concerns, therefore documentation is to be submitted to ADEQ as early as possible.

If the construction site is located within a municipal boundary or urbanized area of Maricopa County, the Contractor shall send a copy of the ADEQ certificate authorizing permit coverage to the local MS4 authority(s).

When Indian Tribal Land is involved a NOI shall be submitted to the EPA. Submittal requirements can be obtained through the website:

www.epa.gov/npdes/stormwater/cgp

A copy of all submitted NOI forms shall be posted at the construction site.

107.2.1.3 Time Extension: Failure by the Contractor or subcontractor of any tier to submit a NOI within the mandated time frame shall result in delay of the construction start date and no claims for extension of time will be granted for such a delay.

107.2.1.4 SWPPP: The Contractor shall develop, sign and certify, implement, update, amend, and revise the SWPPP, as necessary, to assure compliance with permit requirements. The Contractor shall address in the SWPPP, all non-stormwater discharges that are expected to be associated with the project's construction activities as required by the AZCGP.

The Contractor shall ensure that:

- The SWPPP indicates the areas of the project where the County or other entity has operational control over the project specifications, including the ability to make modifications in specifications.
- All other operators implementing portions of the SWPPP impacted by changes made to the SWPPP are notified of such modifications in a timely manner.

- The SWPPP indicates the parties with day-to-day operational control and parties responsible for implementation of the BMPs identified in the SWPPP.

The Contractor and subcontractors shall ensure that construction activities do not render another party's BMP(s) ineffective.

The Contractor shall post the SWPPP authorization number(s) in a conspicuous location near the entrance where most of the construction activity is occurring. A copy of the ADEQ authorization certificate shall be retained with the SWPPP. The SWPPP and a copy of the ADEQ authorization certificate shall be retained on the project site at all times during construction. Copies of forms and guidance for preparing the SWPPP are available in the "Drainage Design Manual for Maricopa County, Volume III Erosion Control." The manual is available at the Flood Control District, 2801 West Durango Street, Phoenix, Arizona 85009. In addition, a "Construction SWPPP Checklist" can be obtained from ADEQ for assisting in the preparation of the SWPPP.

107.2.1.5 Inspections: Contractor shall perform inspections, by qualified personnel, of all stormwater pollution control devices on the project at least once every fourteen (14) days and within twenty-four (24) hours of each 0.5-inch or greater storm event, as required under the provisions of the AZCGP. Contractor shall prepare reports, in accordance with the AZCGP, on such inspections and shall retain the reports for a period of at least three (3) years following the completion of the project. The Contractor shall maintain all stormwater pollution control devices on the project in proper working order, which shall include cleaning and/or repair during the duration of the project.

107.2.1.6 NOT Submittal: Upon project completion, acceptance and demobilization, Contractor shall submit to ADEQ a completed, duly executed Notice of Termination form for each NOI issued, with a copy of the NOT acknowledgement letter to appropriate MS4 authority(s), thereby terminating all AZPDES permit coverage for the project. Contractor shall then provide to the County copies of the SWPPP, inspection information and all other documents prepared and maintained by the Contractor in compliance with the AZPDES Construction General Permit, including records of all data used to complete the NOI to be covered by the AZCGP. Contractor shall retain the originals of such documents for a period of at least three (3) years following the completion of the project and make such documents available for inspection by representatives of the Environmental Protection Agency, the Arizona Department of Environmental Quality, the County, and any municipality having jurisdiction, upon request.

107.2.1.7 Fines and Penalties: Fines and penalties imposed by the ADEQ, MS4 authority, or the EPA for Contractor's failure to comply with any of the AZPDES permit requirements and conditions shall be borne by the Contractor.

107.2.1.8 Payment: The lump sum price for AZPDES shall include all material, labor, and costs relating to the NOI, NOT, and the SWPPP. This includes but is not limited to the preparation, installation, maintenance, and removal of temporary SWPPP elements,

assuring proper operation of the pollution control devices installed, and all maintenance, cleaning, and disposal costs associated with clean-up and repair following storm events, runoff or releases on the project. The lump sum price for AZPDES shall be inclusive of all related costs, and no additional claims shall be made by the Contractor under any other specification provision, including changed conditions. Contractor shall be compensated for this item at a rate of 25% of the total contract price paid with the first progress payment, the remaining 75% will be prorated over the entire length of the project.

107.3 PATENTED DEVICES, MATERIALS AND PROCESSES, add the following:

All materials not specifically noted as provided by the County or other participating agency shall be obtained from commercial sources. Contractor shall pay all royalties or any other charges or expenses incurred in connection with the securing and hauling of the material. Contractor shall provide the Engineer with a list of proposed commercial sources prior to utilization of such sources and shall present satisfactory evidence that the material obtained from the commercial sources meets the specifications of this project.

107.4 ARCHAEOLOGICAL REPORTS, add the following:

If previously unidentified archaeological, historical, or paleontological features are encountered during any activity related to construction of a County project, the Contractor shall stop work immediately at that location and shall notify the Engineer. The Engineer will notify MCDOT Environmental Program Branch (602-506-8082) to evaluate the significance of the resources and determine the appropriate next action.

107.5 SAFETY, HEALTH AND SANITATION PROVISIONS:

Section 107.5 add the following:

All water for Contractor's own use, drinking water, temporary electric power, heat, and telephone services shall be arranged for or provided by the Contractor, at Contractor's sole expense.

107.5.3 HAZARDOUS MATERIAL HANDLING

107.5.3.1 Material Safety Data Sheets: Contractor shall furnish to the County Material Safety Data Sheets (MSDS) for all regulated and/or hazardous substances which Contractor plans to bring to the site and which may be harmful to humans, animals, vegetation, ground and surface water, and the environment and which are regulated under the Hazardous Material Transportation Act, the Toxic Substances Control Act, the Resources Conservation and Recovery Act, and the Comprehensive Environmental Response, Compensation, and Liability Act.

107.5.3.2 Regulated and/or Hazardous Materials: Contractor shall further furnish to the County prior to the start date of the work a list of all regulated and/or hazardous materials, identified above, which Contractor intends to bring to the site. The list shall contain the following information:

Quantity of material
Description of material
Intended use of the material

Additionally, Contractor shall furnish the County with Material Safety Data Sheets for all regulated and/or hazardous substance Contractor plans to bring to the site or use during the performance of the work.

Contractor shall immediately report spills of oil, gasoline, diesel, lubricants, chemicals and other hazardous material or regulated substances to the County and to all federal, state and local agencies having jurisdiction. Accidental spills shall be immediately contained, the spilled material and contaminated soil removed in accordance with the guidelines established on the Material Safety Data Sheets and in accordance with all applicable federal, state and local laws, mandates, regulations and ordinances. After completion of the clean-up activities, Contractor shall restore the spill area to preexisting conditions.

107.5.3.3 Identify Potentially Hazardous Materials: The County will make reasonable effort to locate and identify potentially hazardous materials and/or underground storage tanks within the project area, prior to construction.

In the event material is found by the Contractor or subcontractors of any tier, during the performance of the work, that is suspected to be hazardous, Contractor shall follow the following procedure:

- (A) Call “911” in a life threatening situation.
- (B) Stop work at the affected area and remove all personnel from that area.
- (C) Barricade the area and provide traffic control to prohibit unauthorized entry.
- (D) Notify the Maricopa County Safety Office (602 506-8601) and the Engineer.
- (E) Notify the appropriate regulatory agency(ies) and emergency services.

The Engineer, in consultation with the appropriate regulatory agencies and emergency services, will determine the necessary remediation plan for the Project.

Remediation activities shall only be performed by a certified hazardous waste disposal remediation company, approved by the County.

107.5.4 Energized Electric Power Lines: Whenever the Contractor has construction equipment and personnel in the immediate vicinity of energized aerial electric power lines, the Contractor shall not consider these lines to be insulated. Construction personnel working in proximity to these lines are exposed to extreme hazard from electrical shock. Contractors, their employees, and all other construction personnel working on this project must be warned of the danger and instructed to take adequate protective measures, including maintaining a minimum clearance between the lines and all construction equipment and personnel. Minimum clearances to be maintained are ten (10) feet from 12kv lines, eleven (11) feet from 69kv lines and sixteen (16) feet from 230kv lines (see OSHA Std. 1926.550 (a) 15 and Arizona Revised Statutes 40.360.41 through 45.). When it is necessary to work less than the designated distance from energized power lines the Contractor must notify the appropriate utility company and make necessary arrangements which will ensure adequate protection of personnel, equipment and the utility company power lines. The cost of such temporary arrangement will be borne by the Contractor.

107.5.5 Safety Plan: The Contractor's Safety Plan, in accordance with 29 CFR1926.20, must be completed by the contractor and submitted to the Construction Engineer no later than five (5) business days prior to the pre-construction conference. Contractor Safety Plan Guidelines are available on the MCDOT website at:

<http://www.mcdot.maricopa.gov/technical/home.htm>

107.6 PUBLIC CONVENIENCE AND SAFETY, add the following:

107.6.3 Control of Airborne Pollutants and Sediment Tracking: Contractor shall cover dump trucks while transporting materials that may become airborne during transit. After dumping of such materials, Contractor shall either cover truck bed or take measures to remove all residues that may become airborne.

Contractor shall minimize off-site tracking of sediments by brushing or blowing off construction vehicles, or any other method deemed appropriate by Contractor, prior to exiting the construction site.

107.6.4 Protective Fencing: The Contractor shall furnish and install 6-foot high temporary chain link fencing, or approved equal, satisfactory to the Engineer, around all major structure construction areas (i.e., bridges, pump houses, drop structures, retaining walls, etc.) and around any unattended excavations with slopes steeper than 2:1. Temporary fencing shall completely enclose the construction activity and shall be secured after normal working hours to prevent unauthorized access.

Section 107, add the following new section:

107.15 COMMUNITY RELATIONS SUPPORT:

107.15.1 General: The Contractor for Maricopa County contracted work shall provide assistance for the project's community relations / public information program. The program assistance shall include, but not necessarily be limited to:

- (A) Participate in public meetings as required by the Engineer.
- (B) Provide project notification signage.
- (C) Distribution of community relations program notices and newsletters as required by the Engineer.
- (D) Documenting existing property conditions prior to starting construction.

The Contractor shall assist the County's public information program by providing information needed to inform the local residents and businesses of hours of construction, necessary operations that create high noise levels, interruption of utilities, street or lane closures, commute delays, detour locations, disruption of bus routes, haul routes and material delivery routes, and other delivery/pick-up routes. Contractor shall assist the Engineer in responding to questions or complaints concerning construction operations or procedures.

If roadside memorials are located within the Contractor's designated work zone and present a potential conflict to operations, the Contractor shall contact the MCDOT Public Information Office at 602-506-3342 to arrange for relocation. County forces will be responsible for removal/relocation/replacement of roadside memorials within the work zone.

107.15.2 Public Meetings: Contractor shall attend and participate in public meetings when deemed necessary by the Engineer. Meeting times, locations, and agenda will be determined by the Engineer and the MCDOT Communications Branch. The Contractor may be required to attend a public pre-construction meeting at a location convenient to residents and business operators affected by the project. This meeting may be conducted after execution of contract documents and prior to the start of construction. The meeting if conducted prior to the Notice to Proceed shall not be included in the Contract Time.

107.15.3 Project Notification Signage: Contractor shall provide and maintain variable message signs when required by the contract documents or requested by the Engineer. Signing shall be installed at least 14 days before beginning construction to inform the public of the forthcoming project, construction dates, and suggested alternate routes. Sign messages will be provided to the Contractor. The Contractor shall update sign messages as requested by the Engineer. Project notification signs are not part of Section 401 Traffic Control but their location shall be shown in the Traffic Control Plan.

107.15.4 Existing Conditions Documentation: Contractor shall document existing property conditions within a 100-foot (minimum) radius of the project limits prior to construction. Documentation shall be Digital Video Disc (DVD) format supplemented with digital M-PEG photographs (180 DPI or greater). The DVD shall not be made from a moving vehicle. One (1) copy of the documentation package shall be provided to the Engineer within ten (10) calendar days of the Notice to Proceed date and at least one day prior to commencement of construction operations.

107.15.5 Payment: Payment for COMMUNITY RELATIONS SUPPORT will be based on approved time and material invoices in accordance with Section 109.5 for authorized work performed in assisting with the County's public information program.

SECTION 108

COMMENCEMENT, PROSECUTION AND PROGRESS

108.1 NOTICE TO PROCEED:
Add section 108.1.1 as follows:

108.1.1 Pre-Construction Conference: After execution of the Contract by both parties and prior to the commencement of the work, the Engineer will schedule a pre-construction conference at the facilities of the Maricopa County Department of Transportation located at 2901 West Durango Street, Phoenix, AZ 85009. Contractor shall be represented at a minimum by a company official with signature authority on behalf of its organization.

Contractor shall submit to the Engineer during the pre-construction conference the following documents:

- (A) List of all subcontractors
- (B) List of all material sources
- (C) Assumptions and calculations used to determine each of the unit prices
- (D) Preliminary work schedule
- (E) Traffic control plans
- (F) Emergency telephone numbers
- (G) Signing authority letter
- (H) Name and telephone number of the certified safety professional
- (I) Copies of all Permits required for project Construction
- (J) Preliminary SWPPP and NOI

The following items shall be submitted at the preconstruction conference when reasonably feasible. When not submitted at the preconstruction conference, the submittal(s) shall be specifically shown in the work schedule. The submittals shall be scheduled at least 45 days prior to intended use and/or material transport to the project site.

(K) Material safety data sheets

(L) Mix designs

(M) Manufacturer's certification for all materials

(N) Shop drawings

The pre-construction conference will cover topics such as critical elements of the work schedule, payment application and the processing of invoices. Additionally, a scheduled start date for the work will be determined.

108.2 SUBLETTING OF CONTRACT, add the following:

The Engineer will not consent to subletting of any portion of the contract if a copy of the subcontract or lower tier subcontract is not received. The Engineer's consent shall in no way be construed to be an endorsement of the subcontractor or its ability to complete the work in a satisfactory manner.

The subcontract, purchase order, or lease agreement shall be evidenced in writing and contain all pertinent provisions and requirements of the prime contract. The following data shall be submitted seven calendar days prior to the start of each subcontractor's work.

- (A) A complete copy of each subcontractor agreement and each second tier subcontractor agreement.
- (B) Verification that all required Federal Provisions; i.e., Federal Form 1273, Executive Order, and Wage Determination Decisions are attached to each subcontract in any federal-aid funded contract.
- (C) Subcontracts must show the total price subcontracted. The items of work, and quantities of each item subcontracted shall be shown. Unit Prices or Extended Prices may be deleted except in the case of DBE subcontractors.
- (D) DBE subcontracts shall include full extensions of all unit prices.
- (E) Partial items shall be explained in detail and show the amount of each contract item being subcontracted. Non-contract item work shall be fully explained.
- (F) The contractor shall certify to the County that all of its subcontractors have all required registrations.

108.4 CONTRACTOR'S CONSTRUCTION SCHEDULE, replace with the following:

Contractor shall be solely responsible for the planning, scheduling and execution of the work to assure timely completion of the project.

108.4.1 The initial schedule shall be submitted to the County in triplicate for review at the pre-construction conference. The schedule shall be a schematic (arrow) or precedence diagram, reflecting the work stages and all activities required for the successful completion of the project. The schedule shall show enough detail to allow day to day monitoring of Contractor's operation and shall include major milestone dates for the work.

108.4.2 The schedule shall include a complete critical path schedule and shall include a detailed network diagram with the following elements:

108.4.2.1 Contractor's schedule shall be time scaled in calendar days and all activities shall be recorded from the initial start dates to their completion dates. Unless specific approval was given by the Engineer, the individual activities shall not exceed fifteen (15) calendar days in length. The plot size and scale shall be acceptable to the Engineer.

108.4.2.2 The schedule shall reflect the order and the individual categories for each activity described in section 108.4.2.7, below. Critical activities shall be highlighted by use of color or any other method acceptable to the Engineer.

108.4.2.3 The schedule shall include, in addition to all construction activities, such tasks as mobilization, demobilization, submittal and approval of material samples and shop drawings, procurement of major material and equipment items, fabrication of special items and the installation and testing of such items. The schedule shall also reflect coordination activities with other projects.

108.4.2.4 Activities shall show sufficient detail to allow the reviewer to easily follow the sequence of the work, for example, forming, reinforcing and placement of concrete on the specific calendar days such activities are scheduled.

108.4.2.5 The diagram shall show each activity, the preceding and the following activity, the activity description, the total float time, and the duration of the activity in working days.

108.4.2.6 Activity descriptions on the diagram shall be job-specific and not of a generic nature.

108.4.2.7 In addition to the diagram, Contractor shall submit a schedule report of the network outlining the following data for each activity:

- (A) preceding and following event and activity numbers
- (B) activity description
- (C) activity duration
- (D) earliest commencement date
- (E) earliest completion date
- (F) latest commencement date
- (G) latest completion date
- (H) total float times
- (I) responsible party for specific activity

108.4.3 Contractor shall update its schedule as mandated by the following events or as requested by the Engineer.

108.4.3.1 Contractor shall submit to the County on the tenth (10th) working day of each month a construction progress report (three originals and three copies) describing all completed or in progress activities and the level of completion of all activities to date in connection with this project. Detailed information shall be given for all negative float time. If the Engineer determines that any or all parts of the network diagram requires revision, Contractor shall furnish the County with the requested revisions within ten (10) calendar days of such request.

108.4.3.2 The monthly report shall be accompanied by a brief description of the job progress, problems encountered, current and anticipated delaying factors and the potential impact on the project schedule, and a description of corrective measures taken or proposed. It shall also include any departures from earlier schedules, including but not limited to, logical sequence or logical ties, constraints, changes in scheduled activities and the duration of such changes, addition or deletion of event numbers, activity numbers and activity descriptions. Contractor shall outline the reason for the departure from the original schedule.

108.4.3.3 All costs and expenses incurred by the Contractor for the preparation of schedules and/or reports and all revisions thereto, are considered an overhead item and therefore not reimbursable as a separate pay item.

108.4.3.4 In addition to allowances for various activities in connection with the work, Contractor shall base the schedule on normal weather conditions and shall incorporate the following factors:

- (A) procurement and shipping times for material
- (B) concrete curing time
- (C) reasonable allowances for relocation of utilities

108.4.3.5 The Engineer's review of the schedule shall not constitute an acceptance of responsibility by the County for the content of the schedule and shall not relieve Contractor of its obligations to commit all its resources to meet the schedule set forth in the specifications. Free float time within the project's stated contract time limit shall remain available for use by the project. The County or the Contractor may use as needed the available project free float time. The Engineer's review of the schedule shall not constitute a basis for additional time to complete the work specified in the scope of work nor shall it serve as basis for additional compensation.

108.5 LIMITATION OF OPERATIONS

Add the following:

Regular work hours vary depending on time of year, the Contractor shall submit proposed weekday regular work hours at the pre-construction meeting (pre-job conference) for approval. The Contractor shall be subject to additional inspection fees for overtime work when work is performed on weekends, legal holidays, or at times other than the approved regular work hours.

The Contractor shall comply with all local noise ordinances. For unincorporated areas the Contractor shall not conduct any work during the hours 7:00 p.m. to 6:00 a.m. without the written approval of the Engineer. Special noise abatement conditions and procedures may be required if nighttime work is approved.

108.8 GUARANTEE AND WARRANTY PROVISIONS:

The first paragraph of the guarantee and warranty provisions of the Uniform Standard Specifications shall be replaced with the following paragraphs:

Contractor warrants that the work performed and materials used shall be free of defects for the period of one (1) year from the date of substantial completion (when established) or the date of final acceptance of the work, excluding ordinary wear and tear or unusual abuse and neglect. Additionally, Contractor warrants that all corrections made under the warranty provisions of Section 108.8 of the Uniform Standard Specifications shall be free of defects in workmanship and material for a period of one (1) year, commencing on the day of final acceptance of the corrections by the Engineer.

Failure by the Engineer to reject defective workmanship and/or material during construction shall not be construed as an acceptance of said workmanship and/or material and Contractor shall correct such workmanship and/or material at the request of the County at any time prior to final acceptance of the work and for a one (1) year period thereafter.

SECTION 109

MEASUREMENTS AND PAYMENTS

109.7 PAYMENT FOR BOND ISSUES AND BUDGET PROJECTS, add the following:

The County will accept securities in a form and from a financial institution acceptable to the County, in accordance with the Arizona Revised statutes, Section 34-221, as amended, in lieu of ten percent (10%) retainage on pay estimates, if requested by Contractor.

109.8.2 CONTRACTING AGENCY DELAYS, add the following:

Recovery of expenses incurred by Contractor for a delay for which the County is responsible, and which is unreasonable under the circumstances and which was not contemplated by the parties, shall be negotiated between Contractor and the County. This provision shall not be construed to void any provisions of the Contract which require notice of delays, provide for arbitration or other procedures for settlement, or provide for the assessment of liquidated damages.

SECTION 110

NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION

Section 110 is deleted in its entirety and replaced with the disputes provision of Article 9 of the Maricopa County Procurement Code.

Part 100 add the following new Section:

SECTION 111

ENGINEER'S OFFICE FACILITIES

111.1 DESCRIPTION:

Contractor shall provide office space with adequate lighting, located on or near the project site for exclusive use by the Engineer during the project construction. Proposed offsite office locations shall be subject to approval by the Engineer. The facility shall be made available concurrent with the construction notice to proceed, and shall remain continuously available for the sole use of the Engineer until seven (7) days after project acceptance. The facility (meeting the requirements of Type I or Type II Engineer Office Facilities) may either be separate or in the same structure or trailer used by the Contractor. If a shared structure or trailer is provided, a separate lockable area, with floor to ceiling walls shall be provided. Trailer type facilities shall be equipped with tie-downs. Type I and Type II Engineer Office Facilities shall be exclusive use facilities for the Engineer. Type II Engineer Office Facilities will be required unless otherwise indicated by the Engineer or the project special provisions.

Contractor shall provide the same level of security for the Engineer's Office Facility as is being provided for the Contractor's field office. Protection against illegal entry, vandalism, and theft shall be provided.

The contractor shall be responsible for maintaining the office and all facilities and equipment therein in good working condition. Utility costs shall be the responsibility of the contractor as well as any fees for permits, sanitary, water, electrical or gas hookups, installation charges, etc.

Contractor shall provide a separate sanitary facility for the Engineer and inspectors. Contractor shall provide janitorial supplies and services to maintain cleanliness of office, meeting spaces, and sanitary facilities. Janitorial services shall be at least twice a week.

Heating and cooling facilities shall be adequate to maintain interior temperature of 72°-78° F.

All office facilities shall be available 24 hours a day, this includes but is not limited to electrical power, water, internet services, etc.

Project completion requires removal of the office and appurtenant structures, utilities, surfacing, etc. and restoration of the affected area(s) to their former condition or improved as required by project plans and specifications.

111.2 Type I Engineer Office Facilities shall consist of a weatherproof insulated temporary office type trailer built to the uniform building code series of codes with floor

plan and equipment layout similar to the following drawing and meeting or exceeding the following minimum requirements:

111.2.1 Facility:

Dimensions (minimum): 28 feet long x 8 feet wide with an inside room height of 7' - 6".

Windows: a minimum of four (4) with provisions for cross ventilation and locking.

Exterior doors: two – shall be reinforced and have dead bolt locks. An exterior landing with steps and handrails shall be located at each door.

Heating: a thermostat controlled forced air unit with a minimum input capacity of 200 BTU per 1.0 square foot of floor area.

Air conditioning: one unit with capacity equal to 8,300 BTU minimum.

Electrical: work shall conform to the national electrical code for 110/220 volts 60 HZ applications and provide reliable uniform power to properly operate all field office equipment.

Lighting: fluorescent lighting directly over all drafting tables and desk areas.

Fire extinguisher: one dry chemical 10 lb class ABC Underwriters Laboratories Inc. approved.

Drinking water: bottled drinking water dispensed from an acceptable cooling device.

111.2.2 Furnishings:

Desk: one desk top 30" deep x full inside room width x 30" high located at office end of the trailer. Supported along each adjacent wall and having one 2-drawer legal size metal filing cabinet center pedestal. Each desktop shall have an overhead shelf and two pen drawers.

Meeting table: one 96" x 30" or two 48" x 30".

Drafting table: one 36" x 72" hinged board. Board to be 37" high at front edge and slope upward at 12:1 (horiz:vert) rate.

Chairs: Two (2) chairs with rollers and two (2) drafting stools each of appropriate height. Ten (10) folding chairs.

Trash receptacles: Two (2) each.

Facsimile machine: One (1) plain paper FAX machine (including toner).

Copy machine: One (1) plain paper copier (including toner) with an automatic document feeder capable accepting multiple size sheets and of sorting 10 stacks.

Printer/scanner/copier: One (1) HP printer/scanner/copier 700 series (or equivalent) including installation software compatible with Windows NT or 2000 and one set of manufacture replacement printing cartridges.

Dry Marker Erase Board: wall mounted adjacent to meeting table, size = 3' x 6' with markers and eraser.

111.2.3 Telephones and Data Circuits:

Two telephones. Three private lines with touch tone service from the local service provider. One phone line is to be shared by the two telephones and have voice mail service from the local service provider. The second phone line is to be a dedicated line connected to the computer. The third phone line is to be a dedicated line connected to the facsimile machine. Trailer wiring shall include four boxes equipped with RJ -11 jacks (two wire pairs per jack) two at each end of trailer.

The dedicated computer line shall be a high-speed DSL line and include internet service. When high-speed internet service is available through a cable TV service, it shall be provided and the corresponding telephone line requirement deleted.

All initial hook up and basic monthly telephone charges, high-speed internet service, basic fax service, and electrical expenses for the Engineer's Office Facility shall be borne by the Contractor. The Contractor will be reimbursed for all long distance charges authorized by the Engineer.

111.3 Type II Engineer Office Facilities shall consist of a weatherproof insulated temporary office type trailer built to the uniform building code series of codes with floor plan and equipment layout similar to the following drawing and meeting or exceeding the following minimum requirements.

111.3.1 Facility:

Dimensions (minimum): 50 feet long x 12 feet wide with an inside room height of 7'-6".

Windows: a minimum of six (6) with provisions for cross ventilation and locking.

Doors: Two inside doors may be located either at one side or at center of partition. The two exterior doors shall be reinforced and have deadbolt locks. An exterior landing with steps and handrails shall be located at each exterior door.

Heating and Air Conditioning: 3-ton capacity air conditioning and 80,000 BTU capacity heating, connected to ducting and be thermostat controlled.

Electrical: work shall conform to the national electrical code for 110/220 volts 60HZ application and provide reliable uniform power to properly operate all field office equipment.

Lighting: fluorescent lighting directly over all drafting tables and desk areas.

Fire extinguishers: Two (2) dry chemical 10 lb class ABC Underwriters Laboratories Inc. approved.

Drinking water: bottled drinking water dispensed from an acceptable cooling device.

Sanitary facilities consisting of a toilet and wash sink shall be located in a separately enclosed room inside the Type II Facility.

111.3.2 Furnishings:

Desk: one desk top 30" deep x full inside room width x 30" high located at each end of trailer. Desktops are to be supported along each adjacent wall and have two 2-drawer legal size metal filing cabinets acting as pedestals. Each desktop shall have an overhead shelf and two pen drawers.

Drafting table: one 36" x 72" table. Board to be 37" high at front edge and slope upward at 12:1 (horiz:vert) rate or have provision for adjusting the slope.

Tables: Three (3) 48" x 30" tables.

Chairs: Four (4) chairs with rollers and two (2) drafting stools, each of appropriate height. Fourteen (14) folding chairs.

Trash receptacles: Three (3) each.

Plan storage: a plan rack or file for full size plans.

Facsimile machine: One (1) plain paper FAX machine (including toner).

Copy machine: One (1) plain paper copier (including toner) with an automatic document feeder capable accepting multiple size sheets and of sorting 10 stacks.
Printer/scanner/copier: One (1) HP printer/scanner/copier 700 series (or equivalent) including installation software compatible with Windows NT or 2000 and one set of manufacture replacement printing cartridges.
Dry Marker Erase Board: wall mounted adjacent to meeting table, size = 3' x 6' with markers and eraser.

111.3.3 Telephones and Data Circuits:

Three (3) two-line telephones. Four private lines with touch tone service from the local service provider. Two lines are for telephone service with roll over capability for the three telephones and voice mail service from the local service provider. The third line is to be a dedicated line connected to a computer. The fourth line is to be a dedicated line connected to the facsimile machine. Trailer wiring shall include six boxes equipped with RJ-11 jacks (two wire pairs per jack), two in each office and center area.

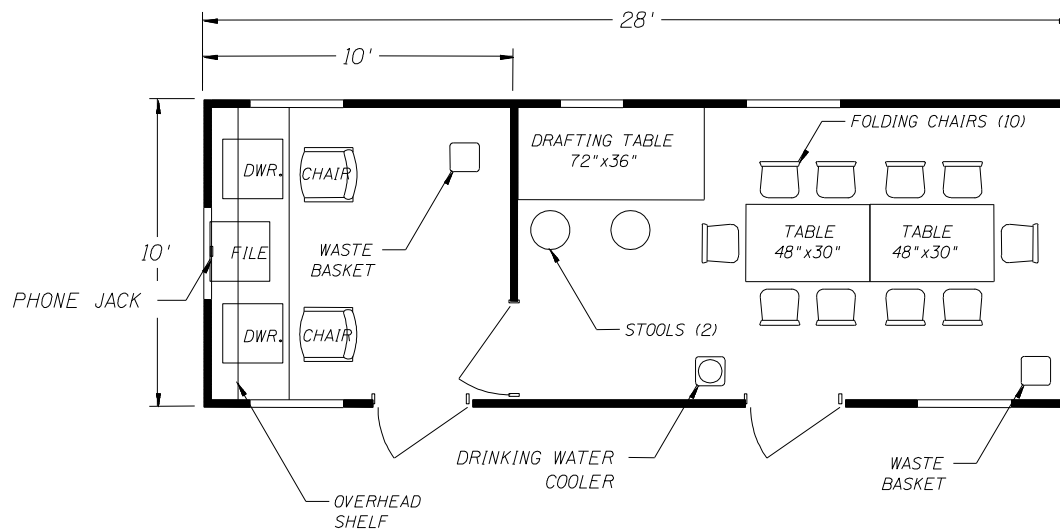
The computer line shall be a high-speed DSL line and include internet service. When high-speed internet service is available through a cable TV service, it shall be provided for the computer and the corresponding telephone line requirement deleted.

All initial hook up and basic monthly telephone charges, high-speed internet service, basic fax service, and electrical expenses for the Engineer's Office Facility shall be borne by the Contractor. The Contractor will be reimbursed for all long distance charges authorized by the Engineer.

111.4 Payment:

Payment for Type I Engineer Office Facilities or Type II Engineer Office Facilities will be made at the contract lump sum price. Payment shall be made in equal one-third portions. The first payment shall be paid with Contractor's initial billing. The second payment shall be made when the total payments to the Contractor equals one-half of the initial contracted amount. The remaining one-third payment shall be paid as part of the final payment due the Contractor. No additional payment will be made for occupancy and services resulting from contract time extensions.

Payment reduction for incomplete facilities or unsatisfactory maintenance shall be made at a rate of 1% of the contract lump sum price for Engineer Office Facilities for each calendar day the facility remains out of compliance with the requirements of this specification. Payment reduction for incomplete facilities shall commence on the day following the notice to proceed date and shall continue until the facilities are brought into compliance with the specifications.

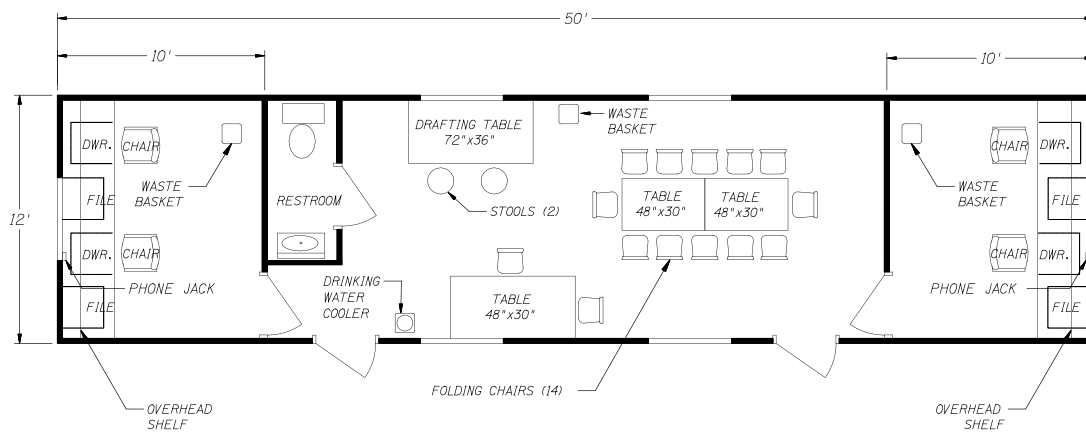


SAMPLE SCHEMATIC

Maricopa Co. Dept. of Transportation

CONSTRUCTION TRAILER (TYPE I)

5-21-03



SAMPLE SCHEMATIC

Maricopa Co. Dept. of Transportation

CONSTRUCTION TRAILER (TYPE II)

5-21-03

Part 200 add the following new Section:

SECTION 202

REMOVAL OF STRUCTURES

202.1 DESCRIPTION:

The work under this Section shall consist of the removal, wholly or in part, and satisfactory disposal of all structures within the right-of-way which have not been designated on the project Plans or specified in the Special Provisions to remain, except for those structures which are to be removed and disposed of under other items of work in the contract. The work shall also include salvaging of designated materials and backfilling the resulting cavities.

Existing structures and other existing improvements which are to become an integral part of the planned improvements shall remain even though not specifically noted.

Materials removed and not designated to be salvaged or incorporated into the work shall become the property of the Contractor.

202.2 BLANK

202.3 CONSTRUCTION:

202.3.1 General: Bridges, culverts, retaining walls, and other structures in use by or facilitating traffic shall not be removed until satisfactory arrangements have been made to accommodate the traffic.

Blasting or other operations necessary for the removal of an existing structure, which may damage new construction, shall be completed prior to commencing the new work.

Items designated to be salvaged shall be carefully stockpiled or stored by the Contractor at locations designated in the Special Provisions or as requested by the Engineer.

Items which are to be salvaged or reused in the new construction, that are damaged or destroyed as a result of the Contractor's operations, shall be repaired or replaced by the Contractor at no additional cost to the County.

Holes, cavities, trenches and depressions resulting from the removal of major structures, except in areas to be excavated, shall be backfilled with suitable material which shall be compacted to a density of not less than 95 percent of maximum density, as requested and approved by the Engineer.

202.3.2 Removal of Bridges: The removal of existing bridges, either wholly or in part, shall be as shown on the project plans or as described in the Special Provisions. Bridge removal operations shall be conducted in such a manner as to cause the least interference to public traffic.

At least ten days before beginning bridge removal over or adjacent to public traffic or railroad property, the Contractor shall submit to the Engineer details of the removal operations showing the methods and sequence of removal and equipment to be used.

When total bridge removal is specified, all materials designated for salvage, such as structural steel, structural steel members, timber and other reusable materials shall be carefully dismantled, removed and salvaged in accordance with the requirements of Section 202.3.1. Steel members shall be match marked as requested by the Engineer.

Piling, piers, abutments, footings and pedestals shall be removed to at least 1.0 foot below ground line or 5 feet below finished subgrade elevation unless specified otherwise in the Special Provisions or on the project Plans.

When partial bridge removal is specified or alteration of an existing bridge requires removal of portions of the existing structure, such removal shall be performed with sufficient care as to leave the remaining portion of the structure undamaged.

In case of damage to the existing bridge structure, the Contractor shall make necessary repairs at no additional cost to the County. Reinforcing steel extending from the remaining portion of the structure shall be protected, cleaned and incorporated in the new portion of the structure in accordance with the details shown on the project plans or as requested by the Engineer.

Flame cutting and saw cutting may be used for removing, widening, or modifying bridges, provided the Contractor complies with all protection, safety and damage requirements.

Explosives shall not be used in bridge removal operations unless approved by the Engineer.

Before beginning concrete removal operations involving the removal of a portion of a monolithic concrete element, a saw cut a minimum of 1 inch deep shall be made to a true line along the limits of removal on all faces of the element which will be visible in the completed work.

Removed concrete and other debris shall be disposed of as provided in Section 104.1.4.

202.3.3 Removal of Minor Structures and Miscellaneous Structural Concrete: Minor structures and miscellaneous structural concrete shall be defined as all or portions of minor retaining walls, spillways, drainage structures, concrete box culverts,

foundations, footings and all other portland cement concrete construction, except bridges. All existing miscellaneous concrete shall be removed to a depth of at least 5 feet below finished subgrade elevation, unless otherwise specified in the Special Provisions or on the project plans.

Where new concrete is to join existing concrete, the existing concrete shall be saw cut to a true line with straight planar edges free from irregularities.

Concrete removal operations shall be performed without damage to any portion that is to remain in place. All damage to the existing concrete which is to remain in place shall be repaired to a condition equal to that existing concrete damaged by the Contractor's operations shall be at no additional cost to the County.

Existing reinforcement that is to be incorporated in new work shall be protected from damage and shall be thoroughly cleaned of all adhering material before being embedded in new concrete.

Removed concrete and other debris shall be disposed of as provided in Section 104.1.4.

The floors of concrete basements, pits, and structures not required to be removed, and which are located within the roadway, shall be broken in a manner that will prevent the entrapment of water.

202.4 MEASUREMENT:

Removal of structures will be measured on a lump sum basis except when the fee schedule contains specific items under this section on a unit basis, measurement will be made by the units designated in the fee schedule.

202.5 PAYMENT:

Payment for the accepted quantities of removal of structures will be made by lump sum, or by specific removal items, or by a combination of both. Payment for removal of structures and obstructions not listed in the fee schedule, but necessary to perform the construction operations designated on the project plans or specified in the Special Provisions, shall be considered as included in the prices of contract items.

The prices shall include all excavation and subsequent backfill related to the removals, and the salvaging, hauling, storing and disposing of all materials as provided herein.

SECTION 205

ROADWAY EXCAVATION

205.1 DESCRIPTION, add the following:

Roadway excavation shall also consist of the placement and compaction of excavated material in embankments as provided under Section 211 Fill Construction.

Part 200 add the following new Section:

SECTION 212

ROADWAY OBLITERATION

212.1 DESCRIPTION:

Roadway obliteration shall consist of removing abandoned roadway elements and grading the area to blend in with the surrounding terrain. In undeveloped areas the grading is to restore the natural contours.

212.2 CONSTRUCTION:

The Contractor shall remove existing pavement and base materials. The Contractor shall dispose of materials in fill areas or as approved by the Engineer. Grading and shaping operations shall consist of excavating prior filled areas and the placing of fill material as needed for terrain restoration. The roadway's native subgrade shall be scarified prior to placement of any fill. Fill material in excess of project construction requirements shall be placed in the area of the old roadway and shaped to blend with natural contours according to the obliteration detail or specified grades, to the satisfaction of the Engineer. Compaction of fill in the restored areas shall range between 85% and 90% when tested with methods defined in section 211.4. Care shall be taken to ensure proper drainage. The area shall be seeded in accordance with Section 430 Landscaping and Planting.

212.3 MEASUREMENT:

Measurement of Roadway Obliteration will be the square yards of pavement designated to be removed within roadway obliteration limits.

212.4 PAYMENT:

Payment for Roadway Obliteration will be at the contract unit price. Payment shall be full compensation for removal of all asphalt pavement and base materials together with the grading and shaping operations, complete in place.

Part 200 add the following new Section:

SECTION 213

DEWATERING

213.1 DESCRIPTION:

The work under this Section consists of furnishing all necessary labor and materials, installing and maintaining all necessary pumps, piping and other equipment for removing water from various locations, and maintaining excavations free of water as required for construction.

213.2 AUTHORIZATION:

If high groundwater levels are encountered, the Engineer will determine whether to implement:

- a) Dewatering, as specified herein, or
- b) Demobilization and remobilization, with a contract time extension in accordance with Section 108.7 of the Specifications.

213.3 CONSTRUCTION:

213.3.1 General Excavation: Prior to starting any work on removal of water from excavations, the Contractor shall have an approved Groundwater and Surface Water Handling Plan. The Plan shall include the Contractor's proposed method of removing water from excavations. The Plan may be placed into operation upon approval of the Engineer, but nothing in this section will relieve the Contractor from full responsibility for the adequacy of the water control.

Contractor shall furnish to the Engineer one set of dewatering calculations as part of the dewatering plan. These calculations shall include determination of well spacing, header sizing, pump selection, pump rating curves, typical well point cross-sections and depth of screened section. They shall include sketches and figures of sufficient detail to illustrate the layout of the dewatering system for the different portions or phases of the dewatering for the work areas. The Contractor shall furnish a listing of all equipment, including model numbers, vendors and suppliers, and catalogue cuts.

The dewatering calculations shall be prepared by a Professional Engineer or Professional Geologist.

The Contractor's Plan shall conform to all local, state and federal requirements. Any groundwater, stormwater or surface water encountered during construction shall be disposed of in such a manner that will not cause damage to public or private property or constitute a nuisance or menace to the public.

213.3.2 Soil-Cement Construction: Where excavation for the soil-cement construction extends below the water table, the portions below the water table shall be dewatered in advance of excavation. The dewatering shall be accomplished in a manner that will prevent the loss of fines, maintain stability of the slopes and bottom of the excavation, and result in construction operations being performed under reasonably dry conditions.

During placement and compaction of the concrete, the water level at every point of the excavation shall be maintained a minimum of three (3) feet below the placement level until the soil-cement has been in place a minimum of 48 hours.

213.4 PAYMENT:

Payment for Dewatering or demobilization and remobilization will be based upon approved time and material invoices, in accordance with Section 109.5 in an amount not to exceed the ALLOWANCE shown in the fee Schedule under Item DEWATERING, for approved work performed for the project.

SECTION 215

EARTHWORK FOR OPEN CHANNELS

215.7 MEASUREMENT:

The second paragraph of this Section is revised to read:

Quantities will be computed by the average end area method.

Part 200 add the following new Section:

SECTION 222

CEMENT STABILIZED ALLUVIUM BANK PROTECTION

222.1 DESCRIPTION:

The work under this section consists of constructing cement stabilized alluvium (CSA) bank protection at the locations shown on the plans and in accordance with these specifications, including excavating, backfilling and grading the river bed and banks to the lines, grades and cross sections shown on the plans or established by the Engineer; furnishing, processing and mixing aggregate, cement, fly ash and water; spreading and compacting the mixture; and placement of curing seal.

222.2 MATERIALS:

222.2.1 Aggregate shall be clean, sound, durable, uniform in quality and free of any soft, friable material, organic matter, oil, alkali or other deleterious substances. Aggregate shall conform to the following requirements.

Aggregate Size	Percent Passing
3 inch	100
No. 4	30-65
No. 200	0-8

Sampling and sieve analysis shall be performed in accordance with ASTM D75 and ASTM C136.

The plasticity index shall be no greater than 10 in accordance with the requirements of AASHTO T-90. Clay lumps larger than one inch shall be screened out of the raw soil prior to mixing.

Before placing aggregates upon the stockpile site, the site shall be cleared of vegetation, trees, stumps, brush, rocks and other debris, and the ground leveled to a smooth, firm, uniform surface.

Stockpiles shall be constructed upon prepared sites. The piles when completed shall be neat and regular in shape. The stockpile height shall be limited to a maximum of 13 feet.

Stockpiles in excess of 200 cubic yards shall be built up in layers not more than 4 feet in depth. Stockpile layers shall be constructed by trucks, "clamshells", or other methods approved by the Engineer. Pushing aggregates into a pile by a bulldozer will not be permitted. Each layer shall be completed over the entire layer of the pile before depositing aggregates in the next layer.

The aggregate shall not be dumped so that any part of it runs down and over the lower layers in the stockpile. The method of dropping from a bucket or spout in one location so as to form a cone shaped pile will not be permitted. Any method of placing aggregates in stockpiles, which, in the opinion of the Engineer, segregates, breaks, degrades or otherwise damages the aggregates will not be permitted.

Only pneumatic tired equipment shall be used on the processed or manufactured aggregates in constructing the stockpiles. When removing materials from the face of the stockpile, the equipment shall be operated in such a manner as to face-load from the floor to the top of the stockpile to obtain maximum homogeneity of materials.

Stockpiles shall not be constructed where traffic, vehicles or Contractor's equipment will either run over or through the stockpile, or cause foreign matter to be mixed with the aggregates.

222.2.2 Cement shall conform to the requirements for low alkali, Type II Portland Cement of Section 725.2.

222.2.3 Fly ash shall conform to the requirements of Section 725.2.1 for pozzolonic materials.

222.2.4 Water used for mixing shall be potable and free from oil, vegetable matter and any other deleterious matter; and shall conform to Section 725.4.

222.2.5 CSA shall have a minimum compressive strength of 0.75 ksi at seven days, determined in accordance with the requirements of Arizona Test Method 241 (Modification of AASHTO T-134). At least one test (two cylinders) shall be made for each 1,300 cubic yards of CSA placed.

222.2.6 Bedding Mortar shall consist of broomable, high portland cement/fly ash content, heavily sanded mortar, with a compressive strength of 2.9 ksi at 28 days, and shall have a slump of approximately 8.0 to 9.0 inches. The sand (fine aggregate) shall satisfy Sections 701.3, 776.3 and the following gradation:

<u>Aggregate Size</u>	<u>Percent Passing</u>
3/8 inch	100
No. 4	95-100
No. 16	45-80
No. 50	0-30
No. 140	0-10
No. 200	0-4

222.2.7 Exterior Concrete shall be Class B, conforming to Section 725.1.

222.2.8 Forms shall be mortar tight and designed, constructed, braced and maintained so that the finished concrete will be true to line and elevation; and will conform to the required dimensions and contours. They shall be designed to withstand the pressure of concrete, use of set-retarding admixtures or pozzolonic materials in the concrete, effects of vibration as the concrete is being placed and all loads related to the construction operations, without distortion or displacement.

All forms shall be treated with an approved release agent before concrete is placed. Any material that will adhere to or discolor the concrete shall not be used.

222.3 CONSTRUCTION:

222.3.1 Mix Design: Contractor shall determine the mix proportions of the aggregate, cement, fly ash and water; and shall furnish CSA conforming to the requirements specified herein. The job-mix design with supporting test results shall be submitted to

the Engineer for review. The Engineers approval shall be obtained prior to incorporating any material into the work.

The mix design objective is to provide the minimum cement plus fly ash content (C+P), W/C ratio and mix proportions to meet the specified strength, plus 2% additional cementitious materials (same C+P content) for durability and material variations. At the same time, the mix shall be dry (stiff) enough to support heavy placement and compaction equipment, yet wet enough to permit effective consolidation by adequate distribution of the paste binder throughout the CSA mass, during the mixing and placing process. The C+P content during CSA production shall not be decreased nor increased from that of the approved job-mix design unless approved by the Engineer. Actual mix designs, used on this project, shall be determined from the Contractor's laboratory tests from material stockpiled after construction of the stockpiles is completed.

The mix design shall be performed in accordance with Arizona Test Method 220 (Determination of Cement Content Required for Cement Treated Mixtures, a modification of AASHTO T-144) to determine the cementitious (C+P) content necessary for the strength required for CSA.

Determination of the optimum moisture content for compaction of the CSA mixture, including the additional 2% cementitious material for durability, shall be in accordance with AASHTO T-134, Method B. The additional 2% cementitious materials shall be a mixture of cement and fly ash in the same proportions as used in the mix design to meet the strength requirement. The total weight of cement replaced by fly ash shall not exceed 15%.

The Contractor shall follow the general provisions in accordance with Arizona Test Method 220 and AASHTO T-99, Method D, with the following exceptions.

The AASHTO T-99, Method D, shall be used in determining maximum dry density, modified to the extent that a rock correction will be calculated to correct for aggregate passing the 3.0-inch and retained on the 5/8 inch sieves. No correction will be used in determining the optimum moisture content.

Included in the job-mix design data shall be the grade of cement, brand of fly ash, and source of aggregate. A new mix design shall be submitted for approval at least two weeks prior to use, any time the Contractor requests a change in materials or proportioning of the materials from that given in the approved mix design.

222.3.2 Preparation of Subgrade: CSA shall be placed on a prepared subgrade shaped to the lines and grades shown on the plans, or be placed on existing CSA. The subgrade shall be compacted to a minimum of 95% of the maximum density in accordance with Section 301.3. When the embankment material is composed predominately of rock such that these compaction procedures will not achieve the required density, the Engineer will determine the amount of compaction required and the adequacy of equipment used to obtain the required compaction.

Immediately prior to placement of the CSA, the subgrade shall be uniformly moistened and maintained in an acceptable condition throughout the placement operation. Soft or yielding subgrade shall be corrected and made stable before construction proceeds. Saturated or submerged subgrade shall remain dewatered a minimum of 48 hours after placement of the CSA.

When CSA is to rest on rock, the rock shall be fully uncovered. The surface of the rock shall be removed to a depth sufficient to expose sound rock. Bedrock shall be roughly leveled or cut to approximate horizontal and vertical steps. Seams in the rock shall be grouted where determined by the Engineer.

When placed on existing CSA, the surface receiving the new CSA shall be cleaned to the satisfaction of the Engineer in the following manner:

After exposing the CSA structure, the surface shall be thoroughly cleaned of all loose materials foreign to the CSA. The surface shall be cleaned by sand-blast or hydro-blast (2.0 ksi maximum) to remove all foreign or loosened particles and hand scaled, if necessary, to provide a clean rough surface, free of loose materials, satisfactory to the Engineer.

The old CSA surface shall be moist at the time of placement and a ¼ inch layer of broomable bedding mortar (2.9 ksi) shall be used between the old and new CSA. A set retarding admixture shall be used in the mortar during hot weather placement.

222.3.3 Mixing, General Requirements: Aggregate, fly ash and cement shall be proportioned and mixed in a central mixing plant, unless otherwise permitted by the Engineer. The plant shall be either the batch mixing type (using revolving blade or rotary drum), or the continuous mixing type. The aggregate fly ash and cement shall be proportioned by weight. Certification for each shipment of cement or fly ash shall be provided to the Engineer.

The fly ash and cement shall be added in such a manner so that they are uniformly distributed throughout the mixing operation.

There shall be safe, convenient facilities for sampling the cement and fly ash in the supply line to the weight hopper or pugmill. The charge in the batch mixer or continuous mixer shall not exceed that which will permit complete mixing of the materials.

The water shall be proportioned by weight or volume and there shall be some means to enable the Engineer to verify the amount of water in each batch or the rate of water flow for continuous mixing. The time of the addition of water or the points where it is introduced into the mixer shall be as approved by the Engineer.

Control of water content in the field shall be accomplished in two ways:

(1) The moisture-density relationship for the CSA shall be determined in accordance with AASHTO T-134, Method B, on a routine basis, or when any significant shift in the gradation or rock content occurs.

(2) The actual moisture content of the mixture at the time of compaction, or shortly thereafter, shall be determined in accordance with ASTM D2216 (oven dry) or AASHTO T 310 (nuclear method), to determine if the optimum moisture content as determined by AASHTO T 134, Method B, is being maintained.

Water content in the aggregates is to be continuously monitored and the mixing water shall be adjusted as necessary to maintain proper moisture.

222.3.4 Batch Mixing: The mixer shall be equipped with a sufficient number of paddles of a type and arrangement to produce a uniformly mixed batch. The mixer shall be equipped with a timing device which will indicate, by a definite audible or visual signal, the expiration of the mixing period. The device shall be accurate to within two seconds. The time of mixing shall begin after all the ingredients are in the mixer and shall end when the mixer is half emptied. The allowable tolerance for weight batching of aggregates and cementitious material will be 2.0% and 0.5%, respectively, for each batch.

The batch mixing plant shall provide sampling facilities that are satisfactory to the Engineer and which will allow representative samples of the CSA to be obtained easily and safely.

222.3.5 Continuous Mixing: A control system shall be provided that will automatically close down the plant when the material in any storage facility approaches the strike-off capacity of the feed gate. The plant will not be permitted to operate unless this automatic control system is in good working condition.

The feeder for the aggregate shall be mechanically or electrically driven.

Aggregate shall be drawn from the stockpile by a feeder or feeders that will continuously supply the correct amount of aggregate.

The cement/fly ash and aggregate feeders shall be equipped with devices that can accurately determine the rate of feed while the plant is in full operation.

Continuous mix plants shall provide sampling facilities which are satisfactory to the Engineer, and that allow representative samples of the aggregate and CSA mixture to be obtained easily and safely.

222.3.6 Transporting/Spreading: Mixed materials shall be transported from the plant to the construction site in vehicles and spread on the prepared subgrade or previously completed CSA. Spreading shall be accomplished by the use of approved motor

graders or crawler type equipment. The compacted lifts of CSA shall not exceed 8.0 inch or be less than 4.0 inch in thickness.

Aggregate shall not be mixed or placed when the air temperature is below 45° F in the shade, unless the air temperature is at least 45° F in the next 24 hours. CSA shall not be mixed or placed when the air temperature is greater than 109° F in the shade.

222.3.7 Compacting/Finishing: All completed CSA surfaces that will be covered with succeeding layers of CSA shall be kept continuously moist by fog spraying until placement of next lift.

CSA shall be uniformly compacted to a minimum of 98%, with an average of 100%, of maximum density as monitored by nuclear density tests in accordance with AASHTO T 238 and T 310. Maximum density shall be determined in the lab in accordance with the requirements of AASHTO T 99, Method D, for minus 0.75 inch material only, with rock correction at each density test location according to AASHTO T 224, Section 2.2.2. At least one density test shall be taken for each 460 cubic yards of CSA.

At the start of compaction of each lift, the mixture shall be in uniform, loose condition throughout its full depth. The moisture content shall be as previously specified herein. No section shall be left undisturbed for longer than thirty minutes during compaction operations. Compaction of each lift shall be accomplished in such a manner as to produce a dense surface, free of compaction planes, and shall be completed within one (1) hour from the time water is added to the mixture. After compaction, CSA shall be shaped to the required grades, cross sections and rolled to a reasonably smooth surface. Whenever the Contractor's operation is interrupted for more than two hours, the top surface of the completed layer, if smooth, shall be scarified to a depth of at least 1 inch with a spike-tooth instrument prior to placement of the next lift. The surface, after scarifying, shall be swept using a power broom or other method approved by the Engineer, to completely free the surface of all loose material prior to the placement of the next lift.

At the time of compaction, the moisture content shall not be more than one percent (1%) below optimum and shall not be more than one percent (1%) above optimum when the mean air temperature during construction hours does not exceed 90° F.

When the mean air temperature does exceed 90° F, or there is a breeze or wind which promotes rapid drying of the CSA mixture, the moisture content shall be increased as needed, at the direction of the Engineer, but shall be less than the amount that will cause the CSA to become unstable during compaction and finishing operations.

Backfill shall not be placed within 40 inches of the top of the CSA surface. Construction joints shall be provided at the end of each day's work or when work is halted for two hours or more. The joints shall be trimmed to a straight line and vertical to the full depth of the lift. Before resuming placement of new material, the joints shall be roughened and loose material removed by power broom or compressed air.

Compaction equipment shall be capable of obtaining specified requirements without detrimentally affecting the compacted material. The equipment shall be modern, efficient compacting units approved by the Engineer. The units shall be of a type that is capable of compacting each lift of material as specified, and meet the minimum requirements as contained herein:

Self-propelled drum drive vibratory roller shall be of a type that will transmit dynamic impact to the surface to be compacted through a steel drum by means of revolving weights, eccentric shaft or other methods. The compactor shall have a gross mass of not less than 23,000 lbs. and shall produce a dynamic force of at least 13 lbs. per inch of drum width when operated at 2,400 cycles per minute (cpm). The dynamic force is defined as the force developed by revolving the eccentric weight at 2,400 cpm. The roller shall have a smooth drum or drums and the drum diameter shall be between 48 inches and 70 inches, and the width shall be between 28 inches and 100 inches. The frequency of vibration during operation shall be 2,400 cpm. The roller shall be operated at speeds not to exceed 15 mph in the forward direction. The engine driving the eccentric mass shall have a rating of not less than 90 kilowatts. Variation in speed, frequency and method of operation will be determined when found necessary to secure maximum compaction of materials.

Heavier compacting units may be required to achieve the required density.

222.3.8 Bedding Mortar: Bedding Mortar shall be used between CSA that has been in place more than seven (7) days and the new CSA after the existing CSA has been properly cleaned. The bedding mortar is to be used for achieving bond between the old and new CSA layers and to eliminate and prevent segregation or voids along the margins of CSA placements. Adjustment to the mix design may be required by the Engineer.

222.3.9 Control Strips: A control strip shall be constructed at the beginning of work on the CSA to be compacted. The control strip construction will be required to establish procedures necessary to obtain densities for the specific course plus use of portable nuclear moisture/density testing equipment to determine in-place densities.

Each control strip, constructed to acceptable density and surface tolerances shall remain in place and become a section of the completed CSA. Unacceptable control strips shall be corrected or removed and replaced at the Contractor's expense. A control strip shall cover an area of approximately 420 square yards and be of the same dimensions specified for the CSA course.

The materials used in construction of the control strip shall conform to the specification requirements. They shall be furnished from the same source and be of the same type as used in the CSA. The underlying surface for the control strip shall have prior approval of the Engineer.

The equipment used in the control strip shall be of the same type and weight as used for the CSA.

Compaction of control strips shall start immediately after the course has been placed to the specified thickness, and shall be continuous and uniform over the entire surface. Compaction of the strip shall continue until no discernible increase in density can be obtained by additional effort.

Upon completion of compaction, the mean density of the control strip will be determined by averaging the results of ten density tests taken at random sites within the strip. If the mean density of the control strip is less than 98% of the laboratory compacted specimens as determined by testing procedures appropriate for the material being placed, the Engineer may order the construction of another control strip.

A new control strip may be ordered by the Engineer, or requested by the Contractor when:

- (1) A change in material or mix design.
- (2) There is reason to believe that the control strip density is not representative for the material being placed.
- (3) Ten days of production have passed without a new control strip.

222.3.10 Power Tampers and Small Vibratory Rollers: Small vibratory rollers that are capable of operating within a few millimeters of a vertical face shall be used for compaction adjacent to guide banks, next to utilities and drainage conduit, at transitions to previously constructed levee protection and at other areas where larger vibratory rollers cannot maneuver. The dynamic force produced by the small vibratory rollers shall be at least 140 lbs. per inch of drum width.

Tampers shall be a type capable of developing a force per blow of at least 1390 lbs. The amount of rolling and tamping required shall be whatever is necessary for the particular equipment to provide the same degree of compaction as would be obtained by four passes of the large self-propelled vibratory roller. Standby replacement equipment shall be available within one hour if needed.

222.3.11 Curing: Temporarily exposed surfaces shall be kept continuously moist. Care must be exercised to ensure that no curing material other than water is applied to the surface that will be in contact with succeeding layers.

Permanently exposed surfaces shall be kept in a moist condition for seven days, or they may be covered with bituminous or other suitable curing material, subject to the Engineer's approval. Any damage to the protective covering within the seven days shall be repaired to the satisfaction of the Engineer.

Regardless of the curing material used, any permanently exposed surface shall be kept moist until the protective cover is applied. This protective cover is to be applied as soon as practical, with a maximum time limit of twenty-four hours between the finishing of the surface and the application of the protective cover.

222.3.12 Maintenance: The Contractor will be required, within the limits of the contract, to maintain the CSA and curing seal in good condition until the work is completed and accepted. Maintenance shall include repairs to any defects that may occur. This work will be done at the Contractor's expense and repeated as often as necessary. Faulty work shall be replaced for the full depth of the layer.

222.4 MEASUREMENT:

The work will be measured by the cubic yard of completed CSA bank protection constructed to the lines, grades and cross-sections shown on the plans.

The maximum limit for the placement of CSA due to over excavation or sloughing of existing soils shall be 4 inches. Any placement beyond these limits will not be included in the pay quantity.

222.5 PAYMENT:

The accepted quantities of CSA will be paid for at the contract price per cubic yard for CSA Bank Protection, subject to the following penalties for failure to achieve the required strength requirements:

<u>Percent of Specified Strength</u>	<u>Percent of Contract Unit Price</u>
≥100	100
97-99	92
94-96	85
90-94	77
85-89	68
80-84	60
75-79	50
<75	See Note

Note: Material represented by lots attaining seven day compressive strengths with a mean value less than 75% of the specified compressive strength will be evaluated as to acceptance. The Engineer will determine if the material can be left in place or removed and replaced at the Contractor's expense.

Part 300 add the following new Section:

SECTION 308

LIME SLURRY WITH FLY ASH STABILIZATION

308.1 DESCRIPTION:

This section shall consist of constructing a mixture of soil, lime slurry, fly ash and water for the stabilization of soils or base materials. The work shall be performed in conformity with the lines, grades, thickness, and typical cross sections shown on the plans.

308.2 MATERIALS:

308.2.1 Soil or Subgrade: The soil or subgrade material used for this work shall consist of materials on the site or imported and shall be free of roots, sod, weeds, and stones larger than 3 inches.

308.2.2 Quicklime and Hydrated Lime: Lime used to manufacture the Commercial Lime Slurry specified herein, shall be either Quicklime or Hydrated lime and shall conform to the requirements of ASTM C977. Lime may only be used in the production of lime slurry. The direct use of dry hydrated lime or quicklime to the soil material is strictly prohibited. All lime shall come from a single source. If a source change is requested, a new mix design shall be submitted using lime from the proposed new source. The new design must be approved by the Engineer prior to use.

308.2.3 Commercial Lime Slurry: Commercial lime slurry shall be a pumpable suspension of solids in water. The water or liquid portion of the slurry shall not contain dissolved material in sufficient quantity naturally injurious or objectionable for the purpose intended. The solids portion of the mixture, when considered on the basis of solids content, shall consist principally of hydrated lime of a quality and fineness sufficient to meet the following requirements as to chemical composition and residue.

(A) Chemical Composition: The solids content of the lime slurry shall consist of a minimum of 90 percent by weight, of calcium and magnesium oxides (CaO and MgO), as determined by ASTM C25.

(B) Residue: The percent by weight of residue retained in the solids content of lime slurry shall conform to the following requirements:

Residue retained on a No. 6 sieve	Max. 0.2%
Residue retained on a No. 30 sieve	Max. 4.0%

(C) Grade: Commercial lime slurry shall conform to a dry solids content as approved by the Engineer.

A certificate of compliance and a field summary of lime slurry produced shall be provided to the Engineer for each load of slurry.

308.2.4 Water: Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Water shall be tested in accordance with and shall meet the suggested requirements of AASHTO T-26. Water known to be of potable quality may be used without test.

308.2.5 Fly Ash: Fly ash shall meet the requirements of AASHTO M-295, Class C.

308.3 MIX DESIGN:

Before commencing lime / fly ash treatment work, the Contractor shall submit for approval by the Engineer, a proposed mix design. A testing laboratory under the direction and control of a registered Professional Engineer shall prepare the proposed mix design. The mix design shall be determined using the soils or subgrade material to be stabilized and lime and fly ash from the proposed suppliers and shall determine the following:

Percent of fly ash and rate of application.

Percent of lime and rate of application of lime slurry in the treated soil or subgrade material.

Optimum water content during mixing, curing and compaction.

Gradation of in-situ mixture after treatment.

Additional mixing or equipment requirements.

Mellowing time requirements, if needed.

The mix design shall comply with the following requirements:

Plasticity Index: Less than 3, per AASHTO T-89 & 90.

Swell Potential: One (1) percent or less vertical expansion of an air dried soil when inundated with water and allowed to swell at a confined pressure of 60 psi.

Unconfined Compressive Strength: Minimum 300 psi in five days curing at 100° F when tested in accordance with ASTM D1633 Method A.

308.4 CONSTRUCTION:

308.4.1 General: The completed subgrade shall consist of a uniform lime / fly ash mixture, free from loose segregated areas, have a uniform density and moisture content, and be well bound for its full depth. A smooth surface suitable for placing subsequent courses is required if pavement is to be placed directly on the treated subgrade.

Prior to beginning stabilization, the subgrade shall be constructed and brought to grade and shall be shaped to conform to the typical sections, lines, and grades as shown on the plans.

When the design requires treatment to a depth greater than 12 inches, the subgrade soil shall be treated in equal layers. The top layer(s) of soil shall be removed and stockpiled. The lower layer of soil to be treated shall then be treated and allowed to cure in place. After final mixing, the lower layer shall be compacted in maximum 12 inch compacted lifts. The stockpiled soil shall then be placed, treated, mixed and compacted in successive maximum 12 inch compacted lifts.

308.4.2 Weather Limitation: Lime slurry / fly ash treated subgrade shall not be constructed if the atmospheric temperature is below 40° F or when conditions indicate that temperatures may fall below 40° F within 24 hours.

308.4.3 Equipment: Contractor shall provide all equipment necessary to complete the work, including grading and scarifying equipment, lime slurry spreader (gravity feed spreaders will not be permitted), fly ash spreader, mixing and pulverizing equipment, sheepsfoot and pneumatic rollers, sprinkling equipment, and trucks. When using dry hydrate to make slurry, agitators are mandatory in spreader. All equipment used for this work shall be subject to approval by the Engineer.

308.4.4 Application: Lime slurry and fly ash slurry shall be spread only on that area where the mixing operations can be completed during the same working day. The application and mixing of lime and fly ash with the soil shall be accomplished by the methods hereinafter described as Slurry Placing.

Slurry Placing: Fly ash shall be spread with trucks equipped with an approved distribution system on the prepared subgrade at the rate specified by the job mix design in a single pass, just prior to the application of the lime slurry. The fly ash may be added to the lime slurry and placed together, if approved by the Engineer. Lime slurry / Lime slurry fly ash, shall be mixed in a portable mixing unit and spread with trucks equipped with an approved distribution system as a slurry. Commercial lime slurry shall be applied with a lime percentage not less than specified herein. The distribution of lime slurry shall be attained by successive passes over a measured section of subgrade until the proper amount of lime has been spread, as determined in the job mix design. The rate of application shall be verified using ASTM D3155 methods.

Thickness: The thickness of the lime slurry treated subgrade shall be determined by visual inspection and/or by depth tests taken at intervals so that each test shall represent no more than 1000 square yards per layer, if more than one layer. The method used to remove material to determine depth of lime treatment may be by shovel and/or pick, coring or other method approved by the Engineer. Phenolphthalein solution shall be used to detect the presence of lime. When the grade deficiency is more than 1 inch, the Contractor shall correct such areas in a manner satisfactory to the Engineer. Contractor shall replace, at no cost to the Agency, the material where depth tests are taken.

No traffic other than the mixing equipment will be allowed to pass over the spread of lime slurry until after completion of mixing.

308.4.5 Mixing: The full depth of the treated subgrade shall be mixed with an approved mixing machine. The use of disc plows or blades are prohibited except in areas specified by the engineer. To ensure a complete chemical reaction of the lime, fly ash and soil or subgrade, water shall be used as required to maintain a moisture content at or above the optimum prior to beginning compaction and held above optimum during compaction. During the interval of time between application and mixing, lime that has been applied, unmixed and exposed to the open air for 10 hours or more will not be accepted.

After mixing and prior to compaction, clay lumps shall meet the following criteria:

	Percent (by Weight)
Minimum of clay lumps passing 1½ inch sieve	100
Minimum of clay lumps passing No. 4 sieve	60

308.4.6 Compaction: Compaction of the mixture shall begin after final mixing. Sheepsfoot or segmented steel rollers shall be used during initial compaction. Steel wheel or pneumatic tired rollers shall be used only during final compaction, if pavement is to be placed directly on the treated subgrade. Areas inaccessible to rollers shall be compacted to the required density by methods approved by the Engineer.

The material shall be aerated or watered as necessary to provide and maintain required moisture content. The field density of the compacted mixture shall be a least 95 percent of the maximum density at 0-4 percent above optimum moisture. A composite of treated soil or subgrade materials from a minimum of five (5) random locations, per soil type, within the area to be stabilized shall be used to determine the maximum density and optimum moisture content in accordance with ASTM D558. The in-place field density shall be determined in accordance with ASTM D1556, ASTM D2167 or ASTM D2922.

After each section is completed, tests will be made by the Engineer. If the material fails to meet the density requirements, it shall be reworked to meet requirements.

If pumping subgrade should become evident at any time prior to paving, the Engineer may require proof rolling with a pneumatic-tire roller or other approved equipment in order to identify the limits of the unacceptable area. The proof rolling will be performed at no additional cost to the Contracting Agency.

All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required, and reshaping and compacting. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts. Compaction and finishing shall be

done in such a manner as to produce a smooth dense surface free of compaction planes, cracks, ridges, or loose materials.

Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion, shall be smooth and shall conform with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density, and finish before the next course is placed or the work is accepted, it shall be recompacted and refinished at no cost to the County.

308.4.6.1 Tolerances: At final compaction, the lime, fly ash and water content for each course of subgrade treatment shall conform to the approved mix design with the following tolerances.

<u>Material</u>	<u>Tolerance</u>
Lime	+0.5% of design, (ASTM C114)
Fly Ash	±1.0% of design, (ASTM C114)
Water	+4%, -0% of optimum, (ASTM D698)

308.4.7 Finishing and Curing: After the final layer or course of lime slurry / fly ash treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the plans. The completed section shall then be finished by rolling with a pneumatic or other suitable roller.

The final layer of lime slurry / fly ash treated subgrade shall be maintained in a moist condition until the next layer of pavement structure is placed. If required, a fog seal for curing, in compliance with Section 333, shall be furnished and applied to the surface of the final layer of the lime stabilized material as soon as possible after the completion of final rolling and before the temperature falls below 40° F. Curing seal shall be applied at a rate between 0.10 and 0.20 gallons per square yard of surface. The exact rate will be determined by the Engineer.

After curing begins, all traffic, except necessary construction equipment shall be kept off the lime slurry / fly ash stabilized subgrade for a minimum of 7 days or until the final pavement structure layer(s) are placed.

308.4.8 Maintenance: The Contractor shall maintain, at his / her own expense, the entire lime slurry treated subgrade in good condition from the start of work until all the work has been completed, cured, and accepted by the Engineer.

308.5 MEASUREMENT:

The quantity of lime slurry / fly ash treated soils shall be measured by the square yard,

measured in place, treated, compacted, to the proper depth, and accepted.

The quantity of curing seal shall be measured by the ton, diluted.

308.6 PAYMENT:

The lime slurry / fly ash treated soils measured as provided above will be paid for at the contract price per square yard, which price shall be full compensation for the item complete in place, as herein described and specified.

Payment for curing seal will be made at the contract price per ton for Fog Seal (Contingent Item) based on the rate of application as requested by the Engineer.

SECTION 310

PLACEMENT AND CONSTRUCTION OF AGGREGATE BASE COURSE

310.4 THICKNESS AND/OR PLASTICITY INDEX DEFICIENCY, revise Table 310-1 by deleting “or gradation deficiency” from the Deficiency column for Type IV.

310.5 PAYMENT, add the following:

The Contractor shall furnish the Engineer certified weight tickets for the aggregate base (AB) placed on the project. Final pay quantities for aggregate base will be based upon the scale tickets submitted to the Engineer for aggregate base specifically used to construct the roadway untreated base to the limits as shown in the contract documents.

SECTION 317

ASPHALT MILLING

317.2 CONSTRUCTION REQUIREMENTS, add the following:

Asphalt milling adjacent to valley gutters or curb and gutter shall include removal and disposal of built-up asphalt concrete, slurry seal, microsurfacing and similar materials from adjacent concrete valley gutters or concrete gutter pans.

317.3 MEASUREMENT AND PAYMENT, add the following:

Removal and disposal of built-up materials from adjacent portland cement concrete surfaces shall not be measured; the associated cost shall be included in the contract unit price for Asphalt Milling.

SECTION 321

PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

321.8.2 Joints, add the following:

Longitudinal joints shall be located to maintain a minimum 6 inch clear distance from the edge of any proposed longitudinal pavement stripe.

321.8.6 Asphalt Concrete Overlay, replace paragraphs (a) and (b) with the following:

(a) Areas designated for pavement repair or surface replacement by the contract documents (which may include localized pavement failures, severely raveled areas, severely cracked areas, over-asphalted areas, and other defects) shall be cut out and replaced. Pavement repairs and surface replacements shall be completed and approved before placing asphalt concrete overlay.

(b) Before placing asphalt concrete overlay, thermoplastic pavement markings and raised pavement markers shall be removed and milling shall be completed. Milling shall be as shown on the plans or specified in the special provisions in accordance with Section 317.

321.10.1 Acceptance Criteria, replace the third sentence with the following:

When the quantity of asphalt concrete placed in a day exceeds 1000 tons but is less than 2000 tons, the day's production will be divided into two (2) approximately equal sublots. Where the quantity of asphalt concrete placed in a day exceeds 2000 tons, the day's production will be divided into three (3) approximately equal sublots. A minimum of one sample will be obtained from each lot.

321.13 PAYMENT, add the following:

Payment for removal of thermoplastic markings and raised pavement markers prior to roadway overlay operations will be as specified in Section 460.

Payment for asphalt pavement replacement and asphalt pavement repair required prior to roadway overlay operations will be as specified in Section 336.

SECTION 325

PLACEMENT AND CONSTRUCTION OF ASPHALT-RUBBER ASPHALT CONCRETE

325.7 PLACEMENT:

325.7.2 Placing and Construction Methods, add the following:

Longitudinal joints shall be located to maintain a minimum 6 inch clear distance from the edge of any proposed longitudinal pavement stripe.

325.7.3 Compaction:

Delete the phrase “any desired” from the first sentence.

325.7.5 Adjustments, add the following:

When the Engineer determines an insufficient amount of material is available for shoulder adjustment, the Engineer may require the Contractor to provide additional material.

325.8 QUALITY CONTROL, add the following:

Requests for an Engineering Analysis or Referee Testing as described in 325.9.4 and 325.10 will not be considered unless based on quality control test results by an AMRL and CCRL accredited laboratory using properly certified technicians in accordance with ASTM D3666, Section 7 (Personnel Qualifications).

325.9 ACCEPTANCE:

325.9.1 Acceptance Criteria, replace the third sentence with the following:

When the quantity of ARAC placed in a day does not exceed 1000 tons, the day's total production shall be considered as a single subplot. When the quantity of ARAC placed in a day exceeds 1000 tons but is less than 2000 tons, the day's production shall be divided into two (2) approximately equal sublots. Where the quantity of ARAC placed in a day exceeds 2000 tons, the day's production shall be divided into three (3) approximately equal sublots.

325.9.2 Gradation and Binder Content, replace the first paragraph with the following:

Acceptance testing for gradation and binder content will be performed in accordance with section 325.9.2.2 End Product Sampling and Testing.

325.9.2.2.1 Mineral Aggregate Gradation and Binder Content, add the following:

The Engineer may run tests to determine the correction factor to be used with AASHTO test procedure T 308. When requested by the Engineer, the contractor shall provide calibration materials to the Engineer.

325.9.6 Engineering Analysis (EA), replace Table 325-4 with the following:

TABLE 325-4		
ENGINEERING ANALYSIS PENALTIES for REMOVAL* LOTS/SUBLOTS LEFT IN-PLACE		
Acceptance Criteria	Acceptance Limits	Penalty When Contracting Agency is the Owner (\$/Ton)
Asphalt-Rubber Binder Content	Over 0.2% points from that Permitted	\$9.00
Laboratory Air Voids (Measured at 75 blows)	Deviation from Target Greater Than $\pm 4.0\%$	\$7.50

325.12 PAYMENT, add the following

Payment for removal of thermoplastic markings and raised pavement markers will be as specified in Section 460.

Payment for asphalt pavement replacement and asphalt pavement repair will be as specified in Section 336.

SECTION 329

TACK COAT

329.1 DESCRIPTION, add the following:

Emulsified asphalt for tack coat shall be grade SS-1h.

SECTION 333

FOG SEAL COATS

333.1 DESCRIPTION, add the following:

Fog seal coats for curing seal purposes as specified in Section 308 or Section 309 shall consist of the application of emulsified asphalt.

333.6 APPLICATION OF ASPHALT EMULSION, add the following:

For curing seal applications over Lime Slurry Stabilization or Lime Slurry with Fly Ash Stabilization the application rate shall be between 0.10 to 0.20 gallons per square yard.

SECTION 336

PAVEMENT MATCHING AND SURFACE REPLACEMENT

336.2 MATERIALS AND CONSTRUCTION METHODS

336.2.3 Temporary Pavement Replacement, add the following:

Temporary pavement replacement that uses cold-mix asphalt concrete shall be replaced no later than seven (7) calendar days after initial placement.

336.2.4 Permanent Pavement Replacement and Adjustments, add the following:

336.2.4.3 Pavement Repair: Areas designated for pavement repair are suspected subgrade failure areas within asphalt pavement. Pavement repair consist of removal of the existing pavement structural section (asphalt pavement and the underlying aggregate base), exposing and then removal of subgrade material to a depth of eight inches (8"), backfill and compact subgrade and aggregate base materials to depths as directed by the Engineer, and replacement of the asphalt pavement. The Engineer may revise the removal boundary limits at any time during this work. The Engineer shall be notified and given the opportunity to inspect the soil conditions when the subgrade is exposed prior to excavating subgrade material and again at the completion of subgrade excavation.

After approval of the excavation by the Engineer, the Contractor shall proceed with placement of subgrade and aggregate base materials to elevations directed by the Engineer. Compaction of subgrade and aggregate base shall comply with requirements of Table 601-2. The aggregate base material placed shall be compliant with section 702 requirements; the removed aggregate base may or may not be compliant. After placement of the aggregate base course to the bottom of the adjacent pavement, sawcut and remove asphalt pavement to one foot back of the newly placed aggregate base and then construct new asphalt pavement matching the adjacent existing grades and slopes. Asphalt pavement shall be constructed in accordance with the Section 336.2.4.1 Permanent Asphalt Pavement Replacement, except application of a seal coat is not required.

336.3 TYPES AND LOCATIONS OF TRENCH SURFACE REPLACEMENT, add the following:

Type B trench repair is not approved for use within County right of way.

336.4 MEASUREMENT, add the following:

(I) Measurement for Asphalt Pavement Repair will be the area of new pavement installed for pavement repair rounded to the nearest square yard.

336.5 PAYMENT, add the following:

Payment for asphalt pavement repair shall be full compensation for all labor, equipment, and materials required for the complete in place repair including but not limited to pavement removal, excavation, aggregate base coarse placement, and asphalt pavement replacement.

SECTION 337

CRACK SEALING

337.2 MATERIALS:

Revise the Brookfield Viscosity requirement as shown below.

TEST	REQUIREMENT
Brookfield Viscosity, 380°F (193°C) (ASTM D2669)	40-90 Poise

SECTION 340

CONCRETE CURB, GUTTER, SIDEWALK, SIDEWALK RAMPS, DRIVEWAY AND ALLEY ENTRANCE

340.2 MATERIALS:

340.2.1 Detectable Warnings, add the following:

Approved products are posted on MCDOT's website:

<http://www.mcdot.maricopa.gov/technical/home.htm>

Surface applications dependent on an adhesive bonding agent(s) are not approved for use. Request for product approval are to include a) Product Specifications, b) Installation Instructions, c) Product Sample, and d) List of Locations of proposed use. Requests are to be directed to: MCDOT Operations and Maintenance Division, 2919 West Durango Street, Phoenix, 85009; Phone: (602) 506-8362.

SECTION 350

REMOVAL OF EXISTING IMPROVEMENTS

350.1 DESCRIPTION, add the following:

The work under this Section shall consist of the disposal of any obstacle to construction, unless specifically noted on the Plans for removal or relocation by other entities.

Arrangements for disposal of all waste material shall be the responsibility of Contractor. All usable pipe culvert, as determined by the Engineer, shall be stockpiled within the right-of-way for salvage by the County. Removal and storage of traffic signs and other traffic control devices shall comply with section 401.2.5. Delivery of salvaged traffic signal and lighting equipment shall comply with section 470.6.

Removal of existing improvements shall be performed in a safe manner avoiding damage to improvements not designated for removal.

350.2 CONSTRUCTION METHODS

350.2.2 Others, add the following:

Removal of traffic signal pole foundations unless otherwise indicated shall be to a depth of at least 18 inches below finished grade.

Remove and Salvage Traffic Sign Assembly shall consist of salvaging existing sign panels and posts, removing and disposing of the existing foundations, backfilling and compacting all voids, and restoring the existing surface to match previous existing conditions. The sign panels and posts shall be dismantled in a manner that will prevent damage. Concrete sign foundations shall be disposed of by the contractor. Contractor shall pre-arrange delivery of sign panels and posts by calling (602) 506-8662. The sign panels and posts shall be transported to and unloaded at 2909 W. Durango Street by the contractor in a manner that will prevent damage. The quantity measured for Remove and Salvage Traffic Sign Assembly includes all sign panels and posts that are a part of the assembly.

Part 300 add the following new Section:

SECTION 351

RELOCATION AND ADJUSTMENT OF EXISTING IMPROVEMENTS

351.1 DESCRIPTION:

This work shall consist of the movement of existing improvements and specialty items to accommodate project construction. Relocation is the horizontal movement or change in location of an existing improvement or item, as shown or described on the Project Plans. Adjustment is a change in the vertical position of an existing improvement or item, typically required to accommodate a change in grade at the location of the existing improvement.

351.2 MATERIALS:

All relocations and adjustments requiring reseating, replacement, or the use of additional materials shall be accomplished using materials of the same or better quality than found in the existing improvements, as approved by the Engineer.

For mailbox relocations the Contractor shall supply a replacement support post for any mailbox installation deemed hazardous by the Engineer. Hazardous mailbox installations may include but are not limited to support posts that act as fixed objects (i.e. rigid or non-deflecting posts that exceed the stiffness or breakaway characteristics of a nominal 4"x4" wood post buried 36 inches into the ground) and installations of multiple mailbox receptacles mounted on a horizontal beam.

351.3 CONSTRUCTION:

The work shall include the removal of posts, foundations, and other associated items directly related to the relocation or adjustment of the existing improvement; filling and compacting all holes left by such removals; and installing, adjusting, or reconstructing moved items in their new location.

Improvements shall be moved in such a manner that the moved elements and all remaining unmoved portions of previously attached improvements are not damaged. All portions of moved and remaining unmoved improvements that are damaged during the relocation or adjustment shall be repaired, or shall be replaced in kind by the Contractor, as approved by the Engineer, at the Contractor's expense.

All relocated or adjusted improvements shall exhibit the same quality, integrity, function, and appearance as the improvements exhibited prior to relocation or adjustment. The unmoved portion of the moved improvement shall be repaired or restored to the same type, quality, appearance, and strength as existed prior to relocation or adjustment.

If for any reason the improvement cannot be removed, relocated, and adjusted within the same working day, the disturbed/removed portion shall be secured from theft and damage until such time that it can be permanently installed in its final location. Also, where the move cannot be accomplished within the same working day, a temporary substitute facility shall be provided to accomplish the required function, as approved by the Engineer. Example: security fencing is to be relocated and the relocation is incomplete at the end of a work day, the contractor is to provide appropriate temporary fencing or approved alternative measures to secure the fenced area.

When the materials of the existing facility are insufficient in quantity to meet the relocation or adjustment requirement, then the Contractor shall provide additional new materials of like kind as needed to complete the relocation or adjustment.

When materials in the existing facility cannot be moved without deterioration in quality, appearance, strength, or function then the Contractor shall provide new replacement materials of like kind as needed for the relocation or adjustment.

Relocate Traffic Sign consists of salvaging the existing sign panel and post, removing the existing foundations, backfilling and compacting all voids, restoring the existing surface to match previous existing conditions and installing the traffic sign panel on a post or posts of appropriate length mounted on new post foundations. New post foundations shall be measured separately and not included as part of the Relocate Traffic Sign pay item.

351.4 MEASUREMENT:

Relocated or adjusted items will be measured by the number of improvements and/or the number of linear feet as designated in the fee proposal.

For linear items such as relocated fencing, the length measured shall be the installed length; no measurement of the removal length shall be made.

The measurement of relocated mailboxes will be the number of mailboxes relocated to a new permanent location as indicated by the project plans or directed by the Engineer and shall include replacement posts to correct conditions deemed hazardous, as required for an acceptable complete in place installation. No measurement will be made for temporary relocations made to maintain mail delivery during construction.

351.5 PAYMENT:

Payment will be made at the contract unit price for each relocated or adjusted improvement. Payment shall be full compensation for all tools, equipment, labor, materials, services, transportation, and incidentals necessary for relocation or adjustment of the improvement including additional new materials or replacement material and repairs or adjustments to the unmoved remainder of fences and other facilities.

SECTION 401

TRAFFIC CONTROL

401.2 TRAFFIC CONTROL DEVICES:

Section 401.2 add the following:

All traffic control devices and their application shall conform to the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD - United States Department of Transportation, Federal Highway Administration) as modified by the Arizona Department of Transportation's Supplement, the Maricopa County Department of Transportation's Traffic Control Manual, the special provisions, and any field modifications made by the Engineer.

All traffic control devices shall meet the guidelines of NCHRP 350 or the AASHTO 2009 Manual for Assessing Safety Hardware.

If at any time the Engineer is unable to contact the Traffic Control Technician, the Engineer reserves the right to make contact with the traffic control subcontractor to request any materials or services deemed appropriate by a demonstrated or apparent need in accordance with the standards and guidelines established by the MUTCD as supplemented by the Arizona Department of Transportation and the Maricopa County Department of Transportation's Traffic Control Manual for the safety of the public or workers. The cost of these materials or services shall be part of the cost of Traffic Control.

401.2.1 Installation of Temporary Traffic Control Devices: It shall be the responsibility of the Contractor to provide, erect, maintain, remove and/or relocate all temporary and existing traffic control devices and signal indications necessary to properly mark and control the construction area(s) for the safe and efficient movement of all roadway users.

The contractor shall maintain all traffic control devices 24 hours a day, 7 days a week (including weekend and holidays) for the entire duration of the construction or maintenance project. It shall be the contractor's or permittee's responsibility to have all traffic control devices inspected at least once during each workday, once per week during nighttime hours and immediately after a wind or rain storm. Any traffic control device not properly located shall be immediately adjusted or reinstalled.

The Contractor shall install temporary traffic control warning signs and devices prior to the start of any work in accordance with the approved Traffic Control Plan (TCP). All existing signs in conflict with the construction signs shall be covered, removed, or relocated.

The Contractor shall provide additional devices as determined by the Engineer, to safely control traffic.

All advanced warning construction signs shall be mounted on channels driven into the ground or be mounted on temporary spring stands. Each approach at one mile and at one half-mile point prior to the project shall be signed with "Road Work Ahead" and with speed limit signs, mounted on channels driven into the ground or mounted on temporary spring stands and placed at locations where the need for relocation during construction is minimized.

All temporary traffic control devices shall be ballasted with sandbags or other approved ballast. The amount of sandbags used shall be enough to provide adequate safety for the traveling public.

Ground mounted temporary traffic control signs for rural areas shall be mounted with the bottom of the sign at least five feet and not more than six feet above the near edge of the pavement and for urban areas shall be mounted with the bottom of the sign at least seven feet and not more than eight feet above the near edge of the pavement.

The Contractor shall mount signs on wind resistant, spring-type bases when conditions warrant or as requested by the Engineer.

The Contractor shall place flags above all signs.

The Contractor shall use warning lights to mark traffic control devices at night.

The Contractor shall mount Type B high-intensity flashing warning lights on all stop signs within the work zone.

All construction warning signs (black on orange) shall use retroreflective sheeting with fluorescent orange Type VIII, IX or XI and all regulatory signs (black on white) shall use retroreflective sheeting with a minimum of Type IV retroreflective sheeting.

The Contractor shall use an arrow board for all stationary or moving lane closures.

The Contractor is responsible for all costs incurred in replacing lost or damaged traffic control devices and traffic control warning signs.

401.2.2 Traffic Cones: Are effective for daytime channelization of traffic and to delineate minor maintenance areas. Traffic cones are versatile because they are portable and if struck, they will minimize damage to vehicles. They can be set up and removed quickly. When traffic cones are approved by the Engineer for use, it is necessary to check them often because vehicles frequently move them. The minimum height for cones is 28" high and minimum weight is 10 pounds on arterials/collectors

and 7 pounds on local roadways. When used at night, cones must have retroreflective bands as called for in the MUTCD.

401.2.3 Temporary Longitudinal Traffic Barriers: Temporary longitudinal traffic barrier installations shall be portable concrete barrier (PCB) or other segmented longitudinal barrier. The barrier and installation shall be in accordance with Chapter 9 of the AASHTO Roadside Design Guide. PCB shall use F-shape faces. Each barrier section shall be properly connected to the adjacent section to provide barrier continuity to resist movement, snagging, and/or instability of impacting vehicles. Panels and connections shall meet NCHRP 350 Test Level 3 or an approved test level of the AASHTO 2009 Manual for Assessing Safety Hardware.

401.2.4 Pavement Markings: Pavement markings used as an integral part of the traffic control plan shall be kept distinct and visible during their use. Temporary pavement markings shall match and meet the markings in place at both ends of their usage.

401.2.5 Removal of Permanent Traffic Control Devices: The Contractor shall notify the Engineer and obtain the Engineer's approval prior to the removal of any permanent traffic control device.

The Contractor shall remove (without damage) all permanent signs including sign posts that are no longer applicable. The sign panels and posts shall be dismantled and transported to the MCDOT sign shop in a manner that will prevent damage. Concrete sign foundations shall be removed and disposed of by the Contractor. The Contractor shall coordinate with the MCDOT sign shop (602) 506-8662 to establish an acceptable delivery time during normal working hours. The sign panels and posts shall be delivered to:

2909 West Durango Street
Phoenix, Arizona 85009.

401.4 TRAFFIC CONTROL MEASURES, add the following:

401.4.1 Traffic Control Plan: Construction shall not commence without an approved Traffic Control Plan (TCP). At the time of the pre-construction meeting, the Contractor shall submit preliminary traffic control plans for each phase of the work for review. Plans shall be of an appropriate size and legible, plans found to be deficient by the Engineer shall be returned. The Contractor shall design the traffic control plan using the posted speed limit existing prior to commencement of work as the design speed. The TCP shall show all striping, signing, barricading and distances for all devices for all movements of roadway users during each phase of construction. The TCP shall show existing traffic control signs and temporary construction signs; shall identify conflicting signs to be covered/removed or relocated; and shall identify other features that may conflict with the placement of temporary signage. The TCP shall also show the duration with the start and end date of each phase. When requested by MCDOT, the Contractor shall supply a copy of the manufacturer's certification of compliance with NCHRP 350 test requirements (or compliance with a designated approved test level of the AASHTO

Manual for Assessing Safety Hardware) for any of the Contractor proposed traffic control devices. The manufacturer's certification shall identify the NCHRP 350 or AASHTO test number. The County will within 10 working days review the plan and notify the Contractor of approval or note items to be revised.

401.4.2 Traffic Control Technician: The Contractor shall appoint a Traffic Control Technician (other than the superintendent/foreman), who has been properly trained and certified in the application of work zone traffic control, to maintain all necessary traffic control devices. At the beginning and end of each workday and at a minimum of once during nighttime hours during the work week, and periodically throughout the day, the Traffic Control Technician shall inspect the construction work site. The Traffic Control Technician shall ensure that all construction signs and barricades are standing upright in accordance with the approved traffic control plan, free of dirt and debris and visible to intended traffic. At the end of the workday all non-essential traffic control devices will be removed. The Traffic Control Technician shall also inspect the construction work site at least once during weekends. The Contractor shall immediately correct deficiencies noted by the Engineer. The Contractor shall provide an after-hours pager and telephone number for the Traffic Control Technician at the pre-construction meeting.

401.4.3 Intersection Restriction: Off-duty uniformed police officers are required at all signalized intersections when restrictions are present, and may be required at other locations as requested by the Engineer. Any work performed in the right of way within 300 feet of signalized intersections and intersections formed by two multilane roadways shall require an off-duty uniformed police officer.

401.4.4 Traffic Control Devices: The Contractor shall provide and maintain all necessary traffic control devices until acceptance of the project by the County.

Pavement markings used as an integral part of the traffic control plan shall be kept distinct and visible during their use. Temporary pavement markings shall match and meet the markings in place at both ends of their usage.

401.4.5 Flaggers: All flaggers shall be properly trained and certified by a recognized source, such as the American Traffic Safety Services Association (ATSSA) or the International Municipal Signal Association (IMSA) and shall carry with them at all times a current certification as proof that all training requirements have been completed.

401.4.6 Failure to Provide Adequate Traffic Control Measures: If the Contractor fails to provide adequate traffic control measures, the Engineer may have the work accomplished by other sources. The cost of having this work accomplished by other sources will be computed in accordance with Section 109.5. The total cost will be deducted from monies due or to become due to the Contractor.

401.5 GENERAL TRAFFIC REGULATIONS, add the following:

The Sheriff's Department shall be provided with the name and phone number of the person responsible for 24-hour maintenance of all traffic control devices.

The Contractor shall notify all affected emergency services such as fire departments, police stations, and emergency management system by handbill a maximum of 48 hours and minimum of 24 hours in advance of any street restrictions.

401.5.1 Road Closure and Road Restrictions: A road closure for the convenience of the Contractor is not authorized. Traffic restrictions are not permitted on arterial or collector streets during peak traffic hours of 6:00 a.m. to 8:30 a.m. and 4:00 p.m. to 7:00 p.m. unless authorized by the traffic or project engineer or their designated representatives.

401.5.2 Minimum Lane Requirements: At signalized intersections, during peak hours, four lanes shall be open on roads with five or more lanes, and three lanes shall be open on roads with four or less lanes with a center lane. During off-peak traffic hours, the minimum number of lanes shall be two lanes (one in each direction) on streets with four lanes or less, and four lanes (two lanes in each direction on streets with five or more lanes).

401.5.3 Temporary Lane Diversions: For construction or trenching that requires movement of traffic from the normal travel lanes, temporary lane diversions may be used only during daylight hours and the normal traffic lanes shall be restored prior to the end of daylight hours. Traffic plates and temporary pavement shall be used to restore traffic lanes. The Engineer, under unusual conditions, may authorize exceptions.

401.5.4 Regulatory Speed Limit Signs: An appropriate regulatory speed limit sign shall be used where traffic is maintained on temporary detour roads, diversions, or on traffic lanes that are severely restricted.

401.5.5 Access to Adjacent Property: Access to all adjacent properties shall be maintained whenever possible. When access cannot be maintained, Contractor shall notify the adjacent residents at least two working days in advance of the access closure. In no case shall the access be closed for more than four hours. Access to fire stations, hospitals, sheriff stations and schools shall be maintained at all times.

401.5.6 Signal Equipment Repair: If existing signal equipment is damaged the Contractor shall notify the County Traffic Signals Branch Manager at (602) 506-8660, in order to facilitate the prompt restoration of the traffic signal operation. All costs associated with the repair of damaged traffic signals, caused by Contractor construction activity, shall be borne by the Contractor.

401.5.7 Temporary Longitudinal Traffic Barriers / Steel Plating: Open excavations and trenches within 10 feet of an active traffic lane shall be protected at night and during

non-working hours from vehicle traffic by steel plating or the use of temporary longitudinal traffic barriers complying with requirements of section 401.2.3. Open excavations as may occur with reinforced concrete box culvert construction and other work shall require temporary longitudinal traffic barriers to separate vehicle traffic from the work site. The Contractor shall use temporary longitudinal traffic barriers when construction hazards warrant, or as requested by the Engineer. Impact attenuation devices shall be provided by the Contractor commensurate with barrier end treatment requirements.

401.6 MEASUREMENT:

Section 401.6 is replaced with the following:

Measurement for Traffic Control shall be made on a Lump Sum basis. This lump sum measurement shall include all materials, equipment and labor necessary to facilitate traffic control per the contract documents. Traffic Control includes but is not limited to the application and removal of temporary pavement markings including related modification of existing pavement markings, pilot cars, flagmen, barricades, sign panels, sign stands, warning lights, and related temporary pavements.

No direct measurement of individual traffic control elements or devices will be made. All traffic control devices, unless otherwise noted, shall be considered as included in the lump sum measurement for the Traffic Control pay item.

No direct measurement for temporary pavements will be made. All sawcutting, grading, aggregate base course materials, asphaltic concrete pavement, labor, and equipment shall be considered as included in the lump sum measurement for the Traffic Control pay item.

No direct measurement for removal of temporary pavements will be made. All sawcutting, and removal of aggregate base course materials and asphaltic concrete pavement shall be considered as included in the lump sum measurement for the Traffic Control pay item.

Uniformed Off-duty Law Enforcement Officers including vehicle and equipment will be measured by the hour for each hour required to perform traffic control duties. When an officer is used less than the agency's minimum number of hours and the Contractor is charged for the agency's minimum number of hours, the minimum hours charged will be approved for payment. Time over the agency's minimum number of hours will be measured by the hour.

When included as a separate pay item within the fee schedule, Portable Concrete Barrier shall be measured by the foot. Otherwise, portable concrete barrier shall not be measured and shall be considered a traffic control device.

401.7 PAYMENT:

Section 401.7 is replaced with the following:

Payment for Traffic Control other than Uniformed Off-duty Law Enforcement Officers shall be made at the lump sum contract price in equal payments distributed over the entire duration of the project. Payment for Traffic Control shall be full compensation for all labor, pilot cars, flagmen, materials, traffic control devices, and miscellaneous items necessary to complete the work.

Payment for Uniformed Off-Duty Officer will be based on approved time sheets or invoices for all actual hours Contractor provided a Uniformed Off-Duty Law Enforcement Officer for traffic control purposes at the request and with the approval of the County. Expenses, eligible for reimbursement, are labor costs, supported by approved time sheets or invoices and directly related documented expenses such as taxes, bond cost charges to Contractor in connection with the Uniformed Off-Duty Law Enforcement Officer assignment, and special jurisdictional requirements. No additional mark-up for profit and/or fee for Contractor will be eligible for reimbursement.

Separate payment for Portable Concrete Barrier will only be made when Portable Concrete Barrier is included as a separate pay item within the fee schedule. Payment will be full compensation for the furnishing, transportation, installation, adjustment, maintenance, and removal of the temporary barrier system.

SECTION 405

SURVEY MONUMENTS

405.5 PAYMENT, add the following:

For Maricopa County Department of Transportation contracted work the preparation and recording of required corner records or results of survey will be accomplished by MCDOT unless noted otherwise in the project Special Provisions.

SECTION 415

FLEXIBLE METAL GUARDRAIL

415.2 MATERIALS, add the following:

Corten guardrail shall conform to AASHTO M 180, Type IV, Class B with ASTM A588 steel.

Part 400 add the following new Section:

SECTION 416

GUARDRAIL END TREATMENTS

416.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials and constructing new guardrail end treatments at the locations shown on the project plans and in accordance with specified details and the requirements of these specifications.

This work shall also include all the work and materials to delineate guardrail end treatments.

416.2 MATERIALS:

End treatment materials shall conform to Section 415.2 Materials. Adhesive materials for applying reflective sheeting to guardrail terminals shall be in accordance with the sheeting manufacturer's recommendations.

All guardrail terminal sections and guardrail transition sections shall be NCHRP 350 Test Level 3 compliant or compliant with an equivalent test level of the AASHTO Manual for Assessing Safety Hardware (MASH) and have a published acceptance letter by the Federal Highway Administration. Guardrail terminal sections compliant with test level 2 may be used when specifically approved for a specific location by the MCDOT Traffic Engineer or authorized representative. Manufacturer's specifications and installation instructions for guardrail end treatments shall be submitted to the Engineer when requested.

Guardrail leading approach terminals subject to head-on impact shall be tangential energy absorbing terminals listed on the MCDOT Approved Materials List. The MCDOT Approved Materials List is available on the MCDOT website:

<http://www.mcdot.maricopa.gov/technical/home.htm>.

All materials shall be new except as otherwise indicated by the contract specifications or plans.

416.3 CONSTRUCTION:

The construction of the various types or lengths of guardrail end treatments shall include the assembly and erection of all component parts, complete in place in accordance with the manufacturer's specifications and installation instructions at the locations shown on the project plans or as requested by the Engineer. Manufacturer's specifications and installation instructions shall be available at the worksite during installation and inspection.

Workmanship shall be equivalent to good commercial practice and all edges; bolt holes and surfaces shall be free of torn metal, burrs, sharp edges and protrusions.

Foundation tubes shall be installed with an approved driving head. The tubes shall not be driven with the wood post in place. If approved by the Engineer, foundation tubes may also be installed in drilled holes. When foundation tubes are placed in drilled holes, the space around and under the tubes shall be backfilled with ½ sack CLSM or backfilled with selected earth, free of rock, placed in layers approximately 4-inches thick and each layer shall be moistened and thoroughly compacted to the density of the surrounding soil.

Foundation tubes shall not protrude more than 4-inches above the ground as measured along a 5-foot cord.

Damaged components of end treatments shall be repaired or replaced immediately.

416.3.1 Approach Terminals: Guardrail leading approach terminals shall be installed at the locations shown on the project plans and in compliance with the manufacturer's details.

The approach surface in front of all guardrail terminals shall be leveled as shown on the project plans and MCDOT Standard Details. The approach surface slope shall not exceed 1:10 (vertical:horizontal).

A MASH compliant Midwest Guardrail System tangential approach terminal may be connected to a 28" high strong post W-beam system provided an approved 31" to 28" guardrail transition is installed between the two guardrail systems.

416.3.2 Delineation: Delineation for end terminals shall consist of one reflector tab installed at each W-beam splice. The reflector tab shall face approaching traffic of the adjacent traffic lane and be installed at a splice bolt on the top of the bottom rib of the W-beam at every odd numbered post starting at post number three. Reflector tabs shall conform to Section 415.2 requirements.

416.3.3 Departure End Terminals: Installation of departure end terminals shall conform to MCDOT Standard Detail 3007.

416.4 MEASUREMENT

416.4.1 Approach Terminals: Accepted installations of guardrail approach terminals will be measured as a unit for each type and length furnished and installed, complete in place, including but not limited to guardrail impact head, ground strut, anchor assembly, steel tubes, posts, steel w-beam, hardware, delineation, excavation, backfill, and disposal of surplus material.

Delineation is considered part of the installation of guardrail end terminals and will not be measured.

416.4.2 Departure End Terminals: Accepted installations of departure end terminals will be measured as a unit, complete in place, including but not limited to excavation, backfill, and disposal of surplus material.

416.5 PAYMENT:

416.5.1 Approach Terminals: The accepted quantities of guardrail approach terminals will be paid for at the contract unit price.

416.5.2 Departure End Terminals: The accepted quantities of departure end terminals will be paid for at the contract unit price.

Part 400 add the following new Section:

SECTION 417

CRASH CUSHIONS

417.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials and installing new crash cushions or impact attenuators at the locations shown on the project plans in accordance with these specifications.

417.2 MATERIALS:

All impact attenuation devices and transition components shall be TRACC™ Crash Cushions as supplied by Trinity Highway Products, LLC, 2525 North Stemmons Freeway, Dallas Texas, 75207 unless otherwise approved by the Engineer. Manufacturer's specification and installation instructions shall be submitted to the Engineer for approval and shall be available at the worksite during installation and inspection. All TRACC systems shall include a reinforced concrete pad foundation in compliance with the manufacture's specifications.

417.3 CONSTRUCTION:

The construction of crash cushions shall include the construction and assembly of all component parts complete at the locations shown on the project plans and in compliance with the manufacturer's details. For assembly and installation details contact Trinity Highway Products, LLC 1-800-722-7976.

417.4 MEASUREMENT:

Measurement for crash cushions will be for each type of unit installed and accepted by the Engineer.

417.5 PAYMENT:

Payment for crash cushions will be for furnishing and installing each type, complete in place including any required foundation, transition, and delineation.

SECTION 430

LANDSCAPING AND PLANTING

430.1 DESCRIPTION, add the following:

The work under this section includes relocation of native plants.

430.2 GENERAL, add the following:

Native plant relocation work shall be performed by an Arizona licensed landscape contractor in good standing and must have a minimum of three years of previous satisfactory experience in relocating native plants similar to those identified on the project plans.

The Contractor shall submit a transplanting Plan to the Engineer for review and approval prior to the beginning of any ground breaking work by the Contractor. The Transplanting Plan shall address requirements for each type of native plant identified for relocation and contain but not be limited to the following:

1. Method for coordinating the transplanting with construction sequencing.
2. List of mechanical and hand equipment to be used to accomplish all work.
3. A description of the removal, transplanting procedures and transporting methods.
4. A watering plan to identify how the plants will be watered from the initiation of the transplanting activities through the end of the construction contract.

Plant orientation, plant supporting requirements and methods, the locating, exposing and protection of various root types and acceptable root lengths required for removal, receiving pit excavation requirements, and treatment for root cuts and other plant wounds shall be addressed in the Transplanting Plan within the section on removal, transplanting procedures and transporting methods.

430.5 TREE SHRUB AND GROUND COVER PLANTING, add the following:

430.5.7 Water Truck Irrigation:

When trees, shrubs, and groundcover are planted, they shall immediately be started on an irrigation schedule. All trees, shrubs, and groundcover shall receive ½" of water weekly. The water is to broadcast evenly by a 2200 gallon water truck with a wand. All cacti and hydro seeded areas are to be omitted from the irrigation schedule. The Contractor is responsible for irrigating the above mentioned plant material for a period of no less then (6) six months after the start of the maintenance period. Watering truck shall place a "Watering in Progress" warning sign a minimum of 400 ft. away and a maximum of 2,000 ft. away from the watering truck. There shall be a "Watering in Progress" sign placed at the beginning of that day's work area. Cones shall be used to divert traffic away from the lane the watering truck occupies.

430.5.8 Hydro Seeding:

The Contractor shall hydro seed the areas indicated by the plans or special provisions. When native hydro seeding is required the Contractor shall hydro seed all unpaved areas disturbed by construction not stabilized by other means. Section 430.9 Plant Establishment Period shall not apply to hydro seeded areas; the Contractor shall maintain all hydro seeded areas until project completion and acceptance.

Water truck irrigation shall not be used for hydro seeded areas.

430.5.8.1 Seed Mixture:

Hydro seeding will use native seed mix of table 430-1 unless otherwise directed by the project special provisions.

Table 430-1 Native Seed Mix for Areas Adjacent to Roadways (Within Designated Clear Zones)		
Common Name	Scientific Name	Pure Live Seed Pounds Per Acre
Brittle Bush	<i>Encelia farinosa</i>	4.0
Creosote Bush	<i>Larrea tridentata</i>	8.0
Globe Mallow	<i>Sphaeralcea ambigua</i>	3.0
Indian Wheat	<i>Plantago insulariss</i>	2.0
Purple Three-Awn	<i>Aristida purpurea</i>	2.0
Desert Marigold	<i>Baileya multiradiata</i>	1.5
TOTAL Seed Mixture		20.5

The seed mixture shall consist of all the listed varieties proportioned to obtain the indicated coverage for each variety. Seed mixture substitution requests shall comply with Section 430.5.1 Substitutions.

Seed source shall be from elevations below 3,000 feet.

Deliver in sealed undamaged containers labeled in accordance with Arizona Revised Statutes and the U.S. Department of Agriculture regulations under the Federal Seed Act. Labels shall indicate the variety of strain of seed, the percentage of germination, purity and weed content, and the date of analysis which shall not be more than nine months prior to the delivery date.

Deliver seed packaged with identification of mixtures, weights, analysis and source.

Weed content shall not exceed 0.5%.

Protect from moisture, heat and sunlight until application.

Seed that has become wet, moldy, or otherwise contaminated or damaged is not acceptable.

430.5.8.2 Application of Seed and Seeding Materials:

The seed mixture shall be mixed thoroughly and spread evenly throughout the area to be treated. Seed shall be broadcast at the rate shown in the seed mixture table. Application rates of seed as specified are for pure live seed (PLS). Do not soak seed in hydro seeder tank for more than 20 minutes before application.

Straw mulch shall be used as the primary mulch cover, applied evenly at a rate of 1.5-2.5 tons per acre. Clumps and accumulations of straw must be loosened and evenly spread. It shall be placed within 48 hours of seeding and immediately affixed by crimping and/or tacking. The affixing shall consist of pure mucilage at a rate of 150 lbs. per acre tackifier and 500 lbs. per acre cellulose fiber.

Straw shall be from oats, rye, wheat, or other grain-type crop. It shall be clean and free from invasive weeds, mold and other objectionable materials. It shall initially be in a dry condition suitable for spreading.

Cellulose fiber mulch at 200 lbs per acre for slopes up to 1:3 (Vert:Horz), 600 lbs. per acre for slopes greater than 1:3, and 1000 lbs. per acre for extremely erosive/steep slopes.

Cellulose fiber mulch shall consist of at least 70% specially prepared virgin wood cellulose fiber and processed specifically for use as hydro mulch.

Tackifier/Binder: Pure mucilage tackifier shall be added at 50 lbs. per acre for slopes up to 1:3 (Vert:Horz), and 80 lbs. per acre for slopes greater than 1:3.

Chemical fertilizer: Ammonium phosphate (16-20-0) standard commercial grade, suitable for application with standard equipment shall be applied at the rate of 300 lbs. per acre. Ammonium phosphate shall have the minimum analysis and in the physical form of 16-20-0. The first number shall represent minimum percent soluble nitrogen; the second, the minimum percent available phosphoric acid; and the third, the minimum percent water soluble potash. Furnish in sealed containers labeled with name, weight and guaranteed analysis of contents.

Seeding equipment: Standard grass seeding equipment with double disk openers, disk bands, packer wheels or drag chains, rate control adjustments, seed boxes with agitators, and separate boxes for small seed.

430.5.9 Native Plant Relocations:

Native plant relocation activities shall comply with the approved Transplanting Plan. Native plant relocations not in compliance with the Transplanting Plan shall be subject to rejection by the Engineer.

430.10 MEASUREMENT AND PAYMENT, add the following:

Relocated native plants will be measured by the number and types of plants relocated in accordance with the approved transplanting plan and accepted by the Engineer. Payment will be at the contract unit price established in the proposal. The contract unit price shall be full compensation for furnishing the Transplanting Plan together with all labor, material, tools, and equipment and for performing all work necessary for native plant relocation, complete in place.

Hydro seeding will be measured in acres to the nearest one hundredth of an acre. Payment will be at the contract unit price established in the proposal.

Part 400 add the following new Section:

SECTION 432

GRAVEL MULCH

432.1 DESCRIPTION:

The work consists of the preparation of subgrade, placement and water settlement of gravel mulch to the lines and grades shown on the plans.

432.2 MATERIALS:

Gravel and crushed rock shall meet the requirements of Section 701.

Gravel mulch shall consist of a combination of crushed rock and gravel free of debris, fines and soil particles. A minimum of 50 percent by weight shall be crushed rock. Crushed rock shall have at least three fractured faces. A sample of the gravel mulch must be approved by the engineer prior to delivery to the site.

Material durability of gravel mulch shall be tested in accordance with ASTM C535. The percentage of wear shall not exceed 40 after 500 revolutions.

The gradation shall be within the following limits when tested in accordance with ASTM C136:

Sieve Size	Percentage by Weight Passing Sieve
3-inch	100
2-inch	25-60
1½-inch	0-15
1-inch	0

432.3 CONSTRUCTION:

432.3.1 Subgrade Preparation: The subgrade surfaces shall conform to the neat lines and grades indicated by the plans. The prepared subgrade surface shall be a loose roughened surface that will keep the gravel mulch in place. This is the normal surface resulting from tillage operations.

The area designated for gravel mulch shall have surface vegetation removed [as directed by the Engineer](#), and the soil loosened. Motorized equipment shall be used where it can be safely operated (generally slopes 3.5:1 or flatter). Areas where equipment cannot safely operate shall be hand-tilled. Rocks larger than 3 inches in diameter, trash, weeds, and other debris shall be removed.

Subgrade preparation shall be discontinued when soil moisture conditions are not suitable for the preparation of a satisfactory subgrade as determined by the Engineer.

Gravel mulch shall not be placed until the subgrade surfaces of both equipment and hand-tilled areas have been inspected and approved by the Engineer.

432.3.2 Placement: Gravel mulch shall only be placed on approved surfaces. The gravel mulch shall be delivered and placed in a manner that will ensure the in-place layer remains reasonably homogeneous. The mulch shall be constructed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials. Hand placing of gravel mulch shall be required to the extent necessary to prevent damage to permanent works. The average thickness of the gravel mulch shall be 3 inches. In no case shall the thickness of the gravel mulch layer be less than 2.5 inches.

The gravel mulch shall be hand raked and smoothed to the satisfaction of the Engineer prior to water spray settling. The application of a uniform spray of water shall be at a rate not exceeding the infiltration rate of the underlying soils to minimize run off. All sprinkling equipment shall be equipped with pressure pumps and spray bars. The use of gravity flow spray bars and splash plates will not be permitted.

432.4 PAYMENT:

Payment for gravel mulch shall be at the contract unit price per square yard. Payment shall be considered full compensation for the item complete-in-place including all labor, materials, equipment, and all other items necessary and incidental to the placement of the gravel mulch. No separate payment will be made for water spray settling.

Part 400 add the following new Section:

SECTION 460

REMOVAL OF PAVEMENT MARKINGS AND RAISED PAVEMENT MARKERS

460.1 DESCRIPTION:

The Contractor shall furnish experienced supervision, labor, all materials, equipment, tools, transportation and supplies required accomplish the pavement marking removal in accordance with these specifications, where indicated on the Striping Plans, or where determined by the Engineer.

460.2 CONSTRUCTION:

| The Contractor shall determine the type of pavement markings that exist in the field.

Existing traffic pavement markings shall not be covered over with slurry seal, black paint or stain of any kind.

The Contractor shall accomplish pavement marking removal as indicated by the construction documents, when a specific method is not indicated removal may be by any option identified herein. The Contractor shall be responsible for verifying the striping removal limits of the project before commencement of the work. The striping removal limits may exceed the construction project limits, or new striping limits in order to match and tie into the existing striping.

Existing pavement markings shall be removed to the fullest extent possible from the pavement by one of the methods identified in this Section, unless another method is approved by the Engineer. The method used shall not materially damage the surface or texture of the pavement.

Material deposited on the pavement as a result of removing pavement markings shall be collected and removed as the work progresses. Accumulations of material, which might interfere with drainage or might constitute adverse safety conditions to traffic, will not be permitted.

Where blast cleaning is used for the removal of pavement markings or for removal of objectionable material, the residue produced shall be removed immediately after contact between the blast material and the surface being treated. Such removal shall be by a vacuum attachment operating concurrently with the blast cleaning operation, or by other methods approved by the Engineer. Blasting shall not be used within 12 ft. of a lane occupied by traffic.

Where grinding is used for the removal of pavement markings or for removal of objectionable material, the residue produced shall be removed immediately after contact

of the grinding heads with the surface being ground. Such removal shall be by a vacuum attachment operating concurrently with the grinding operation, or by other methods approved by the Engineer.

Removed pavement markers and debris resulting from removed markings shall be collected and disposed of by the Contractor.

Any damage to the pavement caused by pavement marking removal shall be repaired by methods acceptable to the Engineer. When asphalt slurry is used to repair damage to the pavement caused by pavement marking removal or the obliteration of the marks remaining after the markings have been removed, the asphalt slurry shall be placed parallel to the new direction of travel and shall not be less than two feet in width.

460.2.1 Approved Methods of Removal: The following methods have been approved by the County for the removal of traffic paint, thermoplastic markings, Type 1 (Permanent) preformed plastic tape, raised pavement markers and barrier/guardrail markers.

460.2.1.1 Traffic Paint:

(1) Water blasting

(2) Chip Seal: When using this method, the entire roadway surface, edge of asphalt to edge of asphalt, shall be covered.

(3) Asphalt Overlay: The asphalt overlay thickness and dimensions shall meet County specifications.

460.2.1.2 Thermoplastic:

(1) Water blasting

(2) Grinding followed by water blasting.

(3) Milling is an option only for areas to receive an asphalt overlay.

460.2.1.3 Type I - Preformed Plastic Pavement Marking Tape:

(1) Grinding

(2) Chip Seal: The application of this method depends on the length of time the Tape has been on the roadway surface. The use of a chip seal before grinding is at the discretion of Contractor. If the chip seal does not adhere to the existing tape markings, Contractor shall grind off the tape markings and chip seal over the exposed area. All costs for this work shall be borne by the Contractor.

When applying chip seal, the entire roadway surface, edge of asphalt to edge of asphalt, shall be covered

Chip seal shall not be applied to a portland cement surface

(3) Asphalt Overlay: The asphalt overlay thickness and dimensions shall meet the County specifications

460.2.1.4 Raised Pavement Markers:

(1) Hammer and Chisel

(2) Blade (Use of Heavy Duty Equipment)

460.2.1.5 Barrier Markers for Bridges, Concrete and Guardrail:

(1) Hammer and Chisel

460.3 MEASUREMENT:

Measurement for removing painted stripe, removing thermoplastic stripe and Type 1 – preformed plastic marking tape will be by the linear foot along the centerline of the pavement stripe to be removed. Skips in dashed lines will not be included in the measurement. Measurement for removing striping with a plan width greater or less than the basic 4” wide stripe will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Linear Foot}}{4.0 \text{ (inches)}}$$

Double marking lines, consisting of two 4” wide stripes will be measured as two individual marking lines. Crosswalk lines, stop bars, stop lines, gore lines, cross hatch lines, and chevron lines will be measured for centerline length and adjusted for widths other than 4” as defined above.

Thermoplastic pavement symbols and legends will be measured by each symbol or legend removed.

Removal of thermoplastic or painted markings located on surfaces to be removed shall not be measured.

Measurement for the removal of raised pavement markers and barrier markers for bridges, concrete, and guardrail will be by the unit for each marker removed.

460.4 PAYMENT:

Payment for Removing Painted Stripe will be at the unit contract price per linear foot for the length of painted line removed to the nearest foot.

Payment for Removing Painted Symbols and Removing Painted Legends will be for each symbol or legend removed.

Payment for Removing Thermoplastic Stripe and Removing Type 1 – Preformed Plastic Marking Tape will be per linear foot of striping removed.

Payment for Removing Thermoplastic Symbols and Removing Thermoplastic Legends will be for each symbol or legend removed.

Payment for Removing Raised Pavement Markers and for Removing Barrier Markers for Bridges, Concrete and Guardrail will be per each marker removed.

All damage to the surface of the road caused by pavement marking removal shall be repaired by the Contractor at his expense.

Part 400 add the following new Section:

SECTION 461

PAINTED PAVEMENT MARKINGS

461.1 DESCRIPTION:

The work under this section shall consist of cleaning and preparing the pavement surface, furnishing all materials, experienced supervision, labor, equipment, tools, transportation, supplies and applying white or yellow, water-borne, lead-free, rapid-dry traffic paint and reflective glass beads at the locations and in accordance with the details shown on the plans, MUTCD, the requirements of these specifications, or where determined by the Engineer.

461.2 MATERIALS:

461.2.1 Pavement Marking Paint:

(A) General: All material used in the formulation of the pavement marking paint shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of the Engineer.

Certificates of Compliance conforming to the requirements of Arizona State Department of Transportation (ADOT) Standard Specifications for Road and Bridge

Construction 2008 edition, section 106.05 shall be submitted for each lot or batch of paint prior to its use. A Certificate of Analysis conforming to ADOT Standard Specifications for Road and Bridge Construction 2008 edition, section 106.05 for the heavy metal concentration in glass beads shall be furnished to the Engineer prior to their use.

(B) Composition Requirements: The pavement marking paint shall be a ready-mixed, one component, water-borne lead-free traffic line paint, of the correct color, to be applied to either asphaltic or portland cement concrete pavement. The composition of the paint shall be a cross link polymer emulsion equivalent to or better than PervoPlastic™ 6050 Series, acceptability of proposed equivalency to be determined by the Engineer. The marking paint shall be a pigmented water-borne paint containing all the necessary co-solvents, dispersant, wetting agents, preservatives and all other additives, so that the paint shall retain its viscosity, stability and all of the properties as specified herein. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, toluene, chlorinated solvents, hydrolyzable chlorine derivatives, ethylene-based glycol ethers and their acetates, and not any carcinogen, as defined in 29 CFR 1910.1200. Lead content shall not exceed 0.06 percent of weight of the dry film, and the test for chromium content shall be negative.

No glass beads will be allowed in the pavement marking paint. Glass beads will be applied after the paint has been applied.

(C) Manufacturing Formulations: The manufacturer shall formulate the pavement marking paint in a consistent manner and notify the Engineer of any change of formulation. The formulation of the paint shall be determined by the manufacturer. It will be the manufacturer's responsibility to formulate paint which will meet the quantitative and qualitative requirements of this specification. Any change in the formulation of the paint must be approved by the Engineer.

(D) Quantitative Requirements of Mixed Paints:

	White	Yellow
Pigment: percent by weight, ASTM D3723, allowable variation from qualifying sample	± 2.0	± 2.0
Non-volatile Content: percent by weight, ASTM D2369, allowable variation from qualifying sample	± 2.0	± 2.0
Viscosity: Krebs Units at 77° ± 1°F, ASTM D562	80 - 95	80 - 95

	White	Yellow
Weight per Gallon pounds per gallon at 77° ± 1°F, ASTM D1475, allowable variation from qualifying sample	± 0.3	± 0.3
Vehicle Composition: Vehicle Infrared Spectra, ASTM D2621, allowable variation from qualifying sample	None	None
pH: ASTM E70, allowable variation from qualifying sample	± 1.0	± 1.0
Fineness of Dispersion: HEGMAN, minimum, ASTM D1210	3.0	3.0
Volatile Organic Compounds: pounds per gallon of paint, maximum, ASTM D3960 according to 7.1.2.	2.1	2.1
Flash Point: °F, minimum, ASTM D93, Method A	100	100
Dry Time to No Pick Up: with no beads, minutes, maximum ASTM D711	10	10
Dry Through Time: minutes, ASTM D1640 except no thumb pressure is used when thumb is rotated 90 degrees on paint film	20	20
Flexibility: TT-P-1952D	Pass	Pass

(E) Qualitative Requirements:

(1) Color of Yellow Paint: The color of the yellow paint shall closely match Federal Standard 595b, Color No. 33538. The color shall be checked visually, and will be checked against Tristimulus Values for the color according to Federal Test Method Standard No. 141.

(2) Dry Opacity: Dry opacity for the paint will be determined using a black-white Leneta Chart, Form 2C Opacity and a Photovolt 577 Reflectance Meter or equal. Using a 10-mil gap doctor blade, a film of paint is drawn down, covering both black and white portions of the chart. The film shall be allowed to dry 24 hours. After calibrating the Reflectance Meter according to the manufacturer's instructions, measure the reflectance over the white and black portions with the green Tristimulus filter. Dry Opacity is calculated as follows:

$$\text{Dry Opacity} = \frac{\text{Reflectance over black}}{\text{Reflectance over white}}$$

Dry Opacity for both white and yellow paint shall be a minimum 0.90.

(3) Yellowness Index: Yellowness Index for white paint will be determined as described for dry opacity, only use a 15-mil gap doctor blade to draw down the paint. After 24 hours for drying, measure the reflectance of the paint film, using the green, blue, and amber Tristimulus filters. Calculate the Yellowness Index as follows:

$$\text{Yellowness Index} = \frac{\text{Amber} - \text{Blue}}{\text{Green}} \times 100$$

Yellowness Index for the white paint shall be a maximum of 10.

(4) Reflectance: Reflectance for both white and yellow paint will be determined using the same 15-mil drawdown film as for the Yellowness Index. For white paint the same sample may be used for both the Yellowness Index and Reflectance. Measure the reflectance of the paint film using the green Tristimulus filter. Reflectance for the white paint shall be a minimum of 85. Reflectance for the yellow paint may range from 42 to 59, inclusive.

(5) UV Color Durability: UV Color Durability shall be determined using a QUV Weatherometer, with Ultra Violet Light and Condensate Exposure according to ASTM G53, for 300 hours total. The repeating cycle shall be four hours UV exposure at 60 °C followed by four hours condensate exposure at 40 °C. After 300 hours of exposure, the Yellowness Index for white paint shall not exceed 12, and yellow paint must still match Federal Standard 595b, Color No. 33538.

(6) Static Heat Stability: To determine static heat stability for the paint, place one pint of paint in a sealed can and heat in an air circulation oven at 120° ±1° F for a period of one week. Remove the paint from the oven and check the viscosity in Krebs Units at 77° ±1° F according to ASTM D562. The viscosity measured must be in the range from 68 to 90, inclusive. Also, check for any signs of instability.

(7) Heat-Shear Stability: To determine heat-shear stability for the paint, one pint of the paint is sheared in a Waring Blender at high speed to 150° F. The blender should have a tight fitting lid taped onto it to minimize volatile loss. When the paint reaches 150° F, stop the blender, immediately pour the paint into a sample can, and apply a cover to seal the can. Let the paint cool overnight and examine for jelling or other signs of instability. Measure viscosity in Krebs Units at 77° ±1° F according to ASTM D562. The viscosity measured must be in the range from 68 to 95 inclusive. If not within the upper limit, run total solids on the sheared paint and adjust solids, if necessary, by adding water to reach the original solids content. If the solids content

required adjustment, again check the viscosity of the paint. The viscosity must be in the range from 68 to 95 inclusive.

(8) Scrub Resistance: Scrub Resistance will be determined according to ASTM D2486. Use an appropriate doctor blade to provide a dry film thickness of 3 to 4 mils. Allow the paint to cure for 24 hours. Perform the scrub resistance test at $77^{\circ} \pm 1^{\circ}$ F and $50 \pm$ five percent humidity. Record the number of cycles to remove the paint film. The number of cycles recorded must be a minimum of 800.

(9) Spraying Properties: The paint shall be applied at a 15-mil wet film thickness in the field. The paint shall show the following properties at ambient temperatures of 50° to 100° F with a paint spray temperature of 150° F, maximum, and 6 to 8 pounds of post-applied glass beads per gallon of paint. Beads shall conform to Section 461.2.2.

- (a) Dry to a no-track condition in five minutes or less when the line is crossed over in a passing maneuver with a standard-sized automobile.
- (b) Produce a clean-cut, smooth line with no overspray or puddling.
- (c) Paint immediately after application shall accept glass beads so that the spheres shall be embedded into the paint film to a depth of 50 percent of their diameter.
- (d) Paint when heated to the temperature necessary to obtain the specified dry time, shall show no evidence of instability such as viscosity increase, jelling, or poor spray application.

(10) Freeze-Thaw Properties: The paint viscosity or consistency shall not change significantly when the paint is tested for resistance to five cycles of freeze-thaw according to ASTM D2243.

(11) Road Service Rating: Test stripes of the paint shall be applied transversely across the road, 4" in width and approximately 12 ft. long at a location approved by the Engineer.

Wet film thickness of the test stripes shall be approximately 15-mils as determined according to ASTM D4414 and ASTM D713 prior to test stripe application. To aid in obtaining the correct film thickness, a length of roofing paper placed by the side of the road can be used. Place a rigid metal test panel on the roofing paper in the path of a test line. Immediately after the test line is applied by the striper, measure the wet film thickness. If not satisfactory, adjust the spray pressure and repeat until the target wet film thickness is attained. It is important that no glass beads be present that would give a false wet film thickness. When the wet film thickness is correct, apply a test line across a tarred metal test panel. After this, apply another test line across a different

tarred metal test panel, this time also adding the beads. These samples are necessary to determine the initial bead retention.

Glass beads conforming to the requirements of Section 461.2.2 shall be applied after the paint has been applied, but during the same striping operation at a rate such that the initial bead retention on the test line is a minimum of 6 pounds of beads per gallon of wet paint. The initial bead retention will be determined analytically by MCDOT concurrently with the determination of the dry paint thickness utilizing tarred metal test panels. The paint shall accept the glass beads so that the spheres are embedded into the paint film to a depth of 50 percent of their diameter. Test stripes will be observed for a period of 180 days from date of application. Paints will be evaluated for wear according to ASTM D913.

After 180 days of service, on a visual rating scale of 0 to 100 percent, paints must have a rating of 92 percent or better to be acceptable. All ratings will be taken in the wheel track area. Glass beads shall show no more than a 30 percent loss after 180 days of test. This will be determined by taking close-up photographs of the paint film and by count determining the average bead loss.

The road service test may be waived at the option of the Engineer or evaluated for a period of time less than 180 days.

(12) Workmanship: Paint shall be free from foreign materials, such as dirt, sand, fibers from bags, or other material capable of clogging screens, valves, pumps, and other equipment used in a paint striping apparatus.

The paint pigment shall be well ground and properly dispersed in the vehicle. The pigment shall not cake or thicken in the container, and shall not become granular or curdled. Any settlement of pigment in the paint shall result in a thoroughly wetted, soft mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sidewise manual motion of a paddle across the bottom of the container, to form a smooth uniform product of the proper consistency. If the paint cannot be easily redispersed, due to excessive pigment settlement as described above or due to any other cause, the paint shall be considered unfit for use.

The paint shall retain all specified properties under normal storage conditions for 12 months after acceptance and delivery. The Contractor shall be responsible for all costs and transportation charges incurred in replacing paint that is unfit for use. The properties of any replacement paint, as specified herein, shall remain satisfactory for eight months from the date of acceptance and delivery.

(F) Manufacturing Requirements:

(1) Inspection: The manufacturer of the paint shall advise the Engineer when paint is to be manufactured, shall furnish the Engineer free access to all parts of

the plant involved in the paint manufacture, and shall furnish every reasonable facility for sampling both the paint and the raw materials during the process of manufacturing.

All materials used in formulation shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of the Engineer.

All manufactured paint shall be prepared at the factory ready for application.

When paint is shipped to a distributor or paint applicator who will store the paint prior to its use, the distributor or paint applicator shall furnish the Engineer free access to all parts of the facility where paint is stored and shall furnish every reasonable facility for sampling the paint.

Paint shall normally be sampled at the place of storage either at a warehouse or on the site prior to application of the paint. Application of the paint will not be permitted until the paint has been approved by the Engineer. It is the Contractor's responsibility to notify the Engineer a minimum of 14 working days prior to any traffic painting operation and to allow access at that time for paint sampling at the storage location.

A minimum of one paint sample shall be obtained from each lot of paint.

Check-samples of finished paint while being applied will be taken at intervals as determined by the Engineer.

(2) Testing: All tests will be conducted in accordance with the latest test methods of the American Society for Testing and Materials, Federal Test Method Standard No. 141, and methods in use by the Materials Group, Highways Division, and the Arizona Department of Transportation as specified herein.

Evidence of adulteration or improper formulation shall be cause for rejection.

(3) Packaging: All shipping containers for paint must comply with the Department of Transportation Code of Federal Regulations, Hazardous Materials and Regulation Board, Reference 49 CFR. The container and lids must be lined with a suitable coating so as to prevent attack by the paint or by agents in the air space above the paint. The lining must not come off the container or lid as skins.

Containers shall be colored white, including lids, and containers shall have an identifying band of the appropriate color around and within the top one third of the container.

All containers shall be properly sealed with suitable gaskets, shall show no evidence of leakage, and shall remain in satisfactory condition for a period of 12 months after delivery to a distributor or paint applicator. The Contractor shall be responsible for all costs and transportation charges incurred in replacing paint and containers.

(4) Marking: All containers of paint shall be labeled showing the manufacturer's name, date of manufacture, paint color, product code, manufacturer's batch number, and quantity or weight of paint on both the side of the container and also the lid. Containers shall be clearly marked or labeled Rapid or Fast Dry lead-free Water-Borne Traffic Paints.

All containers of paint shall be labeled to indicate that the contents fully comply with all rules and regulations concerning air pollution control in the State of Arizona, Maricopa County.

The manufacturer of the paint shall be responsible for proper shipping labels with reference to whether the contents are toxic, corrosive, flammable, etc., as outlined in the U.S. Department of Transportation, Hazardous Materials Regulations, Reference 49 CFR.

(5) Unused Paint: Disposal of unused quantities of traffic paint shall be the responsibility of the Contractor and must meet all applicable Federal regulations for waste disposal. Paint which is saved to be used later shall be packaged as specified previously and shipped to a storage location. Unused paint must be identified on the container. Unused paint may be used on a future project provided the paint still conforms to all specifications contained herein.

461.2.2 Reflective Glass Beads (Spheres): The term "glass bead" shall be synonymous with the term "glass sphere" as used herein.

The beads shall be manufactured from glass of a composition designated to be highly resistant to traffic wear and to the effects of weathering.

The glass beads shall be moisture-proof; contain less than 0.25 percent moisture by weight; and be free of trash, dirt, or other deleterious materials.

Beads shall be essentially free of sharp angular particles showing milkiness or surface scoring or scratching. Beads shall be water white in color.

(A) Gradation: When tested by the method provided in ASTM D1214, the grade sizes of the beads shall be as follows:

Size of Sieve	Percent Passing
No. 30	100
No. 50	15 - 35
No. 70	0 - 15
No. 100	0 - 5

(B) Roundness: When tested by the method provided in ASTM D1155 Procedure B, beads retained on any screen specified in the gradation requirements shall contain a minimum of 75 percent true spheres.

(C) Index of Refraction: When tested by a liquid immersion method at a temperature of 25 °C, the beads shall have an index of refraction of 1.50 to 1.57.

(D) Specific Gravity: The specific gravity of the beads shall be in the range 2.40-2.60 when tested in accordance with the following procedures:

Place 100 grams in an oven at 110 °C for one hour.

Remove beads and place in a desiccator until the sample is cool.

Remove approximately 60 grams of beads from the desiccator and weigh the sample accurately.

Pour the beads slowly into a clean 100-milliliter graduated cylinder containing 50 milliliters of isopropyl alcohol. Make certain that air is not entrapped among the beads.

The total volume, minus 50, will give the volume of the beads.

Calculate the specific gravity as follows:

$$\text{Specific Gravity} = \frac{\text{Weight of the sample}}{\text{Volume of the sample}}$$

(E) Chemical Stability: Beads which show any tendency toward decomposition, including surface etching, when exposed to atmospheric conditions, moisture, dilute acids, or alkalis or paint film constituents, may be required to demonstrate satisfactory reflectance behavior, prior to acceptance, under such tests as may be prescribed.

(F) Heavy Metal Concentration: Heavy metal concentration in glass beads shall be as specified in the following table, when tested by an independent laboratory, approved by the Engineer, using EPA Method 3052 and EPA Method 6010B. A Certificate of Analysis shall be furnished to the Engineer prior to use.

Heavy Metal	Concentration
Arsenic	< 75 ppm
Antimony	< 75 ppm
Lead	< 100 ppm

(G) Moisture Proofing: All glass beads shall have a moisture-proof overlay consisting of water repellent material applied during the process of bead manufacture. The beads so treated shall not absorb moisture in storage and shall remain free of clusters and lumps and shall flow freely from dispensing and testing equipment.

The beads shall pass the test for water repellency and free flow using the following equipment:

(1) Test bag: The bag used is approximately 10½" by 17½" after sewing. The material used in the construction of the bag is unbleached cotton sheeting with a thread count of 48 by 48. The material before sewing is approximately 18" by 22". The cloth is folded in half lengthwise and stitched in the shape of an "L" with the short side left open at the top. The material can be obtained from selected manufacturers of cloth and paper packaging. The finished bag may also be obtained from the manufacturer of the glass beads.

Newly fabricated bags must be thoroughly washed with hot water and detergent and rinsed before use to remove the sizing which may be present in the cloth. Subsequent to the initial washing, the bags need only be rinsed clean of beads from previous tests and dried thoroughly before use.

(2) Funnel: The funnel used is a standard laboratory funnel with a top opening diameter of 125 millimeters and a 150-millimeter stem length. The inside diameter of the stem is between nine and 10 millimeters. This funnel is available from most laboratory glassware supply houses, Corning No. 6100 or equal.

(3) Ring Stand and Clamp.

(4) Balance accurate to 0.1 grams.

(5) Distilled water.

(H) MOISTURE TESTING PROCEDURE: Glass beads shall be tested for compliance with specification requirements. Testing shall be conducted at standard conditions of temperature ($25 \pm$ one degrees Celsius) and humidity ($50 \pm$ five percent Relative Humidity) and shall consist of the following procedure or an approved alternate:

Weigh 900.0 grams of glass beads into a clean, dry, flat-bottomed pan.

Dry beads at 150 °C for two hours.

Cool beads to room temperature ($25 \pm$ one degrees Celsius) in a desiccator.

Using the clean, pre-washed bag described under apparatus section, turn the bag inside out so that the sewn seam and seam-allowance are on the outside.

Quantitatively transfer the beads into the inverted cotton bag.

Grasp the gathered top of the bag with one hand and lower the bag into a container of distilled water until the beads are approximately 25 millimeters below

the water level. The container shall be of such dimensions that the bag does not contact the bottom or sides during immersion. Each bag shall be immersed individually. Do not allow one bag to contact another if multiple tests are run.

Remove the bag after 30 seconds of immersion time.

Cradle the bottom of the bag uniformly in the palm of one hand and twist the top neck of the bag until the twisted bag is compressed firmly against the beads. Twist until excess water no longer drips from the bag.

After the excess water has been squeezed from the bag, allow the bag to unwind.

Gather the top of the bag and clamp. Suspend the bag on a ring stand or other support such that the bottom or sides of bag do not contact the support.

After a standing time of two hours at room temperature ($25 \pm$ one degrees Celsius), remove bag from support. Mix sample thoroughly by holding the bottom seam allowance in one hand and gathered neck of the bag in the other, invert bag and shake up and down five times. Transfer the sample into a clean, dry funnel of the type described under apparatus. If consecutive tests are run, be sure the funnel is clean, dry and free of beads from prior tests.

The entire sample shall flow through the funnel without stoppage.

At the start of the test only, it is permissible to lightly tap the stem of the funnel to initiate flow.

Small quantities of beads which have adhered to the side of the funnel or stem shall not be cause for failure.

461.3 CONSTRUCTION

461.3.1 Equipment: The traffic paint and beads shall be placed on the pavement by a spray-type, self-propelled pavement marking machine except that temporary striping during construction may be placed with other equipment designed for application of paint and beads with the approval of the Engineer.

The application equipment to be used on roadway installation shall have, as a minimum, the following characteristic and/or apparatus:

The machine shall be capable of applying clear-cut lines of the width specified on the project plans.

The machines shall be equipped with a mechanical device capable of placing a broken reflectorized line with a 10 foot painted segment and a 30-foot gap.

The machine shall be equipped with an air-operated glass bead drop-in dispenser controlled by the spray gun mechanism.

A glass bead dispenser which is capable of placing the glass beads into the paint line as the paint is applied to the pavement shall be used. This dispenser shall provide satisfactory marking and delineation.

461.3.2 Application

(A) Pavement Surface: Pavement markings shall not be applied to any new asphalt pavement surface within the first 72 hours after pavement placement or after the placement of a surface treatment. Pavement markings shall be applied when the pavement surface is dry and the weather is not foggy, rainy, or otherwise adverse to the application of markings. The surface shall be free from excess asphalt or other deleterious substances before traffic paint, beads or primer are applied. The Contractor shall remove dirt, debris, grease, oil, rocks or chips from the pavement surface before applying markings. Any area that cannot otherwise be satisfactorily cleaned shall be scrubbed with a biodegradable chemical. The method of cleaning the pavement surface and removal of detrimental material is subject to approval by the Engineer and shall include sweeping and the use of high-pressure air spray.

(B) Temperature Conditions: Painting shall not be performed when the atmospheric temperature is below 50° F when using water-borne paint, nor when it can be anticipated that the atmospheric temperature will drop below said 50° F temperature during the drying period. Water-borne paints shall not be applied if rain is expected within one hour of its application, unless otherwise approved by the Engineer. Water-borne paint shall not be heated to a temperature greater than 150° F to accelerate drying.

(C) Placement Locations: The placing of traffic markings shall be done only by personnel who are experienced in this work. Pavement markings shall be positioned as defined on the plans and in the specifications. When it becomes necessary for proper installation, the Engineer may revise individual marking locations as necessary.

When the use of temporary chip seal pavement markers have been approved for use they shall be augmented by spot marks. Temporary chip seal pavement markers shall be collected and disposed of by the Contractor prior to the final inspection.

The Contractor shall spot mark the entire project at 10-foot intervals in conformance with the striping plans. Removal of existing pavement markings shall be completed prior to the spot marking. Upon completion of the spot marking, the Contractor shall notify the Engineer that the project is ready for inspection. County will conduct an inspection after the spot marking is completed, within three working days from notification of Contractor.

Approval of the spot marking shall not relieve the Contractor from obtaining a final inspection. Upon final inspection, if the Engineer decides that more than one coat is required, it will be done at the Contractor's expense.

The final striping inspection will be made by the Engineer within three working days after all pavement markings and markers have been installed.

The Striping in the field may exceed the construction project limits in order to match and/or tie into the existing striping. Contractor shall perform a field inspection and determine if the striping exceeds the construction project limits.

If a conflict exists between actual field conditions and the pavement marking plans, the Contractor shall cease work and notify the Engineer immediately.

(D) Paint Application: The Contractor shall provide the necessary personnel and equipment to divert traffic from the installation area where the work is in progress and during drying time when, in the opinion of the Engineer, such diversion of traffic is necessary.

The volume of paint in place shall be determined by measuring the paint tank with a calibrated rod. At the option of the Engineer, if the striping machine is equipped with air-atomized spray units (not airless) and paint gauges, the volume of paint may be determined by utilizing said gauges.

The quantity of glass reflectorizing beads in place shall be determined by measuring the glass reflectorizing bead tank with a calibrated rod.

The paint shall not bleed, curl, or discolor when being applied to the roadway surface. If bleeding, curling or discoloration occurs, the unsatisfactory areas shall be given additional coats of paint to correct the problem. In the event that the additional coats are not sufficient, the Engineer will determine what method of correction may be used. Such corrections will be at the Contractor's expense.

The paint shall not be applied over the decorative design in the median.

If a seal is required, sufficient drying time, minimum forty-eight (48) hours, shall be allowed before applying any pavement markings.

After the forty-eight (48) hour drying time has passed and the seal remains tacky, or excessive oil has risen to the roadway surface, a sand blotter shall be applied to absorb the excess oil. If the seal remains tacky, no pavement markings shall be applied.

If a sand blotter is applied after the installation of pavement markings, then all markings affected shall be removed and re-applied at the Contractor's expense.

(E) Tolerances for Placing Paint, Beads, and Primer: The length of painted segment and gap shall not vary more than 6 inches in a 40-foot cycle.

The finished line shall be smooth, aesthetically acceptable and free from undue waviness.

Painted lines shall be 4.0", 8.0", or 12.0" wide as shown on the plans with a tolerance of plus or minus 1/8 inch and shall be placed at a minimum rate of 16 gallons per mile for a solid 4.0 inch line and 4 gallons for a broken 4.0 inch line, based on a 10 foot stripe and a 30 foot gap (40 foot cycle).

New pavement striping shall not vary more than 1/2 inch in 50 feet from the striping plans. Existing pavement markings requiring re-stripe shall be re-striped to completely cover existing markings within 1/4 inch and be within a longitudinal tolerance of 6 inches at the beginning and at the end of each stripe.

Glass reflectorizing beads shall be applied on the wet paint at a minimum rate of 8 lbs. to each gallon of paint.

Wet thickness shall not be less than 15 mils, unless otherwise shown on the plans.

461.4 MEASUREMENT:

Pavement marking paint will be measured by the linear foot along the centerline of the pavement stripe. Skips in dashed lines will not be included in the measurement. Length of pavement markings will be based on 4-inch wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or requested by the Engineer will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Linear Feet}}{4 \text{ (inches)}}$$

Painted temporary striping installed in compliance with section 462.3.2(A) will be measured and included in the striping quantities.

Symbols, legends, painted medians, painted curbing, and painted islands will be measured by each unit applied. Each legend, regardless of the number of letters, will be considered as a single unit.

No separate measurement will be made for cleaning and preparing the pavement surface, including abrasive sweeping and high-pressure air spray. The cost of disposal of excess materials, cleaning fluids, and empty material containers, will be considered as included in contract items

461.5 PAYMENT:

Pavement striping of the type specified, measured as provided above, will be paid for at the contract price per linear foot for the total length of painted line applied to the nearest foot, which price shall be full compensation for the work complete, including cleaning and preparing the pavement surface and glass beads, as described and specified herein and on the project Plans.

Pavement symbols, legends, painted medians, painted curbing, and painted islands measured as provided above, will be paid for at the contract price for each painted symbol or legend, which price shall be full compensation for the work complete, including cleaning and preparing the pavement surface, and glass beads, as described and specified herein and on the project Plans.

Part 400 add the following new Section:

SECTION 462

THERMOPLASTIC PAVEMENT MARKINGS

462.1 DESCRIPTION:

The work under this section shall consist of cleaning and preparing pavement surfaces and furnishing and applying either white or yellow thermoplastic reflectorized pavement markings or approved preformed pavement markings.

Thermoplastic markings shall use hot sprayed reflectorized thermoplastic material. When approved by the Engineer preformed markings may be used for arrows, symbols, and legends. Screed or extrusion application of thermoplastic may be allowed, if approved by the Engineer, for short application work such may occur at intersections.

The Contractor shall furnish all materials, supervision, labor, equipment, tools, transportation and supplies required to complete the work according to the pavement marking plans, these specifications and the project special provisions.

462.2 MATERIALS:

462.2.1 General Requirements: Only pavement marking materials currently shown on the Arizona Department of Transportation's Approved Products List shall be used. The current Approved Products List is available on the internet.

Certificates of Compliance conforming to the requirements of the Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted for each lot or batch of thermoplastic reflectorized material or preformed pavement markings prior to its use.

462.2.2 Hot Sprayed Thermoplastic Reflectorized Material: The thermoplastic reflectorized material shall consist of a solid mixture of heat-stable resins, white or yellow pigment, inter-mixed glass beads, filler, and other materials in granular or block form specifically compounded for reflectorized pavement markings to be applied to the pavement in a molten state. The characteristics of the liquefied material shall be such that complete and even coverage of specified areas to the required thickness is provided by the required application method and rate. Upon cooling to normal pavement temperature, this material shall produce an adherent reflectorized marking capable of resisting deformation and wear in the roadway.

The thermoplastic composition shall conform to the following requirements:

Component	Percent by Weight	
	White	Yellow
Binder (minimum)	20	20
Titanium dioxide (minimum)	10	-----
Yellow Lead-Free Pigment (minimum)	-----	1.5
Reflective glass inter-mix beads	30 - 45	30 - 45
Calcium carbonate or equivalent filler	20 - 42	20 - 42

The filler shall be a white calcium carbonate or equivalent filler with a compressive strength of at least 5.0 ksi.

Titanium Dioxide shall conform to the requirements of ASTM D476 Classification Type II.

The yellow pigment shall be heat resistant and lead free. The type of yellow pigment shall be at the option of the manufacturer provided that the material conforms to all color requirements in a stable and durable fashion as specified herein.

The ingredients of the thermoplastic shall be thoroughly mixed and in a solid block or free flowing granular form. The material shall readily melt into a uniform mixture and be free from all skins, dirt, foreign objects or any other ingredient which would cause bleeding, staining, blotting, or discoloration when applied to the bituminous or concrete pavement.

The thermoplastic formulation shall use an alkyd binder. The alkyd binder shall consist of a mixture of synthetic resins, at least one of which is solid at room temperature, and of high boiling point plasticizers. At least one third of the binder composition and no less than eight percent by weight of the entire material formulation shall be solid maleic modified glycerol ester resin or solid maleic modified pentaerythritol ester resin. The alkyd binder shall not contain any petroleum based hydrocarbon resins.

The thermoplastic material shall not exude fumes which are toxic, injurious, or require specialized breathing apparatus when heated to the temperature range specified by the manufacturer for application. The material shall remain stable when held for four hours at this temperature, or when subjected to four reheating cycles, not exceeding a total of four hours, after cooling to ambient temperature. The temperature viscosity characteristics of the plastic material shall remain constant throughout the reheating cycles and shall show like characteristics from batch to batch. There shall be no obvious change in color of the thermoplastic material as a result of reheating, and the color of the material shall not vary from batch to batch.

(A) Color: The thermoplastic material, after heating for four hours \pm five minutes at $425^{\circ}\text{F} \pm 3^{\circ}\text{F}$ and cooled to $77^{\circ}\text{F} \pm 3^{\circ}\text{F}$, shall meet the following:

White: Daylight reflectance at 45 degrees - 0 degrees shall be 75 percent minimum.
The color shall match Federal Test Standard Number 595, Color Chip No. 17925.

Yellow: Daylight reflectance at 45 degrees - 0 degrees shall be 45 percent minimum.
The color shall match Federal Test Standard Number 595, Color Chip No. 13538.

(B) Color Stability: Using accelerated weathering per ASTM G155, Cycle 1, white color stability shall be measured for no color change after 500 hours of exposure, and yellow color stability shall be measured for no color change after 1000 hours of exposure.

(C) Retroreflectance: The white and yellow thermoplastic materials shall have the following minimum retroreflectance values at 86.5 degrees illumination angle and 1.5 degrees observation angle as measured by an LTL-X Delta Retrometer or similar device, within 30 days after application to the roadway surface:

Color	Retroreflectance (millicandelas/m ² /lux)
White	350
Yellow	200

(D) Water Absorption and Specific Gravity: The thermoplastic material shall not exceed 0.5 percent by weight of retained water when tested in accordance with the requirements of ASTM D570.

The specific gravity of the material, as determined by Section 16 of AASHTO T 250, shall be between 1.85 and 2.15.

(E) Bond Strength: After heating the thermoplastic material for four hours \pm five minutes at 425° F \pm 3° F, the bond strength to portland cement concrete shall be not less than 0.18 ksi. The bond strength shall be determined in accordance with the procedures specified in Section 7 of AASHTO T 250.

(F) Cracking Resistance at Low Temperature: After heating the thermoplastic material for four hours \pm five minutes at 425° F \pm 3° F, applying to concrete blocks, and cooling to 15° F \pm 3° F, the material shall show no cracks when observed from a distance exceeding 1 foot. Testing for low temperature crack resistance shall be in accordance with the procedures specified in Section 8 of AASHTO T 250.

- (G) **Impact Resistance:** After heating the thermoplastic material for four hours \pm five minutes at $425^{\circ}\text{ F} \pm 3^{\circ}\text{ F}$ and forming test specimens, the impact resistance shall be not less than 10 inch-pounds when tested in accordance with Section 9 of AASHTO T 250.
- (H) **Softening Point:** After heating the thermoplastic material for four hours \pm five minutes at $425^{\circ}\text{ F} \pm 3^{\circ}\text{ F}$ and testing in accordance with ASTM D36, the thermoplastic materials shall have a softening point of $215^{\circ}\text{ F} \pm 15^{\circ}\text{ F}$.
- (I) **Flowability:** After heating the thermoplastic material for four hours \pm five minutes at $425^{\circ}\text{ F} \pm 3^{\circ}\text{ F}$, and testing for flowability in accordance with Section 6 of AASHTO T 250, the white thermoplastic shall have a maximum percent residue of 18 and the yellow thermoplastic shall have maximum percent residue of 21.
- (J) **Yellowness Index:** The white thermoplastic material shall not exceed a yellowness index of 0.12 when tested in accordance with Section 4 of AASHTO T 250.
- (K) **Flowability (Extended Heating):** After heating the thermoplastic material for eight \pm one-half hours at $425^{\circ}\text{ F} \pm 3^{\circ}\text{ F}$, with stirring the last six hours, and testing for flowability in accordance with Section 12 of AASHTO T 250, the thermoplastic shall have a maximum percent residue of 28.
- (L) **Abrasion Resistance:** The abrasion resistance of the thermoplastic material shall be determined by forming a representative lot of the material at a thickness of 1/8 inch on a 4" by 4" square monel panel (thickness $0.05\text{ inch} \pm 0.001\text{ inch}$), on which a suitable primer has been previously applied, and subjecting it to 200 revolutions on a Taber Abraser at 77° F , using H-22 calibrated wheels weighted to 0.55 lbs. The wearing surface shall be kept wet with distilled water throughout the test.

The maximum loss of thermoplastic material shall be 0.0011 lbs.
- (M) **Flash Point:** The thermoplastic material shall have a flash point not less than 475° F when tested in accordance with the requirements of ASTM D92.
- (N) **Storage Life:** The materials shall meet the requirements of this specification for a period of one year from the date of manufacture. The thermoplastic must also melt uniformly with no evidence of skins or unmelted particles for this one-year period. Any material which does not meet the above requirements, or which is no longer within this one year period at the time of application, shall be replaced by the Contractor at no additional cost to the County
- (O) **Primer Sealer:** Primer Sealers for use on portland cement concrete or hot mix asphaltic concrete surfaces prior to application of the thermoplastic material shall

be either as recommended by the thermoplastic material manufacturer or especially compounded for use with the specified thermoplastic material.

462.2.3 Reflective Glass Beads: Inter-mix and drop-on reflective glass beads shall conform to the requirements of Section 461.2.2, except as noted herein.

The inter-mix beads shall conform to AASHTO M 247, Type 1, and may be coated or uncoated as recommended by the manufacturer. If uncoated beads are used, the thermoplastic formulation shall be configured to minimize settling of the intermix beads when the material is heated and applied.

Drop-on beads shall conform to the gradation requirements of AASHTO M 247 for Type 1 and Type 3 beads.

462.2.4 Preformed Pavement Markings: Preformed pavement markings listed on the Arizona Department of Transportation's Approved Products List may be used when requested by the Contractor and approved by the Engineer. Preformed pavement markings shall be weather resistant and shall show no appreciable fading, lifting, shrinkage or significant tearing, roll back, loss of skid resistance, or signs of poor adhesion throughout the useful life of the marking. The markings shall be capable of conforming to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures.

Preformed thermoplastic markings shall be supplied at a minimum thickness of 0.090 inches (90 mils).

Preformed plastic film or tape shall be a minimum of 0.065 inch thick excluding any adhesive.

462.3 CONSTRUCTION:

462.3.1 Equipment (Hot Sprayed Applied Thermoplastic): The equipment used to install hot sprayed applied thermoplastic material shall be constructed to provide continuous uniform heating to temperatures exceeding 400° F while mixing and agitating the material. The heating mechanism of the kettle shall be equipped with a heat transfer medium consisting of oil or air. The burner flame shall not directly contact the material vessel surface. The mixing and agitating mechanism shall be capable of thoroughly mixing the material at a rate which ensures constant uniform temperature distribution. The kettle shall be equipped with two temperature gauges: one to indicate the temperature of the oil or air heat transfer medium, and the other to indicate the temperature of the thermoplastic material. The kettle shall also be equipped with an automatic thermostatic control device that allows for positive temperature control to prevent overheating or underheating of the material.

The conveying portion of the equipment, between the main material reservoir and the line dispensing device, shall be configured to prevent accumulation. All parts of the

equipment which will come in contact with the material shall be constructed for easy accessibility for cleaning and maintenance. The equipment shall operate so that all mixing and conveying parts, including the line dispensing device, will maintain the material at the plastic temperature. The use of pans, aprons or similar appliances which the dispenser overruns will not be permitted. The equipment shall provide for varying traffic marking application widths.

All melting and application equipment shall have functioning and calibrated temperature sensing devices to verify that temperature requirements are being met. Upon request of the Engineer, the Contractor shall provide proof that the temperature sensing devices and verification thermometers are fully functional.

The application equipment to be used on roadway installations shall consist of either truck-mounted units, motorized ride-on equipment, or manually pushed equipment, depending on the type of marking required.

The truck-mounted or motorized ride-on units used for center lines, lane lines, gore lines, and edge lines shall consist of a mobile self-contained unit carrying its own material capable of operating at a minimum speed of five miles per hour while applying striping, and shall be sufficiently maneuverable to install curved and straight lines, both longitudinally and transversely.

The truck shall be equipped with high pressure air spray jets in front of the pavement marking material applicators to remove loose matter from the pavement surface where the marking material is to be applied.

Hand applicator equipment, to be used for all other roadway installations, shall be either self-contained melter application units or reservoir application units that are filled from a separate melter unit. Both types of units shall be equipped to maintain and measure the required application temperatures. The hand applicator equipment shall be sufficiently maneuverable to install symbols and legends, and curved and straight lines, both longitudinally and transversely.

The application equipment shall be so constructed as to assure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off square stripe ends and shall provide a method of applying "skip" lines. The equipment shall be constructed so as to provide varying widths of traffic markings. The application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The equipment operator shall be located in such a position as to enable full visibility of the striping apparatus.

A glass bead top dressing shall be applied to the completed thermoplastic stripe by an automatic glass bead dispenser attached to the striping machine in such a manner that the beads are applied to the molten thermoplastic material immediately after it has been applied. The bead dispenser shall use pressure type spray guns which will embed the beads into the stripe surface to at least one-half of the bead diameter. The bead

dispenser shall be equipped with an automatic cut-off synchronized with the cut-off of the thermoplastic material.

A special kettle shall be provided for uniformly melting and heating the thermoplastic material. The kettle must be equipped with an automatic thermostat control device and material thermometer for positive temperature control to prevent overheating or underheating of the material.

The heating kettle and application equipment shall meet the requirements of the National Fire Underwriters and the National Fire Protection Association and of the state and local authorities. Thermoplastic melting units, trucks or trailers, shall be equipped with foam-type fire extinguishers suitable for application to thermoplastic material that is at the flash point.

If screed or extrusion application of thermoplastic is allowed by the Engineer for short applications, the screed/extrusion application method shall be used wherein one side of the shaping die is the pavement and the other three sides are contained by equipment suitable for heating or controlling the flow of material. The equipment shall form an extruded line which shall be uniform in shape having clear and sharp dimensions.

For hand liner applications, a gravity bead dispenser may be allowed by the Engineer if it properly gauges and dispenses the correct amount of glass spheres.

462.3.2 Application: Thermoplastic pavement markings shall not be applied to any new asphalt pavement surface within the first 72 hours after pavement placement or after the placement of a surface treatment. During hot weather if the Engineer determines that the asphalt surface is prone to tracking, the Engineer may direct the contractor to provide temporary painted pavement markings complying with Section 461.

Thermoplastic pavement markings shall not be applied to any new asphalt-rubber pavement surface within the first 30 days after pavement placement. The Contractor shall install painted temporary striping at locations where thermoplastic striping is required. Painted temporary striping shall comply with section 461 except temporary striping may be applied 24 hours after placement of the new asphalt-rubber pavement.

Preformed pavement markings for legends, arrows, and other symbols may be applied 24 hours after placement of asphalt concrete pavement and asphalt-rubber asphalt concrete pavement. Preformed pavement markings for legends and symbols shall be installed when temporary painted striping is installed.

If a preservative or fog seal is required, sufficient drying time, minimum of forty-eight (48) hours, shall be allowed before applying any pavement markings.

After the forty-eight (48) hour drying time has passed and the seal remains tacky, or excessive oil has risen to the roadway surface, a sand blotter shall be applied to absorb

the excess oil. The Contractor shall sweep the roadway surface free of sand prior to pavement marking applications.

If a seal or blotter is applied after the installation of pavement markings, any pavement markings affected by the seal or blotter shall be removed and re-applied at the Contractor's expense.

(A) Placement: Pavement markings shall be positioned as defined on the plans and specifications. If a conflict exists between actual field conditions and the pavement marking plans, the Contractor shall cease work and notify the Engineer immediately. The Engineer may revise individual marking locations as necessary.

(B) Pavement Surface Preparation: The Contractor shall remove all dirt, grease, oil or other detrimental material from the road surface prior to application of stripes, arrows, legends or symbols.

The method of cleaning the surface is subject to approval by the Engineer and shall include sweeping and the use of high-pressure air spray. The method of surface preparation shall also be in accordance with the marking material manufacturer's recommendations. Loose material including all grindings and obliterated markings shall be removed from the pavement surface and disposed of properly.

When pavement markings are to be applied to new portland cement concrete pavement, any curing compound present shall be removed by means of a high-pressure water jet followed by sweeping and high-pressure air spray. The concrete curing compound shall be removed at least two inches beyond the entire perimeter of each marking to be installed.

At the time of application of primer-sealer and thermoplastics, the road surface shall be absolutely dry with no detectable or measurable surface or near-surface dampness. If precipitation or other surface wetting is imminent, all marking operations shall be stopped. If any surface dampness is detected during marking activities, marking operations shall be stopped until the pavement dries. If hot-applied thermoplastic marking blisters upon application, marking operations shall be stopped until the cause, potentially including subsurface moisture is determined and corrected.

(C) Primer Application On old and new portland cement concrete pavement, a primer-sealer shall be used if recommended by the manufacturer of the marking material. The primer-sealer shall be applied at the manufacturer's recommended application rates prior to placing the pavement marking material. The primer-sealer shall be allowed to set up for the manufacturer's specified cure or evaporation time, and shall be free of solvent and water when the pavement marking material is applied.

The thermoplastic material shall be applied to primed pavement surfaces within the working time specified by the primer-sealer and thermoplastic materials manufacturers. If the primed surfaces are not marked within these time limits, the Contractor shall re-

prime the surfaces as required by the manufacturer at no additional cost to the Department. If an epoxy primer is used, the thermoplastic application shall be completed before the epoxy has cured.

Improper primer-sealer application may result in bond failure between the thermoplastic and the pavement surface and may cause the thermoplastic surface to pinhole or blister. Should these conditions occur, application operations shall stop until the cause is determined and corrected. All such defective markings shall be removed and replaced at no additional cost to the Department.

462.3.3 Application of Preformed Pavement Markings: The Contractor shall mark the proposed location of all legends and symbols. Preformed pavement markings shall not be installed until after the location has been approved by the pavement markings inspector.

All markings shall be applied in accordance with the manufacturer's recommendations. Preformed pavement markings shall not be applied over other markings or old paint unless allowed by the manufacturer and approved by the Engineer prior to application.

The contractor shall use butt splices only and shall not overlap the marking material.

The contractor shall immediately correct all misalignments when so ordered by the Engineer. The misaligned portions shall be removed and reinstalled.

All areas marked with preformed pavement markings shall be ready for traffic immediately after application.

462.3.4 Application of Hot Sprayed Thermoplastic: Preparation and application equipment shall be in accordance with the plans and specifications, and shall conform to the recommendations of the materials manufacturer.

The Contractor shall make daily maintenance and operation inspections of all application equipment to ensure that it is operable within the requirements of the specifications. The Contractor shall inform the Engineer of any equipment breakdowns, intermittent malfunctions, or other conditions that may impact the proper application of specified markings. Any equipment judged to be unsuitable by the Engineer shall be repaired or replaced.

(A) Location Pre-Marking: When the use of temporary chip seal pavement markers have been approved for use they shall be augmented by spot marks. Temporary chip seal pavement markers shall be collected and disposed of by the Contractor prior to the final inspection.

The field striping requirements may exceed the construction project limits to correctly match into the existing striping. The Contractor shall perform a field inspection with the pavement markings inspector to determine locations for matching the existing striping.

The Contractor shall spot mark the entire project at 10-foot intervals in conformance with the striping plans. Upon completion of the spot marking, the Contractor shall notify the Engineer that the project is ready for inspection. County will conduct an inspection after the spot marking is completed, within three working days from notification of Contractor.

Approval of the spot marking shall not relieve the Contractor from obtaining a final inspection. Upon final inspection, if the Engineer decides that more than one coat is required, it will be done at the Contractor's expense.

The final striping inspection will be made by the Engineer within three working days after all pavement markings and markers have been installed.

(B) Materials Selection and Compatibility: All hot sprayed applied thermoplastic material, drop-on glass beads, and primer-sealer will be inspected and approved by the Engineer prior to their application. The Contractor shall also provide samples of said materials if requested by the Engineer.

All materials shall be properly packaged and stored. Each container to be used on the project shall be clearly labeled to indicate the following information:

- Nature, type, and formulation of the material;
- Manufacturer, batch number, and date of manufacture;
- Application requirements and constraints; and
- Compatibility requirements and constraints, particularly those pertaining to equipment, storage, and other materials to be used.

Incompatible materials shall not be used together. The Contractor shall not combine alkyd and hydrocarbon materials in preparation or application equipment. The Contractor shall completely clean preparation and application equipment when materials are changed.

The Contractor shall dispose of excess materials, cleaning fluids, and all empty material containers at a site in conformance with the state and federal requirements.

(C) Pavement Temperatures: The air and road surface temperature at the time of application of hot sprayed applied thermoplastic shall not be less than 55° F, and the pavement surface shall be absolutely dry. If at any time during marking operations the air or pavement temperature falls below these requirements, all hot sprayed applied thermoplastic marking operations shall stop. To ensure optimum adhesion, the hot sprayed applied thermoplastic material shall be installed in a melted state at a temperature from 400° F to 440° F.

The Contractor shall measure pavement surface temperatures one half hour prior to the start of the striping installation activities and as deemed necessary by the Engineer until the end of the application period. For elevation changes greater than 1000 feet

temperature readings at the highest elevation shall govern unless otherwise requested by the Engineer. The lowest temperature so measured shall govern, unless otherwise requested by the Engineer. The temperature measurements shall be recorded in a log book and provided to the Engineer when required. The pavement surface temperature shall be measured with a standard surface temperature thermometer or a non-contact infrared thermometer.

(D) Thermoplastic Application: The hot sprayed applied thermoplastic pavement marking material shall be extruded or sprayed onto the pavement surface at a material temperature between 385° F and 415° F, depending on the manufacturer's recommendations, the ambient air and pavement temperatures, and the nature of the pavement surface. The Contractor shall verify temperature requirements with a non-contact infrared thermometer as directed by the Engineer.

The hot sprayed applied thermoplastic material temperatures shall not exceed 450° F. Material temperatures exceeding 440° F shall be allowed for short periods of time; however, in no case shall the material be held for more than four hours at temperatures above 440° F. Total heating time for any batch of material shall not exceed six hours. The Contractor shall note in the temperature log the time when each batch of thermoplastic material is first heated. The start of heating time shall also be marked on the side of the kettle to which it applies.

Specified temperature requirements shall be maintained at all times during application of applied material. The Contractor shall monitor hot sprayed applied material temperature at thirty-minute intervals, unless otherwise requested by the Engineer, and maintain a log of temperature readings taken. Readings shall be taken at the melting kettle or the application outlet point, as determined by the Engineer.

The Contractor shall minimize the thermoplastic material remaining in the kettle at the end of the work day and shall blend a minimum of 80 percent fresh material the start of each day. During project delays, the Contractor may transfer heated thermoplastic material into approved containers for later re-use, subject to specified limits on total acceptable heating time for each batch.

Drop-on glass beads shall be mechanically deposited into the molten hot sprayed thermoplastic material immediately after the thermoplastic marking is applied, using a double drop method. Each drop shall be comprised of a minimum of six pounds of glass beads per 100 square feet of line (200 linear feet of six-inch stripe). One drop shall be Type 1 glass beads and the other drop shall be Type 3 glass beads. The contractor shall determine which type of glass bead is to be applied in each drop; however, both types shall be used. Double drop methods using all Type 1 or Type 3 beads will not be allowed.

The dispensers shall evenly distribute the beads in the thermoplastic material. Both Type 1 and Type 3 glass beads shall be embedded in the surface of the thermoplastic to a depth of between 50 and 60 percent of the bead diameter. If the glass beads do not

adhere to the thermoplastic marking, operations shall be stopped until the problem has been corrected. All markings which do not meet the retroreflectance requirements of Section 462.2.2 (C), as determined by the Engineer, shall be removed by the contractor and replaced at no additional cost to the Department.

Unless otherwise specified, all thermoplastic pavement markings shall be extruded, and shall be 0.090 ± 0.002 inches thick. The thermoplastic thickness shall be uniform and consistent throughout the total length of the marking project.

The Contractor shall perform periodic spot checks of thermoplastic material to verify that the required thickness has been attained. Random spot checks of the thermoplastic thickness will be made by the Engineer to ensure conformance with the required criteria. Suggested spot check procedures include the following:

- Wet:** Thickness can be field tested immediately after the thermoplastic marking is applied by inserting a thin, graduated machinist rule or similar instrument into the molten thermoplastic to the depth of the pavement surface. The thickness is then determined visually by noting on the scale the depth of the penetration or coating of the instrument.
- Dried:** Thickness can be field tested by placing a small flat sheet of metal with a known thickness immediately ahead of the striping apparatus. After striping, remove the sample and use a suitable measuring device, such as a caliper or micrometer, to determine the thickness of the dried marking.

Longitudinal lines shall be offset at least 6 inches clear from construction joints unless otherwise requested by the Engineer.

The finished thermoplastic line shall have well defined edges and be free from waviness. Lateral deviation of the thermoplastic line shall not exceed 1.0 inches in 100 feet. The longitudinal deviation of a painted segment and gap shall not vary more than 6 inches in a 40-foot cycle. The actual width of line shall be within the limits specified in the following table, according to the width of stripe called for on the plans:

Plan Width	Actual Width
4 inches	4 to 4½ inches
8 inches	8 to 9 inches
Over 8 inches	± 1.0 inches

After application and sufficient drying time, the thermoplastic marking shall show no appreciable deformation, cracking, or discoloration under local traffic conditions with air and road temperature ranging from -10° F to 180° F. The drying time shall be defined as the minimum elapsed time, after application, when the thermoplastic pavement markings shall have and retain the characteristics required herein, and after which

normal traffic will leave no impression or imprint on the newly applied marking. When applied at a temperature range of $400^{\circ}\text{F} \pm 15^{\circ}\text{F}$ and thickness of 90 mils, the material shall set to bear traffic in not more than two minutes when the air and road surface temperature is approximately $50^{\circ}\text{F} \pm 3^{\circ}\text{F}$, and not more than ten minutes when the air and road surface temperature is approximately $90^{\circ}\text{F} \pm 3^{\circ}\text{F}$. The Engineer may conduct field tests in accordance with ASTM D711 to verify actual drying times.

Thermoplastic markings shall not be applied over concrete pavers or decorative asphalt.

462.4 MEASUREMENT:

Thermoplastic pavement markings of longitudinal and transverse lines, such as edge lines, lane lines, gore lines, cross-walks and stop bars, will be measured by the linear foot along the center line of the pavement stripe and will be based on a 4 inch wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or requested by the Engineer will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Linear Feet}}{4 \text{ (inches)}}$$

No measurement will be made of the number of linear feet of skips in the dashed line.

Double marking lines, consisting of two 4-inch wide stripes will be measured as two individual marking lines. Crosswalk lines, stop bars, stop lines, gore lines, cross hatch lines, and chevron lines will be measured for centerline length and adjusted for widths other than 4 inches as defined above.

Pavement symbols and legends will be measured by each unit applied. Each pavement symbol and each legend, as shown on the Plans, will be considered a unit. The railroad symbol includes the cross bars, both R, and the transverse lines.

No separate measurement will be made for cleaning and preparing the pavement surface, including abrasive sweeping and high-pressure air spray. The cost of disposal of excess material, cleaning fluids, and empty material containers will be considered as included in the contract items.

Removal of curing compound from new portland cement concrete pavement and the application of primer-sealer applied to old or new portland cement concrete pavement, prior to application of thermoplastic striping or pavement legends and symbols, shall be measured by the linear foot or unit each, respectively, depending on the type of marking to be placed and in accordance with the contract fee schedule and special provisions.

462.5 PAYMENT:

The accepted quantities of pavement symbols and legends, measured as provided above, will be paid for at the contract unit price, complete in place including pavement surface preparation.

The accepted quantities for removal of curing compound from portland cement concrete pavement and the application of primer-sealer, measured as provided above, will be paid for at the contract unit price.

The accepted quantity of striping, rounded to the nearest foot, will be paid for at the contract unit price, complete in place including pavement surface preparation.

Part 400 add the following new Section:

SECTION 463

RAISED PAVEMENT MARKERS

463.1 DESCRIPTION:

The work under this section shall consist of cleaning and preparing the pavement surface; furnishing all materials, equipment, tools and labor; and placing raised pavement markers of the type specified at the locations and in accordance with the details shown on the plans and the requirements of these specifications.

463.2 MATERIALS:

463.2.1 General: Certificates of Compliance for raised pavement markers and adhesive conforming to the Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05, shall be submitted to the Engineer at least 10 days prior to use. A minimum of one sample per lot per type of marker shall be made available to the Engineer for compliance testing.

The base of the pavement markers shall be free from glass glaze or from substances which may reduce its bond to the adhesive. The base shall be flat and its deviation from a flat surface shall not exceed 0.05 inches.

463.2.2 Reflective Pavement Markers: Reflective markers shall be non-adhesive with an adhesive surface. Pavement markers shall be both wet and dry retro-reflective, impact resistant, abrasion resistant, water resistant and have molded-in body colors.

Reflective pavement markers shall be of the following type:

Type D	Yellow, two-way
Type G	Clear, one-way
Type H	Yellow, one-way
Type BB	Blue, two-way

Reflective pavement markers shall be of the prismatic reflector type consisting of a polycarbonate body and a polycarbonate lens with built-in micro-cube corners. The lens shall have a protective hard-coat.

The exterior surface of the shell shall be smooth and shall contain one or two prismatic reflector faces of the color specified.

When illuminated by an automobile headlight, the color of the reflectors shall be an approved clear or yellow as designated. Reflectors not meeting the required color may be rejected.

Permanent reflective pavement markers will be tested for compressive strength, abrasion resistance and specific intensity. Permanent reflective pavement markers shall have thin untempered glass or other abrasion resistant material bonded to the prismatic reflector face to provide an extremely hard and durable, abrasive resistant reflector surface.

The area covered by the glass, or other abrasion resistant surface, shall not be less than (3) three square inches.

The strength by compressive loading shall be at least 2,000 lbs. for both permanent and temporary reflective pavement markers.

The original specific intensity of each reflecting surface for both temporary and permanent reflective markers shall not be less than the following:

Reflectance	Specific Intensity: candelas/foot-candle		
	Clear	Yellow	Red
0 Degrees Incidence	3.0	1.8	0.75
20 Degrees Incidence	1.2	0.72	0.30

Permanent reflective pavement markers shall be subject to an abrasion resistance test as follows:

Steel Wool Abrasion Procedure: Form a 1.0 inch diameter flat pad using No. 3 coarse steel wool per Federal Specification FF-W1825. Place the steel wool pad on the reflector lens face. Apply a force of 50 lbs. and rub the entire lens surface 100 times. After the lens surface has been abraded, the specific intensity of each clear and yellow reflective surface shall be not less than that required above for the original specific intensity.

463.2.3 Non-Reflective Pavement Markers and Reflectorized Dagmars:

Non-reflective pavement markers shall be, Type A - white

Reflectorized Dagmars shall be of the following types:

Type J	white
Type JY	yellow

Non-reflective pavement markers and reflectorized dagmars shall consist of a heat-fired, vitreous ceramic base and a heat-fired, opaque glazed surface which will produce the required properties. Markers shall be produced from any suitable combination of intimately mixed clays, shales, flints, feldspars, or other inorganic material which will meet the properties herein required. Markers shall be thoroughly and evenly matured and free from defects which will affect appearance or serviceability.

The top surface of the marker shall be in reasonably close conformity with the configuration shown on the plans. Markers shall be convex and the radius of curvature shall be between 3.5 inches and 6.0 inches, except that the radius of the ½ inch nearest the edge may be less. All edges shall be rounded and any change in curvature shall be gradual. The top and sides shall be smooth and free of mold marks, pits, indentations, air bubbles, or other objectionable marks or discolorations.

Non-reflective pavement markers and dagmars shall meet the following requirements:

Glaze Thickness, minimum, inches	0.005
Moh Hardness, minimum	6
Directional Reflectance (White Only), minimum Glazed Surface Body of Marker	75 70
Yellowness Index (White Only), maximum Glazed Surface Body of Marker	0.07 0.12
Color (Yellow Only) Purity, percent, range Dominant Wave Length, mu, range Total Lumious Reflectance (Y valve), minimum	75 - 96 579 - 585 0.41
Compressive Strength, pounds, minimum	1,500
Water Absorption, percent, maximum	2.0
Autoclave	Glaze shall not spall, craze or peel

Reflectorized dagmars shall have encapsulated lens reflectors conforming to standard manufacturing practices.

463.2.4 Bituminous Adhesive:

Crafco, Incorporated
6975 West Crafco Way
Chandler, Arizona 85226

Materials by manufacturers other than the above listed may be used when approved by the Engineer prior to use.

463.3 CONSTRUCTION:

Raised pavement markers shall be installed after the permanent pavement striping has been completed and approved.

The portion of the highway to which the markers are to be attached shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers and any other material which could adversely affect the bond of the adhesive. The pavement must be clean and dry. If rainfall or other pavement wetting event occurs, the pavement shall be allowed to dry for at least twenty-four (24) hours before proceeding with the installation of markers.

Markers shall not be placed on asphalt that is cracking or showing signs of failure.

Chip Seal surfaces shall be swept of excess aggregate and open to traffic for 30 days prior to installation of the markers. Markers shall not be installed on chip seal surfaces with large, void spaces and/or loose aggregate with a weak bond to the underlying road surface.

Slurry Seal and Fog Seal surfaces shall be allowed to cure at least twenty-four (24) hours prior to placement of the markers. Excess sand applied to soak up surface emulsions must be swept clean prior to installation of the markers.

The method of cleaning the pavement surface and removal of detrimental material is subject to approval by the Engineer and shall include sweeping and the use of high-pressure air spray. On portland cement concrete pavement and old asphalt concrete pavements, cleaning shall be accomplished by water blasting, followed by sweeping and/or air blowing. Newly placed asphalt concrete pavement need not be water blasted unless, in the opinion of the Engineer, the surface is contaminated with materials that would adversely affect the bond of the adhesive.

The adhesive shall be placed uniformly on the cleaned pavement surface in an amount sufficient to result in complete coverage of the area of contact of the markers, with no voids present and with a slight excess after the markers have been placed. The markers shall be placed in position and pressure applied until firm contact is made with the pavement. The markers shall be protected against impact until the adhesive has set to the degree acceptable to the Engineer.

Excess adhesive on the pavement and on the exposed surfaces of the markers shall be immediately removed. Thinners or solvents which may be detrimental to either the markers or the bond provided by the adhesive shall not be used in removing excess adhesive.

Markers shall not be installed when the temperature of the pavement surface or the atmosphere is less than 40° F, when the relative humidity is 80 percent or higher or

when the pavement surface is not dry.

All markers shall be installed to the line approved by the Engineer and in such manner that the reflective face of the markers is perpendicular to a line parallel to the roadway centerline. Raised Pavement Markers installed next to a solid stripe shall be placed to the side of the stripe with a four inch clear space between the edge of stripe and edge of the marker. Raised Pavement Markers installed in broken or dashed striping shall be centered on the striping and centered in the middle of the striping gap. No pavement markers shall be installed over longitudinal or transverse joints of the pavement surface.

463.4 MEASUREMENT:

Pavement markers will be measured as a unit for each marker furnished and placed.

463.5 PAYMENT:

The accepted quantities of pavement markers, measured as provided above, will be paid for at the contract unit price for the type designated, complete in place, including adhesive and surface preparation.

Part 400 add the following new Section:

SECTION 464

ROADSIDE SIGN SUPPORTS

464.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing square perforated tube sign post, U-channel sign post, and foundations.

Sign post and foundations shall conform to the requirements of MCDOT Standard Details.

464.2 MATERIALS

464.2.1 General: Certificates of Analysis conforming to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted for all square perforated tube sign posts and U-channel sign posts.

Excessive damage to the finish of the posts during shipping, handling, or installation will result in rejection of the damaged posts.

464.2.2 Perforated Sign Posts: Single and telescoping perforated posts shall be square tube fabricated from 0.105 inch cold-rolled sheet carbon steel conforming to the requirements of ASTM A366/A366M. Posts shall be welded directly in the corner by high frequency resistance welding or equal. The outside edges of the posts shall be externally scarfed to agree with standard corner radii of 5/32 inch \pm 1/64 inch. Bolts, nuts and washers shall conform to the requirements of ASTM A307, Grade A.

Perforated posts shall be galvanized after fabrication in accordance with the requirements of ASTM A525M, Coating Designation 275. Bolts, nuts and washers shall be zinc coated in accordance with the requirements of ASTM A153.

The diameter of holes on perforated sign post shall be 7/16 inch \pm 1/64 inch on 1.0 inch centers, on four opposite sides for the entire length of the post. Holes shall be on the centerline of each side on true alignment and opposite to each other. All material cuts must be centered between hole patterns and at a 90-degree angle to the length of material.

The finished sign posts shall be straight and have a smooth uniform finish. All consecutive sizes of posts shall be freely telescoping for not less than 120 inches of their length without the necessity of matching any particular face to any other face.

464.2.3 U-Channel Sign Posts: U-channel sign post shall be used for temporary signing only.

U-channel posts shall be fabricated from rerolled rail steel conforming to the requirements of ASTM A499 or hot-rolled carbon steel bars.

Prior to rerolling the rail steel, the rail nominal weight shall be 91 pounds per yard and shall meet the requirements of ASTM A1 pertaining to quality assurance.

Yield Point of the steel shall be 80,000 psi minimum.

The cast heat analysis of the steel shall conform to the following requirements:

Element	Composition (Percent)
Carbon	0.67 - 0.82
Manganese	0.70 - 1.10
Phosphorus, max.	0.04
Sulphur, max.	0.05
Silicon	0.10 - 0.25

Posts shall be a uniform, modified, flanged channel section as shown in MCDOT Standard Detail 2059. Weight of the posts shall be 2.00 lbs. per lineal foot, plus or

minus five percent. The post shall be punched with continuous 3/8-inch diameter holes on 1.0-inch centers. The first hole shall be 1.0 inches from top and bottom of post.

The post shall consist of two parts, a sign post and a base post. The sign post lengths shall be supplied in 6-inch increments up to 12.0 feet as required for the installation location. The base posts shall be 3.5 feet in length, pointed at one end, and have at least eighteen holes in the base post, starting 1.0 inches from the top and continuing at 1.0-inch increments.

Posts shall be machine straightened to have a smooth uniform finish, free from defects. All holes and edges shall be free from burrs. Permissible tolerance for straightness shall be within 1/16 inch in 36 inches.

Posts shall be galvanized after fabrication in accordance with the requirements of ASTM A123. Bolts, nuts, washers and spacers shall be zinc plated in accordance with the requirements of ASTM B633.

U-channel base posts shall be driven into the ground to a minimum depth of 36 inches.

464.2.4 Concrete: Concrete for perforated sign post foundations shall be Class B in accordance with Section 725.

464.3 CONSTRUCTION:

Foundations for perforated sign posts and U-channel posts shall be constructed to the details and dimensions shown on the plans.

Sign posts shall be erected plumb.

464.4 MEASUREMENT:

Perforated sign posts and U-channel sign posts shall be measured by the foot, to the nearest inch for each post furnished and installed. The total length of all posts of the same type will be rounded to the nearest foot. Telescoping post members will be considered as one post after installation and will not be measured separately. The length of perforated sign post shall be measured from the top of the post to the bottom of the eighteen inches (18") located in the post foundation. The length of U-channel sign posts shall not include the U-channel base post.

Perforated sign post foundations shall be measured by the unit each.

U-channel base post installations shall be measured by the unit each.

464.5 PAYMENT:

The accepted quantities of perforated sign posts, U-channel sign posts, perforated sign post foundations, and U-channel base post installations measured as provided above, will be paid for at the contract unit prices.

The contract unit prices paid shall include full compensation for furnishing all labor, excavation, materials, tools, equipment and incidentals, and for doing all the work involved in constructing foundations, furnishing and erecting the sign posts including galvanizing and furnishing all metal plates and hardware, as shown on the plans and as specified herein, complete in place.

Part 400 add the following new Section:

SECTION 465

SIGN PANELS

465.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing sign panels in accordance with the details shown on the plans and the requirements set forth herein.

465.2 MATERIALS:

465.2.1 General: Certificates of Compliance conforming to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction 2008 edition, Section 106.05 shall be submitted for all materials, including reflective sheeting, required for fabricating sign panels.

Shipment, storage, and handling of sign panels shall conform to the recommendations of the manufacturers of the sign panel components. Fabricated signs and overlay sheets shall be shipped on edge. Damage to the sign panel or legend resulting from banding, crating or stacking shall be cause for rejection of the signs.

465.2.2 Flat Sheet Aluminum Sign Panels with Direct Applied or Silk Screened Characters: Panels shall be fabricated from 5052-H38 Aluminum Alloy conforming to the requirements of ASTM B 209M.

Panel facing shall be prepared and covered with retroreflective sheeting in accordance with the recommendations of the sheeting manufacturer. Color and type of sheeting shall be as specified or shown on the plans.

All surfaces not covered shall be etched to reduce glare from reflected sunlight.

Splicing of retroreflective sheeting shall not be allowed on sign panels having a minimum dimension up to and including 4 feet.

Messages on these sign panels shall be reflectorized white or, if called for in the plans, opaque black and produced by silk screening or direct applied characters or lettering.

465.2.3 Reflective Sheeting: Panels to be installed on Roadside Sign Supports shall be fabricated from flat sheet aluminum and shall be reflectorized as specified herein.

All surfaces of panels to be covered with retroreflective sheeting shall be prepared in accordance with the recommendations of the sheeting manufacturer.

High Intensity Prismatic grade retroreflective sheeting shall comply with ASTM D4956 Type IV sheeting.

Diamond grade retroreflective sheeting shall comply with ASTM D4956 Type IX or Type XI sheeting.

(A) WARNING SIGNS:

Warning signs shall be reflectorized with yellow retroreflective High Intensity Prismatic grade sheeting or as specified by the Traffic Engineer. The following will be the exceptions to this rule:

1. Stop Ahead symbol signs (W3-1), Yield Ahead symbol signs (W3-2), Signal Ahead symbol signs (W3-3), Road Name Cross Traffic Does Not Stop (W4-4c), Cross Traffic Does Not Stop (W4-4P), No Passing Zone pennant signs (W14-3), and Advanced Railroad Crossings signs (W10-1) shall be reflectorized with yellow Diamond grade retroreflective sheeting.
2. School Advanced Warning signs and supplemental plaques and School Crosswalk Warning Assembly signs shall be reflectorized with fluorescent yellow-green Diamond grade retroreflective sheeting.

(B) REGULATORY SIGNS:

Regulatory signs shall be reflectorized with silver-white retroreflective High Intensity Prismatic grade sheeting or as specified by the Traffic Engineer.

Reflectorized red signs shall be reflectorized with silver-white retroreflective High Intensity Prismatic grade sheeting. The red color shall be produced by silk screening.

Regulatory signs with reflectorized red circles and slashes shall be reflectorized with silver-white retroreflective High Intensity Prismatic grade sheeting as background. The red color shall be produced by silk screening.

All Stop Signs (R1-1), Yield Signs (R1-2), All-Way plaques (R1-3P), and Road Closed signs (R11-2) shall be reflectorized with red/white/yellow Diamond grade retroreflective sheeting.

(C) ROUTE MARKERS:

Interstate route markers shall be cut to shape. The colors and legend shall conform to the plans and shall be reflectorized with silver-white retroreflective High Intensity Prismatic grade sheeting. The Interstate route colors shall be silk screened and the hue of the colors shall be within the limits established for the Interstate Route Marker sign color standards. The numerals may be silk screened or direct applied characters.

United States, State Route, and Cardinal Direction markers shall be reflectorized with silver-white retroreflective High Intensity Prismatic grade sheeting unless otherwise shown on the project plans.

(D) STREET NAME SIGNS:

All Street Name Signs shall be manufactured with retroreflective Diamond grade sheeting attached to the standard signage aluminum plates. Street Name Sign imaging shall consist of an acrylic based electronic cuttable film (3M 1170 Series or equivalent) or silk screened with standard highway colors (Diamond grade).

Street Name Signs shall be reflectorized with green or blue retroreflective Diamond grade sheeting as background. The characters shall be direct applied lettering reflectorized with silver-white retroreflective Diamond grade sheeting or as requested by the Traffic Engineer. Street Name Signs fabrication and installation shall conform to the requirements of MCDOT Standard Detail 2054.

(E) METRO STREET NAME SIGNS:

Metro Street Name Sign panels shall be reflectorized with green retroreflective Diamond grade sheeting as background. The characters shall be direct applied lettering reflectorized with silver-white retroreflective Diamond grade sheeting or as requested by the Traffic Engineer. Metro Street Name Sign fabrication and installation shall conform to the requirements of MCDOT Standard Detail 4780. Internally illuminated Metro Street Name Signs shall comply with project special provision sections 470 and 477.

465.2.4 Silk Screened and Direct Applied Characters: Silk screened letters, numerals, arrows, symbols, and borders, shall be applied on the retroreflective sheeting background of the sign by direct or reverse screen process. Messages and borders of a color darker than the background shall be applied to the reflective sheeting by direct process. Messages and borders of a color lighter than the sign background shall be produced by the reverse screen process.

Opaque or transparent colors, inks, and paints used in the screen process shall be of the type and quality recommended by the manufacturer of the retroreflective sheeting.

The screening shall be performed in a manner that results in a uniform color and tone, with sharply defined edges of legends and borders and without blemishes on the sign background that will affect intended use.

Signs after screening shall be air dried or baked in accordance with the manufacturer's recommendations to provide a smooth hard finish. Any signs on which blisters appear during the drying process will be rejected.

Direct Applied letters, numerals, symbols, borders, and other features of the sign message shall be cut from black opaque or retroreflective sheeting of the color specified and applied to the retroreflective sheeting of the sign background in accordance with the instructions of the manufacturer of the retroreflective sheeting and shall be applied by heat activation of the adhesive.

Retroreflective sheeting shall meet or exceed the minimum Specific Intensity Per Unit Area (SIA) requirements of AASHTO M 268.

465.3 CONSTRUCTION:

465.3.1 Fabrication: Fabrication of the sign panels shall be in accordance with the details shown on the project plans and the requirements of these specifications. Panels shall be cut to size and shape and shall be free of buckles, warps, dents, cockles, burrs and defects resulting from fabrication. Sign panel colors, lettering, and symbols shall be in accordance with requirements established by the Manual of Uniform Traffic Control Devices (MUTCD).

Fabricated signs and overlay sheets shall be stored indoors and kept dry during storage. If packaged signs become wet, all packaging material shall be removed immediately and the signs allowed to dry. The signs may be repackaged using new dry materials. If outdoor storage is necessary, all packaging materials shall be removed. Signs shall be stored on edge, above ground, in an area where dirt and water will not contact the sign face. Materials used to support stored signs shall not contact sign faces.

465.3.2 Installation of Sign Panels: The sign panels shall be installed on roadside sign supports in accordance with the details shown on the plans.

Minor scratches and abrasions resulting from fabrication, shipping and installation of panels may be patched; however, patching shall be limited to one patch per 54 square feet of sign area with the total patched area being less than five percent of the sign area. Panels requiring more patching than the specified limit will be rejected. Patches shall be edge sealed by a method approved by the retroreflective sheeting manufacturer.

The face of bolts on the panel face shall be anodized or painted to match the background or legend color in which they are placed. The zinc coated washers on the

panel face shall be the color of, or shall be painted to match, the background or legend color in which they are placed. The sign manufacturer's name and date of installation shall be placed on the back of each sign in black, one-inch block letters. Use of felt markers for this purpose will not be permitted. Bolts shall be tightened from the back by holding the bolt head stationary on the face of the panel. Twisting of the bolt head on the panel face shall not be allowed.

465.3.3 Permanent Road Closures using Type III Barricades: Permanent Type III barricades shall be installed in accordance with MCDOT Standard Details 2057 Series as deemed appropriate to the field conditions.

465.3.4 Inspection: An inspection of the completely installed sign panels will be made by the Traffic Engineer during the daytime and at night for proper appearance, visibility, color, specular gloss and proper installation.

Each sign panel face shall be cleaned thoroughly just prior to the inspection as recommended by the manufacturer. The cleaning solvent and cleaning material shall in no way scratch, deface or have any adverse effect on the sign panel components.

The Contractor at no additional cost to the County shall correct all apparent defects disclosed by the inspection. If color variations or blemishes between aluminum extruded sign panel increments are visible from a distance of 50 feet either during the day or at night, the panels shall be removed and replaced at the Contractor's expense.

465.4 MEASUREMENT:

Sign panels will be measured by the square foot for each type or types of sign panels furnished and installed. The area of each sign panel, except for warning, regulatory and marker sign panels will be measured per plan dimensions.

For warning, regulatory and marker sign panels, the area of each sign panel will be measured to the nearest 0.1 square foot. The areas of each rectangular, square or triangular sign panel will be determined from the dimensions shown on the project plans. The area of irregular shaped signs, such as stop signs and route markers, will be determined by multiplying the maximum height in feet by the maximum width in feet, using the dimensions shown on the project plans.

The total area of all sign panels of the same type will be rounded to the nearest square foot.

Metro Street Name Sign Installation shall be measured by the unit each for every installed and approved Metro Street Name Sign.

465.5 PAYMENT:

The accepted quantities of each type of sign panel, measured as provided above, will be paid for at the contract unit price.

Payment will be made for the total rounded area of each type of sign panel.

The contract unit price shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for performing all the work involved in furnishing and installing the sign panels, except for Metro Street Name Sign panels, complete in place, including furnishing and applying all retroreflective sheeting, all fastening hardware, all necessary sign support accessories, stringers and post ties, all as shown on the plans and as specified.

The contract unit price for Metro Street Name Sign Installation shall be full compensation for furnishing all labor, materials, tools, equipment, fastening hardware, all necessary sign support accessories, stringers, post ties and incidentals, and for performing all the work involved in installing the Metro Street Name Sign panels, complete in place, as shown on the plans and as specified.

Part 400 add the following new Section:

SECTION 470

GENERAL REQUIREMENTS FOR TRAFFIC SIGNAL AND INTERSECTION LIGHTING SYSTEMS

470.1 DESCRIPTION:

It is the purpose of this section to provide general information necessary for completion of the installation of traffic signals and intersection lighting in accordance with the details shown on the Traffic Signal Plan and the MCDOT Details.

All electrical systems and appurtenances shall be complete, functional and in operating condition at the time of acceptance.

470.2 DEFINITIONS:

The words defined in the following section shall for the purpose of these specifications have the meanings ascribed to them pertaining to signals and lighting.

470.2.1 Actuation: The operation of any type of controller initiated by a detector.

470.2.2 Back Plate: A thin metal strip extending outward parallel to the signal face on all sides of a signal housing to provide suitable background for the signal indications.

470.2.3 Controller: That part of the controller assembly, which performs the basic timing and logic functions for the operation of the traffic signal.

470.2.4 Controller Assembly: The cabinet and complete assembly for controlling the operation of a traffic signal, consisting of a controller unit, and all auxiliary and external equipment housed in a weatherproof cabinet.

470.2.5 Coordinated Traffic Signal System: A group of signals timed together to provide a specific relationship among signal phases.

470.2.6 Cycle: A complete sequence of signal indications.

470.2.7 Detector: A device for indicating the passage or presence of vehicles or pedestrians.

(A) Inductive Loop Detector: A detector capable of sensing the passage or presence of a vehicle by a change in the inductance characteristics of the wire loop.

(B) Magnetometer Vehicle Detector: A detector capable of being actuated by the magnetic disturbance caused by the passage or presence of a vehicle.

(C) Pedestrian Detector: A detector for pedestrians, usually of the push button type.

(D) Video Detector: Video Camera capable of detecting the presence or passage of vehicles or pedestrians.

470.2.8 Flasher: A device used to open and close signal circuits at a repetitive rate.

470.2.9 Flashing Feature: This feature, when operated, discontinues normal signal operation and causes a predetermined combination of flashing signal lights.

470.2.10 Interval: The part or parts of the signal cycle during which signal indications do not change.

470.2.11 Luminaire: The assembly, which houses the light source and controls the light emitted from the light source. Luminaires consist of a housing, lamp socket, reflector and glass globe or refractor when specified.

470.2.12 Manual Operation: The operation of a signal controller unit by means of a hand-operated switch.

470.2.13 Mounting Assembly: The framework and hardware required to mount the signal face(s) and pedestrian signal(s) to the pole.

470.2.14 Pedestrian Signal: A traffic control signal for the exclusive purpose of directing pedestrian traffic at signalized locations.

470.2.15 Pre-timed Controller Assembly: A controller assembly for operating traffic signals in accordance with a predetermined fixed-time cycle.

470.2.16 Red Clearance Interval: A clearance interval, which follows the yellow, change interval during which both the terminating phase and the next right-of-way phase display red.

470.2.17 Signal Face: An assembly controlling traffic in a single direction and consisting of one or more signal sections. Circular and arrow indications may be included in a signal assembly. The signal face assembly shall include back plate and visors.

470.2.18 Signal Indication: The illumination of a signal section or other device, or of a combination of sections or other devices at the same time.

470.2.19 Signal Section: A complete unit for providing a signal indication, consisting of a housing, lens, reflector, lamp receptacle and lamp, or LED unit.

470.2.20 Traffic Phase: A part of the time cycle allotted to any traffic movement or combination of movements receiving the right-of-way during one or more intervals.

470.2.21 Traffic-Actuated Controller Assembly: A controller assembly for operating traffic signals in accordance with the varying demands of traffic as registered with the controller unit by detectors.

470.2.22 Vehicle: Any motor vehicle normally licensed for highway use.

470.2.23 Yellow Change Interval: The first interval following the green right-of-way interval in which the signal indication for the phase is yellow.

470.3 REGULATIONS AND CODES: All electrical equipment shall conform to the current standards of the National Electrical Manufacturers Association (NEMA), National Electric Safety Code (NESC), Underwriters' Laboratory Inc. (UL), when applicable. All

material and workmanship shall conform to the requirements of the National Electric Code (NEC), Illumination Engineers Society (IES), Standards of the American Society for Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), requirements of the Traffic Signal Plan, these specifications, the special provisions, and to any other codes, standards, or ordinances which may apply. Whenever references are made to any of the standards mentioned, the reference shall be interpreted to mean the code, ordinance, or standard that is in effect at the time of the bid advertisement.

470.4 SOURCE OF SUPPLY:

The Contractor shall furnish all traffic signal material and equipment required to complete the work except as noted otherwise.

470.4.1 Quality Requirements: Only materials and equipment conforming to the requirements of these specifications shall be incorporated into the work. Material and equipment shall be new except as may be provided in the special provisions.

Maricopa County Department of Transportation reserves the right to reject proposed traffic signal material or equipment if, in the judgment of the Engineer any or all the following may apply:

- 1) The equipment does not meet the requirements of the specifications.
- 2) The material or equipment is not in the best interest of Maricopa County Department of Transportation and the public.
- 3) The material or equipment past field performance has been unsatisfactory.
- 4) The material or equipment is not compatible with the material or equipment presently in use, which may cause the need to purchase additional spare parts, provide additional training, and/or long term maintenance problems.

In addition, Maricopa County Department of Transportation reserves the right to pre-approve traffic signal material and equipment by brand name model or part number which in the judgment of the Engineer meets the intended purpose of these specifications. Pre-approved items are posted on MCDOT's website:

<http://www.mcdot.maricopa.gov/technical/home.htm>

Deviations from the pre-approved materials list, if any, will be listed in the project special provisions or construction plans.

470.4.2 Approval Of Material And Equipment: All traffic signal materials and equipment shall be approved by the Engineer prior to incorporation in the work. Any work in which materials or equipment not previously approved are used shall be performed at the Contractor's risk and may be considered as unauthorized and unacceptable and not subject to the payment provisions of the contract. Such materials or equipment may be subject to removal at the discretion of the Engineer.

The Contractor shall obtain the Engineer's approval before ordering or installing any material or equipment. The Contractor shall submit four (4) copies of each proposed material and/or equipment list, including shop drawings. Submittal shall be to the County at the pre-construction conference. To be acceptable, the list shall be complete

and comprehensive containing all items to be supplied on the project by the Contractor, including pre-approved items. MCDOT reserves the right to reject any incomplete or unclear material submittal. All items on the list shall be identified by manufacturer's part number, model, specification or other pertinent catalogue information. The materials from any catalog cuts shall be clearly indicated by the contractor. One (1) copy will be returned to the Contractor for further action.

All equipment or material specified or shown on signal plans, or other drawings, by brand name, part number, or model number is intended to be descriptive of the type and quality of material or equipment desired. Another equal brand name, part number, or model number may be substituted so long as it is in accordance with these specifications and is equal in form, fit, function, performance, reliability, and is approved by the Engineer.

The contractor shall provide complete wiring diagrams for controller assemblies and auxiliary controller cabinets at the time of delivery for testing. A mylar original and four sets of prints shall be provided with each controller assembly. The wiring diagram shall illustrate all circuits and components in detail. All components shall be identified by name or number so as to be clearly noted in the drawings.

It is the Contractor's responsibility to ensure adequate lead time in ordering signal equipment to prevent project delay. The Contractor shall notify the Engineer in the event signal equipment is not received in a timely manner.

470.4.3 Warranties and Guaranties: In addition to the requirement of Section 108.8 manufacturers warranties and guaranties furnished for material and equipment used in the work shall be delivered to the Engineer prior to acceptance of the project.

470.5 MARICOPA COUNTY FURNISHED MATERIAL AND EQUIPMENT:

Traffic signal material and equipment furnished by Maricopa County Department of Transportation or tested by Maricopa County Department of Transportation will be made available at the following address:

Maricopa County Department of Transportation Warehouse
Procurement Distribution Center
2222 South 27th Avenue
Phoenix, Arizona 85009-6357

The Contractor shall contact the MCDOT Traffic Signals Branch Manager (602) 506-8660 five working days prior to desired pick-up date to confirm the item list, availability, date and time. Warehouse hours for pick-up and delivery are 6:00 am – 2:00 pm Monday through Thursday. A map of the warehouse loading area will be made available upon request.

The cost of handling and placing all material and equipment, including pick-up by the Contractor is included in the contract price of the associated pay item. The Contractor using the Contractor's equipment shall load the furnished materials (poles, mast arms, etc.) onto the Contractor's vehicle for transportation to the project site. MCDOT personnel

shall not load the materials. The Contractor shall be responsible for any damage that occurs during the loading process.

The Contractor will be held responsible for all material and equipment received. The Traffic Signal Supervisor or designee will issue a receipt for the materials provided. All materials will be issued in serviceable condition; the Contractor will note any exceptions on the receipt. The receipt will be placed in the project file and a copy given to the Contractor. The cost to make good any shortages or deficiencies, from any cause whatsoever and for any damage which may occur after receipt will be deducted from any monies due or becoming due to the Contractor.

470.6 REMOVAL AND SALVAGE OF EXISTING FACILITIES:

The operation of existing or temporary traffic signals shall not be modified or disrupted without the consent of the MCDOT Traffic Signals Branch Manager. Existing signals to be replaced shall not be disconnected or dismantled until the new signal is operational and ready for turn on. The Contractor shall coordinate with the MCDOT Traffic Signals Branch Manager regarding allowable time and duration of any shutdown of existing traffic signals.

All removals shall be done in accordance with Section 350, and as shown on the Traffic Signal Plan. Any item noted on the Traffic Signal Plan to be salvaged shall be delivered to the County warehouse or as directed by the Engineer. Delivery to the County warehouse shall include unloading the salvaged materials at a designated warehouse location by the Contractor using the Contractor's own equipment. Two working days (forty-eight hours minimum) in advance of the intended date of delivery, the Contractor shall coordinate the proposed date, time and items to be delivered with the MCDOT Traffic Signals Branch Manager (602) 506-8660. Warehouse hours for receiving deliveries are 6:00 am – 2:00 pm Monday through Thursday. The address for the County warehouse is:

Maricopa County Department of Transportation Warehouse
Procurement Distribution Center
2222 South 27th Avenue
Phoenix, Arizona 85009-6357

470.7 INSTALLATION OF TRAFFIC SIGNALS AND RELATED ITEMS

470.7.1 General: The Contractor shall furnish labor and supervision with experience in the construction of the traffic signals and all materials, equipment, tools, transportation and supplies required to complete the work in an acceptable manner; within the time specified, and in full compliance to these specifications, terms of the contract, the Traffic Signal Plan and special provisions.

The contractor shall have on the work site at all times a competent supervisor capable of reading and thoroughly understanding the plans and specifications and thoroughly experienced in the construction of traffic signals. Unless waived by the special provisions, the Contractor's supervisor shall possess an International Municipal Signal Association (IMSA) Level II Traffic Signal Electrician Certification.

470.7.2 Traffic Signal Plan: The Traffic Signal Plan graphically describes the location of signal component parts, the equipment and materials to be used, and the standards for construction. The plans shall be supplemented by MCDOT Details or other drawing(s) deemed necessary for the acceptable completion of the work.

Where dimensions on the plans are given or can be computed from other given dimensions, they shall govern over scaled dimension.

After completion of the project the Contractor shall provide the Engineer with a set of as-built drawings on clean prints of the original drawings. The as-built drawing shall indicate in a neat and accurate manner all changes and revisions in the original design. As-built drawings shall be submitted before final payment for completed work will be made.

Part 400 add the following new Section:

SECTION 471

ELECTRICAL UNDERGROUND INSTALLATION

471.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing electrical conduit, and pull boxes for traffic signals and intersection lighting including jacking, drilling, excavating placing and compacting backfill material in accordance with the locations shown on the Traffic Signal Plan, requirements of these specifications, and MAG specifications.

471.2 MATERIALS:

471.2.1 Electrical Conduit: All conduit and conduit fittings shall be listed by UL, and conform to NEC standards. Except as specified below, all conduit to be installed underground or in concrete structures shall be rigid polyvinyl chloride (PVC) conforming to the requirements of UL 651 for Rigid Nonmetallic Conduit. PVC conduit and conduit fittings shall be Schedule 40, heavy wall, manufactured from high impact material and shall be rated for use at 90° C. High Density Polyethylene (HDPE) conduit will be considered for approval for directional boring applications.

All exposed conduit and conduit fittings to be installed above ground shall be rigid metallic type manufactured of galvanized steel conforming to requirements of UL 6 for Rigid Metallic Conduit and to NEC standards.

471.2.2 Conduit Warning Tape: Conduit warning tape shall be a four (4) mil inert plastic film specially formulated for prolonged use underground and shall be a minimum of 3 inches wide. All tape shall be highly resistant to alkalis, acids, and other destructive agents found in the soil.

Tape shall have a continuous printed message warning of the location of underground conduits. The message shall be in permanent ink formulated for prolonged underground use and shall bear the words, 'CAUTION--ELECTRIC LINE BURIED BELOW' in black letters on a red background.

471.2.3 Pull Boxes: Pull boxes, pull box covers and pull box extensions shall be constructed of polymer concrete with reinforced heavy-weave fiberglass in accordance with MCDOT Details 4711 and 4712. Pull boxes and covers shall be concrete gray color and rated for no less than 8,000 lbs. over a 10" x 10" area and be designed and tested to temperatures of -55° F. Material compressive strength shall be no less than 1584 ksf. Covers shall have a minimum coefficient of friction of 0.5. Pull boxes shall be stackable for extra depth. Covers shall be secured with two (2) 3/8 inch corrosion resistant metallic hex bolts with corrosion resistant metallic washers. The bolts shall be in accordance with the requirements of MCDOT Detail 4711.

The words "TRAFFIC SIGNAL" shall be cast in the pull box covers in 1-inch high letters.

At the request of the Engineer the Contractor shall furnish pull box plans and specifications.

Chipped or cracked pull boxes, covers and extensions will not be accepted.

471.2.4 Metal Junction Boxes: Metal junction boxes and covers for installation in concrete structures shall be fabricated from a minimum of 59 mils thick type 304 stainless steel. All seams shall be continuously welded and shall conform to the dimensions and details called out for or shown on the project plans. A neoprene gasket with a thickness of 1/8 inch shall fit between the box and the cover. The cover shall be made to fit securely and shall be held in place with a minimum of four stainless steel machine screws. Tabs for ease of installation may be attached to the junction box at the option of the contractor.

471.3 CONSTRUCTION:

471.3.1 Installation Of Electrical Conduit:

(A) General Requirements: Conduit shall be furnished and installed at the locations and of the sizes shown on the Traffic Signal Plan. Unless changes are necessary to avoid underground obstructions all underground conduit shall be installed in a straight line from pull box to pull box and/or from foundation to pull box and shall be of one continuous size. Any change in conduit routing must be approved by the Engineer and documented by the Contractor on as-built traffic signal plans.

All PVC conduit shall be stored and handled in an approved manner to minimize ultraviolet deterioration due to exposure to sunlight.

The PVC conduit shall be cut square and trimmed to remove all rough edges. PVC conduit connections shall be of the solvent weld type. Purple primer conforming to the requirements of ASTM F 656 shall be applied to the joined surfaces prior to use of cement. The joint cement shall be the gray PVC cement conforming to the requirements of ASTM D 2564. Where a connection is made to rigid metallic conduit, the coupling used shall be a PVC female adapter.

Expansion joint fittings shall not be installed in PVC conduit runs between pull boxes unless specified. Expansion joint fittings shall be installed in conduit runs in which both ends of the conduit are fixed in place, such as conduit runs between two foundations. Expansion joint fittings shall be installed in conduit runs which cross a concrete structure expansion joint. Approved expansion fittings shall allow for a linear thermal expansion of up to 6 inches.

Conduit embedded in concrete structures shall be securely attached to the reinforcing steel at intervals of approximately 12 inches. Expansion fittings shall be installed where conduit crosses expansion joints in the structure. Where bonding is not continuous, expansion fittings shall be provided with a bonding jumper of number 6 AWG flexible wire. Where it is not possible to use expansion fittings, sleeves of sufficient size shall be installed to provide a minimum ½ inch clearance between the conduit and the inside wall of the sleeve. The sleeve shall be discontinuous at the expansion joints.

All existing conduits and conduit embedded in concrete structures shall be cleaned out with a mandrel and blown out with compressed air.

Field PVC conduit bends shall be made without crimping or flattening, using the longest radius practical but not less than specified by the NEC. Collapsed conduit, no matter how small, is not acceptable. The number of bends between pull boxes or between pull box and foundations shall not contain more than equivalent of two quarter bends (180 degrees, total), including the bends at the pull boxes or foundations, unless authorized by the Engineer.

Conduit entering a pull box or foundation shall be fitted with a factory made 90 degree elbow with a minimum sweep radius per the table below:

<u>Conduit Size</u>	<u>Sweep Radius</u>
2 inches	10 inches
3 inches	13 inches

Conduit entering pull boxes shall terminate a minimum of 3" inside the box wall. The conduit shall be between 2" and 4" above the bottom of the pull box and shall be sloped to facilitate the pulling of conductors. Conduit entering through the bottom of a pull box shall be located near the sides and ends and extend no more than 4" above the bottom of the pull box including the length of the conduit bell end in order to leave the major interior portion clear. At all outlets, conduits shall enter from the direction of the run and allow for expansion and contraction.

Conduit for future use shall have a ¼ inch nylon rope and a No. 8 AWG bare copper wire installed that extends 24 inches beyond each end of the PVC conduit run. The pull rope and bond wire shall be coiled and inserted into the conduit so as to be easily recovered from either end. Conduit ends shall be capped with conduit end cap fittings after the pull rope is installed. Conduit end cap shall remain in place until wiring is started. When end caps are removed, PVC ends shall be provided with an approved conduit end bell. End bells shall be installed prior to the installation of the conductors. Approved insulated grounding bushings shall be used on steel conduit ends.

The Contractor shall place warning tape (as specified in Section 471.2.2) in all open trenches in which conduit is placed. All warning tape shall be buried at a depth of 6" to 8" below final grade.

Where conduit is to be installed under existing roadway pavement by jacking or drilling methods, the jacking and/or drilling pits shall be kept 2 feet clear of the edge of the pavement.

Conduit stub-outs under curbs or roadway edges for loop detection lead-in conductors shall conform to the requirements of MCDOT Details 4758 and 4759. Loop detection

conduit stub-outs shall not be installed until completion of curb and gutter work. A 3-inch "X" shall be chiseled into the curb directly over conduit located under curbs.

Installation of conduit for underground electrical service shall be in accordance with the Standard Details, as shown on the Traffic Signal Plan and in accordance with the requirements of the utility company providing electrical service. Conduit installed in railroad right-of-way shall be installed in accordance with the requirements of the railroad company.

(B) Conduit Depth Requirements: Conduits installed in protected areas such as behind curbs, under side-walks, etc., that are not subject to any vehicular traffic shall be at a minimum depth of 24 inches below final grade. Conduits installed under roadways, driveways, or any open area where there is the possibility of vehicular traffic, shall be installed at a minimum depth of 36 inches below final grade. When conduit cannot be installed at the minimum depth, it shall be completely encased in 3" of class C concrete in accordance with Section 725.

(C) Trenching, Backfilling and Compaction: Trenches shall not be excavated wider than necessary for the proper placement of conduit and pull boxes. Trenching shall be done in accordance with MAG Section 601. Backfilling, compaction and bedding of conduit runs shall be in accordance with MAG Section 601.4.9.

Open trench excavation across any existing paved areas, shall have two (2) parallel cuts made at a distance not to exceed 16 inches. All removal and replacement of existing paved areas shall be in accordance with Section 336.

Open trench excavation across an existing portland concrete area shall have two (2) parallel cuts made at a distance not to exceed 16 inches. All removal and replacement of existing portland concrete areas shall be done in accordance with Section 336.

After each excavation is complete and materials in place, the Contractor shall notify the Engineer for inspection, and under no circumstances shall any underground material or equipment be covered with fill without proper approval.

471.3.2 Installation of Pull Boxes: Pull boxes of the type specified on the Traffic Signal Plan shall be furnished and installed at the locations shown on the Plan. Pull boxes shall be installed in accordance with MCDOT Detail 4713. All relocation of pull boxes to avoid driveways and/or other structures shall be approved by the Engineer and documented by the Contractor on the as-built traffic signal plans.

Pull boxes shall be set and adjusted so that they are flush at curb or sidewalk grade. When no grade is established pull boxes shall be set as requested by the Engineer.

All pull box covers shall be secured with the required bolts and washers before final acceptance of the project.

All pull boxes shall be left in a clean condition, free of dirt and debris upon completion of the work.

471.4 MEASUREMENT:

Conduit will be measured by the linear foot for each diameter size.

Pull boxes will be measured as a unit for each pull box size.

471.5 PAYMENT:

The accepted quantities of conduit, measured as provided above, will be paid for at the contract unit price per linear foot, which shall be full compensation for the item, COMPLETE IN PLACE, including excavation, concrete encasement required due to insufficient depth, backfill, warning tape, pull rope or bond wire and any incidentals necessary to complete the work. No direct payment will be made for rigid metal conduit bends or rigid non-metallic conduit bends at pull boxes, expansion fittings and coupling fittings, the cost being considered as included in the contract price for the conduit.

The accepted quantities for pull boxes, measured as provided above, will be paid for at the contract unit price, which shall be full compensation for the item, COMPLETE IN PLACE, including excavating, backfilling, and restoration of disturbed landscaping.

Part 400 add the following new Section:

SECTION 472

TRAFFIC SIGNAL FOUNDATIONS

472.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials and constructing all traffic signal foundations and other designated pole foundations including signal poles, cabinet and electrical service pedestal foundations for the traffic signals, and intersection lighting system in accordance with the locations and details designated on the Traffic Signal Plan, MAG Specifications, and the requirements of these specifications.

Pole foundations shall include all conduit, conduit elbows, anchor bolts, re-bar cages, grounding electrode, and forms required for construction of the foundation. The traffic signal pole foundations shall conform to the requirements of MCDOT Details 4720 and 4721.

The controller and combination service pedestal and battery back-up system cabinet foundations shall conform to the requirements of MCDOT Details 4723 and 4724.

472.2 MATERIALS:

472.2.1 Excavation and Backfill: Trenches shall not be excavated wider than necessary for the proper placement of conduit and pull boxes. Trenching, backfilling and compaction shall be done in accordance with Section 601.

All excavations within the roadway shall be backfilled and compacted in accordance with Section 211.

472.2.2 Concrete: Concrete used for all foundations shall be class 'A' concrete and shall be in accordance with the requirements of Section 725.

472.2.3 Anchor Bolts: All anchor bolts shall meet or exceed the minimum requirements of ASTM F1554 Grade 105, shall be hot dip galvanized in accordance with the requirements of ASTM A153. Anchor bolts shall be in accordance with referenced details, for standard traffic signal foundations see Details 4725 and 4726. Welding shall not be performed on any portion of the body of anchor bolts.

Certificates of Analysis conforming to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted for high strength anchor bolts, washers and nuts.

472.2.4 Rebar Cage: All rebar cages shall be in accordance with MCDOT Detail 4721.

472.2.5 Electrical Conduit: All electrical conduit and conduit fittings shall be in accordance with these specifications.

472.2.6 Grounding Electrode: The grounding electrode shall be in accordance with these specifications and MCDOT Details 4720, 4721, 4723 and 4724.

472.3 CONSTRUCTION:

The excavations required for the installation of foundations and other items shall be performed in such a manner as to avoid any unnecessary damage to streets, sidewalks, landscaping and other improvements. Any damage by the contractor's operation shall be replaced or reconstructed where determined by the Engineer at the expense of the contractor. The trenches shall not be excavated wider than necessary for the proper construction of the foundations and other equipment. Excavation shall not be performed until immediately before construction of foundations. The material from the excavation shall be placed in a position that will minimize obstructions to traffic and interference with surface drainage.

All surplus excavated material shall be removed and properly disposed of within 48 hours by the contractor, as directed by the Engineer. After each excavation is completed, the contractor shall notify the Engineer for inspection, and under no circumstances shall any underground materials or equipment be covered with fill without the approval of the Engineer.

Excavation and backfill shall be in accordance with the requirements of Section 105.12. At the end of each working period, all excavations shall be barricaded or covered, or both, to provide safe passage for pedestrian and vehicular traffic.

Excavations in the street or highway shall be performed in such a manner that not more than one traffic lane is restricted at any time, unless otherwise provided in the Special Provisions.

Sidewalk and pavement excavations shall be kept well covered and protected to provide safe passage for pedestrian and vehicular traffic until permanent repairs are made.

The elevation of signal and lighting pole foundations shall be set as follows unless otherwise noted within the construction plans or special provisions. Signal and lighting pole foundations shall be set flush with the existing or new sidewalk when sidewalk is present. Where curb exists without sidewalk, the foundations shall be set flush with a surface defined by a 1.5% upward slope from the top of curb. Where there is no curb or sidewalk pole foundations shall be as shown on the project plans. The dimensions and locations of foundations shall be as specified on the project plans; however, the Engineer may direct that changes be made in locations due to obstructions or other existing conditions. Any change in locations shall be documented by the contractor on as-built traffic signal plans. The contractor shall verify top of foundation elevations with the Engineer prior to foundation construction.

Concrete shall be placed in holes which have been augured against undisturbed earth. If the material in the bottom of the hole is not firm and stable, it shall be compacted or treated as directed by the Engineer. The walls and the bottoms of the holes shall be thoroughly moistened prior to placing concrete.

If the soil is not stable, a deeper foundation than specified may be required or forms shall be used as determined by the Engineer. The forms shall be of the proper size and dimensions and shall be rigid and securely braced.

Foundation forming material shall extend no more than 20 inches below the foundation final grade and shall be removed after placement and curing of concrete.

Anchor bolts shall be oriented such that the bolt pattern sides are both parallel and perpendicular to the roadway centerlines unless otherwise specified on the Traffic Signal Plan. A 25-foot coil of No. 4 AWG bare copper conductor shall be installed below the foundation and covered with fill material such that no part of the coils will be in contact with the concrete foundation. An extension of the No. 4 AWG bare copper wire shall extend into the pole. Anchor bolts, conduit and rebar cage shall be centered within the foundation, set at the specified height and plumb within $\pm 1/2$ degree. During placement of concrete, anchor bolts shall be securely held in proper alignment, position, and height with a suitable template.

After excavations are completed and anchor bolts and conduit installed, the Contractor shall notify the Engineer for inspection. Under no Circumstances shall concrete be placed without approval of the Engineer.

The concrete pour shall be continuous and consolidated by means of vibrators. All exposed surfaces of the foundation shall receive a finish that is smooth, level, and free of form marks.

Type 'A' and 'SB' pole foundations, type 'P' cabinet foundation, and type 'SP' service pedestal foundation shall set for a minimum of three (3) days prior to installation of poles and/or cabinets. Type 'E', 'F', 'J', 'Q', 'K' and 'R' pole foundations shall set for seven (7) days prior to installation of poles.

Before the concrete for the cabinet foundation has set, depressions shall be made around the anchor bolts for adjustment of the cabinet leveling nuts in accordance with MCDOT Detail 4723.

472.4 MEASUREMENT:

Foundations for traffic signals and intersection lighting system will be measured as a unit for each type of foundation constructed.

472.5 PAYMENT:

The accepted quantities of foundations for traffic signal and intersection lighting system, measured as provided above, will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE, including excavations, backfill and incidentals necessary to complete the work.

No measurement or direct payment will be made for anchor bolts or re-bar cages, the cost being included in the unit price paid for foundations.

Part 400 add the following new Section:

SECTION 473

DETECTORS

473.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing vehicular and pedestrian detectors at the locations shown on the Traffic Signal Plan and in accordance with the requirements of these specifications.

473.2 MATERIALS:

473.2.1 Loop Detector Sensor: Loop detector sensors shall be of the size and type specified on the Traffic Signal Plan and shall conform to the requirements of MCDOT Detail 4757. The conductors for inductive loop detection and the loop detector lead in cable shall be as specified by Section 478.2.1.

Roadway loop detector sensor wire shall conform to IMSA specification 51-5 and installed in accordance with the requirements of these specifications and MCDOT Details 4757, 4758, and 4759.

473.2.2 (A) Hot Applied Rubberized Sealant: The saw cut loop sealant shall be a hot applied rubberized asphalt formulated specifically for use as a loop sensor saw cut sealant. The sealant shall be non-tracking during application and relatively stiff but flexible after application at low pavement temperatures. At application temperatures the sealant shall be a thin, free flowing fluid which penetrates the saw cut, encapsulating the loop conductors and self-levels permitting uniform and easy application.

The sealant shall be applied using a pressure feed melter/applicator equipped with a heated hose and handgun control.

When heated in accordance with ASTM D3407 the sealant shall meet the following physical properties:

SPECIFICATIONS

TEST PARAMETER	LIMITS	TEST METHOD
Cone Penetration, TIF 150g, 5 sec; .004 inch	35 max	ASTM D 3407, Sec. 5
Flow, 140F, SM; inch	0.2 max	ASTM D 3407, Sec. 6
Resilience, TIF	30% min	ASTM D 3407, Sec. 8
Softening Point	180°F min	ASTM D 2398
Ductility, TIF 2"/min	12" min	ASTM D 113
Mandrel Bend	Pass	SEE NOTE BELOW
Pour Temperature	379°F	
Safe Heating Temperature	410°F	

NOTE: A sample of sealant is poured in a 0.12 inch thick by 1.0 inch wide and 4.0 inches long configuration on a glycerin coated brass plate using appropriate molds. The specimen is removed from the molds, placed in a freezer maintained at 0°F ±2°F

for one (1) hour. To test, remove the specimen from the freezer and immediately bend over a 1-inch diameter mandrel through a 180-degree arc in five (5) seconds at a uniform rate. To pass the test, the sample shall not show any cracks.

473.2.2(B) Optional Cold Applied Emulsion Sealant: As an alternative sealant, the loop sealant shall be a single component asphaltic emulsion sealant designed to fill and seal inductive loop saw cuts. Loop sealant shall be “Tri-American TA-500” or approved equal.

SPECIFICATIONS

TEST PARAMETER	LIMITS	TEST METHOD
Residue by evaporation, weight percent	70 min	ASTM D 2939
Ash content, weight percent	50 min	ASTM D 2939
Firm set time, hours	4 max	ASTM D 2939
Brookfield viscosity, Poise RVT Spindle #3, 10 RPM at $75 \pm 2^\circ \text{F}$	50 to 125 $^\circ \text{F}$	
Tensile strength, psi,	20 min	ASTM D 2523
Elongation, %	2.0 min	ASTM D 2523
Flexibility	No full depth cracks	ASTM D 2939 SEE NOTE BELOW
Resistance to water	No blistering, re-emulsification or loss of adhesion	ASTM D 2939, Alternative B

NOTE: Flexibility: Except air-dry specimens to constant weight at $75^\circ \pm 5^\circ \text{F}$ and $50^\circ \pm 10^\circ \text{F}$ relative humidity. Condition the mandrel and specimens for 2 hours at $75^\circ \pm 2^\circ \text{F}$ before test.

473.2.3 Pedestrian Detectors: All pedestrian push buttons shall be in accordance with the Americans with Disabilities Act Accessibility Guidelines (latest revision).

The housing of the push-button station shall be of substantial tamper-proof construction made of cast aluminum. The assembly shall be weather-proof and so constructed that it will be impossible to receive any electrical shock under any weather conditions. The housing shall be shaped to fit the curvature of the pole to which it is attached and shall provide a rigid installation. The housing body shall contain a direct push-type actuator button, microswitch-type or approved equal. The housing cover shall contain the push-button sign as described below.

Pedestrian push-button signs shall be fabricated from 5052-H38 Aluminum Alloy conforming to the requirements of ASTM B209, 6 inches by 12 inches in size. Corners of the sign shall be finished round for safety and neat appearance. Panel facing shall be prepared and covered with High Intensity Prismatic retroreflective sheeting. Instructions on the signs shall be black letters and orange symbols on a white background. The legend shall be as indicated by the plans.

The standard pedestrian detector shall be a push-button switch mounted inside an approved push-button housing. The switch shall be the phenolic-enclosed SPST-type with momentary contacts. The contacts shall be rated at 15 amps and 125 volts AC.

The switch shall have screw-type terminals and shall have a rated life of not less than one million operations. The switch shall operate in the normally open position.

Audible pedestrian detectors shall provide 4-wire interface inside an approved housing. Audible detectors shall have ambient gain compensation for the pushbutton locator tone, audible walk tone, and programmable message. They shall have a tactile arrow and vibro-tactile indication during the walk cycle.

473.2.4 Video Detectors: The video image detector system shall include cameras with environmental enclosures, mounting hardware, the image processor, software, cables, surge protection, lightening protection, together with other accessories as required by project plans or special provisions.

The number of cameras for the video image detection system will be based on the plans or as directed by the Engineer.

The video image detector system shall be an approved system identified on the MCDOT Approved Materials List, available on the MCDOT website
<http://www.mcdot.maricopa.gov/technical/home.htm>

473.2.4.1 Mounting Locations: The contractor shall confirm with the Engineer the exact location for mounting each video detection camera before ordering equipment.

473.2.4.2 Cables: The cables for power and control shall comply with the video detection camera manufacturer's specifications. A single cable of an appropriate length without splices shall connect each video image detector with the control cabinet.

The cables for video detection equipment shall either conform to requirements for Coaxial Cable and Power Cable [(A) and (B)] or for Video over Power Cable (C):

(A) Coaxial Cable:

1. Conductor: 20 AWG Solid BC (Bare Copper), 0.78 mm diameter
2. Insulation: Polyethylene 5.02 mm diameter
3. Outer Shield: Two layers of braided TC (Tinned Copper), 98% coverage
4. Outer Jacket: Polyethylene
5. Operating Temperature Range: -55 to +80 degree C
6. Non-UL Temperature Rating: 80 degree C

(B) Power Cable:

1. Conductors: 16 AWG fully annealed stranded bare copper, Class K stranding per ASTM B 174
2. Insulation: Oil resistant Thermoplastic Elastomer (TPE)
3. Jacket: Water, sunlight, and oil resistant, flame-retardant Thermoplastic Elastomer (TPE).

(C) Video Over Power Cable:

1. Conductors: 18 AWG fully annealed stranded bare copper, Class K stranding per ASTM B 174.
2. Jacket: Polyethylene.

473.3 CONSTRUCTION:

473.3.1 Vehicular Loop Detector Sensors:

(A) General: Vehicular loop detector sensors of the size and type specified on the Traffic Signal Plan shall be installed in accordance with the locations shown on the Traffic Signal Plan and the requirements of these specifications. Any change in loop detector sensor location or deviation in loop detector sensor installation not in accordance with these specifications must be approved by the Engineer and documented by the Contractor on as-built signal plans. The installation of the detectors shall be such that the operation shall not be affected by temperature changes, water, ice, rain, snow, chemicals, or electromagnetic noise.

(B) Loop Detector Sensor Conductor Installation: The loop detector sensor conductors shall be installed prior to the placement of a finishing course or overlay when the project includes the installation of a finishing course or overlay. The loop detector sensor conductors shall be installed in accordance with MCDOT Detail 4757. All saw cuts shall be made with an abrasive type saw. The sawed slot shall extend to the curbside PVC conduit for each loop sensor. Separate lead-in sawed slots extending from the loop to the stub-out conduit shall be cut for each loop sensor. To ensure that all saw cuts are true and straight a loop sensor layout shall first be made on the pavement surface.

All corner points shall be cored drilled at full depth of the loop saw cut or have diagonal and corner saw cuts with overlap such that the sawed slot is at full depth through all turn points.

The sawed loop sensor slot and drill points shall be flushed clean of all debris with a high-pressure stream of water and completely dried by means of an air stream prior to installation of loop sensor conductors.

After the sawed slot is dry and free of debris, wind the specified number of wire turns into the sawed slot in accordance with the details shown on MCDOT Detail 4757. Wind loops which are in close proximity in opposite directions, (i.e. No. 1 clockwise, No. 2 counter clockwise, etc.). This may be accomplished by reversing loop "start-finish" lead-in conductors at the curb-side pull box.

The lead-in conductors from the loop sensor to curb-side pull box shall be continuous and twisted a minimum of six turns per foot in the lead-in saw cut and under curb stub out conduit.

(C) Sawcut Sealant: The loop sensor conductors shall be permanently anchored in the sawed slot using the hot applied rubberized asphalt or cold applied single component emulsion sealant as specified. The sealant shall completely surround the loop sensor conductors and fill the sawed slot to within 1/8 inch of the pavement surface. Surplus sealant shall be removed from the road surface without the use of solvents. Traffic lane closure shall remain in place until the sealant has set up; Contractor shall cleanup

sealant tracking problems at no additional cost to the County. During hot weather, when approved by the Engineer, a sand blotter may be used.

(C.1) Hot Application: The sealant shall be applied with a sealant melter/applicator which melts the sealant and pressure applies the sealant at 379° F via a heated hose and applicator handgun control. The handling of the sealant melter/applicator and the filling of the saw slot shall be in accordance with the directions of the melter/applicator manufacturer.

(C.2) Cold Application: The emulsion sealant shall be thoroughly mixed per the manufacturer's recommendations. The emulsion sealant may be poured directly from container or any other suitable applicator, applied into sawcuts.

(D) Loop Detector Sensor Connection: Each pair of loop sensor conductors entering the curb-side pull box shall be identified as to which loop it represents (i.e. inside lane, outside lane, through lane, or left turn lane). Each conductor pair shall also be marked to signify its winding direction, "S" for start and "F" for finish. Marking identification tags shall be in accordance with Section 478.2.1.

The loop sensor conductors shall be spliced to the detector lead-in cables in the adjacent curb-side pull box. Detector lead-in cable shall run continuous and unspliced from curb-side pull box to the controller cabinet.

Unless otherwise specified or requested, the maximum number and size of loop detector sensors connected to a detection channel shall be as follows:

LOOP SIZE	LEAD-IN LENGTH	LOOPS PER CHANNEL	LOOP USE
6.0 ft. x 6.0 ft.	500 ft. or less	1	Advance detection
6.0 ft. x 6.0 ft.	500 ft. or greater	1	Advance detection
6.0 ft. x 40.0 ft.	200 ft. or less	1	Call detection
6.0 ft. x 40.0 ft.	200 ft. or greater	1	Call detection
6.0 ft. x 50.0 ft.	As required and greater	1	Left turn detection

All detector wire splices will be made by the MCDOT Signal Shop at time of acceptance of the detectors

(E) Loop Detector Sensor Field Test: Before and after sealing the saw cut the Contractor shall perform an insulation resistance to ground test. The insulation resistance to ground shall be at least 50 mega-ohms measure at a voltage between 400 and 500 volts D.C. Any loop detector sensor not meeting the above insulation test or

fails to tune when connected to a loop detector amplifier unit shall be replaced by the Contractor at no cost to Maricopa County Department of Transportation.

473.3.2 Pedestrian Detectors: The type of pedestrian push button detector indicated (with sign) shall be installed at locations shown on the plans in compliance with the referenced detail.

473.3.3 Video Detectors Camera Installation: Video detection cameras shall be installed per the manufacturer's installation requirements and as shown in MCDOT Detail 4755.

The Contractor shall install all mounting equipment and adapter plates needed to securely mount each video detector to the luminaire mast arm of the traffic signal pole or other structure as indicated on the project plans.

The video image detection control panel and cable connections shall be installed in the traffic signal cabinet.

Terminals and connectors shall be installed on cabling at the cameras, the control panel, and controller cabinet. The video detector shall be bound to the mounting bracket or pole.

The camera shall be adjusted to view approaching or receding traffic or both as directed by MCDOT.

Surge protection equipment shall be installed on the rack-mounted Control Panel in the traffic signal controller cabinet. The Contractor shall install in the Control Panel the connections for surge protectors for all conductors (power, data, and video) that run between the pole mounted cameras and the cabinet-mounted machine vision processor.

The surge protector shall be grounded to a terminal block mounted to the cabinet rack. The terminal block shall be bonded directly to the cabinet ground using a #14 AWG copper ground wire. The surge protector leads shall be installed in a straight line on the wall of the traffic signal cabinet.

The Contractor shall coordinate the programming of the video image detection areas/zones by factory approved technical staff. All video shall be tested and operational prior to and on the day of signal activation.

473.4 MEASUREMENT:

Vehicular and pedestrian detectors will be measured as a unit for each type of detector furnished and installed.

Video detection system will be measured as a unit for each signalized intersection based on the number of intersection legs equipped with video image detection.

473.5 PAYMENT:

The accepted quantities of detectors measured as provided above, will be paid for at the contract unit price. Payment shall be full compensation for all labor, materials, and equipment required for the installation and testing, COMPLETE IN PLACE.

Part 400 add the following new Section:

SECTION 474

TRAFFIC SIGNAL POLE INSTALLATION

474.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing traffic signal poles, mast arms, and modifying multi-use poles in accordance with the plans, the referenced details, the special provisions, and these specifications.

Poles shall include a shaft, base, mast arms (if required), and other hardware required to support the traffic signal apparatus or other supported items.

474.2 GENERAL STANDARD:

Steel poles for traffic signals and highway lighting shall include pole shafts, mast arms, and pole bases.

Material standards for traffic signal and lighting supports shall be in conformance with the 2011 Interim Revisions to the (2009) 5th edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. All pole supports shall be designed to withstand the minimum wind load of the 3-second gust wind speed of 90 mph for Exposure C category in any direction.

All welding design, fabrication and inspection of welding for structural steel shall be performed in accordance with the requirements of the 2012 Interim Revisions to the (2010) 6th edition of the AASHTO/AWS D1.5M/D1.5 Bridge Welding Code.

The use of electro-slag welding process on structural steel will not be permitted.

474.3 TYPES OF POLES:

Types of poles to be furnished are as follows:

1. Type 'A', Standard Detail 4738
2. Type 'E', Standard Detail 4740
3. Type 'F', Standard Detail 4741-1
4. Type 'J', Standard Detail 4742
5. Type 'Q', Standard Detail 4743
6. Type 'K', Standard Detail 4748
7. Type 'R', Standard Detail 4749-1
8. Type 'PB' Standard Detail 4750

(A) Pole Shafts: The tapered pole shafts shall be fabricated from sheet steel of weldable grade which shall meet or exceed the minimum strength requirements of ASTM A36 for all poles except for Type K and Type R poles. The Type K and Type R poles shall be constructed from sheet steel that has a minimum yield stress after fabrication of 48 ksi. A taper rate of 0.125" minimum to 0.140" maximum change in diameter per linear foot is required unless otherwise specified. Pole shafts shall be fabricated according to the thickness requirements shown on the Standard Details.

Standard pipe pole shafts for Type A poles shall be fabricated from standard weight structural steel which conforms to the minimum strength requirements of ASTM A53, Grade B and an outside diameter in inches as indicated on the Standard Details. Each section shall be fabricated from not more than two pieces of sheet steel. When two pieces are used, the longitudinal welded seams shall be directly opposite one another. When the sections are butt-welded, seams shall be directly opposite one another. When the sections are butt-welded together, the longitudinal welded seams on adjacent sections shall be placed to form continuous straight seams from base to top of pole. Pole shafts shall be straight, with a permissive variation not to exceed 1-inch measured at the midpoint.

Pole shafts shall be galvanized in accordance with the requirements of ASTM A123. The visual appearance of the galvanized finish shall be uniform. Discoloration of the galvanized finish such as dark areas, dark streaks, dark rings or transportation handling marks, which are considered excessive by the Engineer, shall not be allowed. Pole shafts that have a finish unacceptable to the Engineer shall either be repaired or replaced to the satisfaction of the Engineer at no additional cost to the Department.

Hand holes in the base of the poles shall conform to the details shown on the Standard Details. All welds shall be continuous and any exposed welds, except fillet welds, shall be ground flush with the base metal.

A metal tag shall be permanently attached to the pole above the hand hole stating the manufacturer's name, pole type per the Department's plan, pole drawing number, shaft length and inches of material thickness.

(B) Standard Bases: Poles shall have standard bases fabricated from structural steel plates per MCDOT Details, and conform to the minimum strength requirements of ASTM A36. Exposed surfaces shall be finished smooth and all exposed edges shall be neatly rounded to a 1/8 inch radius. Standard bases shall be galvanized in accordance with the requirements of ASTM A123.

(C) Foundation Attachment: Foundation anchor bolt washers and nuts shall be fabricated from steel which meets or exceeds the minimum requirements of ASTM F1554 Grade 105 unless noted otherwise and shall be hot dip galvanized in accordance with the requirements of ASTM A153. Welding shall not be performed on any of the anchor bolts.

(D) Mast Arms: The tapered mast arms shall be fabricated from sheet steel conforming to the requirements of ASTM A36. The mast arms for the Type K and Type R poles shall be constructed of sheet metal with a minimum yield stress of 48 ksi after fabrication. Mast arms shall be fabricated according to the thickness requirements shown on the MCDOT Details. A taper rate of 0.125" minimum to 0.140" maximum change in diameter per foot is required unless otherwise specified. All bolts, washers and nuts for mast arms shall be fabricated from steel conforming to the requirements of ASTM A325 and shall be hot dip galvanized in accordance with the requirements of ASTM A153.

Mast arms shall be galvanized in accordance with the requirements of ASTM A123. The visual appearance of the galvanized finish shall be uniform. Discoloration of the galvanized finish such as dark areas, dark streaks, dark rings or transportation handling marks which are considered excessive by the Engineer shall not be allowed. Mast arms

that have a finish unacceptable to the Engineer shall either be repaired or replaced to the satisfaction of the Engineer at no additional cost to the County.

Mast arms shall be bent to the dimensions and curvature shown on the MCDOT Details.

A metal tag shall be permanently attached on the side of the mast arm near the base stating the manufacturer's name, pole type per the Department's plan, mast arm or pole drawing number, length and material thickness.

(E) Luminaire Mast Arms: The tapered mast arms for the luminaires shall be fabricated from sheet steel conforming to the requirements of ASTM A36. Mast arms shall be fabricated according to the thickness requirements shown on the MCDOT Details. A taper rate of 0.125" minimum to 0.140" maximum change in diameter per foot is required unless otherwise specified. All bolts, washers and nuts for mast arms shall be fabricated from steel conforming to the requirements of ASTM A325 and shall be hot dip galvanized in accordance with the requirements of ASTM A153.

Luminaire mast arms shall be galvanized in accordance with the requirements of ASTM A123.

Mast arms shall be bent to the dimensions and curvature shown on the MCDOT Details.

A metal tag shall be permanently attached on the side of the mast arm near the base stating the manufacturer's name, pole type as required on the plans, mast arm or pole drawing number, length and thickness in inches.

474.4 WARRANTIES:

Each type 'A', 'E', 'F', 'J', 'Q', 'K', 'R' and 'PB' signal pole shall be warranted by the manufacturer against all defects in material and workmanship for a period of twelve (12) months and in accordance with the requirements of Section 108.8.

474.5 CONSTRUCTION:

474.5.1 Base Plates and Poles:

High strength bolts, nuts, and washers for bases shall be assembled as specified in the Standard Details. Anchor bolts and nuts are to be drawn down tight to produce a snug-tightened joint. Anchor bolts, washers, and nuts required for relocating existing poles shall be furnished by the contractor.

Poles shall be drilled and tapped for mounting hardware as shown on the Standard Details.

Sidewalks, curbs, gutters, pavement, base material, lawns, plants, and any other improvements removed, broken, or damaged by the contractor's operations shall be replaced or reconstructed.

Where existing pole installations are to be modified, materials and equipment shall be used, salvaged, or disposed of as specified in the Special Provisions and as directed by the Engineer.

Existing poles shall be either relocated or used in place as specified in the project plans. The contractor shall inspect the poles and provide the materials and work necessary to recondition the poles so they can be reused. Holes left in the shafts of existing poles, due to removal of items such as signal mounting assemblies, shall be repaired and painted with zinc galvanized paint.

If any poles are damaged by the contractor's operations, such repairs or replacements shall be at no additional cost to the Department.

New poles that are damaged by improper drilling of holes will be rejected.

474.5.2 Signal Poles and Mast Arms: Installation of traffic signal poles shall be scheduled at a time that minimizes disruption of traffic and minimizes exposure of the travelling public to potential harm. Traffic signal pole installation shall occur during nighttime hours unless prevented by local ordinances or regulations or an alternative time is approved by the Engineer.

Poles and mast arms shall be of the type shown on the Traffic Signal Plan and shall be installed in accordance with the MCDOT Details.

Poles shall be drilled and tapped for mounting of hardware. The use of a welding torch is not authorized.

All poles shall be plumbed to the vertical with all mast arms, signal heads, and luminaires installed. When mast arms are bolted to the pole shaft, the mast arm end over the roadway shall adjust to the horizontal.

474.6 MEASUREMENT:

Poles for traffic signals will be measured as a unit for each type pole installed, COMPLETE IN PLACE. The poles including signal and luminaire mast arms, base plates and all materials required shall be furnished by the contractor unless otherwise indicated.

474.7 PAYMENT: The accepted quantities of poles will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE.

Part 400 add the following new Section:

SECTION 475

ELECTRICAL POWER SERVICE AND CONTROLLER CABINET INSTALLATION

475.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing electrical power service equipment in accordance with the location and details on the Construction Plans, MCDOT Details, the requirements of these specifications, and the specifications of the utility company serving the location, and the picking up, installing and wiring of the controller cabinet assembly in accordance with the type and location as designated on the Construction Plans and the requirements of these specifications.

475.2 MATERIALS:

475.2.1 Electrical Service Pedestal System: Each electrical service pedestal system consists of the cabinet, electrical service equipment wiring and wiring devices.

Combination Electrical Service Pedestal and Battery Back-Up Cabinet: The combination underground service meter pedestal and battery back-up cabinet shall be TESCO catalog number 27-000/22-000 or pre-approved equal, consisting of the meter socket, circuit breaker panel, test bypass facilities, pedestal locking device, ground mount enclosure, batteries, full power by-pass, isolation module and necessary fittings all of which shall conform to the requirements of Detail 4731-1, Traffic Signal Plans, and the project Special Provisions.

Service Pedestal Cabinet: The underground service meter pedestal cabinet shall be TESCO catalog number 26-000 or pre-approved equal, consisting of the meter socket, circuit breaker panel, test bypass facilities, pedestal locking device, ground mount enclosure and necessary fittings all of which shall conform to the requirements of Detail 4829-1, Construction Plans, and the project Special Provisions.

Electrical service equipment wiring and wiring devices shall be in conformance with NEMA, the NEC, MCDOT Details and the specifications of the utility company providing electrical service.

(A) Breakers: All circuit breakers shall have an interruption capacity of 10,000 amperes and supplied as indicated in the wiring schematic diagram.

(B) Meter Loop Assembly: The meter loop assembly shall be bonded and grounded in accordance with the requirements of these specifications.

(C) Conductors: Conductor size and color shall be as specified on the Traffic Signal Plan conductor schedule and in accordance with the requirements of these specifications. All electrical apparatuses shall be UL listed.

475.2.2 Controller Cabinet Assembly: The Controller Cabinet Assembly shall include a weatherproof cabinet. Cabinet type and configuration shall be supplied as specified by the Construction Plans, Standard Details, and in accordance with these specifications.

The Contractor shall deliver the signal controller and controller cabinet assembly to Maricopa County Department of Transportation's Traffic Signal Operations section located at 2909 W. Durango Street, Phoenix, Arizona for final configuration testing and programming. The Contractor shall coordinate the proposed delivery date and time with the MCDOT Traffic Signals Branch Manager (602) 506-8660 at least 1 week prior to the Contractor's anticipated installation date.

475.3 CONSTRUCTION:

475.3.1 Electrical Service Pedestal System

Combination Service Pedestal and Battery Back-Up System: The electrical service meter pedestal and battery back-up system shall be assembled and installed on a concrete foundation at the location shown on the Traffic Signal Plan and in accordance with Detail 4724.

Service Pedestal System: The electrical service meter pedestal shall be assembled and installed on a concrete foundation at the location shown on the Traffic Signal Plan and in accordance with Detail 4829-2.

475.3.2 Controller Cabinet Assembly: The Contractor shall notify the Engineer five (5) days in advance of the intended date the Contractor is to pick up the Controller Cabinet Assembly. The wired cabinet shall be in accordance with the requirements of these specifications.

The controller cabinet assembly shall be picked up at the following address:

Maricopa County Department of Transportation
Traffic Signal Operations
2909 W. Durango Street
Phoenix, Arizona 85009-6357

Contractor shall install the controller cabinet assembly. After the installation and leveling of the controller cabinet, an approved non-shrink type grout shall be placed between the cabinet and foundation.

Contractor shall be responsible for connecting all of the field wiring, except the loop detector lead-ins, to the cabinet terminals. The traffic signal controller will be installed by MCDOT. The Engineer will test the connections before accepting the Controller Cabinet Assembly pay item.

475.4 MEASUREMENT:

Controller cabinet assemblies will be measured as a unit for each type installed.

Each type of Electrical Service Pedestal System installed and accepted will be measured as a unit.

475.5 PAYMENT:

The accepted quantities for the installation of the controller cabinet assemblies, measured as above, will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE.

The accepted quantities for each type of electrical service pedestal system will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE.

Part 400 add the following new Section:

SECTION 476

SIGNAL INDICATIONS AND MOUNTINGS

476.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing vehicular and pedestrian traffic signal indications and mounting assemblies in accordance with the types and locations shown on the Traffic Signal Plan, MCDOT Details 4773, 4774, 4775, 4776, 4778-1, 4778-2, 4794, and 4795 and the requirements of these specifications. Signals, except pedestrian type, for newly signalized intersections shall be of the same manufacturer and of the same material.

476.2 MATERIALS:

476.2.1 Vehicular Traffic Signal Heads: Vehicular traffic signal heads shall be assembled of standard 12 inch lens size signal sections with the number of sections or combination of sections specified on the Traffic Signal Plan, MCDOT Detail 4773 and the requirements of the Manual on Uniform Traffic Control Devices.

The optical performance and design of signal heads shall conform to the requirements of the Institute of Transportation Engineers Standards for Vehicular Traffic Control Signal Heads (ITE Publication No. ST-008B), the Traffic Signal Plan and the provisions of these specifications.

(A) Housing: A standard 12 inch signal section shall be a one (1) piece housing with hinged door for housing all optical and electrical components.

Both the one (1) piece signal section housing and door shall be fabricated of corrosive resistant die cast aluminum conforming to Institute of Transportation Engineers Standards. The top and bottom of the housing shall have openings to accommodate standard 1½ inch pipe fitting. Each opening shall have a locking "Shurlock" boss integrally cast into the housing section.

A snap-in, swing-out cast aluminum reflector ring, supported by stainless steel hinge pins shall be provided. The hinge pins shall be supported by mounting lugs integrally cast on the left side of the housing.

The housing door shall be hinged to the signal section housing by stainless steel roll pins and hinge lugs integrally cast in the door and housing. The door shall be latched by means of integrally cast door latch slots, housing hinge bolt lugs and stainless steel hinge bolts and wing nuts. The 12-inch sections require two (2) latching bolts.

A gasket groove on the inside of the door shall accommodate a neoprene gasket to form a positive seal between the door and signal housing when the door is closed and latched. Four (4) quick change type lens clips and four (4) stainless steel screws shall be provided for securing the lens and lens gasket in the door lens opening. Four (4) stainless steel washer head type screws shall be provided to secure the signal visor.

Signal section housings shall be fastened together by two (2) stainless steel, (clover leaf type) clamping washers and three (3) carriage bolts and lock washers. Each complete signal head assembly shall be pre-drilled for mounting of signal backplates.

All signal sections and the outside surfaces of visors shall be painted gloss black. The inside of the visor shall be painted dull black. All painting shall be done by the manufacturer.

(B) Visors: Each signal section shall have a tunnel type visor with a 5 to 7 degree downward tilt. Unless otherwise specified the 12-inch signal sections shall be furnished with 12-inch by 12-inch long visors. All visors shall be retained to the housing section door with stainless steel washer head type screws.

(C) Backplates: Louvered backplates and backplate mounting hardware shall be furnished with each vehicular signal head assembly. The backplate shall be fabricated of anodized sheet aluminum. The 5.0 inch border backplates shall be provided for the 12-inch signal head assemblies. All backplates shall be painted dull black. All painting shall be done by the manufacturer.

(D) Mounting Assemblies: An elevator plumbizer conforming to the requirements of MCDOT Detail 4778-2 shall be installed with all mast arm mounted 12 inch signal heads, as shown on the Traffic Signal Plan. The plumbizer elongated bolt hole shall be positioned to align with the bolt hole drilled 2 3/8 inches from the end of the tenon on the mast arm. The plumbizer shall be held in place with a 3/8 inch bolt with a nut and two (2) washers per MCDOT Detail 4778-2. The plumbizer signal head mounting position shall be in accordance with the requirements of MCDOT Detail 4778-1.

Pole top and side mount mounting assemblies shall consist of 1 7/8" outside diameter (1 1/2" nominal size) standard pipe and fittings. All members shall be so fabricated that they shall provide plumb, symmetrically arranged and securely fabricated assemblies.

Terminal Compartments – A terminal compartment shall be assembled in the mounting brackets as shown in the Standard Details and as called for on the plans. The terminal compartment shall be manufactured of bronze.

A rainproof cover shall be provided for all terminal compartments which will provide ready access to the internal terminal block wiring.

The types of mounting assemblies used, and the methods of mounting them, shall be as shown on the Traffic Signal Plan and shall conform to MCDOT Details.

476.2.2 Led Signal Lamps

(A) General: LED traffic signal modules shall be designed to fit traffic signal housings that meet MCDOT specifications. The module shall be weather tight and shall fit securely in the housing and shall have wire leads long enough for easy connection to the traffic signal head wire terminal block. The wire shall have crimped on terminal connectors. The LED signal module shall be a single, self-contained device. The power supply shall be integral to the sealed LED module.

(B) Module Identification: The Contractor shall ensure that the date of installation is filled in on the module label on each LED module.

(C) Physical and Mechanical Requirements: The LED lamp unit shall be a single self-contained device, not requiring on site assembly for installation. The assembly and manufacturing process for LED Traffic Signal Lamp unit assembly shall be such as to withstand mechanical shock, and vibration caused by winds up to 80 mph.

Signal lens shall be convex to minimize sunlight reflectance.

(D) Optical and Light Output Requirements: The LED shall be manufactured using AlInGaP Technology or other LEDs with low susceptibility to temperature degradation (AlGaS LEDs will not be allowed).

The LED signal lamps shall be in three colors: red, yellow, and green. Multiple color modules shall not be used.

Each LED traffic signal lamp shall meet the minimum laboratory light intensity values, color (chromatically), and light output distribution as described in ITE Standards as shown in Section 11.04, Table I and Section 8.04, Figure 1 of the Vehicle Traffic Control Signal Head Standard. Each LED traffic signal lamp shall meet the minimum requirements for light output for the entire range of allowed voltage.

(E) Electrical: Each unit shall incorporate a regulated power supply engineered to electrically protect the LEDs and maintain a safe and reliable operation. The power supply shall provide capacitor filtered DC regulated current to the LEDs per the LEDs manufacturer's specification. MCDOT does not require the unit be dimmable.

The LED traffic signal lamp shall operate on a 60Hz AC line voltage ranging from 80 volts RMS to 135 volts RMS. The Circuitry shall prevent flickering over this voltage range. Nominal rated voltage for all measurements shall be 117 volts RMS.

The LED traffic signal lamp unit shall be operationally compatible with controllers and conflict monitors used by MCDOT.

Two, captive, color coded, 3 feet long, 600 V, 18 AWG minimum jacketed wires, conforming to the NEC, rated for service at 105° C, are to be provided for an electrical connection.

One Schematic diagram shall be provided for each LED lamp unit along with any necessary installation instructions.

LEDs shall be arranged in no less than 6 loaded circuits.

The LED shall operate with a minimum 0.90 power factor.

Total harmonic distortion (current and voltage) induced into an AC power line by a signal module shall not exceed 20 percent.

LED modules shall have female quick-disconnect type terminals.

476.2.3 Pedestrian Signal Head: The pedestrian signal head shall include an aluminum housing with swing down door frame, a plug-in sealed LED message module, and visor. The pedestrian signal shall be energy efficient with a power consumption of less than 12 watts at 120 volts.

Optically, the pedestrian signal head shall display brightly and uniformly, the alternate symbol messages "HAND" in Portland orange, **"COUNTDOWN NUMERALS" IN Portland orange** and "WALKING PERSON" in lunar white under all ambient light conditions. The message symbols shall not be seen (blank-out) when the message symbol is not energized.

The HAND-WALKING PERSON symbol shall be a minimum of 11 inches high and 7 inches wide and the COUNTDOWN NUMERALS shall be 9" high and 7" wide conforming to the requirements of the Manual of Uniform Traffic Control Devices, Institute of Transportation Engineering Standards for Pedestrian Traffic Control Signal Indications, the Signal Plan and the requirements of these specifications.

(A) Housing and Door Frame: The housing and door frame shall be a one piece corrosion resistant aluminum die casting. The maximum overall dimensions of the pedestrian unit signal housing including door and visor shall be 18 inches wide, 16 inches high, and 9 inches deep. The top and bottom of the housing shall have openings to accommodate standard 1½ inch pipe size fittings. The bottom opening shall have a locking "Shurlock" boss integrally cast into the housing. The distance between the mounting surfaces of the upper and lower opening shall be 15.75 inches.

The housing door frame shall be hinged to the housing by stainless steel pins and hinge lugs integrally cast in the housing and door frame. The swing down door shall be latched by two integrally cast housing hinge bolts lugs, two door latch slots and two stainless steel hinge bolts with wing nuts.

The housing shall be dust proof and weatherproof with the plug-in LED module installed and the door closed and latched. The housing and door shall be painted gloss black by the manufacturer.

(B) LED Message Module: The lunar white and Portland orange LED, solid state controls, and transformers for energizing the LED shall be encased in a plug-in module. The HAND and WALKING PERSON symbol message lens shall be ultraviolet stabilized polycarbonate. The HAND and WALKING SYMBOL message shall be full indications only.

The rear of the module shall have three male quick disconnect lugs for connection of the AC+HAND signal and AC+WALKING PERSON signal. The HAND and WALKING PERSON power consumption shall be less than 12 watts. The COUNTDOWN NUMERALS power consumption shall be less than 7 watts.

476.2.4 Warranties: All LED signal lamps and heads shall be warranted for five (5) years against defects in workmanship and materials and the requirements of Section 108.8.

476.3 MEASUREMENT:

Vehicular and pedestrian signal indications completely (including wiring and mounting assemblies) will be measured as a unit for each type of signal installed.

476.4 PAYMENT:

The accepted quantities of vehicular and pedestrian signal indications, measured as provided above, will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE, including visors, louvered backplates, LED's and all hardware necessary to provide a complete, and functional signal installation.

Part 400 add the following new Section:

SECTION 477

INTERSECTION LIGHTING

477.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing luminaires for intersection lighting in accordance with the location shown on the Traffic Signal Plan and the requirements of these specifications.

477.2 MATERIALS:

477.2.1 General: Intersection lighting materials shall conform to the type of luminaire as indicated on the Traffic Signal Plan.

477.2.2 High Pressure Sodium Luminaire: The luminaire shall be 250 watt, high pressure sodium with an internal ballast and shall be capable of operating on primary voltages of 110 and 220 volts, 60 Hz AC. The luminaire shall be of the horizontal cut-off type. The light distribution pattern shall be Type III medium cut-off unless otherwise specified and shall conform to the Illumination Engineering Society Standards (IES).

All high pressure sodium luminaires shall be supplied with lamps. Each luminaire shall be furnished with an instruction sheet which clearly shows installation procedures and instructions for adjusting the lamp socket. This instruction sheet shall include complete information on all socket positions and the IES light distribution produced from each setting.

477.2.2.1 Housing: The luminaire housing shall be fabricated from a corrosive resistant metal material and have a baked on enamel finish. The housing shall be composed of three (3) sections, an upper housing section and two (2) lower housing sections. The upper housing section retains the reflector, lamp socket, and when specified the photo electric control receptacle. One (1) of the lower housing sections is the lens door frame and shall retain the 90-degree cut-off type flat glass lens. The other lower housing section shall be the ballast module door. The ballast module door shall contain the major electrical components.

The ballast module door shall be lowered by loosening a single stainless steel captive screw. After lowering, the ballast module door shall be removed by unplugging a quick-disconnect electrical plug and lifting the module off its hinges. The hinged lens door housing shall be latched to the upper housing by a spring loaded, single-action latch.

The housing shall have a slipfitter for mounting on a 2-inch mast arm tenon and shall be adjustable for leveling ± 3 degrees from the horizontal.

477.2.2.2 Optical Assembly and Gaskets: The optical assembly shall incorporate a snap-on high specular, anodized reflector and shall contain a filter which effectively absorbs gaseous contaminants or particulate matter. The flat glass lens of the optical assembly shall be manufactured of high quality, heat resistant glass.

A gasket of an approved neoprene material that will maintain a watertight and dust-tight seal throughout the temperature ranges inherent with high intensity discharge (HID)

lamps, shall be securely fastened to the reflector. The gasket between the lamp socket and the reflector shall be polyester fiber that will maintain a dust-tight seal throughout the above specified temperature ranges.

The lamp socket shall be of rugged, high grade porcelain securely mounted on a support bracket which is adjustable in both the vertical and the horizontal directions. Each adjustment shall be clearly and permanently coded for each light distribution setting. The coding shall directly relate to the instruction sheet furnished with each luminaire.

477.2.2.3 Ballast: The ballast shall be pre-wired to the lamp socket and terminal board. The ballast shall be mounted on the ballast module door and rated to the circuit voltage and size of the lamp specified. The ballast shall be a regulator type capable of starting lamps at -20 degrees Fahrenheit and operating them within the limits specified by the lamp manufacturer. The ballast shall limit lamp wattage variations to a maximum of five (5) percent even when the ballast voltage input varies ten (10) percent from the normal values. At the rated line voltage, the ballast shall have a minimum power factor of 90 percent. The starting amperes shall be less than operating amperes. The ballast shall provide the lamp voltage shown in the lamp table of Section 477.2.2.4.

477.2.2.4 Lamps: The lamps shall be universal burning, clear, high pressure sodium type. Each lamp shall be clearly and permanently marked, giving the wattage and the American Standard Association number or the manufacturer's reference number. Lamps of the wattage specified shall conform to the following:

Wattage	Lamp Voltage	Minimum Initial Lumens	Rated Life
250	100	30,000	24,000 hr.

477.2.3 LED Luminaire: The luminaire shall be a horizontal, Type III, conform to Illumination Engineering Society Standards. Luminaires shall be furnished with an instruction sheet which clearly shows installation procedures.

477.2.3.1 Housing: Shall be fabricated from a corrosive resistant metal and shall have a baked-on grey enamel finish. Mounting shall be an internal 2 bolt slip fitter at the rear of the fixture capable of attachment to a two inch (2") inside diameter pipe. The housing shall include a removable door with integral hinges for tool-less maintenance access.

477.2.3.2 Optics: The optics shall create consistent light distributions within the optical orientations and comply with the following requirements.

- Have a color temperature of 4000K at an ambient temperature of 25 degrees Celsius.
- Have an average illumence of 1.4 foot candles at a mounting height of 30 feet and a range from 6 to 2.0 foot candles in the illuminated zone.
- Have backlight control to restrict illumination at the rear.
- Operate at sustained ambient temperatures of up to 100 degrees Fahrenheit at a minimum 70% lumen output.

477.2.3.3 Electrical: The fixture shall:

- a. Have electronic ballast capable of operation at a universal voltage (120-277VAC) at 50/60Hz and shall be accessible without removal of the LED array.
- b. Wired for use with no photo cell and shall be energized from a remote cabinet mounted PEC.
- c. Be designed to withstand a minimum 10Kv of transient line surge.
- d. Incorporate natural conduction and natural convection to rapidly transfer heat from the LED source.

477.2.4 Photo Electric Control (PEC): Photo electric control is a component of the traffic controller cabinet assembly. The remote mounted photo electric control (PEC) shall be rated at 120 volt, 60 Hz AC 3000 volt-ampere. The operating temperature range shall be from -65° F to +158° F and 100 percent relative humidity. The PEC shall be a conventional glass-faced hermetically sealed ½" cell. A time delay shall be incorporated into the PEC circuit to prevent cycling at night by transient lights which might be focused on the PEC.

The PEC shall turn-on at 1.0 ±0.2 foot candles and turn-off at 1.8 foot candles. The PEC shall be UL listed for rain-tight applications. A built-in surge protector shall be provided to protect the PEC from lightning induced and line voltage transients.

The PEC shall be mounted on the controller cabinet with a ½" diameter threaded fitting. PEC shall be (Tork 2105) or approved equal.

The PEC and a luminaire test switch shall be wired in accordance with MCDOT Detail 4737.

477.3 CONSTRUCTION:

Luminaires of the size specified shall be furnished and installed at the locations shown on the Signal Plan. Unless otherwise specified the luminaire shall be adjusted to the horizontal. Field adjustment of the lamp socket in high pressure sodium fixtures shall not be made unless specified on the signal plan or approved by the Engineer. The lamp socket in high pressure sodium fixtures shall be adjusted at the factory to achieve the light distribution as specified herein. All wiring shall be in compliance with the NEC, the requirements of MCDOT Detail 4737 and as shown on the plans. The intersection lighting circuit shall not be connected to the same service leg to which the controller cabinet assembly is connected.

477.4 MEASUREMENT:

Luminaires will be measured as a unit for each type of luminaire furnished and installed.

477.5 PAYMENT:

The accepted quantities of luminaires measured as provided above, will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE.

Part 400 add the following new Section:

SECTION 478

ELECTRICAL CONDUCTORS

478.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing electrical conductors for traffic signals and intersection lighting in accordance with the Traffic Signal Plan, requirements of these specifications, and MAG specifications

478.2 MATERIALS

478.2.1 Electrical Conductors: The wire shall be annealed copper and shall be uncoated unless otherwise specified. The wire shall be solid for number 10, 12 and 14 AWG and smaller diameter wire, conforming to the requirements of ASTM B3 for annealed bare copper wire. Conductors for sizes number 8 AWG and larger diameter wire shall be stranded and shall conform to ASTM B8 for Class B stranding, unless otherwise specified, the conductors shall be insulated with THW grade thermoplastic compound and shall meet the requirements of UL 83. Insulation colors shall be permanent and an integral part of the insulation and shall not be applied as a surface treatment of coating. The insulation thickness shall conform to the requirements of the NEC. Conductor insulation shall be a solid color unless otherwise specified. The color shall be continuous over the entire length of the conductor.

Wire and cable shall be UL listed and rated at 600 volts. The UL label shall be present on each reel, coil or container of wire or cable. When requested, the Contractor shall submit to the Engineer the manufacturer's written certification that the product conforms to the requirements of these specifications.

All single conductors shall have plain, distinctive and permanent markings on the outer surface throughout their entire length showing the manufacturer's name or trademark, insulation type, conductor size, voltage rating and the number of conductors in the cable. Insulation colors shall be permanent and an integral part of the insulation and shall not be applied as a surface treatment coating.

Conductor colors and sizes for use in traffic signal and intersection lighting shall be as specified on the Traffic Signal Plan conductor schedule, and MCDOT Details 4799-1 and 4799-2.

(A) Loop Detector Lead-In Cables: Loop detector lead-in shielded cables shall be two conductor, stranded, twisted pair, tinned copper, polyethylene insulated cable with a polyethylene jacket, rated at 600 volts and 140 degrees Fahrenheit and shall be in conformance with IMSA Specification 50-2.

(B) Wire Tagging: Individual conductors for each vehicular and pedestrian phase group shall be secured together by two layers of plastic electrical tape and tagged with an approved wire I.D. marker (3M Scotchcode Wire Marker Tape or approved equal). Cables for each vehicular and pedestrian phase group shall be wrapped with two layers of plastic electrical tape and tagged with an approved wire I.D. marker (Scotchcode

Wire Marker Tape or approved equal). Wires and cables shall be individually marked in all cabinets and in pull boxes.

When IMSA cable is specified, wire insulation color assignment shall be in accordance with MCDOT Details 4799-1 and 4799-2.

(C) IMSA Cables: IMSA cable shall be used when specified on the plans. IMSA cables shall be polyethylene insulated copper conductors, polyvinyl chloride jacketed, rated at 600 volts for use in underground conduit or as aerial cable conforming to IMSA Specification 19-1.

The IMSA 19-1 cable shall be provided with the number and size of conductors as specified on the plans. The colors and tracers shall be permanent and an integral part of the insulation and shall not be painted, surface coated or adhered to surface. Ink strips are unacceptable. Conductor insulation colors shall be standard IMSA colors (as shown by the following table). Cable conductor color, phase and interval assignments shall be in accordance with MCDOT Details 4799-1 and 4799-2.

(D) Telephone Communication Cable: Telephone communication cable shall be used when specified on the plans. Telephone communication cable shall be in accordance with IMSA Specification 40-2. Cable shall be 19 AWG, 25 conductor, solid, twisted pair, polyethylene jacketed, with a rating of 300 volts.

Conductor Number	Insulation Color	Stripe Color	Conductor Number	Insulation Color	Stripe Color
1	Black	---	11	Blue	Black
2	White	---	12	Black	White
3	Red	---	13	Red	White
4	Green	---	14	Green	White
5	Orange	---	15	Blue	White
6	Blue	---	16	Black	Red
7	White	Black	17	White	Red
8	Red	Black	18	Orange	Red
9	Green	Black	19	Blue	Red
10	Orange	Black	20	Red	Green

478.3. WIRING PROCEDURES:

478.3.1 General Requirements: All wiring shall be in conformance with the NEC and the requirements of these specifications. All wire nuts and other wiring devices shall be UL listed. Conductor sizes and colors shall be as specified on the Traffic Signal Plan conductor schedule. Conductors shall be pulled into runs in a smooth continuous

manner, avoiding contact with sharp objects that might damage the insulation. Approved lubricants shall be used for inserting conductors in conduit. Before installation, conductors' ends shall be taped for moisture protection until connections are made. Splices are permitted in pull boxes, pedestals and cabinets.

Conductors shall have a minimum of 36 inches of slack from the conduit end bell in the pull box.

All phase wiring shall be boxed at the intersection, terminated and spliced in the number seven (# 7) pull boxes.

478.3.2 Conductor Splices: Splices shall be made utilizing wire nut connectors (Ideal model numbers 451, 452 and 454, or approved equal). Wire stripping length and wire size combinations shall be in accordance with the manufacturer's instructions supplied with the wire nut connector. Soldered connections will not be permitted. All phases shall be spliced in all pull boxes and unused phase wiring shall be spliced to the ground rod in the controller cabinet.

Splices shall be dipped or brushed with a minimum of three coats of liquid waterproof splicing compound (3M Scotch Kote or approved equal). The finished splices shall be such that their electrical and mechanical characteristics and insulation quality are equal to those of the original cable.

478.3.3 Bonding and Grounding: All metallic enclosures such as cabinets, pedestals, poles, conduit and cable sheaths shall be bonded to form a continuous grounded system. Non-metallic portions of the system, such as PVC conduit, shall have a No. 8 AWG bare copper bond wire installed with suitable connections to form a continuous grounded system.

At each service disconnect, cabinet foundation, or where otherwise specified, an approved copper-plated ground rod shall be installed. Each ground rod shall be a one-piece solid rod of the copper weld type or approved equal and shall be a minimum of 5/8 inch in diameter and 10.0 feet long. The rod shall be driven vertically into the ground to a minimum 9.0 feet below the surface. If the rod cannot be driven vertically it shall be installed in accordance with article 250-83 of the NEC. The ground rod may be located in a pull box. The service equipment neutral (grounded conductor) and the system grounding conductor (No. 8 AWG bond, solid) shall be connected to the ground rod with a copper-plated bolt or a brass bolt on the ground clamp.

The grounding electrode system shall be in accordance with articles 250-81 and 250-83 of the NEC.

Pole foundations shall have 25 feet of number 4 AWG bare copper conductor coiled and placed at the bottom of the excavation before concrete is poured. Pole foundation grounding electrodes shall be connected to the pole grounding screw in the hand hole with an approved lug connector.

A ground resistance test shall be performed for each installed ground rod prior to final connection of the utility service. Pole foundation coil grounds shall be tested as determined by the Engineer in the field.

The ground resistance shall be measured with a three terminal, fall of potential, direct reading, battery powered earth tester with a 0.50 to 500 ohm scale or digital read-out. The 25 ohm reading shall be approximately at mid scale.

The test shall be performed according to the manufacturer's instructions and OSHA requirements. Two auxiliary copper clad ground rods shall be driven into the ground a minimum of 3 feet. The lateral spacing for each test rod shall be given in writing on the test report form and the spacing shall be approved by the Engineer.

All tests shall be performed in the presence of the Engineer and the test results shall be written down, dated and given to the Engineer for approval.

Each ground rod or foundation ground shall be isolated with the bond wires disconnected when the test is being performed. The resistance to ground shall be 25 ohms or less. If it is not, additional ground rods shall be installed as required at least 15 feet from the original ground and shall be bonded to it. The test shall then be repeated for multiple grounds as necessary to achieve proper grounding below 25 ohms. As many additional ground rods shall be installed as is necessary to achieve proper grounding of 25 ohms or less.

The test shall be performed when the soil is dry. The contractor shall not add any chemical, or salt solutions to any portion of the grounding system. All grounding rods and foundation grounds to be tested shall be installed a minimum of ten days prior to testing unless otherwise determined by the Engineer in the field.

478.4 MEASUREMENT:

Conductors for traffic signals and intersection lighting will be measured on a lump sum basis.

478.5 PAYMENT:

Conductors, measured as provided above, will be paid for at the contract lump sum price, which price shall be full compensation for the item, COMPLETE IN PLACE.

Part 400 add the following new Section:

SECTION 480

INTELLIGENT TRANSPORTATION SYSTEM GENERAL REQUIREMENTS

480.1 DESCRIPTION:

This work shall consist of furnishing and installing Intelligent Transportation System (ITS) field devices in accordance with the project plans, requirements of these specifications, and the special provisions.

ITS elements generally consists of such devices as fiber optic cable and other communications infrastructure, closed circuit television cameras (CCTV), and dynamic message signs (DMS).

All ITS components and appurtenances shall be complete and functional, have successfully passed specified testing, be compatible with existing MCDOT equipment, and be in operating condition at the time of acceptance.

480.2 MATERIAL/EQUIPMENT REQUIREMENTS AND TECHNICAL QUALIFICATIONS:

480.2.1 Environmental: All field installed electronic equipment shall meet the minimum environmental requirements of Section 2, Environmental Requirements of the NEMA Standards Publication TS 2, *Traffic Controller Assemblies with NTCIP Requirements*, including, but not limited to:

1. Operating Voltage and Frequency
2. Power Interruption;
3. Temperature and Humidity;
4. Transients, Power Service and Input-Output Terminals; and Nondestruct Transient Immunity;
5. Vibration; and
6. Shock.

All equipment exposed to the environment shall be corrosion resistant. All connections shall be watertight. Above ground equipment enclosures shall be designed to withstand 80 mph winds with a 30% gust factor and to withstand the effects of sand, dust, and hose-directed water per the hose down test described in NEMA Standards Publication 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*.

480.2.2 Grounding: Grounding shall meet the requirements of Section 478.3.3.

480.2.3 Power: Electronic equipment and power supply shall meet the minimum power requirements of NEMA Standards Publications TS 2, Section 2, Environmental Requirements.

480.2.4 Surge Protection: All equipment shall be provided with a 350-volt surge protector at the input power point. The surge protector shall reduce the effects of power line voltage transients and shall have ratings as follows:

Impulse Breakdown	less than 1,000 Volts in less than 0.1 microseconds at 10 kiloVolts per microsecond
Standby Current	less than 1.0 milliAmpere
Striking Voltage	350 Volts D.C.

All equipment shall be capable of withstanding 15 pulses of peak current each of which will rise in 8.0 microseconds to one-half the peak voltage at three-minute intervals. The peak current rating shall be 20,000 amperes.

All wire, ground, and bond equipment required to complete the surge protection shall comply with Section 250-86 of the NEC.

480.2.5 Electrical Equipment Regulations and Codes: All electrical equipment shall conform to the current standards of the National Electrical Manufacturers Association (NEMA), National Electric Safety Code (NESC), Underwriters' Laboratory Inc. (UL), or the Electronic Industries Association (EIA), when applicable. Material and workmanship shall conform to the requirements of the National Electric Code (NEC).

480.2.6 Approval of Material and Equipment: All materials and equipment shall be approved by the Engineer prior to ordering. Any work incorporating materials or equipment not previously approved shall be performed at the Contractor's risk. Such materials or equipment may be subject to removal or replacement at the discretion of the Engineer.

At the pre-construction conference the Contractor shall submit to the Engineer one CD-ROM disk with electronic PDF files and four (4) printed copies of all proposed ITS materials and equipment with associated pay items identified. The submittal shall contain a listing of all proposed ITS materials and equipment together with product data, shop drawings, Certificates of Compliance, and warranty information. To be acceptable, the submittal shall identify the contract, the materials and equipment list shall be complete, and contain all ITS items supplied on the project by the Contractor, including pre-approved items. All items on the list shall be identified by manufacturer's part number, model, included or excluded options, specification, or other pertinent catalogue information to allow the County to procure exact replacements of all items on the project. MCDOT reserves the right to reject an incomplete or unclear material submittal. All equipment and materials require the Engineer's approval prior to ordering. One (1) copy of the submittal will be returned to the Contractor for further action.

There shall be no substitutions for approved materials or equipment without the written approval of the Engineer. Proposed changes to approved materials or equipment shall be submitted in writing to the Engineer for review and approval. If requested by the

Engineer, the contractor shall submit samples of the proposed materials for inspection, testing, and approval. All material and equipment shall be new.

The Contractor shall provide complete wiring diagrams for controller assemblies and auxiliary controller cabinets at the time of delivery. When requested by the Engineer, a Mylar original and four sets of prints shall be provided with each controller assembly. The wiring diagram shall illustrate all circuits and components in detail. All components shall be identified by name or number so as to be clearly defined in the drawings.

480.2.7 Certificates of Compliance: The Contractor shall submit to the Engineer originals or copies of Certificates of Compliance for all Contractor-supplied items. The submittal shall include identification of the project by Project Number and Title.

If requested by the Engineer, the Contractor shall furnish laboratory results or independent certifications that substantiate compliance with the stated requirements. Materials or equipment covered by the certificate may be sampled and tested at any time, and, if found not in conformity with the requirements of the project plans or specifications, will be subject to rejection.

Certificates of Compliance shall contain the following information:

1. A description of the material or equipment supplied;
2. Means of material identification, such as label, lot number, or marking;
3. Statement that the material complies in all respects with the contract specifications. When identified in the specifications, certificates shall state compliance to specific cited standards, such as RUS 1755.900, NEMA TS 2, etc. and specific required tests, such as burn-through testing for fiber optic conduit;
4. Clearly state any exceptions to the requirements of the specifications; and
5. The name, title, and signature of a person having legal authority to bind the manufacturer or the supplier of the material. The date of the signature shall also be given. The name and address of the manufacturer or supplier of the material shall be shown on the certificate. A copy or facsimile reproduction (fax) will be acceptable; however, the original certificate shall be made available upon request. The person signing the certificate shall be in one of the following categories:
 - An officer of a corporation.
 - A partner in a business partnership or an owner.
 - A general manager.
 - Any person having been given the authority in writing by one of the three listed above.

480.2.8 Maricopa County Furnished Material and Equipment: Material and equipment furnished by Maricopa County Department of Transportation will be made available to the Contractor as specified in the contract documents. All specified items will be available at the following address:

Maricopa County Department of Transportation Warehouse
2222 South 27th Avenue
Phoenix, Arizona 85009-6357

The Contractor shall call (602) 506-4885 forty-eight hours prior to pick-up.

The cost of handling and installing all material and equipment shall be included in the contract price for the respective item.

The Contractor shall be responsible for all material and equipment collected from the warehouse. The cost to make good any shortages or deficiencies from any cause or for any damages that occur after transfer will be deducted from any monies paid to the Contractor.

480.3 CONSTRUCTION:

480.3.1 Cable and Active Electronics Labeling and Management: The Contractor shall provide labeling for all Contractor-installed cables. Labeling shall be done in a neat, professional manner using permanent methods and products approved by the Engineer for each label scenario. At a minimum, the Contractor shall label the following:

1. Trunk line and branch cables at pull boxes, cabinets, racks, and other points of entry with the appropriate cable identification number. Permanently marked, removable cable sleeves shall be used;
2. Both ends of jumper cables and pigtails;
3. The jumper cable (front) side of patch panels, the labeling of which shall be in sequence and in a consistent manner throughout the project; and
4. All active electronics, the labeling of which shall include the device location, name, IP address, subnet mask, gateway, and VLAN.

The Contractor shall provide cable routing and management in a neat and professional manner. Cables shall be grouped and neatly tied to the sides of racks when applicable. Slack or excess cables shall be neatly coiled, tied, and stowed. Cables shall be looped independently of one another. Cable ties shall encompass the cable loops of one cable per cable tie, applying ties to each cable individually. Cable ties shall be tightened to prevent cable slippage, but not deform or damage the cable sheath. Strain relief shall be provided for fiber optic cable, jumpers, and pigtails.

480.3.2 Labor and Supervision: The Contractor shall furnish technically qualified labor and supervision with experience in the construction of the ITS field devices and communications equipment specified within the project's contract documents.

The Contractor shall have on the work site at all times a competent supervisor experienced in the construction of ITS field devices and communications equipment specified by the contract documents. When construction involves traffic signals, the

Contractor's supervisor shall possess an International Municipal Signal Association (IMSA) Level II Traffic Signal Electrician Certification.

(A) Technical Qualifications: The Contractor shall submit the technical qualifications of installation and supervisory personnel to be used for construction of ITS facilities to the Engineer at the pre-construction conference. The Contractor or subcontractor personnel must be certified by the manufacturer or have an industry standard certification prior to the installation and/or integration of the designated ITS equipment. The installation and configuration personnel shall have the following years of experience in addition to the certification levels as outlined below:

1. Fiber Technician – Minimum is Electronics Technicians Association (ETA) Fiber Optical Installer (FOI) certification or manufacturer fiber certification with five years of hands-on experience.

A year of experience can be waived if a higher level of certification in the appropriate field is possessed.

A copy of a resume with five project references and three professional references may be submitted for consideration of approval for individuals not meeting the required certification and experience levels.

480.3.3 Plans and As-Built Drawings: Plans graphically describe the location of component parts. Where dimensions on the plans are given, they shall govern over scaled dimension.

After completion of the project the Contractor shall provide the Engineer with a set of as-built drawings on clean prints of the original drawings. The as-built drawings shall indicate in a neat and accurate manner all changes and revisions to the original design. As-built drawings shall be submitted before final payment for completed work will be made.

480.3.4 Testing: The Contractor shall demonstrate that the equipment and the systems furnished and installed are fully functional as specified in the contract documents. The Contractor shall furnish and maintain all required test equipment.

The Contractor shall conduct or support during project implementation the following tests:

1. Design Approval Test (DAT) (when required);
2. Factory Demonstration Test (FDT) (when required);
3. Factory Acceptance Test (FAT) (when required);
4. Stand-Alone Test;
5. Subsystem Test (SST) (when required);
6. Systems Integration Test (SIT) (when required); and
7. System Acceptance Test (SAT)].

(A) Test Procedures, Testing, Forms, and Software: The Contractor shall prepare test procedures, a testing quality control plan, and forms for recording data and reporting results. The Contractor shall obtain software (when specified) for all required testing procedures. It is recommended that the Contractor request from the Engineer copies of testing procedures approved and used on prior projects.

(1) Approval of Test Procedures, Testing Plan, Forms, and Software: The Contractor shall submit test procedures, the testing plan, data recording/results reporting forms, and software to be used to the Engineer for approval at least 45 calendar days before the scheduled testing. The Engineer will review the submitted procedures, data forms, and software and return them within 14 calendar days after receipt. If approved, tests may be conducted as scheduled. If rejected by the Engineer, the rejected item(s) shall be revised accordingly by the Contractor. The Contractor shall resubmit the revised item(s) to the Engineer for another review. The tests shall be rescheduled. The Contractor shall highlight the portions of the submittal that has changed to aid the Engineer's re-review of the material. Extension of the schedule will not be granted for rejected test procedures, testing plans, data recording or results reporting forms, and/or software.

As a minimum, the Contractor shall prepare test procedures, data recording and results reporting forms that include the following:

- i. A step-by-step outline of the test sequence to be followed, showing a test of every function of the equipment or system to be tested;
- ii. A description of the expected operation, pass/fail criteria, and test results;
- iii. A data recording form to be used to record all data and quantitative results obtained during the test;
- iv. A results reporting form that clearly and concisely conveys the test results; and
- v. A description of any special equipment, setup, manpower, or conditions required for the test.

As a minimum, the Contractor's testing plan shall include the following:

- Acceptance testing of all supplied components;
- Physical and functional testing of all modules; and
- A minimum of 100-hour burn-in of all modules.

(2) Scheduling and Conducting Tests: The Contractor shall conduct tests in the presence of the Engineer's authorized representative using the approved test procedures. The Contractor shall notify the Engineer of the time, date and place of all tests at least 14 calendar days prior to the date on which a test is planned. The Engineer may waive the right to witness certain tests.

The Contractor shall ensure that all equipment to be tested is ready for testing prior to the performance of, and the Engineer's witnessing of, the tests. Costs for transportation, meals, and lodging for the Engineer and his representatives that are

associated with delays in the testing will be deducted from monies due, or to become due, or owed to the Contractor.

The contract period will not be extended for time loss or delays related to testing.

All test data forms shall be signed by the Contractor or authorized representative. When tests are witnessed by the Engineer, the Contractor shall obtain the witnessing Engineer's signature on the test data form.

(3) Reporting of Test Results: The Contractor shall submit the test results to the Engineer using approved test data forms. The Engineer will review the test results for conformance with the requirements of the contract documents. If the equipment or systems fail any part of the test, the Contractor shall make necessary corrections and repeat the entire test.

(B) Design Approval Test (DAT): A DAT shall be conducted when required by the special provisions. A DAT verifies that certain design parameters are satisfied. The Contractor shall provide certification from the manufacturer for the following:

1. The equipment has been laboratory tested and meets or exceeds the environmental requirements of the specifications. The test results and passing criteria for each required test shall be specifically listed.
2. The equipment meets the functional requirements stated in the specifications, and is suitable for the intended application.

The certification shall state any requirements that are not met or have not been laboratory tested. Test procedures and results, or independent laboratory certification shall be made available upon request.

DAT certification shall meet the requirements for Certificates of Compliance. If a DAT and a Certificate of Compliance is required for the same equipment, both requirements may be satisfied by a single Certificate of Compliance.

Submit DAT certification with the equipment submittal data for Engineer's approval.

There is no DAT requirement for equipment that will be furnished by or has been previously tested by MCDOT or certified for use in prior projects where the application is consistent and results deemed favorable. The Contractor should contact MCDOT for information regarding the DAT or certification status of a particular device.

(C) Factory Demonstration Test (FDT): A FDT shall be conducted when required by the special provisions. A FDT is performed on a production unit and verifies that the equipment meets the functional requirements. The FDT requirement for models of equipment previously tested and/or certified by MCDOT for the types of applications required in the project may be waived by the Engineer.

To gain a waiver, the Contractor shall submit certification from the manufacturer stating that the equipment has been tested and meets all the project requirements. The Contractor shall provide or obtain from the manufacturer a statement of any exceptions or requirements not covered by the testing and supporting information such as test procedures, data, and results.

Costs for lodging and transportation for the Engineer and his representatives to witness the FDT, will be borne by MCDOT, for one visit lasting for up to five (5) consecutive days. In the event, the FDT requires multiple visits by the Engineer or lasts longer than five consecutive days, the Contractor shall be responsible for the added cost of transportation and lodging beyond what is covered by the County.

(D) Factory Acceptance Test (FAT): A FAT shall be conducted on each unit of equipment when required by the project specifications. The FAT verifies that each unit of equipment as it comes off the production line operates as specified. The FAT shall verify proper operation of all required functions. The Contractor shall submit a full test report of the quality control and the final test conducted on each item for approval. The Contractor shall not deliver the equipment until the FAT results have been approved by MCDOT. The test report shall indicate the name of the tester and shall be signed by the responsible party representing the supplier.

Cabinet Assemblies: For cabinets and cabinet assemblies the quality control procedure shall include a minimum of 24 hour operation of all cabinet assemblies.

The FAT for each cabinet assembly shall include complete testing for all units and the testing of every item or device furnished in the controller cabinets.

Each complete assembly unit shall be subject to a full cycling and timing test (when applicable).

(E) Stand-Alone Test: A stand-alone tests verifies that after installation but prior to interconnection, the equipment operates as specified and is capable of performing the function(s) for which it was designed.

The Contractor shall conduct approved stand-alone tests on each equipment group that performs a specific function. In addition to the general requirements described below, there may be additional testing requirements for a particular device provided in the specifications for that device. Testing is to use the manufacturer's approved software after the on-site installation of the equipment group is completed. Using the manufacturer's approved software, the Contractor shall demonstrate that:

- Inputs and outputs of each unit are tested and operate properly;
- Character displays and indicators operate properly under the full range of ambient lighting conditions;
- Each item of equipment operates properly; and,

- Each control cabinet assembly operates properly, when assembled and connected to all equipment it houses.

The supplier shall furnish all necessary test equipment and test software.

(F) Subsystem Test (SST): A SST shall be conducted when required by the special provisions. A SST verifies that units forming a subsystem continue to operate as specified when they are interconnected. A subsystem is defined as a logical grouping of field devices and/or central equipment that when interconnected and communicating is capable of performing the function for which it was designed (i.e., CCTV cameras, communications to/from the cameras, central control and display of the video images). Before conducting any SSTs, the Contractor shall submit the proposed test methods to the Engineer for approval. The Contractor shall conduct approved SSTs for the field equipment and related equipment at the hubs and the Traffic Management Center (TMC). After the equipment has been installed and interconnected, the Contractor shall conduct SSTs on groups of equipment identified in the specifications or the special provisions for a particular device, such as CCTV cameras or Dynamic Message Signs.

Subsystem tests shall not be considered successful until all equipment being tested is operational without failure for 72 consecutive hours.

(G) System Integration Test (SIT): A SIT shall be conducted when required by the special provisions. A SIT is performed when previously untested hardware or software is developed and/or added to an existing system to verify that all system interfaces perform properly prior to final acceptance. The Contractor shall begin the SIT upon completion of all required SSTs. The Contractor is responsible to keep the installed equipment operational during the system final integration testing. The Contractor shall identify the SIT in the project schedule. The duration of the SIT shall be based on the complexity of the design. The Contractor shall work with the Engineer to troubleshoot all problems related to non-specification compliant equipment and interfaces.

(H) System Acceptance Test (SAT): A SAT verifies that all interconnected subsystems operate together as one system. The SAT consists of a 30-day test period demonstrating that the total system (hardware, software, materials and construction) is properly installed, is free from identified problems, exhibits stable and reliable performance, and complies with the contract documents.

The Contractor shall demonstrate all system functions using live control equipment. The Contractor shall test all normal and backup functions of redundant system equipment and include in the SAT any emergency conditions for which the equipment is designed to respond.

The Contractor shall troubleshoot, diagnose, identify, and isolate hardware and software problems and inconsistencies; formulate possible solutions; and implement all corrections needed for Contractor installed equipment.

The Contractor shall make available on-site, key technical personnel familiar with the design and construction of each major system component within 48 hours of notification of a problem.

The Contractor shall correct all system documentation errors, omissions, and changes discovered and resulting from the SAT and any previous testing. The system will not be accepted by the Engineer until corrected documentation is submitted.

Failure of any item to meet the requirements for any test will be counted as a defect and the equipment under test will be subject to rejection by the Engineer. In the event of a failure of a single piece of equipment during the SAT, the Contractor shall replace or repair the equipment and restart the 30-day test only for that piece of equipment. If the failure of the single piece of equipment prevents the proper operation of other equipment (e.g., failure of the video encoder prevents proper camera control), all devices affected by the failure will have the test extended by however many days they were out of service.

Rejected equipment may be re-tested provided all areas of non-compliance have been corrected and evidence thereof is submitted to the Engineer by the Contractor. For equipment that has failed and subsequently been repaired or modified, the Contractor shall prepare and deliver a report to the Engineer that describes the nature of the failure and the corrective action taken. Re-design and modification of failed equipment shall be done at no additional cost to the County. Any Contractor supplied item that fails three (3) times will not be considered again for the project. The Contractor shall propose a replacement item with equal or greater functionality.

The following conditions constitute a minor system failure and will result in a suspension of time during the 30-day SAT. After satisfactory remedial action, the 30-day test will be resumed and extended one additional day:

1. Interference with project operations due to vandalism, traffic accident, power failure, or lightning for which lightning protection devices as specified are not sufficient protection;
2. Failure to complete the objective of any test scenario due to lack of adequate documentation for equipment supplied by the Contractor. The Contractor shall re-test using revised documentation; and
3. Intermittent hardware, software, communication, or operation control malfunctions.

The following constitutes a major system failure. Any one of the following conditions shall result in re-initialization of the SAT from day zero:

1. Failure of any hardware or performance item within a 14-day period; and
2. Failure to correct within four hours of notification by the Engineer or his representatives any problem that may adversely impact the safety of the traveling public.

Upon successful completion and acceptance of the SAT, the project will advance to the warranty and operational support period.

480.4 WARRANTIES AND GUARANTIES:

The Contractor shall deliver to the Engineer prior to acceptance of the project all manufacturer's warranties and guaranties for materials and equipment installed by the Contractor. The Contractor shall comply with the requirements of Section 108.8 and the following:

For Contractor-furnished materials, if specific warranty requirements apply, they are listed under specific equipment requirements of the specifications. The cost of warranties and repairs shall be included in the contract unit price.

Within 60 days following approval of material and equipment, the Contractor shall submit a preliminary Warranty Administration Plan (WAP) for Contractor supplied equipment and materials to the Engineer for approval. The WAP is to address how the warranty period shall be administered and who will be responsible for each item. At a minimum, it shall:

1. Provide contact information (manufacturer name, business address, position or title of contact person, email address, and telephone number, etc.) for each manufacturer of Contractor-furnished equipment;
2. Provide a way to track each repair performed during the warranty period by serial number that accounts for removals, replacements, and repaired items put back in service or into the spare inventory; resets the warranty period for all repaired or replaced items, and establishes a new warranty period for all new items;
3. Provide a schedule and summary of all routine maintenance activities required per vendor recommendations, whether or not they fall within the one-year warranty period;
4. Provide a complete list of equipment and vendor warranty periods, including spare equipment using Figure 480.1 or a similar approved form; and
5. Provide copies of all warranty paperwork.

The Contractor shall submit a final WAP to the Engineer for approval at least 45 days prior to final acceptance. An approved final WAP is required prior to final acceptance.

As part of the final WAP, the Contractor shall submit the following to the Engineer for approval:

1. A complete list of all pieces of equipment (by serial number) that have warranties extending beyond the one year warranty period, including spare equipment, using Figure 480.1 or a similar approved form; and
2. All warranty paperwork extending beyond the one-year period, transferring ownership of the warranties to MCDOT.

Figure 480.1 – Equipment Warranties

Project Name Equipment Warranties						
Submitted by: _____ _____ Date: _____					Project No.: _____ Federal Project No.: _____	
Serial #	Description	Location	Warranty Duration	Expiration Date	Date Received	Other Information

480.5 DOCUMENTATION:

The Contractor shall deliver maintenance manuals to the Engineer for all furnished equipment except conduits, pull boxes, and fiber optic cable. The manuals shall be supplied in durable, loose-leaf, three ring binders of appropriate size. All sections shall be permanently titled and have pages numbered and indexed. In addition, an electronic copy of all manuals shall be provided for all equipment and software.

Maintenance manuals shall be formatted in two sections that include the following material for all furnished equipment and components:

Section 1

- Description for each type of equipment and its components.
- Description of operation.
- Troubleshooting procedures at system and device levels.

- Preventative maintenance and adjustment procedures.
- “As-built” drawings including block diagrams, signal path, and detailed device and system connection diagrams (reference Section 480.3.3).
- Equipment source reference including manufacturer and nearest authorized service centers along with associated addresses and telephone numbers.
- Final Warranty Administration Plan.

Section 2

- Manufacturer’s operation and installation.
- Manufacturer’s service and repair guides.

Part 400 add the following new Section:

SECTION 481
FIBER OPTIC CONDUIT AND PULL BOXES:

481.1 DESCRIPTION:

The work under this section shall consist of furnishing, installing, and testing fiber optic conduit, warning tape, duct plugs, and pull boxes.

| In lieu of trenching where indicated on the project plans, the Contractor may propose to install fiber optic conduit by means of directional drilling at no additional cost to the County.

481.2 MATERIALS:

481.2.1 Fiber Optic Conduit: All conduit and conduit fittings shall be listed by UL, and conform to NEC standards.

PVC conduit shall conform to the requirements of UL 651 standard for Rigid Nonmetallic Conduit and ASTM F512: Standard Specification for Smooth-Wall Polyvinyl Chloride (PVC) Conduit and Fittings for Underground Installation. PVC conduit and conduit fittings shall be Schedule 40, heavy wall, manufactured from high impact material and shall be rated for use at the electrical wire temperature of 90 degrees C. PVC conduit bends shall be factory made in increments of 11.25, 22.5, 45, and 90 degrees. Field bending of PVC conduit is not permitted.

PVC conduit shall be properly marked with the ASTM F512 and UL 651 designation on the outside.

All conduits to be installed by means of directional drilling shall be HDPE.

The HDPE formulations used by the manufacturer must be specifically intended for conduit applications in accordance with ASTM F2160: Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD). The HDPE conduit shall be of dimension ratio DR 11 or better. It shall have a cell classification of PE334470C (for black conduit) and PE334470E (for colored conduit) per ASTM D3350: Standard Specification for Polyethylene Pipe and Fittings Materials.

HDPE conduit shall be properly marked with the ASTM F2160 and UL 651A designation on the outside.

All rigid metallic type conduits shall be manufactured of galvanized steel conforming to requirements of UL 6 for Rigid Metallic Conduit and to NEC standards. All exposed conduit and conduit fittings to be installed above ground shall be rigid metallic type.

Bends used for fiber optic conduit runs shall comply with the following requirements:

Conduit Size	Min. Radius
2"	24"
2-1/2"	30"
3"	36"
4"	48"

481.2.2 Multiduct Conduit: Multiduct conduit is described as one of the following:

1. A manufactured and connectable system consisting of a pre-assembled outer duct with four (4) inner ducts, or
2. A manufactured and connectable system consisting of four (4) conduits with spacers for direct bury without an outer duct.

Multiduct conduit shall be marked with a longitudinal print line with the wording "Install This Side Up" or approved equivalent to assure proper innerduct/conduit orientation and alignment. Male ends of multiduct conduit shall have circumferential insertion depth marks to provide a visual indication that proper insertion is achieved.

The outer duct of multiduct conduit to be installed underground by means of trenching or in concrete structures shall be HDPE conduit with a Standard Dimensional Ratio (SDR) of 11 or better, or rigid polyvinyl chloride (PVC).

(A) Outerduct with 4 Rigid Innerducts: This multiduct is pre-manufactured with an outerduct and 4 rigid innerducts and shall be used only with the approval of the Engineer or if indicated on the plans. This multiduct shall meet the following requirements:

Outerducts shall be a minimum nominal size of 4 inches, constructed of HDPE or PVC. Outerduct bends shall have a minimum radius of 4 feet and shall be available from the multiduct manufacturer in increments of 11.25, 22.5, 45, and 90 degrees.

Rigid Innerducts shall be fabricated using HDPE or PVC for straight sections, and HDPE for bends. Innerducts shall contain, or be factory treated with, a friction reducing material that is dry-to-the-touch. Innerducts shall meet the requirements of Telcordia GR-356-CORE (also known as Bellcore GR-356) and the following:

1. Innerducts shall have a nominal diameter of 1.2 inches and shall have a minimum wall thickness of 0.1 inch.

2. All four rigid innerducts shall be a different color with color coded nylon pull tapes. Colors for the pull tape shall be one white, one black, one red, and one orange. Pull tapes shall be placed in the innerducts so that the white pull tape is placed in the innerduct located directly below the outerduct longitudinal print line followed by the black, red, and orange pull tapes in sequential order. Pull tape color shall be consistent throughout the project.

(B) Duct Bank - 4 Rigid Conduits: This multiduct shall be pre-assembled with 4 rigid PVC or HDPE conduits locked together in formation using spacers with tie downs located no more than 5 feet apart along the multiduct. PVC shall be schedule 40 and HDPE conduit shall be DR 11. This type of multiduct shall be used only with the approval of the Engineer or if indicated on the plans. Rigid conduits shall meet the friction reducing material and pull tape requirements for rigid innerducts of section 481.2.2(A).

481.2.3 Geotextile Fabric Innerducts: Geotextile Fabric Innerduct to be installed in fiber optic conduit shall have three cells and be fabricated using an engineered, geotextile mesh fabric material composed of nylon and polyester. Geotextile fabric innerduct shall not be installed in conduit of less than 2 inch nominal size.

Each cell shall have a separate color coded pull tape with the colors white, black, and red.

481.2.4 Conduit and Innerduct Plugs: Conduit plugs, caps, or fittings for sealing empty conduit and occupied conduit shall be durable, easily removable, reusable, and produce a watertight seal. Plugs, caps, and sealing fittings shall be designed for the diameter of the conduit and cable, shall cause no damage to the cable when installed, and shall have a rope tie on the inside end for connection of a pull tape. Plugs, caps, or sealing fittings used for fiber optic conduit shall provide a watertight and airtight seal of at least 20 psi. Plugs that seal conduits containing fiber optic cable shall be of the split design to allow installation and removal around in-place cables. Plugs, caps, or sealing fittings shall be approved by the Engineer.

481.2.5 Coupling bodies shall be incorporated in all lengths of multiduct, bends, and fittings to seal between the outerduct and innerducts. Coupling bodies shall facilitate field assembly of the multiduct sections without the use of lubricants. Sealing components within the coupling bodies shall be of an anti-reversing design to keep the multiduct conduits together without the use of cement. Coupling bodies shall allow for innerduct movement due to expansion/contraction without affecting the innerduct sealing. 'Clam-Shell' type couplings shall not be used to repair broken conduits.

481.2.6 Multiduct terminations used at end of multiduct runs at junction boxes, cabinets, etc. to seal the innerduct to the outerduct shall be durable and fabricated without metallic parts except nuts, bolts, washers and fasteners which shall be stainless steel. Terminations shall provide a watertight and airtight seal of at least 20 psi.

Conduit terminations at pull boxes, cabinets, etc. that contain geotextile fabric innerducts shall be sealed with a termination kit recommended by the fabric innerduct manufacturer. The termination shall provide an airtight seal and shall be reusable to allow future cable installation.

481.2.7 Conduit Spacers and Tie Downs: Conduit spacers and tie downs shall be dielectric and have sufficient strength to support the conduits in a straight line above the bottom of the trench.

481.2.8 Fiber Optic Conduit Warning Tape: Conduit warning tape shall be a four (4) mil inert plastic film specially formulated for prolonged use underground and shall be a minimum of 3 inches wide. All tape shall be highly resistant to alkalis, acids, and other destructive agents found in soil.

Tape shall have a continuous printed message warning of the location of underground conduits. The message shall be in permanent ink formulated for prolonged underground use and shall bear the words, 'FIBER OPTIC CABLE BURIED BELOW' in black letters on an orange background.

481.2.9 Fiber Optic Pull Boxes: Pull box and pull box covers shall conform to requirements of ANSI/SCTE 77 Specification for Underground Enclosure Integrity and MCDOT standard details.

(A) Pull Boxes: Pull boxes shall be compliant with the test provisions of ANSI/SCTE 77: Specification for Underground Enclosure Integrity. Type A through D pull boxes shall meet the ANSI/SCTE Tier 22 load test requirements. Type E pull box shall be rated for AASHTO HL-93 Design Truck wheel loading.

Type B through E pull boxes shall have provisions for lashing coiled cable and installation of underground splice closures.

Type A through D pull boxes shall be manufactured of polymer concrete material. Type E pull boxes shall be manufactured from precast reinforced concrete material.

(B) Pull Box Covers: Pull box covers shall comply with the test provisions of ANSI/SCTE 77: Specification for Underground Enclosure Integrity.

Type A through C pull box covers shall be split type covers manufactured of polymer concrete material and shall meet the ANSI/SCTE Tier 22 load test requirements.

Type D pull box covers shall be of the 'torsion-assist' type and manufactured of diamond plate galvanized or mild steel. Type D covers shall be rated for a static design load of 10,400 lbs. over a 10 inch x10 inch steel plate.

Type E pull box covers shall be of the 'torsion-assist' type and manufactured of A-36 steel plate and structural shapes. Type E covers shall be rated for AASHTO HL-93 Design Truck wheel loading.

The torsion assist lids shall open to 180 degrees, have a failsafe lid lock in open position and have locking hardware made of stainless steel or galvanized steel. The lid shall provide torsion assistance in both directions and shall be of a galvanized steel spring mechanism. Hydraulic or fluid systems shall not be used for torsion assistance. The effort required to open or close the torsion assist lids shall not exceed 30 pounds of force.

Pull box covers shall provide a skid resistant surface. The dry static coefficient of friction shall be 0.6 or higher and the wet static coefficient of friction shall be 0.5 or higher as determined by ASTM C1028 or an equivalent test method.

Pull boxes covers shall be equipped with pull slots with a minimum width of 1/2 inch. The pull slots shall be rated for a minimum pulling force of 3,000 pounds.

Pull box covers shall have the message "MCDOT ATMS" cast in with nominal 1 inch high letters.

Type A through C covers shall be equipped with provisions for attaching #8 AWG tracer wire to the underside of one half of the split covers with access to trace wire connections from outside the unopened cover. The same side of the split covers shall have provisions for five directional labels to be installed on the outside of the cover. The directional labels shall be of UV resistant polycarbonate material and shall be installed with high strength adhesive.

(C) Conduit Terminator Ends in Pull Boxes: Conduit terminator ends installed in pull boxes shall be of injection molded Schedule 40 PVC material.

(D) Cable Racks and Hooks: Cable racks and hook installed in ITS pull boxes shall be manufactured from hot rolled steel material and hot dipped galvanized per ASTM 123/A153.

The Cable racks shall be manufactured from a 1-1/2 inch x 9/16 inch x 3/16 inch hot rolled steel section and shall have 'T' slots installed at 1-1/2 inch spacing.

The cable hooks shall be manufactured of 3/16 inch hot rolled steel and shall have a smooth top surface to prevent damage to fiber optic or communication cables.

481.2.10 Pull Tape: The pull tape used shall be the flat type, Kevlar weave, each meter or foot marked sequentially for easy identification of distance, designed and constructed not to stretch or spring, and shall have a minimum tensile strength of 2500 lbs.

481.2.11 Product Certification: The Contractor shall furnish a Certificate of Compliance from the manufacturer or DAT certification for the following tests:

(A) Fiber Optic Conduit: Bends for fiber optic conduit and innerduct shall conform to the requirements of the following tests for burn resistance and friction:

1. Burn resistance: Perform the burn resistance test on conduit bend or innerduct wrapped around and secured to a rigid form. Thread an appropriate length of 0.25 inch diameter braided polyethylene pull tape through the conduit/innerduct and sew the ends together to create a continuous loop. The loop of pull tape shall be wrapped around a powered capstan and drawn away from the test sample to provide a continuous tension of 450 lbs. Draw the tape continuously through the sample with the powered capstan at a rate of 480 feet per minute. The sample shall not burn through within 90 minutes.
2. Friction: Conduit and innerducts shall have a coefficient of friction of 0.09 or less when tested in accordance with Bellcore GR-356.

Coupling bodies, for multiduct, shall be tested for water tightness and air tightness and burst strength at 73 ± 4 degree F with a relative humidity of 50 percent, in accordance with the following procedures:

1. Water tightness (outerduct): Two lengths of multiduct (one factory bell and one factory spigot end) shall be joined without the use of force other than that required by hand. The center of the section of the multiduct conduit containing the joint shall be enclosed within a housing suitable for containing water at or above a positive pressure of 20 psi or a water column of 12 feet. The enclosure shall be sufficiently filled with water to completely cover the conduit joint within. A regulated air pressure of 20 psi or a water column of 12 feet above the joint shall be applied to the interior of the enclosure by way of a sealed connection. The ends of the multiduct shall protrude through the sealed exterior of the housing in order to facilitate inspection for leakage of water to the inside. The multiduct assembly shall not show signs of leakage for a period of 24 hours.
2. Air tightness (innerducts): Two lengths of multiduct (one factory bell and one factory spigot end) shall be fully joined without the use of force other than that required by hand. One end of an innerduct shall be sealed with a plug. The opposite end of the same innerduct shall be fitted with a plug and hose assembly for application of air pressure. Air pressure shall be applied until the pressure within the test sample is 125 psi. The coupling assembly shall hold the pressure of 125 psi for five minutes. The above procedure shall be repeated on each remaining innerduct.
3. Burst Strength (innerducts): The burst strength of the innerducts shall be tested at 125 psi per procedure outlined in Bellcore GR-356-CORE.

| **(B) Fiber Optic Pull Boxes:** The Contractor shall provide DAT certifications that demonstrate that pull boxes and pull box covers comply with the loading requirements.

| **481.3 CONSTRUCTION**

481.3.1 Fiber Optic Conduit: Conduit shall be furnished and installed at the locations and of the sizes shown on the plans. At no additional cost to the County the Contractor may use a larger size conduit than specified, provided it is continuous for the entire length of the run from outlet to outlet. Size reduction couplings will not be permitted. Changes to the location and size shown on the project plans shall be documented by the Contractor on as-built plans and submitted to the Engineer. Geotextile innerduct shall only be installed by the cable/conductor installer along with the fiber optic cable in one operation.

Underground conduit shall be installed in a straight line from pull box to pull box and/or from foundation to pull box, all exceptions must be approved by the Engineer prior to installation. All conduit installations shall be one continuous run of a single size and a single type of conduit. Any change in conduit routing must be approved by the Engineer and documented by the Contractor on as-built plans.

When obstructions are encountered during installation, the obstruction may when approved by the Engineer, be bypassed by deflecting the conduit at a rate of at least 10:1. Where a 10:1 deflection is not possible, a minimum 4 foot radius and maximum 90 degree bends or flexible bends may be used at locations approved by the Engineer. Conduit runs between any two pull boxes shall not employ more than 4 bends, or exceed an angular sum of 270 degrees in all directions (vertical and horizontal).

| All conduit installed under existing pavement shall be installed using horizontal directional drilling per Section 608. Open trench excavation across an existing roadway shall not be allowed without the written permission of the Engineer.

Conduit spacers shall be used to arrange multiple conduits in the trench and shall provide a minimum of 1-1/2 inch between conduits. Spacers shall be used at intervals not exceeding 5 feet on-center, or the conduit manufacturer's recommendations, whichever is less. Spacers shall remain upright and not collapse during backfilling, compaction, and pavement installation operations.

Fiber optic conduit shall enter pull boxes at the bottom, extend a minimum of three inches inside, and be sloped to facilitate pulling cable. The use of 90 degree elbows at pull boxes is not allowed.

Existing underground conduit to be incorporated into new work shall be cleaned and blown out with compressed air.

| **(A) PVC Conduit:** PVC conduit shall be cut square and trimmed to remove all rough edges. PVC conduit connections shall be of the solvent weld type. Purple primer

conforming to the requirements of ASTM F656 shall be applied to the joined surfaces prior to use of cement. The joint cement shall be gray PVC cement conforming to the requirements of ASTM D2564. Where a connection is made to rigid metallic conduit, the coupling used shall be a threaded PVC female adapter. Expansion joints shall not be used to join two segments of PVC conduit in one run. They shall be used only to repair conduits or when embedded in and spanning across discontinuous sections of concrete, such as in bridge joints.

Conduit embedded in concrete structures shall be securely attached to the reinforcing steel at intervals of approximately 12 inches. Expansion fittings shall be installed where conduit crosses expansion joints in the structure. Approved expansion fittings shall allow for a linear thermal expansion of up to 6 inches. Where bonding is not continuous, expansion fittings shall be provided with a bonding jumper of number 6 AWG flexible wire. Where it is not possible to use expansion fittings, sleeves of sufficient size shall be installed to provide a minimum 1/2 inch clearance between the conduit and the inside wall of the sleeve. The sleeve shall be discontinuous at structure expansion joints. Sleeves and conduit embedded in concrete structures shall be cleaned out with a mandrel and blown out with compressed air.

PVC conduit shall be stored and handled in an approved manner to minimize ultraviolet deterioration due to exposure to sunlight.

(B) Fiber Optic Warning Tape: Fiber optic warning tape shall be placed above fiber optic conduit installed in open trenches. The message side shall face up. If electrical conduit shares the same trench, the conduit warning tape for the electrical conduit is not required. Warning tape shall be buried at a depth of 24 inches below finished grade and shall be centered over the conduit.

(C) Detectable Locator Wire: One #14 AWG solid wire with a green outer jacket is required to run continuously without splices in each conduit. Splicing of #14 AWG wire is permitted only to establish an unbroken path through conduit for locating purposes. There shall be at least eight feet of #14 AWG wire doubled back and capped inside all empty conduits.

(D) Pull Tape: Pull tape shall be in populated and unpopulated fiber optic conduit and innerducts to facilitate future cable installations.

(E) Conduit and Innerduct Plugs: All empty fiber optic conduits and innerducts shall be sealed with a cap or plug at each end and have a pull tape attached to it.

During shipping and while on the job site, the open ends of all runs of ducts, conduit, and multiduct conduit shall be sealed with removable caps, plugs, or sealing fittings to prevent the entry of rodents, dirt, sand and other foreign materials. These caps, plugs, or sealing fittings shall be removed only when the Contractor is in the act of joining sections together, testing, or pulling cable. The open ends shall be immediately recapped or resealed after completion of these activities. This requirement shall be met

for all empty or occupied ducts, conduit, and multiduct conduit located anywhere on the Project site, including but not limited to those at equipment enclosures and pull boxes.

If temporary caps or seals are used, the methods and materials shall be approved by the Engineer. Temporary caps and seals shall be replaced with caps, sealing fittings, or plugs conforming to specification requirements prior to acceptance.

(F) Multiduct Conduits: Multiduct conduit shall be installed in accordance with the project specifications and the manufacturer's recommended installation procedures.

The contractor shall visually inspect each section of multiduct prior to installation and verify that the innerducts are straight and do not sag.

Cutting of multiduct shall not be allowed, except to obtain proper lengths at bridge structures, junction boxes, and when needed for connection of bends at specific points along the multiduct runs.

Should connection of multiduct to existing multiduct be required, the joining multiduct shall be of the same manufacturer as that of the stub out. This requirement does not preclude use of a different manufacturer of multiduct in areas where there are no existing multiduct or areas where multiducts meet at a pull box. At the Contractor's option, a pull box may be installed in order to meet the above requirement; however, the cost of furnishing and installing the pull box shall be included in the cost of the multiduct.

Field bending of multiduct shall not be permitted.

Terminations that provide a watertight seal between the innerduct and outerduct shall be installed for all multiduct ends terminated at junction boxes.

(G) Directional Drilling: The pulling tension for installing the HDPE conduit shall not exceed 75% of the manufacturer's tensile strength rating for each size and configuration of conduit to prevent elongation or "necking down" during installation. For conduit installation not specified as directional drilling, the Contractor may choose to utilize directional drilling instead of trenching at no additional cost to the County.

When joining segments of HDPE conduit, the contractor shall use non-corrosive, sit-tight, water-tight couplings. Heat fusion, electrofusion fittings and mechanical connections are permitted provided the HDPE conduit and joining device manufacture's recommendations are observed and the internal diameter of the HDPE conduit is not reduced. Extrusion welding and hot gas welding to join HDPE conduits is not permitted.

Directional drilling shall be performed in compliance with Section 608 HORIZONTAL DIRECTIONAL DRILLING. A bore Plan/Profile shall be required for all bore size classifications.

Upon completion of joining HDPE conduit sections and setting the pull boxes, the contractor shall clean the HDPE conduit with compressed air.

(H) Trenching, Backfilling, and Compaction: Trenching, backfilling, and compaction shall be in accordance with Section 601. Trenches shall not be excavated wider than necessary for the proper placement of conduit and pull boxes. Minimum trench clear width at each side of conduit at spring line is two inches (2").

If a trench has to be left open overnight, a minimum of six inches of backfill material shall be used as a protective cover to eliminate contraction of the conduit systems. The Contractor shall remove backfill material and have an inspection by the Engineer prior to installation of CLSM.

After conduits, spacers, and tie downs are in place, the Contractor shall notify the Engineer for inspection. The conduit and underground material or equipment shall be approved by the Engineer before placement of Controlled Low Strength Material (CLSM).

The Contractor shall install one-sack CLSM in the bottom 24 inches of fiber optic conduit trenches. CLSM shall be placed in compliance with the requirements of Section 604.

481.3.2 Fiber Optic Pull Boxes: The Contractor shall furnish and install pull boxes of the type specified at the locations shown on the plans. The maximum distance between pull boxes shall not exceed 1200 feet. Chipped or cracked pull boxes, covers, and extensions will not be accepted.

Pull boxes shall be set and adjusted to be flush with the top of the adjacent curb, adjacent sidewalk, or roadway shoulder grade. Where a pull box is not installed adjacent to curb or sidewalk or is installed outside of an unpaved roadway shoulder, it shall be installed one to two inches above the adjacent terrain.

The Contractor shall backfill below pull boxes with an eighteen inch (18") deep uniformly graded gravel bed. Backfill around the sides of the pull box shall be with excavated material compacted to 95 percent maximum density when located in an area subject to vehicular traffic and compacted to 90 percent maximum density when located back of curb.

The Contractor shall secure all pull box covers with tamper proof bolts before final acceptance of the project. The Contractor shall connect the #8 AWG tracer wire to the inside connection points of the Type A through C pull box covers with a minimum of five feet of slack. If multiple tracer wires are connected to a single cover, the Contractor shall situate the wires so that they are not in contact with each other and do not cross paths.

All pull boxes shall be left in a clean condition, free of dirt and debris upon completion of the work.

481.4 TESTING REQUIREMENTS:

Contractor testing shall comply with requirements of Section 480.3.4 and the following:

481.4.1 Stand-Alone Tests:

The Contractor shall demonstrate by pulling a cleaning mandrel or ball mandrel with a diameter of 90% (80% for HDPE) of the inside diameter of the conduit, through all new conduit runs to ensure that the conduit was not deformed during installation. The conduit may be brushed or swabbed, if deemed necessary, prior to pulling the mandrel through the conduit. No separate measurement or payment shall be made for this activity. If the mandrel passes through the conduit the contractor shall install pull tape in the conduit. If the mandrel encounters a deformity in the conduit, the contractor shall replace the entire segment of conduit between pull boxes with new conduit at no additional cost to the County.

481.5 DOCUMENTATION:

The contractor shall provide as-built drawings for all installed conduit and pull boxes. All vertical and horizontal conduit adjustments made shall be recorded on the as-built drawings.

481.6 MEASUREMENT:

Fiber optic conduit will be measured by the linear foot for each type and size installed. Fiber optic conduit will be measured as the horizontal distance along the alignment of the installed conduit from center of pull box to center of pull box, center of pull box to center of pole foundation, center of pull box to conduit riser in the cabinet foundation, and center of pull box to edge of building as applicable. When the Contractor chooses to use directional drilling instead of trenching, measurements will be included for only those items that would have been required for a trenching installation, conduit measurement will be for the type and length of conduit that would have been installed by trenching and measurements will be included for related trenching work such as the replacement of pavements, curb and gutter, sidewalk, driveway and alley entrances, as allowed for by open cut trench construction.

Pull boxes will be measured as a unit for each pull box type. Type A pull box includes the extension in addition to the box and cover.

481.7 PAYMENT:

The accepted quantities of conduit will be paid for at the contract unit price, which shall be full compensation for the item, COMPLETE IN PLACE, including but not limited to couplings, fittings, end closures, potholing and pothole restoration, excavating, placement of CLSM, backfilling, compacting, fiber optic warning tape, detectable locator wire, pull tape, testing, warranty, and documentation. For directional drilled installations

the work associated with compliance to horizontal directional drilling requirements are also included in contract unit price.

The accepted quantities for pull boxes will be paid for at the contract unit price, which shall be full compensation for the COMPLETE IN PLACE installation, including excavating, backfilling, and restoration of disturbed landscaping.

Part 400 add the following new Section:

SECTION 482

FIBER OPTIC CABLE AND EQUIPMENT:

482.1 DESCRIPTION:

The work under this section shall consist of furnishing, installing, and testing fiber optic cable and related equipment, including jumper cable, pigtails, connectors, patch panels, splicing, splice units, termination units, and splice closures.

482.2 MATERIAL REQUIREMENTS:

482.2.1 Fiber Optic Cable: Unless otherwise stated, all fiber optic cable shall be 'Bend-Insensitive' single mode fiber optic (SMFO) cable that is of loose tube construction, filled with a dry water-blocking material (Super Absorbent Polymer) and constructed by a certified ISO 9001 or 9002 manufacturer.

Fiber optic cable shall be dielectric and comply with the requirements of US Department of Agriculture Rural Utility Services specification RUS 1755.900, IEC 60793, ITU-T-G-657 Class A, and ITU G652.D except as modified by the Specifications. The fiber optic cable shall comply with GR20-CORE, EIA/TIA, and REA/RUS PE-90. Indoor fiber optic cable shall also comply with the requirements of Article 770 of the NEC. The color code for up to 12 buffer tubes and 144 fiber optic strands shall comply with Table 1 below:

Table 1: Fiber Optic Strand and Buffer Tube Color Table

		Buffer Tube Color											
		Blue	Orange	Green	Brown	Slate	White	Red	Black	Yellow	Violet	Rose	Aqua
Strand Color	Blue	1	13	25	37	49	61	73	85	97	109	121	133
	Orange	2	14	26	38	50	62	74	86	98	110	122	134
	Green	3	15	27	39	51	63	75	87	99	111	123	135
	Brown	4	16	28	40	52	64	76	88	100	112	124	136
	Slate	5	17	29	41	53	65	77	89	101	113	125	137
	White	6	18	30	42	54	66	78	90	102	114	126	138
	Red	7	19	31	43	55	67	79	91	103	115	127	139
	Black	8	20	32	44	56	68	80	92	104	116	128	140
	Yellow	9	21	33	45	57	69	81	93	105	117	129	141
	Violet	10	22	34	46	58	70	82	94	106	118	130	142
	Rose	11	23	35	47	59	71	83	95	107	119	131	143
	Aqua	12	24	36	48	60	72	84	96	108	120	132	144

(A) Fiber Optic Cable Performance and Construction: Fiber optic cable shall comply with the following requirements:

Cladding diameter:	$125 \pm 0.7 \mu\text{m}$
Core-to-cladding offset:	$\leq 0.8 \mu\text{m}$
Cladding non-circularity:	$\leq 0.5\%$
Maximum attenuation:	$\leq 0.35 \text{ dB/km}$ at 1310 nm; $\leq 0.25 \text{ dB/km}$ at 1550 nm
Microbend attenuation (1 turn, 32 mm diameter):	$\leq 0.05 \text{ dB}$ at 1550 nm
Microbend attenuation (480 turns, 75 mm diameter):	$\leq 0.05 \text{ dB}$ at 1310 nm
Allowable Bending Radius for Fiber	$\geq 15 \text{ mm}$
Attenuation uniformity:	No point discontinuity greater than 0.05 dB at either 1310 nm or 1550 nm.
Mode-field diameter (matched cladding):	$8.6 \pm 0.4 \mu\text{m}$ at 1310 nm; $10.5 \pm 1.0 \mu\text{m}$ at 1550 nm
Maximum chromatic dispersion:	$\leq 3.2 \text{ ps/(nm} \times \text{km)}$ from 1285 nm to 1330 nm and $< 18 \text{ ps/(nm} \times \text{km)}$ at 1550 nm
Fiber polarization mode dispersion:	$\leq 0.2 \text{ ps/(km)}^{1/2}$
Fiber coating:	Dual layered, UV cured acrylate applied by the fiber manufacturer
Coating diameter:	$245 \mu\text{m} \pm 5 \mu\text{m}$
Minimum storage temperature range for Cable:	-40 to +75 degree C (-40 to 167 degree F)
Minimum operating temperature range for Cable:	-20 to +70 degree C (-4F to 158 degree F)
Rated life:	Certify a 25 year life expectancy when installed to manufacturer's specifications
Ensure the change in attenuation for single-mode from -20 to +70 degree C (-4 to 158 degree F) does not exceed 0.2 dB/km at 1550 nm, with 80% of the measured values no greater than 0.1 dB/km at 1550 nm.	

Buffer Tubes: Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel that is free from dirt and foreign matter. The gel shall allow free movement of the fibers, without loss of performance, during installation and normal operation including expansion and contraction of the buffer tubes. The gel shall be readily removable with conventional nontoxic solvents.

Buffer tubes shall be stranded around a central member using the reverse oscillation or "S-Z", stranding process. Filler rods shall be used in the trunkline cable to lend symmetry to the cable section when the number of buffer tubes required is not sufficient to circumscribe the central member.

The nominal outer diameter of the tubes shall be 2.7 mm for tubes with 12 fibers or less.

Central Strength Member: The fiber optic cable shall have a central strength member designed to prevent buckling of the cable. The central member shall be covered with a super absorbent polymer in order to prevent water migration through the center of the cable core should the core become exposed.

Cable Core: The fiber optic cable shall use a dry water-blocking material to block the migration of moisture in the cable interstices.

Two polyester yarn binders shall be applied counter-helically in order to secure the buffer tubes to the central member. The binders shall not crush or deform the buffer tubes. The binders shall be non-hygrosopic, non-wicking, and dielectric with low shrinkage.

For single layer cables, the yarn binders shall contain super absorbent polymers to prevent water migration.

Tensile Strength Members: The fiber optic cable shall have tensile strength members designed to minimize cable elongation due to installation forces and temperature variation.

Underground fiber optic cable shall withstand a 600 lb tensile load applied per EIA-455-33 where the change in attenuation does not exceed 0.2 dB during loading and 0.1 dB after loading. Cable shall be rated for an installed tensile service load of 200 lbs or more.

Cable Jacket: The fiber optic cable jacket shall be constructed of medium density polyethylene (MDPE) that has been applied directly over the tensile strength members and water-blocking material. The jacket shall have at least one ripcord designed for easy sheath removal. Printed on the jacket shall be the cable code to identify the number of fibers, manufacturer name, manufacturer part number, year of manufacturer, and the sequential length markings.

Cable Markings: Cable markings shall include cable length (in feet) and the year of manufacture. Cable markings shall identify the cable as trunkline (cable between communication hubs) or branch (spliced to trunkline cables). All cable markings shall be labeled with indelible markings.

Environmental: Cable shall withstand the following conditions without damage or decrease in function:

1. Cable operating temperature per EIA/TIA-455-03;
2. Total immersion in water with natural mineral and salt contents;
3. Salt spray or salt water immersion for extended periods; and
4. Wasp and hornet spray.

(B) Cable Length and Shipping: The length of each fiber optic cable shall be based on field measurements. Include in the measurement the required amount of slack cable at pull boxes, field cabinets, hubs, and equipment racks.

Stencil, letter, or provide the following information on a weatherproof tag firmly attached to the reel:

1. Factory order number;
2. Job number;
3. Ship date;
4. Manufacturer's cable code;
5. Type of cable (single mode, outdoor, indoor);
6. Beginning and ending length markings; and
7. Measured length and attenuation.

(C) Trunkline Fiber Optic Cable: Trunkline fiber optic cable shall have a minimum of 96 fibers, with 12 fibers per buffer tube. Refer to the plans for the total number of strands per cable used.

(D) Branch Fiber Optic Cable: Branch fiber optic cable shall have 12 fibers, with 12 fibers per buffer tube. Both ends of the branch fiber optic cable shall be bare for splicing.

(E) Fiber Optic Jumper Cable: Jumper cables shall meet the following requirements:

1. 250 μ m buffering of each fiber;
2. 900 μ m buffering of each fiber applied after the initial 250 μ m buffering;
3. Maximum factory measured insertion loss of 0.5 dB per EIA/TIA 455-171;
4. Less than 0.2 dB loss when subjected to EIA/TIA-455-1B, 300 cycles, 0.5 kg;
5. Aramid yarn strength member;
6. Rugged 0.12 inch (approximate) PVC sheathing;
7. Minimum bend radius of 12 inch following installation, 25 inch during installation;
8. Minimum tensile strength of 480 lbs;
9. UPC LC Connectors that are factory terminated; and
10. Lanyard dust caps for fiber optic connectors.

(F) Fiber Optic Pigtail: Fiber optic pigtails shall meet the requirements for jumper cable, except as amended by this section. Pigtails that are totally contained within a fiber optic splice or termination unit need not have a 0.12 inch PVC jacket. All fiber optic pigtails shall be UPC type LC. The other end shall be left bare for splicing to fiber.

(G) Fiber Optic Connectors: Fiber optic connectors shall meet the following requirements:

1. Pre-installed by the cable manufacturer;
2. Type shall be machine polished UPC LC;

3. Designed for terminating single mode fiber with 125 μm cladding;
4. Return loss factory-measured – 55 dB (UPC) or less from -40 to +70 degree C (-40 to 158 degree F);
5. Factory-measured attenuation less than 0.5 dB;
6. Connector attenuation shall not change more than 0.2 dB following 4800 re-matings; and
7. Lanyard dust caps for fiber optic connectors.

Connectorized cable shall have strain relief boots that can withstand an axial pull of 25 pounds force with no physical damage to the connector or performance of the fiber.

All connector types shall use an UPC machine to polish connector ends. Hand polished connectors shall not be used.

482.2.2 Fiber Optic Splice and Distribution Equipment

(A) Fiber Optic Patch Panels: Fiber optic patch panels shall have protective covers for all unused couplers and shall have a minimum of 12 ports per patch panel.

(B) Splice Trays: Splice trays shall be designed specifically for housing single-mode fusion splices. Splice trays shall be easy to install and remove, and have provisions for a minimum entry of four buffer tubes.

(C) Fiber Optic Splice and Termination Units: Fiber optic splice and fiber optic termination units shall be properly sized for the required number of splices and terminations subject to the minimum requirements stated for each configuration. Fiber optic splice and termination units shall meet the following requirements:

1. Have provisions for minimum of 6 fiber optic cable entries;
2. Rack mounted;
3. Have front and rear doors or removable panels;
4. Have a top, bottom, and 4 sides that fully enclose the interior and protect its contents from physical damage;
5. Manufactured using 16 gauge aluminum or approved equivalent and corrosion resistant;
6. Provisions for neatly routing cables, buffer tubes, and fan-out tubing;
7. Have internal feed-through provisions that allow cables to be internally routed between two units installed adjacent to each other;
8. Have provisions for externally securing the fiber optic cable, sheath, and central strength member;
9. Suited for Patch and Splice Modules;
10. Include removable front and rear fiber routing guides;
11. Textured black powder coat finish;
12. 4RU Panels conforming to 15.5 x 17 x 7 (inch);
13. Aluminum construction per ASTM B209;
14. Unloaded weight of 9 pounds (4RU), 5lbs (2RU), and 4 pounds (1RU); and

15. Use LGX interconnect platform.

Fiber Optic Splice Units: Fiber optic splice units shall consist of a single housing with provisions for installation of multiple splice trays as required. The splice unit shall have provisions for future installation of 2 splice trays of minimum 12 splice capacity each, in addition to the required amount.

The splice unit shall have a pull-out shelf that allows easy access to the splice tray, buffer tube and fiber storage area that permits fusion splicing to be conducted at a minimum distance of 16 feet from the housing. Units with hinged shelves are not acceptable. The following permanent marking shall be provided on the door or front access panel: "Fiber Optic Cable Splice Area Inside".

Fiber optic splice units shall consist of a single modular housing that has LGX interconnect adaptability. Each Patch and Splice module shall use ITU-TG-652.D fiber that can be configured for up to 24 fiber splices to LC connectors and corresponding bulkheads. These patch and splice modules shall be self-contained with the bulkheads providing one connection interface and the internal splice chips providing the other connection interface.

Mounting provisions for the patch and splice modules shall include individual rack or wall-mountable brackets that allow for setup in limited-space applications.

Fiber Optic Termination Units: Fiber optic termination units shall consist of a single housing with provisions for installation of one or more patch panels as required. Patch panels shall face to the front of the rack.

Fiber optic termination units shall have cable management brackets or rings, integral to the unit, that secure and support cables between patch panels or splice trays to the vertical rack members while maintaining a minimum 1.5 inch cable radius. Jumper cable troughs may be provided in lieu of this requirement.

The following permanent marking shall be provided on the front of the unit: "Fiber Optic Cable Termination Area Inside".

Integrated Fiber Optic Splice and Termination Units: Integrated fiber optic splice and termination units shall consist of a single housing with provisions for patch panels and splice trays. Integrated fiber optic splice and termination units shall comply with requirements for Fiber Optic Splice Units and with requirements for Fiber Optic Termination Units.

The following permanent marking shall be provided on the door or front access panel: "Fiber Optic Cable Termination and Splice Area Inside".

The fiber optic termination units used in the traffic signal cabinets shall have a black housing fabricated of steel that can accommodate a separate fiber optic cable panel.

The fiber optic cable panel shall accommodate 12 fiber strands, with factory install LC connectors on the front, and approximately 3 feet of fiber optic cable pigtail attached to each connector on the back side. The connector inserts shall be ceramic. The unit shall accommodate a rack mount, with nominal dimensions of 7 inches x 5.5 inches x 2 inches. All 12 strands of the branch cable shall be fusion spliced to a pigtail.

(D) Jumper Cable Troughs: Jumper cable troughs shall be designed to secure, support, store, and horizontally route jumper cables and other fiber optic cables from vertical frame members on one side of the rack, to vertical frame members on the other side of the rack. Jumper cable troughs shall be designed to maintain the manufacturers minimum bend radius for jumper cable's bend radius when transitioning from the trough to vertical frame member. The capacity of each cable trough shall exceed the number of jumpers it houses.

(E) Underground Splice Closures: Underground splice closures shall be cylindrical, butt-end style, corrosion resistant, water-tight, and meet the requirements of GR-771-CORE. Underground splice closures shall seal, bind, anchor, and provide efficient routing, storage, organization, and protection for fiber optic cable and splices. Internal configuration shall have end cap with a minimum of two express ports for entry and exit of uncut trunkline cable and a minimum of three additional ports for branch cables.

The splice enclosure shall be designed to seal terminations using gel-sealing technology. The use of heat-shrink is not authorized. The gel seal cable terminations shall automatically adjust to the cable size and shape, and require no special tools, tapes, or mastics to install. The splice enclosure shall support a minimum of 96 splices. Refer to the plans for the splices required at each splice closure.

Splice closures shall seal both the cable jackets and core tube without the use of water-blocking materials. The gel seals shall be re-usable and cabling shall be easy to remove. The splice closure shall be opened and completely resealed without loss of performance. Splice closures shall be at least 12 inches shorter in length than the longest inside dimension of the pull box.

482.3 CONSTRUCTION:

482.3.1 Fiber Optic Cable: Prior to installing fiber optic cable the Contractor shall provide a fiber pulling plan showing reel setup, assist winch, "figure eight", and assist wheel locations. The fiber pull plan shall identify the estimated pulling tension, route length, number of turns, pull direction, and splice enclosure and access locations. The fiber pulling plan shall include cable pulling lubricants, pulling grips, breakaway swivel, dynamometer, and any other hardware that will be used to assist in maintaining cable's minimum bend radius. The Contractor shall submit the fiber pulling plan to the Engineer for review and approval at least two weeks prior to install. The Contractor shall not install fiber optic cable without prior approval of the fiber pulling plan.

The ITS inspector shall be present at all times during the installation of fiber optic cable.

The pull tape shall be threaded through the pulling eye and sewn back onto itself to reduce the possibility of breakage. A swivel shall be used between the tape and cable to prevent cable twisting. Tension-sensitive, breakable links shall be used to protect the fiber optic cable from over-tension for pulls over 700 feet.

The Contractor shall install fiber optic cable continuous and without splices between allowable splice points as identified by the Plans and Specifications. The Contractor shall only splice fibers in splice closures and at fiber optic splice units that are housed at hub locations and/or the Traffic Management Center (TMC). The Contractor shall perform all final length measurements and order cable accordingly.

The Contractor shall:

- Carefully handle fiber optic cable;
- Not pull cable along the ground;
- Not pull cable over edges or corners, over or around obstructions or through unnecessary curves or bends;
- Not exceed fiber optic cable bend radius at any time;
- Not exceed the maximum pulling tensions at any time; and
- Use manufacturer approved pulling grips, cable guides, feeders, shoes and bushings to prevent damage to the cable during installation.

The Contractor shall place cable in a “figure-eight” configuration, when removing cable from the reel prior to installation, to prevent kinking or twisting. The Contractor shall take care to relieve pressure on the cable at crossovers by placement of cardboard shims (or approved equivalent method) or by creating additional “figure-eights”. The Contractor shall store cables as per the approved fiber pulling plan. Fiber stored using cable reels, the figure eight pattern or other approved means shall use radii larger than the minimum bend radius of the fiber. If the bending radius is violated then the Contractor will replace the section of cable from the last splice point.

The Contractor shall furnish the Engineer with the cable manufacturer's recommended procedures, maximum pulling tension, a list of the cable manufacturer's approved pulling lubricants, and the lubricant manufacturer's procedures for use. The Contractor shall adhere to the manufacturer's installation procedures when installing fiber optic cable. The pulling tension shall be monitored using a strip chart recorder when mechanical pulling techniques are used. If at any time during the pull the cable tension is at 85% of the maximum allowed, the Contractor shall stop the pull and troubleshoot the problem to determine if there is an obstruction, low lubricant, or other difficulties that may cause a high-tension problem. After the tension problem has been thought to have been resolved, continue the pull, and closely monitor the cable tension. If the problem continues, the Contractor shall notify the Engineer of the problem and cease installation until the problem can be identified.

The Contractor shall use high-performance fiber optic cable lubricant to lubricate the conduit for long cable duct pulls beyond 700 feet or pulls with numerous turns totaling

over 180 degrees. The lubricant shall be suitable for outdoor temperatures, flame retardant, unable to affect the properties of the cable jacket, and have a low coefficient of 0.25 when used on PE jacketed or other types of cables. The lubricant is to be present at all points of the fiber optic conduit, cable feed locations, intermediate pull locations, bend locations and approved by UL or CSA. The lubricant shall be applied with a lubricant collar and pump. The Contractor shall use lubricants in quantities and in accordance with the procedures recommended by the lubricant manufacturer.

The Contractor shall furnish attachment hardware, installation guides, and other necessary equipment, not specifically listed herein, as necessary to install the fiber optic cable.

(A) Underground Fiber Optic Cable: At each splice point, coil 150 feet of slack fiber optic cable per cable entry. Each Type C, D or E pull box without a splice closure shall have a minimum of 300 feet of fiber optic cable slack installed. The Contractor shall install 25 feet of slack per cable at each intermediate Type A pull box and 150 feet in each Type B pull box. At each field cabinet, provide a minimum of 16 feet of slack for each fiber optic cable. All cable shall be coiled and neatly stowed in the respective pull box or cabinet.

Underground fiber optic cable shall be installed in fiber optic conduit, unless shown otherwise in the plans.

(B) Indoor Fiber Optic Cable: Indoor fiber optic cable installations shall follow the requirements of local building codes and NEC Article 770.

Splices for indoor fiber cable shall be housed in a rack-mounted fiber optic splice unit or integrated fiber optic termination unit. Coil 16 feet of slack fiber optic cable and stow it in the rack.

(C) Fiber Optic Jumper Cable: Install jumper cables only in field cabinets and indoor locations. Provide permanent labeling on duplex jumper cables that provide a visual distinction between the two fibers. Provide strain relief for jumper cables at both ends and elsewhere as needed. Adhere to manufacturer recommended installation and minimum bend radius requirements.

(D) Fiber Optic Pigtails: Install fiber optic pigtails only in enclosed fiber optic splice and termination units located in field cabinets and indoor locations. When splicing pigtails to individual fibers, match the color of single fiber pigtails with the color of the fiber. Alternatively, single fiber pigtails may be routed through colored fan-out tubing that matches the color of the fiber.

482.3.2 Splicing and Terminations: The Contractor shall splice fibers only at locations that are identified in the Plans. Splice tables in the Plans shall not be revised without approval from the Engineer. For outdoor installations, all splices shall be protected and stored in underground splice closures.

For indoor installations, all splices shall be protected and stored in fiber optic splice units or integrated fiber optic splice and termination units. The fiber optic cable shall enter the rear of the unit. The fiber optic cable sheath and central member shall be secured inside the unit prior to buffer tube fan-out. All entry holes not used shall be plugged. Buffer tubes with fiber designated for splicing shall be routed into and secured in a splice tray. Remaining buffer tubes shall be secured within the splice unit and not accessed.

(A) Splicing Methods: All splices shall be accomplished by means of the fusion splice technique. Each splice shall not add more than 0.1 dB attenuation when splicing new fiber to new fiber, and 0.3 dB attenuation when splicing new fiber to existing fiber. Splices found to exceed the maximum allowed dB attenuation when tested with an optical time-domain reflectometer (OTDR) shall be re-spliced, at no additional cost, until this requirement is met.

Each splice shall be packaged in a protective sleeve and secured in the splice tray. The sleeve shall be approved for use by the fiber optic cable manufacturer and installed in such a manner as to protect the fiber from scoring, dirt accumulation, moisture intrusion, and microbending.

Splicing shall be performed in a clean indoor environment that is free of dust, dirt or any encumbrances that will hinder the splicing of fiber optic cable.

All fibers in a buffer tube shall be spliced within the same splice tray. When splicing to fiber optic pigtails, use spiral wrap (or similar approved method) to group and protect pigtails routed from each splice tray to the corresponding patch panel.

Fiber optic cable splices will fall into one of the following categories:

Mid-cable splices: Perform mid-cable splices when splices are not required for all fibers of a cable. Only fibers within a buffer tube that are designated for splicing shall be accessed, spliced, and secured neatly within the splice tray. The remaining fibers in the buffer tube that are not designated for splicing shall be secured neatly within the splice tray and not cut. Removal of the buffer tube to access the fibers shall be accomplished using equipment specifically designed for buffer tube removal without damaging the individual coated fibers.

Full-cable splice: Perform full-cable splices when the distance exceeds the maximum length of fiber optic cable available on a reel. All fibers, including spares, shall be spliced together to provide a continuous optical path. All fibers shall be secured neatly within the splice trays.

(B) Termination Methods: LC connectors shall be used for terminating fiber optic cables.

Measured attenuation at each termination (inclusive of 2 connectors and coupler) shall not exceed 0.5 dB.

Fiber terminations shall be neatly and permanently labeled on the connector module to designate 'transmit' or 'receive' (as appropriate) and the fiber optic strand number or other designation as determined by the Engineer. Spare fibers shall be terminated when called for by the Plans and labeled as determined by the Engineer.

Protective covers shall be used on all optical connectors and terminations at all times until terminated.

Termination at Hubs and TMC: Termination of fiber optic cable at hubs and the TMC shall be accomplished by fusion splicing fiber to factory prepared, fiber optic pigtails with LC connectors terminated at patch panels. Jumper cables shall have LC connectors. Field termination of fibers to connectors shall not be permitted.

482.3.3 Fiber Optic Distribution Equipment: The Contractor shall install a sufficient number of patch panels to terminate all fibers. Blank patch panel covers shall be of the same manufacturer as the patch panel and shall be installed for all unused patch panel spaces on fiber optic termination units.

Fiber optic patch panels shall have couplers to allow applications to be easily installed and removed from the termination housing.

482.3.4 Fiber Optic Equipment Labeling: Labeling of fiber optic equipment including trunkline cables, branch cables, branch cables, connectors and ports shall comply with the *Cable and Active Electronics Labeling and Management* requirements of Section 480.

482.4 TESTING REQUIREMENTS:

Fiber optic cable and distribution equipment shall meet the following certification, factory and stand-alone test requirements. General test requirements are covered in Section 480.3.4. See figure 482.4-1 for a Sample Fiber Test Report.

The ITS inspector shall be present at all times during the testing of fiber optic cable.

482.4.1 Design Approval Tests (DAT): The Contractor shall submit a certificate of compliance or DAT test results and certification for fiber optic cable. Submittal of RUS certification will satisfy this requirement for the tests that are required by RUS 1755.900.

482.4.2 Factory Acceptance Tests (FAT): All fiber optic cable, pigtails, jumper cables, and patch panels shall be tested in the factory to demonstrate compliance with specification requirements. The Contractor shall submit a copy of the results of factory tests to the Engineer.

482.4.3 Stand-Alone Tests:

(A) Pre-Installation Testing: The Contractor shall visually inspect all cable and equipment upon delivery and again prior to installation. The Contractor shall test any equipment that is found to have visual damage. The Contractor shall perform pre-installation on-reel testing of all fiber optic cable strands prior to installation. Using an OTDR, the Contractor shall test to ensure fiber optic cable strands are free of breaks and micro bends.

(B) Post-Installation Testing: Prior to testing, the Contractor shall furnish the Engineer with a fiber optic testing plan and procedures. Testing of spare fiber is required.

The Contractor shall test for and identify unacceptable losses. Failed splices may be remade and re-tested for compliance. The Contractor shall replace any cable in its entirety that is found not compliant to the Specifications. Post-installation tests shall use the procedures of TIA/EIA-526-7A and all standards and procedures invoked therein, subject to the following clarifications:

Power Meter Tests: The contractor shall conduct unidirectional power meter tests for each fiber to measure installed fiber cable attenuation, demonstrate connectivity, and correct splicing. The contractor shall perform Power Meter Tests on each fiber strand in accordance with Method A.3 of TIA/EIA-526-7 – “Measurement of Optical Power Loss of Installed Single-mode Fiber Cable Plant” and submit test results for each fiber to the Engineer as required by TIA/EIA-526-7. Test results for each link shall be submitted to the Engineer. Power meter tests shall be conducted after all splices have been made and all connectors, jumper cables, and pigtails are in place. Each link shall be tested separately from each field cabinet to the respective trunk cable termination panel in the Hub(s) and from field cabinet to field cabinet for fiber links that do not go directly to a hub. The use of fiber optic jumpers to couple the connectors together in equipment cabinets to create a continuous end to end link is not permitted.

OTDR Tests: The contractor shall conduct bi-directional tests using an OTDR in accordance with TIA/EIA-455-8 (FOTP8) for each fiber strand (including non-spliced fiber strands) from field cabinet to hub location, between hub locations, between field cabinet locations, inclusive of all branch cables, pigtails, and patch panels to demonstrate that attenuation for each fiber strand, termination, and splice, individually and as a whole, comply with allowable losses in accordance with the fiber assignment tables. Test fibers at 1310 nm and 1550 nm.

The OTDR shall be set to operate in auto event mode with the event threshold set at 0.1dB or lower. The Contractor shall submit printed and electronic OTDR traces for approval. Any electronic traces submitted that were shot without the auto events feature shall be re-tested by the Contractor at no additional cost. The Contractor shall clearly annotate each event (connector, pigtail, splice, etc.), event location, and identify the measured loss.

Following completion of all testing, and approval by the Engineer, the Contractor shall compile and submit two organized test notebooks that include all required test results, summary tables, OTDR traces, and electronically saved test data. Test notebooks shall at a minimum, include the following:

1. Identification of each fiber by cable (as it is identified in the field), buffer tube, color, and string number as appropriate;
2. A summary sheet with each submittal that clearly illustrates length and measured loss versus budgeted loss for each fiber or connected fiber string as appropriate; and
3. Calculations and notations for each fiber and wavelength that include total loss, measured dB/km loss, the number of connectors/terminations, pigtails, and jumper cables and any anomalies over 0.1 dB.

SAMPLE FIBER TEST REPORT

FIBER TEST SUMMARY REPORT

Fiber ID	From	To	Wavelength	Length	Number of Splices	Number of Connectors	Loss Budget (dB)	Loss A > B (dB)	Loss B > A (dB)	Loss Average (dB)	Pass/Fail
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								

482.5 WARRANTY REQUIREMENTS:

The following requirements apply in addition to the warranty requirements identified in Section 480.4:

The Contractor shall repair or replace defective fiber optic cable and equipment for a period of one year following final acceptance of the system.

482.6 DOCUMENTATION:

The Contractor shall provide post installation as-built drawings that document fiber distances between manhole/handholes, splice locations, amount and location of coiled slack, and type, size, and number of installed fiber optic cables.

482.8 MEASUREMENT:

Fiber optic cable will be measured by the linear foot for each type installed. The length of cable required to be coiled for cable slack will be measured and included in the total measured amount.

Fiber optic splice units, termination units, integrated splice and termination units, underground splice closures, and patch panels will be measured as a unit for each type installed. The length of the branch connection cable attached to the patch panel will be measured as Fiber Optic Cable (Single Mode 12).

Fiber optic jumper cables, pigtails, connectors, terminations, splice trays, and splices shall not be individually measured, they are considered included as part of other pay items.

482.9 PAYMENT:

The accepted quantities of items, measured as above, will be paid for at the contract unit price, COMPLETE IN PLACE. The cost of testing, warranty, and documentation are included in the unit price of each item.

Part 400 add the following new Section:

SECTION 483

CLOSED CIRCUIT TELEVISION

483.1 DESCRIPTION:

The work under this section shall consist of furnishing, installing, and testing CCTV equipment including software, cables, lightning and surge protection equipment and various accessories as needed.

483.2 MATERIALS:

CCTV camera assemblies shall include the camera, lens, pan/tilt/zoom control receiver, sun shield, and the environmental enclosure together with mounting hardware, CCTV camera panels, cables, lightning and surge protection. The CCTV camera assemblies shall be compatible with existing MCDOT equipment and subject to MCDOT approval.

The CCTV control and power equipment shall be located in the traffic signal controller cabinet of the subject intersection. Where a separate cabinet is required, it shall meet the requirements of Section 475 *Electrical Power Service and Controller Cabinet Installation*.

483.2.1 Local Camera Control Point: The Contractor shall provide a local camera control point in the cabinet housing the camera control equipment.

483.2.1(A) Analog Cameras: For Analog cameras, the control point shall feature:

Video Interface: NTSC Standard with BNC Connector for Test Monitor

Data Interface: RS-422/RS-485

Data rate shall be user selectable with a default of 9,600 bps.

Data Cable: Camera Cable Connector to Existing Video Optical Transceiver Connector (Connector Types on Video Optical Transceivers vary and may include terminal blocks, DB-9 and/or DB-25).

483.2.1(B) IP Addressable HD Digital Cameras: IP Addressable HD Digital cameras shall have H 264 compression and the control point shall feature:

Interface: IP Addressable Ethernet

Data Cable: Camera Cable Connector – RJ45.

483.2.2 Mounting Hardware: Provide all mounting equipment and adapter plates needed to securely mount the pan/tilt unit or dome assembly to the CCTV pole or other structure as required.

483.2.3 Cables: The Contractor shall select suitable cables and camera control systems by taking into consideration the height of installation and distance from the cabinet to ensure that the CCTV system will function properly in an outdoor environment. Power and control cables shall comply with IMSA 20-1 specification requirements.

Coaxial cable shall be RG-59/U and shall meet or exceed the following characteristics:

- Solid copper conductor
- Braided copper shield with 95% coverage
- Attenuation not to exceed 0.65dB/100 feet from 1MHz through 5MHz
- Outdoor rated

The coaxial cable may be replaced by an optical fiber.

A composite cable shall be used for power, camera control, and video between the camera and the cabinet unless otherwise approved by the Engineer.

483.2.4 Surge Suppression: Surge suppression shall comply with requirements of Section 480.2.4. The Contractor shall provide surge suppressors for each power circuit associated with the CCTV system in a weatherproof cabinet at the base of the CCTV pole. The Contractor shall provide detailed diagrams and instructions for the installation of all surge suppressors that are external to the equipment.

483.2.5 CCTV Camera Panel: The Contractor shall provide a CCTV camera panel. All CCTV equipment will be located on the panel. The panel size shall be no less than 11 inches by 11 inches. The panel shall include the following:

1. Single gang outlet box with RJ45 test jack;
2. Video Encoder, refer to Section 486 for Video Encoder requirements;
3. Coaxial Cable Surge Protector;
4. Low Voltage Camera Control Cable Surge Protector;
5. Electrical Bus Bar (ground);
6. Power Cable Surge Protector;
7. 110 Volt Duplex Receptacle Outlet;
8. 6 Outlet Surge Protection;
9. Camera Power; and
10. Video Encoder Power Supply.

483.2.6 Lightning Protection: The Contractor shall provide an air terminal (lightning rod) fabricated of galvanized steel or copper-clad steel for installation on the pole to which the CCTV camera is mounted. The Contractor shall provide 1/2-inch woven copper ground wire for connecting the air terminal to the pole ground rod.

483.3 CONSTRUCTION:

The Contractor shall set electrical or mechanical pan and tilt limits at positions determined by the Engineer. The Contractor shall program camera location identification text labels obtained from the Engineer.

The cables in the cabinet from device to device shall not be longer than required. The cables shall be routed for permanent installation and any excess will be cut to remove the slack. The only exception is the 6 feet of slack inside the cabinet where the cable enters the cabinet.

The Contractor shall provide post-installation photographs in electronic format of the mounted CCTV camera, the slack for each pull box, the CCTV Camera Panel, and the cabinet as part of the inspection. Each photo shall be clearly labeled with the photo location and equipment shown. Any discrepancies with the installation shall be resolved by the Contractor.

Where a Type G cabinet is required or specified in the construction documents, all equipment shall be mounted inside the cabinet either by the use of a panel or DIN rails.

483.3.1 CCTV Camera Installation Plan: The Contractor shall provide to the Engineer a CCTV Camera Installation Plan. The installation plan shall consist of the camera location, estimated cable lengths, cable route, cable slack, wiring diagram, and camera configuration. The Engineer will review the installation plan within 14 calendar days and either approve it or require revisions.

483.3.2 Mounting: All dome cameras shall be mounted to the pole using a pendant arm and strapped to the pole using 3/4-inch type 201 stainless steel bands or approved equal. Bands utilizing a worm gear to tighten and hold the band shall not be used. Mounting shall comply with MCDOT Standard details or approved alternative drawings.

483.3.3 Cables: The Contractor shall install cabling from the CCTV Camera System to the cabinet that will house the camera control equipment.

Each pull box, cabinet, or conduit entry point shall have a minimum of 6 feet of cable slack.

Strain relief shall be used to hold the weight of the electrical, video, and data cables when they hang in a vertical, sloping or horizontal position. The Contractor shall submit a proposed method of strain relief for approval to the Engineer.

An 8 foot service loop is required at the top of the CCTV camera pole or signal pole. A cable grip shall be placed at the beginning and at the end of the service loops to support the weight of the cable and the loop inside the pole.

Drilling of a 1-inch hole into the signal pole to accommodate the cable is authorized for dome cameras.

A grommet shall be used at each hole to prevent the cable from being frayed or damaged.

There shall be no visible cables hanging from the pole or the CCTV Camera enclosure and mounting arm.

483.3.4 CCTV Camera Panel: The CCTV camera panel shall be mounted in the lower right hand corner of the cabinet. The mounting of the items on the panel shall conform to MCDOT Standard Details.

The panel shall be mounted using the existing vertical "C" channels in the cabinet.

The cable shall be tested on the reel and wired directly to the CCTV camera panel.

483.3.5 Lightning Protection: The Contractor shall mount the air terminal to the top of the pole such that it does not hinder the ability of the camera to view areas deemed critical by the Engineer. The air terminal shall be directly grounded by connecting it to the pole ground rod using the 1/2-inch woven copper ground wire.

483.4 DOCUMENTATION:

The Contractor shall provide maintenance manuals for CCTV equipment per the requirements of Section 480.5. Include the following diagrams (as appropriate):

1. Video signal path diagram;
2. Control signal path diagram; and
3. System connection diagram.

483.5 MEASUREMENT:

Each type of CCTV camera assembly will be measured as a unit. Surge suppression, inductive suppressors, lightning protection and the CCTV camera panel are included as parts of the CCTV camera assembly.

CCTV cabinets will be measured as a unit for each type installed.

483.6 PAYMENT:

The accepted quantities of CCTV camera assemblies will be paid for at the contract unit price, COMPLETE IN PLACE including but not limited to testing, warranty, documentation, and training.

The accepted quantities of CCTV cabinet will be paid for at the contract unit price, COMPLETE IN PLACE.

Part 400 add the following new Section:

SECTION 484

DYNAMIC MESSAGE SIGNS

484.1 DESCRIPTION:

The Contractor shall furnish all the necessary labor, materials, and equipment required to install and test all components of structure-mounted dynamic message signs (DMS). This work includes connecting and integrating the DMS into a controller cabinet. It does not include the structure on which the DMS is to be mounted.

484.2 MATERIALS:

The DMS assembly includes the sign case, display matrices, sign controller unit (SCU), software, and accessories. The accessories include but are not limited to mounting hardware; conduit; cabling for power, communications, and grounding; strain relief for cabling; and lightning and surge protection.

The mounting hardware shall withstand the weight of the sign and a wind load of 80 miles per hour with a 30% gust factor.

The DMS controller unit, software, and accessories shall be compatible with existing MCDOT equipment.

484.2.1 Surge Protection: Surge protection shall be in accordance with requirements of Section 480 *Intelligent Transportation System General Requirements*.

484.2.2 DMS Controller Cabinet: The controller cabinet for the DMS assembly shall be as specified in the plans and special provisions and shall meet the requirements of Section 475.2.2 *Controller Cabinet Assembly*.

484.3 CONSTRUCTION:

484.3.1 Conduit: The Contractor shall install a silicon sealant bead around all conduit entries into the sign case to ensure a watertight environment for all cables and conductors.

484.3.2 Wiring: The contractor shall install all cables required to power and operate the DMS signs. The contractor shall install all wiring between the DMS controller cabinet and the DMS Assembly in compliance with the recommendations of the DMS sign manufacturer.

484.3.3 Strain Relief: Strain relief shall be provided for conductors within the DMS support structure. All strain relief (such as wire mesh grip), connectors, and splices within the support structure shall be located within 6 inches of a hand hole.

484.3.4 Grounding: The Contractor shall ground the DMS assembly and contents to the support structure in compliance with the DMS sign manufacturer's recommendations.

484.3.5 Mounting: The Contractor shall provide the DMS sign mounting hardware and attach the DMS sign case to the DMS sign structure as detailed on the construction plans. Shop drawings of alternative mounting schemes may be submitted for review and approval if sealed by an Arizona professional engineer and accompanied by sealed calculations. All alternative mounting proposals shall be designed to withstand the weight of the sign and a wind load of 80 miles per hour with a 30% gust factor.

The Contractor shall mount the controller cabinet to the support structure as detailed by the project plans and special provisions.

484.3.6 Surge Protection: Surge protectors shall be installed in the controller cabinet for all conductors (power and data) between structure-mounted and cabinet-mounted DMS equipment. Each surge protector shall be grounded by connecting it to a terminal block in the cabinet rack. The terminal block shall be attached directly to the cabinet ground using a #8 AWG copper ground wire. Surge protector leads shall be a maximum of 3 feet in length and be installed as straight as possible.

484.4 TESTING

The contractor shall conduct the following tests in accordance with the test requirements of Section 480 *Intelligent Transportation System General Requirements*. The contractor shall furnish all necessary test equipment and test software required to perform the tests.

484.4.1 Stand-Alone Test:

The contractor shall conduct a stand-alone test in the presence of the Engineer and DMS supplier that exercises all stand-alone (non-network) functional operations of the DMS assembly.

The stand-alone test for the DMS assembly shall be performed using both the sign controller unit front display panel and the MCDOT maintenance laptop computer. At a minimum, the test shall verify the following:

- (a) Downloading of messages;
- (b) Placing messages in memory and verifying content;
- (c) Display of all characters in the sign;

- (d) Display of static, alternating (that is, two-panel), and flashing messages of 54 characters;
- (e) Selection of messages;
- (f) Resumption of normal operations after power is restored;
- (g) Diagnostic activation of all pixels at selectable intervals; and
- (h) Diagnostic routines and failure reporting.

484.5 DOCUMENTATION:

The Contractor shall provide maintenance manuals for the DMS equipment as required by the Intelligent Transportation System General Requirements. The documentation shall include the following diagrams:

1. Control signal path diagram; and
2. System connection diagram.

484.6 MEASUREMENT:

DMS assemblies will be measured as a unit complete in place including required testing and documentation.

484.7 PAYMENT:

The accepted quantities of DMS assemblies will be paid for at the contract unit price. Payment for DMS assemblies shall be full compensation for all labor, materials, and equipment required for installation, testing, documentation, and training.

Part 400 is supplemented with the following new Section:

SECTION 486 COMMUNICATIONS EQUIPMENT

486.1 DESCRIPTION:

The work under this section shall consist of furnishing, installing, and testing communications equipment systems including cables, surge protection, lightning protection, software, and accessories. All communications equipment shall be system compatible with existing MCDOT ITS equipment.

486.2 MATERIALS AND EQUIPMENT:

486.2.1 Wireless Access Point: The wireless access point shall be capable of serving as an outdoor Access Point, Client, or Bridge capable of 100Mbps+ speeds and 600mW of power at 2.4 GHZ or 5.0 GHz frequencies as directed by the Engineer. The access

point shall be capable of being connected to any type of RF antenna using N-type male RF connectors.

The wireless access points shall comply with the following minimum requirements:

1. The RF connector shall be an integrated N-type male jack capable of connecting directly to the antenna.
2. Shall have a one (1) RJ-45 10/100 Base TX Ethernet port.
3. The access point shall be equipped with a minimum of 32MB SDRAM and 8MB Flash memory.
4. The access point shall FCC part 15.246, IC RS210, CE and RoHS compliant.
5. Power Supply: The wireless access point shall be powered using passive power over Ethernet (POE) injectors as specified in Section 486.2.4.
6. Mechanical:
 - a. Enclosure shall be an outdoor UV stabilized plastic.
 - b. Shall meet all specified requirements during uncontrolled environmental operations characterized by an operating temperature range of -40 to +80 degree C (-40 to +176 degree F) and a relative humidity range of 5 to 95% (non-condensing).
 - c. The weight shall not exceed 0.4 lbs.
 - d. Shall have weatherproof seals/gaskets at the Ethernet port end.
7. Shall have signal strength LED indicators to assist in antenna alignment.
8. Cables used to connect the wireless access point shall meet the requirements of Section 486.2.12.

486.2.2 Rugged Linear 2x2 MIMO Radio: The 2x2 MIMO radio shall be capable of serving as an outdoor Access Point, Client, or Bridge capable of 150Mbps+ data transfer speeds with a minimum range of 50 km at 900 MHz, 2.4 GHZ or 5.0 GHz frequencies as directed by the Engineer. The radio shall be capable of being connected to any type of high gain RF antenna using N-type male RF connectors.

The radio shall comply with the following minimum requirements:

1. Two Reverse Polarity-Sub Miniature Version A (RP-SMA) RF connectors integrated to the body of the radio.
2. Shall have one (1) RJ-45 10/100 Base TX Ethernet port.
3. Shall have 64MB SDRAM and 8MB Flash memory.
4. Shall be FCC part 15.246, IC RS210, CE and RoHS compliant.
5. Shall be powered using passive power over Ethernet (POE) injectors as specified in Section 486.2.4.
6. Shall be enclosed in an outdoor UV stabilized plastic.
7. Shall meet all specified requirements during uncontrolled environmental operations characterized by an operating temperature range of -30 to +75 degree C (-22 to +167 degree F) with no fans and a relative humidity range of 10 to 95% (non-condensing).
8. The weight shall not exceed 1.25 lbs.
9. Shall have weatherproof seals/gaskets at the Ethernet port end.
10. Shall be capable of withstanding shock and vibration per ETSI300-019-1.4.

11. Shall have signal strength LED indicators to assist in antenna alignment.
12. The cables used to connect the MIMO radio shall meet the requirements set in Section 486.2.12.
13. The radio shall include a pole mounting kit.

486.2.3 Broadband Customer Premises Equipment (CPE): The broadband CPE shall be capable of serving as clients or bridges in Point-to-point (PTP) or Point-to-Multi Point (PTMP) networks, with 150Mbps+ data transfer speeds with a minimum range of 15 km at 2.4 GHZ or 5.0 GHz frequencies as directed by the Engineer. The broadband CPE shall have an integrated hi-gain antenna.

The broadband CPE shall comply with the following minimum requirements:

1. Shall have one external Reverse Polarity-Sub Miniature Version A (RP-SMA) RF connector integrated to the body of the CPE.
2. Shall have one (1) RJ-45 10/100 Base TX Ethernet port.
3. Shall have 32MB SDRAM and 8MB Flash memory.
4. Shall be FCC part 15.246, IC RS210, CE and RoHS compliant.
5. The broadband CPE shall be powered using passive power over Ethernet (POE) injectors as specified in Section 486.2.4.
6. Shall be enclosed in an outdoor UV stabilized plastic.
7. Shall meet all specified requirements during uncontrolled environmental operations characterized by an operating temperature range of -30 to +75 degree C (-22 to +167 degree F) with no fans and a relative humidity range of 10 to 95% (non-condensing).
8. The weight shall not exceed 1.0 lbs.
9. Shall have weatherproof seals/gaskets at the Ethernet port end.
10. Shall be capable of withstanding shock and vibration per ETSI300-019-1.4.
11. Shall be equipped with an integrated antenna with a minimum gain of 8 dB1.
12. The cables used to connect broadband CPE equipment shall meet the requirements set in Section 486.2.12.
13. The broadband CPE shall include a pole mounting kit.

486.2.4 Power over Ethernet (POE) Injectors: The Power over Ethernet (POE) injectors shall be equipped to provide passive power over Ethernet.

The POE injectors shall meet the following functional requirements:

1. Shall be rated for 15 VDC, 24 VDC or 48 VDC as required by the equipment being served. The POE adapter shall be capable of receiving input voltage ranging from 90-260 VAC @ 47-63 Hz.
2. Shall have a minimum of two RJ-45 type ports for communications and power.
3. Shall meet all specified requirements during uncontrolled environmental operations characterized by an operating temperature range of -30 to +75 degree C (-22 to +167 degree F) a storage temperature range of -20 to +85 degrees C (-4 to +185 degree F) and a relative humidity range of 5 to 95% (non-condensing).
4. The power consumption of the POE injectors shall not exceed 10 Watts.

486.2.5 External Antenna: When available the Contractor shall provide and install antennas from the same manufacturer as that of the wireless equipment.

486.2.5.1 Omni Directional Antenna: The omnidirectional antennas used for 2.4 GHZ or 5.0 GHZ frequencies shall meet the following requirements:

1. Shall provide a nominal gain of at least 10 dBi.
2. The antenna dimensions shall not exceed 60 inches (height) by 6 inches (width) for 2.4 GHZ antennas and 40 inches (height) by 4 inches (width) for 5.0 GHZ antennas.
3. Shall be supplied with pole mounting brackets and weather proof RF jumper cables.
4. Shall have a Voltage Standing Wave Ratio (VSWR) of less than 1.7:1.
5. Shall have a minimum cross polarization isolation of 25 dB.
6. Shall operate within a temperature range of -30 to +80 degree C (-22 to +176 degree F) and a relative humidity range of 5 to 95% (non-condensing).
7. The antenna and mounting brackets shall be capable of operating in wind conditions of up to 125 mph.

486.2.5.2 Dish Antenna: The dish antennas used for 2.4 GHZ or 5.0 GHZ frequencies shall meet the following requirements:

1. Shall provide a nominal gain of at least 10 dBi.
2. The antenna dimensions shall not exceed 30 inches diameter for 2.4 GHZ antennas and 42 inches diameter for 5.0 GHZ antennas.
3. Shall be supplied with a pole mounting brackets and weather proof RF jumper cables.
4. The weight of the antenna shall not exceed 25 pounds for 2.4 GHZ antennas and 30 pounds for 5.0 GHZ antennas.
5. Shall have a Voltage Standing Wave Ratio (VSWR) of less than 1.6:1.
6. Shall have a minimum cross polarization isolation of 35 db.
7. Shall operate within a temperature range of -30 to +75 degree C (-22 to +167 degree F) and a relative humidity range of 5 to 95% (non-condensing).
8. The antenna and mounting brackets shall be capable of operating in wind conditions of up to 100 mph.

486.2.5.3 Yagi Antenna: The Yagi antennas used for 900 MHz frequencies shall meet the following requirements:

1. Shall provide a nominal gain of at least 16 dBi.
2. The antenna dimensions shall not exceed 60 inches (length) by 10 inches (width).
3. Shall be enclosed in outdoor UV stabilized plastic.
4. The antenna shall be supplied with pole mounting brackets and weather proof RF jumper cables.
5. The weight of the antenna shall not exceed 1 lb.
6. Shall have a Voltage Standing Wave Ratio (VSWR) of less than 1.5:1.
7. Shall be capable of dual linear polarization.

8. Shall have a minimum cross polarization isolation of 20 db.
9. Shall operate within a temperature range of -30 to +75 degree C (-22 to +167 degree F) and a relative humidity range of 5 to 95% (non-condensing).
10. The antenna and mounting brackets shall be capable of operating in wind conditions of up to 120 mph.

486.2.5.4 Sector Antenna: The Sector antennas used for 900 MHz, 2.4 GHz or 5.0 GHz frequencies shall meet the following requirements:

1. Shall provide a nominal gain of at least 16 dBi.
2. The antenna dimensions shall not exceed 52 inches (length) by 12 inches (width) by 6 inches (depth) for 900 MHz antennas, 30 inches (length) by 6 inches (width) by 4 inches (depth) for 2.4 GHz antennas and 5.0 GHz antennas.
3. Shall be enclosed in outdoor UV stabilized plastic.
4. The antenna shall be supplied with pole mounting brackets and weather proof RF jumper cables.
5. The weight of the antenna shall not exceed 30 pounds for 900 MHz antennas, 14 pounds for 2.4 GHz and 5.0 GHz antennas.
6. Shall have a Voltage Standing Wave Ratio (VSWR) of less than 1.5:1.
7. Shall be capable of dual linear polarization.
8. Shall have a minimum cross polarization isolation of 30 db for 900 MHz antennas, 28 dB for 2.4 GHz antennas and 22 dB for 5.0 GHz antennas.
9. Shall operate within a temperature range of -30 to +80 degree C (-22 to +176 degree F) and a relative humidity range of 5 to 95% (non-condensing).
10. The antenna and mounting brackets shall be capable of operating in wind conditions of up to 125 mph.

486.2.6 Industrial Frame Router: The industrial frame router shall be capable of performing the following networking functions:

1. Terminal Server
2. Ethernet Switch
3. IP Router
4. Frame Relay Access Device
5. Serve as a Channel Service Unit/Data Service Unit (CSU/DSU)

Industrial frame routers shall be supplied with all necessary cabling to provide a functional system.

Industrial frame routers shall be located in the traffic signal controller cabinets and shall comply with the following:

486.2.6.1 WAN Interface

Physical

1. RJ-48 Connector
2. 56/64k Wan option
3. 1.544 Mbps nx 56/64k Line Rate T1/E1 WAN option

4. Integral CSU/DSU

Protocol: Frame Relay, IP

486.2.6.2 Serial Interface

Physical

1. Eight (8) RS232 DTE serial interfaces with DB9 female connectors RJ-48 Connector
2. DB9 female connector
3. Serial Data rates from 300 bps to 230.4 kbps
4. Data Length:1-32 bits supporting legacy SCADA protocols.

Protocol:

1. Async to TCP/IP
2. TCP/IP to serial terminal server, reverse terminal server
3. Select SCADA bit oriented protocols CONITEL, PMS91, MCS-11, GETAC
4. SCADA frame forwarding relay

486.2.6.3 Ethernet Interface

Physical

1. Five (5) RJ-45 10/100 Base TX Ethernet ports with auto-sensing of fixed speed options
2. Full Duplex, Half Duplex with Auto Duplex

Protocol:

1. Ethernet, TCP/IP
2. Full wire speed switching between ports
3. IEEE 802.3x: Flow Control
4. IEEE 802.1Q: Port based VLANs per
5. IEEE 802.1d: Spanning Tree
6. IEEE 802.1w Rapid Spanning Tree
7. Support for 4096 MAC addresses

486.2.6.4 Power Supply:

1. High Voltage: 1A, 90 to 250 VAC/VDC, 50 to 60 Hz, Power Consumption not to exceed: 85 W
2. Low Voltage: 4.5 A, 18 to 60 VDC, 50 to 60 Hz, Power Consumption not to exceed: 81 W

486.2.6.5 Mechanical:

1. Enclosure: Rugged 18-gauge high-strength galvanized steel case with metal mounting plate included. Suitable for 19" front rack, mid-mount or panel mounting. Enclosure shall be permanently and clearly identified with name, model number, serial number, and any other pertinent information required to facilitate equipment maintenance.

2. Meet all specified requirements during uncontrolled environmental operations characterized by an operating temperature range of -40 to +75 degree C (-40 to +167 degree F) with no fans and a storage temperature range of -40 to +85 degrees C (-40 to +185 degree F) and a relative humidity range of 10% to 95% (non-condensing).
3. The weight of the industrial frame router shall not exceed 12 lbs.

486.2.7 Field Hardened Network Gateway Router (FHNGR): The FHNGR shall operate as a Layer 3 device to serve as a network gateway between the MCDOT TMC, Field Hardened Ethernet Backbone Switch, and the Field Hardened Ethernet Access Switches in the field. The FHNGR shall be used in conjunction with a terminal server to interface with Video Detection, Wireless Radio system, and the Signal Controller.

486.2.7.1 Functional Requirements: The FHNGR shall meet the following requirements:

1. The FHNGR shall support standard OSI Layer 3 functionality.
2. It shall support direct connectivity to existing networks configured in ring and mesh fault tolerant topologies enabling applications to operate reliably, and with low latency.
3. It shall be System Compatible with existing MCDOT ITS equipment especially the Field Hardened Ethernet Access and Backbone Switches.
4. It shall have licenses for all software or hardware in the system.
5. It shall be configurable in point-to-point, daisy-chain, ring, and mesh topologies for connectivity into new and existing fiber optic and copper based Ethernet networks.
6. It shall be designed with an operating system that allows individual ports to be configured for port mirroring, speed, duplex, auto-negotiation, and flow control. The operating system shall also provide for broadcast storm frame filtering with user defined thresholds.
7. It shall be designed with an operating system that allows for the collection of statistics on a per port basis and provides for full support of Remote Monitoring (RMON) statistics, history, alarms, and event groups.
8. It shall be designed with an operating system that provides port security to prevent unknown devices from gaining access to the network. Unauthorized attempts to access the network shall result in the port being shut down for a period of time along with Simple Network Management Protocol (SNMP) trap and alarm generation.
9. It shall be enclosed in a high-strength 18-gauge galvanized steel enclosure to seal out insects, dirt, smoke, and other contaminants.
10. All modules and assemblies shall be clearly identified with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.

The equipment shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Network Standards:

1. IEEE 802.1q-VLANs
2. IEEE 802.1w - Rapid Reconfiguration of Spanning Tree

3. IEEE 802.3ab-1000BASE-T Gbit/s Ethernet over twisted pair at 1 Gbit/s
4. IEEE P802.1p-Diffserv, traffic Prioritization for routed IP flows/ports
5. IEEE 802.3-10BaseT
6. IEEE 802.3d-MAC Bridges
7. IEEE 802.3u-100BaseTX, 100BaseFX
8. IEEE 802.3x-Flow Control
9. RFC768-UDP
10. RFC783-TFTP
11. RFC791-IP
12. RFC792-ICMP
13. RFC793-TCP
14. RFC826-ARP
15. RFC854-Telnet Protocol Specification
16. RFC1305-NTP
17. RFC1321-PPP (MD5)
18. RFC1332-PPP (IPCP)
19. RFC1334-PPP Authentication
20. RFC1490-Frame Relay
21. RFC1493-BRIDGE-MIB
22. RFC1519-CIDR
23. RFC1541-DHCP (client)
24. RFC1661-PPP
25. RFC1907-SNMPv2-MIB
26. RFC2012-TCP-MIB
27. RFC2013-UDP-MIB
28. RFC2068-HTTP
29. RFC2338-VRRP
30. RCF2578-SNMPv2-SMI
31. RCF2579-SNMPv2-TC
32. RFC2819-RMON MIB
33. RFC2865-RADIUS
34. RFC3414-SNMPv3-USM
35. RFC-SNMPv3-VACM

486.2.7.2 FHNGR Physical Requirements: The network gateway router shall meet the following physical requirements:

486.2.7.2(A) Ports: The network gateway router shall contain a minimum of:

1. Four 10/100 Ethernet ports configured as auto negotiating RJ45 copper ports
2. Four 100M SFP Ethernet ports for single mode fiber up to 40km.
3. Two 10/100/1000 Gigabit Ethernet copper ports
4. Four Serial DB9 ports with software selectable DB9 interface for data rates ranging from 300 bps to 230.4 kbps.
5. One cellular WAN port supporting 3G EVDO, EVDO & CDMA
6. Four T1/E1 WAN port

486.2.7.2(B) Environmental Monitoring: The FHNGR shall be equipped with two software controllable Form C type NC/NO configurable alarm ports.

486.2.7.2(C) Operating Environment: The FHNGR shall be operable in the following environment:

1. Operating/Storage Temperature Range: - 40 to +185 degree C
2. Ambient Relative Humidity: 5 to 95% Noncondensing
3. Altitude:-200 to +13,000 feet

486.2.7.2(D) Power: The FHNGR shall operate at 24-28 Volts DC, 1.3 Amperes

486.2.7.2(E) Mounting: The FHNGR shall be 19" Rack mountable.

486.2.7.3 FHNGR Network Software Requirements: The Contractor shall provide a Managed Network Software (MNS) for use with the FHNGR. The MNS shall:

1. Be capable of configuring Ethernet ports as switched, routed or a combination of both.
2. Be capable of configuring serial ports as RS232 or RS485 ports
3. Have necessary menus in the WAN configuration to configure T1/E1 ports
4. Support PPP, RSTP-2004, STP, SNMP, SNTP and VRRP protocols.
5. Be capable of providing DHCP services.
6. Provide remote access for secure administration.
7. Support tagged based VLAN's as access VLANs or trunk ports.
8. Be capable of storing a log of most recent events.
9. Provide Modbus interoperability over Ethernet or serial ports.
10. Provide QoS prioritization.
11. Store different configuration files locally or on a remote server and be capable of switching to different configurations easily.
12. Include protocol analyzer for trouble shooting.

486.2.8 Serial Expansion Device: Serial expansion devices shall enable the connection of peripheral serial devices over RS232 port via a 10/100 Ethernet LAN port with RJ45 connectors.

486.2.8.1 Serial Expansion Device Functional Requirements: The serial expansion device shall meet the following functional requirements:

1. A minimum 230 Kbps throughput capacity on all ports
2. Port buffering up to 64 Kbps per port;
3. Frequency range of 47 to 63 Hz.

486.2.8.2 Serial Expansion Device Physical Requirements:

486.2.8.2(A) Ports: Shall contain a minimum of:

1. One (1) 10/100 Ethernet LAN port with RJ45 connector.
2. Four (4) RS-232 serial ports.

486.2.8.2(B) Surge Protection: Shall have surge protection on all ports.

486.2.8.2(C) Operating Environment Shall be operable in the following environment:

1. Operating/Storage Temperature Range: - 29 to +165 degree F
2. Ambient Relative Humidity: 5 to 95% (non-condensing)

486.2.8.2(D) Power: Shall operable at 110 to 250 Volts VAC with a power consumption not to exceed 12 W.

486.2.8.2(E) Mounting:

1. Shall be 19" Rack mountable.
2. Shall be supplied with all necessary cabling to provide full operation. The terminal server shall be compatible with the ASC2/2100 Signal Controller.

486.2.9 Video Encoder: The Video Encoder shall allow for the transmission of live video, data, and audio over an existing Ethernet network, requiring an Internet Protocol (IP) address or Internet Explorer 5.5 or higher, or shall work as an analog-to-Ethernet "bridge" controlling matrices, multiplexers, and pan/tilt/zoom cameras. The video encoder shall operate in a box-to-box configuration allowing for the encoded video to be displayed on an analog monitor.

486.2.9.1 Functional Requirements:

486.2.9.1(A) Video:

1. Compression algorithm: Dual Stream, MPEG-4, H.264
2. Video format: 1x NTSC / PAL (Auto detect)
3. Connector type: BNC
4. Data rate (bandwidth): 9.6 kbps to 4 Mbps
5. Encoding-decoding latency: 200 ms
6. Frame rate: 1 to 30 fps
7. Video Decoder: Used to display the video on a standard analog NTSC or PAL monitor
8. In-/output level: 1 Vpp (± 3 dB)
9. Input impedance: 75 Ω /Hi-Z selectable
10. Number of output streams: 5 (multi- and/or unicast)
11. Image Resolution NTSC: D1(720x480), 1/2HD1(352x480), 2CIF(720x240), CIF (352x240), QCIF(176x144) & VGA

486.2.9.1(B) Audio: Connector Type: RJ45

1. In-/output level: 0 dBV (+6 dBV max.)
2. Input impedance: >50 k Ω or 600 Ω bal.
3. Max. bandwidth: 20 Hz to 20 kHz
4. Number of channels: 2 (full duplex)
5. Number of streams: 3 (multi- and/or unicast)
6. Output impedance: <50 Ω bal.
7. Sampling rate: 44, 16 or 8 kHz (selectable)

8. Sampling resolution: 8/16-bits (linear PCM or G.711)
9. Signal to Noise Ratio: >75 dBA
10. Total harmonic distortion: <0.25% at nom. level

486.2.9.1(C) Transmission Interface:

1. Connector: RJ45
2. Interface: 10/100Base-TX Fast Ethernet
3. Number of interfaces: 1
4. Protocols: MPEG-ES or TS, RTP, UDP, IP, DHCP, IGMP, MX/IP, HTTP, and SNMPv2
5. Selectable: Auto Negotiation, Half Duplex/Full Duplex, 10/100 Mb
6. SFP Slot: One 100 Mbps SFP

486.2.9.1(D) Management:

1. Network Management & Control: SNMPv2, SNM™, MX™, HTTP (password protected)
2. PC Software: Manages the installation and maintenance of all hardware transmitters and receivers on the network
3. LED Status indicators for Power On, No Video, All Lines Operational, Rx/Tx failures and Ethernet ports

486.2.9.1(E) Environmental:

1. Operating temperature: -40 to +74 degree C (–40° to +165 degree F)
2. Relative humidity: 10 to 95% (non-condensing)

486.2.9.1(F) Mechanical:

1. Dimensions (h x w x d): Not to exceed 5.0 x 2.0 x 8.0 in.
2. Housing: Rack-mount or standalone
3. Weight (approx.): Not to exceed 2.0 lbs

486.2.9.1(G) Contact Closure:

1. Connector type: RJ45
2. Input: +3 V pull-up, 2 kΩ
3. Latency: <5 ms
4. Number of channels: 2 (full duplex)
5. Number of streams: 2x 3 (multi- and/or unicast)
6. Output Fail-safe, potential-free
7. Switch rating: 2 A at 30 Vdc
8. Threshold 1.5 V

486.2.9.1(H) Data:

1. Connector: RJ45
2. Data rate: UART mode 300 to 230.4k baud, Latency <5 ms
3. Data rate sampling mode: DC to 19.2 kbps
4. Format: Asynchronous, serial

5. Interfaces: 1x RS232, 1x RS422/485 (2- or 4-wire)
6. Latency: 10 ms
7. Number of channels: 2 (full duplex)
8. Number of streams: 2x 3 (multi- and/or unicast)
9. Sampling rate: 153 k samples/sec

486.2.9.2 Physical Requirements: The Video Encoder shall be constructed using the latest available techniques with a minimum number of parts, sub-assemblies, circuits, cards, and modules to maximize standardization and commonality in the equipment design.

Equipment shall be designed for ease of maintenance, with all component parts being readily accessible for inspection and maintenance. Test points shall be provided for checking essential voltages and waveforms.

All external screws, nuts, and locking washers shall be stainless steel. Self-tapping screws shall not be used unless specifically approved by the Engineer.

All parts shall be made out of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.

All materials shall be protected from fungus growth and moisture deterioration.

All dissimilar metals shall be separated by an inert dielectric material.

486.2.9.3 Operational Requirements: The Video Encoder shall interoperate with an existing central software driver, available from 360 Surveillance. A list of available software drivers may be found at: <http://360surveillance.com>. All components of the Video Encoder shall be off-the-shelf items.

486.2.10 Field Hardened Ethernet Access Switch (FHEAS):

486.2.10.1 Functional Requirements: All Field Hardened Ethernet Access Switches installed on a project shall be of the same manufacturer. All equipment shall be new and in strict accordance with the details shown on the plans and the specifications.

A high-performance managed FHEAS shall support standard Open System Interconnection (OSI) Layer 2. FHEAS shall support direct connectivity to existing networks configured in ring and mesh fault tolerant topologies enabling applications to operate reliably, and with low latency.

All equipment shall include licenses, where required, for any software or hardware in the system.

FHEAS shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

1. IEEE 802.1d: MAC Bridges
2. IEEE 802.1d: Spanning Tree Protocol
3. IEEE 802.1p: Class of Services
4. IEEE 802.1q: VLAN Tagging
5. IEEE 802.1Q-2005: MSTP
6. IEEE 802.1w: Rapid Spanning Tree Protocol
7. IEEE 802.3: 10BASE-T
8. IEEE 802.3ab: 1000BASE-TX
9. IEEE 802.3ad: Link Aggregation
10. IEEE 802.3d: MAC Bridges
11. IEEE 802.3u: 100BASE-TX, 100BASE-FX
12. IEEE 802.3x: Flow Control
13. IEEE 802.3z: 1000BASE-LX
14. RFC768: UDP
15. RFC783: TFTP
16. RFC791: IP
17. RFC792: ICMP
18. RFC793: TCP
19. RFC826: ARP
20. RFC854: Telnet
21. RFC894: IP over Ethernet
22. RFC1112: IGMP v1
23. RFC1493: Bridge MIB
24. RFC1519: CIDR
25. RFC1541: DHCP (client)
26. RFC1907: SNMP v2 MIB
27. RFC2012: TCP MIB
28. RFC2013: UDP MIB
29. RFC2030: SNTP
30. RFC2068: HTTP
31. RFC2236: IGMP v2
32. RCF2284: EAP
33. RCF2475: Differentiated Services
34. RCF2865: RADIUS
35. RCF3414: SNMPv3-VSM
36. RCF3415: SNMPv3-VACM
37. RFC2578: SNMP v2 SMI
38. RFC2579: SNMP v2 TC
39. RFC2819: RMON MIB
40. RFC2863: IF MIB

486.2.10.2 FHEAS Physical Requirements: The FHEAS shall have a physical design that meets the following minimum requirements:

1. Minimum two Gigabit Ethernet full-duplex switched Ethernet single-mode fiber ports.

2. Minimum six switched 10/100 MB or better Ethernet or higher copper (RJ 45) ports.
3. Be configurable in point-to-point, daisy-chain, ring, and mesh topologies for connectivity into new and existing fiber optic and copper based Ethernet networks.
4. Be *System Compatible* with existing MCDOT ITS equipment especially the Field Hardened Network Gateway Routers and Backbone Switches.
5. Have capability to support bi-directional single strand fiber
6. Have long haul optics capability that will support Gigabit distances up to 70 km.
7. Be designed with an operating system that allows individual ports to be configured for port mirroring, speed, duplex, auto-negotiation, and flow control. The operating system shall also provide for broadcast storm frame filtering with user defined thresholds.
8. Be designed with an operating system that allows for the collection of statistics on a per port basis and provides for full support of Remote Monitoring (RMON) statistics, history, alarms, and event groups.
9. Be designed with an operating system that provides port security to prevent unknown devices from gaining access to the network. Unauthorized attempts to access the network shall result in the port being shut down for a period of time along with Simple Network Management Protocol (SNMP) trap and alarm generation.
10. Have high-strength 18-gauge galvanized steel enclosure to seal out insects, dirt, smoke, and other contaminants.
11. Have clear identification for all modules and assemblies with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.

The equipment shall have the following functionality and features:

486.2.10.2(A) Ports Performance

1. Provide Ethernet Single-mode Fiber ports that operate at 1000 Mbps with a link loss budget sufficient for the fiber link it will use.
2. Provide Ethernet RJ-45 ports that auto-negotiate operation at 10/100Mbps or higher if available.
3. Provide external optical attenuators as necessary to support interconnectivity with close range devices upstream or downstream.

486.2.10.2(B) Packet-Processing

1. Processing type: store and forward
2. Auto-learning: 8192 Media Access Control (MAC) address
3. Frame buffer memory: 2 Mbit
4. Switching Latency: 7 microsecond
5. Priority queues: 4
6. Virtual Local Area Networks (VLANs): 255
7. Internet Group Management Protocol (IGMP) multicast groups: 256
8. Switching bandwidth: 5.6 Gbps

9. Port Rate Limiting: 128kbps, 256 kbps, 512 kbps, 4 Mbps, 8Mbps
- 10.No Head of Line Blocking

486.2.10.2(C) Ethernet Network Connectors

1. Eight RJ-45 connector ports for 10/100 Mbps or higher
2. Two dual LC connector 1000 Mbps ports for single-mode fiber

486.2.10.2(D) LED Indicators: One LED for power; three LEDs per Ethernet port for link, Tx, and Rx activity.

486.2.10.2(E) Power Supply

1. AC power connector: Terminal block at rear of power supply chassis
2. Input Voltage: 85 to 264 VAC (auto-ranging)
3. Power Consumption: 8 watts (max)
4. Fast Transient Protection: Compliant with IEEE C37.90.1

486.2.10.2(F) Mechanical

1. Enclosure: Rugged 18-gauge high-strength galvanized steel case with metal mounting plate included. Suitable for stand-alone, shelf, pedestal or wall mounting. Enclosure shall be permanently and clearly identified with name, model number, serial number, and any other pertinent information required to facilitate equipment maintenance.
2. Meet all of its specified requirements when the input power is 115 VAC \pm 10%, 60 \pm 3 Hz, for any Field Hardened Ethernet Access Switch furnished or installed under this item.
3. Design the equipment such that the failures of the equipment shall not cause the failure of any other unit of equipment connected upstream or downstream of the device.
4. Make all parts out of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.
5. Protect all materials used in construction from fungus growth and moisture deterioration.

486.2.10.2(G) Environmental: The FHEAS shall meet all specified requirements during uncontrolled environmental operations characterized by an operating temperature range of -40 degrees to +85 degrees C (-40 degrees to +185 degrees F) and a relative humidity range of 10% to 95% (non-condensing).

486.2.10.2(H) Alarm: Form-C failsafe contact relay: 1A@30VDC

486.2.11 Field Hardened Ethernet Backbone Switch (FHEBS)

486.2.11.1 Functional Requirements: All Field Hardened Ethernet Backbone Switches shall be from the same manufacturer as the Field Hardened Ethernet Access Switches installed on the project. All equipment shall be new.

A high-performance and field hardened backbone switch shall support standard OSI Layer 2 functionality. The FHEBS shall support direct connectivity to existing networks configured in ring and mesh fault tolerant topologies enabling applications to operate reliably, and with low latency.

FHEBS shall include all equipment licenses, where required, for any software or hardware in the system.

FHEBS shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

1. IEEE 802.1D: Spanning Tree Protocol
2. IEEE 802.1D: MAC Bridges
3. IEEE 802.1p: Class of Services
4. IEEE 802.1q: VLAN Tagging
5. IEEE 802.1Q-2005: MSTP
6. IEEE 802.1w: Rapid Spanning Tree Protocol
7. IEEE 802.1x: Port Based Network Access Control
8. IEEE 802.3: 10BASE-T
9. IEEE 802.3ab: 1000BASE-TX
10. IEEE 802.3ad: Link Aggregation
11. IEEE 802.3d: MAC Bridges
12. IEEE 802.3u: 100BASE-TX, 100BASE-FX
13. IEEE 802.3x: Flow Control
14. IEEE 802.3z: 1000BASE-LX
15. RFC768: UDP
16. RFC783: TFTP
17. RFC791: IP
18. RFC792: ICMP
19. RFC793: TCP
20. RFC826: ARP
21. RFC854: Telnet
22. RFC894: IP over Ethernet
23. RFC1112: IGMP v1
24. RFC1493: Bridge MIB
25. RFC1519: CIDR
26. RFC1541: DHCP (client)
27. RFC1907: SNMP v2 MIB
28. RFC2012: TCP MIB
29. RFC2013: UDP MIB
30. RFC2030: SNTP
31. RFC2068: HTTP
32. RFC2236: IGMP v2
33. RCF2284: EAP
34. RCF2475: Differentiated Services
35. RFC2578: SNMP v2 SMI

- 36.RFC2579: SNMP v2 TC
- 37.RFC2819: RMON MIB
- 38.RFC2863: IF MIB
- 39.RCF2865: RADIUS
- 40.RCF3414: SNMPv3-USM
- 41.RCF3415: SNMPv3-VACM

486.2.11.2 FHEBS Physical Requirements: The FHEBS shall have a physical design that conforms to the following requirements:

1. Operates as a Layer 2 interface to the Network Gateway Router for all Field Hardened Ethernet Switches.
2. Provide nine built-in SFP 1000 MB full-duplex switched Ethernet single-mode fiber ports with the ability to reach the necessary distance.
3. Be *System Compatible* with existing MCDOT ITS equipment especially the Field Hardened Network Gateway Routers and Ethernet Access Switches.
4. Be configurable in point-to-point, daisy-chain, ring, and mesh topologies for connectivity into new and existing fiber optic and copper based Ethernet networks.
5. Have long haul optics capability that will support Gigabit distances up to 70 km.
6. Have capability to support bi-directional single strand fiber.
7. Be designed with an operating system that allows individual ports to be configured for port mirroring, speed, duplex, auto-negotiation, and flow control. The operating system shall also provide for broadcast storm frame filtering with user defined thresholds.
8. Be designed with an operating system allows for the collection of statistics on a per port basis and provides for full support of RMON statistics, history, alarms, and event groups.
9. Have high-strength 18-gauge galvanized steel enclosure to seal out insects, dirt, smoke, and other contaminants.
10. Have clearly identification for all modules and assemblies with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.

The equipment shall have the following functionality and features:

486.2.11.2(A) Ports Performance:

1. Provide Ethernet Single-mode Fiber ports that operate at 1000 Mbps with a link loss budget sufficient for the link it will use.
2. Provide Ethernet RJ-45 ports that auto-negotiate operation at 10/100/1000 Mbps.
3. Provide external optical attenuators as necessary to support interconnectivity with close range devices upstream or downstream.

486.2.11.2(B) Packet-Processing:

1. Switching Method: Store and Forward

2. Frame buffer memory: 2 Mbit
3. IGMP multicast groups: 256
4. MAC address table size: 64kbytes
5. MAC addresses: 8192
6. Priority Queues: 4
7. Switching bandwidth: 18 Gbps
8. Switching latency: 7 us
9. Switching method: Store & Forward
10. VLANs: 255
11. Port Rate Limiting
12. No Head of Line Blocking

486.2.11.2(C) Ethernet Network Connectors:

1. Nine RJ-45 connector ports for 10/100/1000 Mbps
2. Nine dual SC connector 1000 Mbps ports for single-mode fiber

486.2.11.2(D) LED Indicators: One LED for power; three LEDs per Ethernet port for link, Tx, and Rx activity

486.2.11.2(E) Power Supply:

1. AC power connector: Terminal block at rear of power supply chassis
2. Input Voltage: 85 to 300 VAC (auto-ranging)
3. Power Consumption: 30 watts (max)
4. Fast Transient Protection: Compliant with IEEE C37.90.1

486.2.11.2(F) Mechanical:

1. Enclosure: Rugged 18-gauge high-strength galvanized steel case with metal mounting plate included. Suitable for stand-alone, rack, shelf, pedestal or wall mounting. Enclosure shall be permanently and clearly identified with name, model number, serial number, and any other pertinent information required to facilitate equipment maintenance.
2. FHEBS shall comply with all specified requirements when the input power is 115 VAC \pm 10%, 60 \pm 3 Hz, for any FHEBS furnished or installed under this item.
3. The equipment shall be designed such that the failures of the equipment shall not cause the failure of any other unit of equipment connected upstream or downstream of the device.
4. All parts shall be made out of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.
5. All materials used in construction shall be protected from fungus growth and moisture deterioration.

486.2.11.2(G) Environmental: All specified requirements shall be met during uncontrolled environmental operations characterized by an operating temperature range of -40 degrees to +85 degrees C (-40 degrees to +185 degrees F) and a relative humidity range of 10% to 95% (non-condensing).

486.2.11.2(H) Alarm: Form-C failsafe contact relay: High Voltage - 2A @ 250 VAC/125 VDC, Low Voltage - 1A@30VDC

486.2.12 Cables for Communication Devices:

RF cables shall be used to connect the Antennas to the wireless equipment where required. Ethernet cables shall be used to provide power over Ethernet and for connecting the communications equipment to the internet backbone or client devices as applicable.

486.2.12.1 RF Jumper Cables: The cables used for communications equipment shall meet the following physical requirements:

1. RF jumper cables shall be low loss type with a maximum attenuation of 3.9 dB per 100 feet @ 900 MHz.
2. RF jumper cables shall have preinstalled Type N-connections for connecting the antenna with the wireless equipment.

486.2.12.2 Ethernet cables: The cables used for communications equipment shall meet the following physical requirements:

1. Ethernet cables shall be shielded Category 5e (Cat5e) or Category 6 (Cat6) twisted pair copper cables.
2. Ethernet cables shall comprise of 24AWG twisted pairs copper cables.
3. Ethernet cables shall be equipped with an Electrostatic Discharge (ESD) drain wires to prevent damage to the equipment from electrostatic discharge.
4. Ethernet cables shall have a minimum of one 0.35 μ m foil shield.
5. Ethernet cables shall be enclosed in an outdoor UV rated PVC jacket.
6. Ethernet cables shall have preinstalled connections for 10/100 Mbps Ethernet connectivity.

486.3 INSTALLATION REQUIREMENTS:

486.3.1 Personnel Qualifications: The minimum qualifications required for the Contractor or designated subcontractors involved in the installation and testing of the Ethernet equipment are:

1. Five years' experience in the installation and configuration of Ethernet equipment.
2. Two years direct experience in the configuration and deployment of the Rapid Spanning Tree protocol.
3. Two installed systems where Ethernet switches are installed and the system has been in continuously satisfactory operation for at least two years. The Contractor shall submit as proof, photographs or other supporting documents, and the

names, addresses and telephone numbers of the operating personnel who can be contacted regarding the communication system.

4. Documentation of contractor qualifications shall be approved by the Engineer prior to purchasing the FHEAS.

486.3.2 General Requirements: The Contractor shall meet the following minimum requirements for the installation and testing of the communications equipment:

1. The equipment shall be installed to provide for ease of maintenance, all component parts shall be readily accessible for inspection and maintenance.
2. All external screws, nuts and locking washers shall be stainless steel. Self-tapping screws shall not be used unless specifically approved by the Engineer.
3. The Contractor shall comply with all requirements of the National Electrical Code for all wiring external to the FHEAS switch. The Contractor shall cut all wires to proper length before assembly. The Contractor shall neatly lace wires into cable with nylon lacing or plastic straps. Secure cables with approved clamps for both fiber and copper cable types. Provide service loops at all connections.
4. Connecting harnesses (i.e. jumper cables) shall be of appropriate length with a minimum length of one foot and terminated with matching connectors for interconnection with the FHEAS switches.
5. The Contractor shall separate dissimilar metals by inert dielectric materials.

Testing, warranties, documentation, and training shall conform to the Intelligent Transportation System General Requirements.

486.3.3 Video Encoder: The Contractor shall install the video encoder in the CCTV panel that is mounted on the lower right hand corner on the left side of the traffic signal cabinet per the CCTV Construction Requirements.

486.4 MEASUREMENT:

Communications equipment systems including Wireless Access Points, Rugged 2x2 MIMO Radios, Broadband Customer Premises Equipment, Omnidirectional Antennas, Dish Antennas, Yagi Antennas, Sector Antennas, Industrial Frame Routers, Field Hardened Network Gateway Routers, Serial Expansion Devices, Field Hardened Ethernet Access Switches and Field Hardened Backbone Switches, will be measured as a unit for each type furnished, installed, made fully functional, tested, and accepted COMPLETE IN PLACE.

486.5 PAYMENT:

The accepted quantities of the items measured as above will be paid for at the contract unit price which shall be full compensation for the work described including testing, warranty, documentation, and training.

The price will include all equipment described under these items, all cables and connectors, all documentation and testing, and the cost of furnishing all labor, materials, software, warranty, training, and equipment necessary to complete the work. Items such as cables, mounting, excavation, surge suppression, lightning protection, local software, and various accessories as needed will be included in the price.

The Power over Ethernet (POE) Injectors will not be measured for payment. The cost of furnishing and installing the POE Injector will be included in the price of the equipment it provides power to.

The Video Encoder will not be measured for payment. The cost of furnishing and installing the Video Encoder will be included in the price of the CCTV camera assembly.

Part 500 add the following new Section:

SECTION 502

DRILLED SHAFT FOUNDATIONS

502.1 DESCRIPTION:

502.1.1 General: The work under this Section shall include furnishing all materials and constructing reinforced concrete shafts formed within a drilled excavation. Each Drilled Shaft Foundation shall consist of a shaft section with or without casing left in place, as specified or requested, with or without a rock socket or bell footing. Each Drilled Shaft Foundation shall be constructed to conform to the details and dimensions shown on the Project Plans, and the requirements of these Specifications and the Special Provisions.

502.1.2 Installation Plan: The Contractor shall submit to the Engineer, for review and approval, a detailed Installation Plan. The Installation Plan shall be based on available geotechnical information. To assist in plan evaluation and upon request by the Engineer, the Contractor shall provide copies to the Engineer of the geotechnical information used to develop the Installation Plan. The Installation Plan shall contain the following information:

(1) Equipment: List of proposed equipment to be used including cranes, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry pumps, sampling equipment, tremies or concrete pumps, casing, and any other equipment essential to the successful installation of the proposed Drilled Shaft Foundations. Information provided on each proposed equipment unit shall be sufficient to identify the unit in the current edition of the Rental Rate Blue Book.

(2) Personnel: List of all personnel to be committed to the installation of the Drilled Shaft Foundations on the project, and a summary of the relevant experience of each individual, including their involvement in the projects listed under (11).

The On-Site Supervisor in charge of the installation of the Drilled Shaft Foundations shall have not less than five (5) years of comparable in-charge experience with drilled shaft installations similar in nature and magnitude to the foundation requirements for the specified project. The On-Site Supervisor shall be on or immediately available to the project during all foundation construction activities.

At least one (1) Drill Operator, having not less than five (5) years of experience on the equipment that the Contractor proposes to use, working on drilled shaft foundation installations similar to those for the specified project, shall be on or available to the project during all foundation construction activities.

(3) Construction Sequence: Details of the overall construction operation sequence, and the sequence of shaft installation in bents or groups. Supporting

justification shall be provided for all variations between the Contractor's proposed sequence of shaft installation, and shaft sequence requirements called out on the Project Plans.

(4) Shaft Excavation: Details of shaft excavation methods, including equipment and procedures for checking the location, alignment, and dimensions of each shaft excavation.

(5) Slurry: When slurry is required, details of the method proposed to mix, circulate and desand the slurry, and methods proposed to comply with the requirements of Sections 502-3.4(A) and 502-3.7(C), including disposal of the slurry.

(6) Excavation Cleaning: Details of methods to clean the shaft excavation.

(7) Steel Reinforcement: Details of reinforcement placement, including support and centering methods.

(8) Concrete Mixes: Details of concrete mix designs, and the mitigation of possible loss of slump during placement.

(9) Concrete Placement: Details of concrete placement.

(10) Casing: Details of casing dimensions, material, and splice details.

(11) Construction Experience: List of all drilled shaft construction experience by the Contractor on previous projects of a similar nature, from the present and covering the past 3 to 5 years, highlighting major features of the drilled shaft operations and installations, describing any complexities and/or problems, and their subsequent resolution.

(12) Additional Information: Other information shown on the plans or requested by the Engineer.

(13) Emergency Shaft Joints: Emergency horizontal construction joint method if unforeseen stoppage of work occurs.

(14) Safety Plan: List of safety equipment, and the Contractor's Safety Plan for the drilled shaft construction.

The detailed Installation Plan for the Drilled Shaft Foundations, complete with all required information relevant to the project, and any supplemental information the Contractor believes relevant, shall be submitted to the Engineer not less than four (4) weeks before the work on the drilled shafts is to begin. The Engineer will review the submittal package and return comments to the Contractor within ten (10) working days. No drilled shaft work shall be performed until the Contractor's final submittal has been approved by the Engineer. Such approval will not relieve the Contractor of

responsibility for results obtained by use of the Installation Plan, or any other responsibilities under the Project Contract.

Based on the Contractor's experience, the project Contract Documents, and the Geotechnical and Foundation Report, including the Foundation Boring logs, if the Contractor reasonably concludes that slurry will not be required for shaft installation, information required under (5) Slurry may be omitted from the Installation Plan, subject to the approval of the Engineer. If it is subsequently determined that slurry will be required for shaft installation, the approval of the omission by the Engineer in no way relieves the Contractor of responsibility for constructing acceptable Drilled Shaft Foundations, in accordance with the requirements of Section 502.3.1(A).

The Contractor shall submit shop drawings in accordance with Section 105.2 for drilled shaft reinforcing steel, casings, and all other drilled shaft elements to remain in place and requiring prefabrication.

502.2 MATERIALS

502.2.1 Concrete: Concrete shall conform to the requirements of Section 725 for the class and strength shown on the plans, with the following additions or modifications:

(A) Cement: Concrete placed in drilled shaft excavations containing slurry or water shall have a cement content between 660 and 750 lbs/C.Y.

(B) Aggregate: Maximum aggregate size shall be limited to 1/5 of minimum clear bar spacing (vertical and horizontal), not to exceed one inch.

502.2.2 Reinforcing Steel: Reinforcing steel shall conform to the requirements of Section 727. Welded splices will not be allowed, except as shown on the Project Plans.

502.2.3 Casing: The casing shall be steel, and may be of unit or sectional construction. The casing shall be of sufficient strength to withstand handling and driving stresses, to withstand the pressure of concrete and the surrounding earth, and to prevent seepage of water. Steel shall conform to the requirements of AASHTO M 270M/M 270 (ASTM A709/A709M), Grade 36 (Metric Grade 250), unless otherwise specified in the Special Provisions.

When telescoped casing is used, the Contractor shall not allow concrete to overfill any interior casing. Spillage shall be removed from the annulus, or the shaft shall be declared deficient.

Temporary casing shall be clean, inside and out, prior to placement in the excavation. All casing shall be handled so as to limit distortion to plus or minus two percent (2%) of the diameter. No side shear capacity will be allowed where an installed temporary casing becomes permanent. If conditions permit, and if approved by the Engineer, temporary casings may be corrugated and non-watertight.

The Contractor shall be responsible to compensate for loss of frictional capacity in the cased zone if temporary casing is abandoned in the shaft. Such modifications shall be at no additional cost to the County.

502.3 CONSTRUCTION:

502.3.1 General: The construction methods and equipment used shall be suitable for the intended purpose and materials encountered. Construction shall be by either the dry method, wet method, temporary casing method or permanent casing method, as defined by the current AASHTO LRFD Bridge Construction Specifications with Interim revisions as applicable. Drilled shafts shall be sound, durable concrete foundation shafts free of defects, subject to approval of the Engineer. The permanent casing method shall be used only when required by the Project Plans and Special Provisions, or authorized by the Engineer.

(A) Installation Changes: If at any time during the construction of the drilled shafts, the Engineer determines that the equipment, materials, personnel, or procedures are such that defects in the work may occur, the Engineer may stop the work until appropriate changes are made by the Contractor. The Contractor shall also revise the Installation Plan, as approved by the Engineer. In no case shall the Contractor be relieved of responsibility for constructing acceptable Drilled Shaft Foundations.

(B) Adjacent Drilled Shafts: The successive installation of Adjacent Drilled Shafts shall not be allowed, to minimize any potential disturbance to newly cast drilled shafts. An Adjacent Drilled Shaft is defined as being any drilled shaft to be located within four (4) diameters of an installed shaft, measured center to center of shafts. Drilling for an Adjacent Drilled Shaft shall not be started within 48 hours of the completion of casting concrete for the installed drilled shaft, unless otherwise approved by the Engineer. The Contractor's sequence of shaft installation, detailed as required in Section 502.1.2(3), shall also conform to shaft sequence requirements called out on the Project Plans, unless otherwise approved by the Engineer in the Contractor's Installation Plan.

502.3.2 Confirmation Shafts: When called out on the Project Plans, or when required in the Contract Special Provisions, the Contractor shall construct a Confirmation Shaft. The Confirmation Shaft is constructed to determine the adequacy of the Contractor's equipment, materials, personnel, and procedures for completion of the Drilled Shaft Foundations, in accordance with the requirements of the Project Plans, these Specifications and the project Special Provisions, and the Installation Plan. The Confirmation Shaft normally will be the first production Drilled Shaft Foundation developed, subject to the approval of the Engineer.

The location of all Confirmation Shafts shall be as shown on the Project Plans, or as approved by the Engineer. All Confirmation Shaft holes and shaft installations shall be completed in the same manner as proposed for other similar production shafts. The Contractor shall revise drilled shaft installation methods and equipment, at any time

during the installation of each Confirmation Shaft, as required. Such revisions may be made during the drilling of the Confirmation Shaft hole, and/or the placement of shaft reinforcement and concrete. Such revisions shall result in satisfactory installation of the Confirmation Shaft, COMPLETE IN PLACE, as approved by the Engineer.

When the Contractor fails to satisfactorily demonstrate the adequacy of his installation methods, procedures, or equipment; or when unforeseen conditions require revision, such as the need for slurry, the Installation Plan shall be revised. The next shaft to be constructed in accordance with the Contractor's approved installation sequence shall be designated as the Confirmation Shaft for the approved, revised Installation Plan, or the Confirmation Shaft shall be installed at a location approved by the Engineer.

When shown on the Project Plans, or when ordered by the Engineer in writing, the reaming of shaft bell footings or the development of shaft rock sockets at the specified Confirmation Shaft holes shall be required to establish installation feasibility in specific soil strata.

502.3.3 Excavation: The Contractor shall perform all excavation required for the shafts, rock sockets, and/or bell footings, through whatever materials encountered, to the dimensions and elevations shown on the Project Plans, or as approved by the Engineer. Unless otherwise shown on the Project Plans, the maximum deviation from plumb shall be not more than one and one-half percent (1 1/2%). The maximum permissible variation of the longitudinal center axis of both the shaft hole and reinforcing steel cage, from the Project Plan location at the top of the Drilled Shaft Foundation, shall be five percent (5%) of the Project Plan shaft diameter, not to exceed 3 inches. The Contractor shall determine shaft hole verticality by plumb lines in dry excavations, and by Kelly bar position readings at 10' intervals in wet excavations, or as approved by the Engineer. The Contractor shall provide the Engineer with these readings for each drilled shaft constructed, to verify verticality. When bell footings or rock sockets are required, they shall be excavated so as to form a bearing area of the size and shape shown on the Project Plans.

Temporary surface casings may be used to aid shaft location and alignment, and to prevent sloughing of the top of the shaft excavation, if approved by the Engineer.

If satisfactory foundation materials are not encountered when a shaft excavation has been advanced to the Bottom of Shaft Elevation shown on the Project Plans, the bottom of the drilled hole may be lowered, at the direction of the Engineer. Any lowering of the Bottom of Shaft Elevation will be based on the completed Drilled Shaft Foundation complying with foundation design requirements. Reinforcing steel and shaft concrete shall not be placed in the shaft excavation until the revised, final Bottom of Shaft Elevation has been established, and the shaft excavation completed. Similarly, the raising of any Bottom of Shaft Elevation, from the elevation shown on the Project Plans, shall require approval by the Engineer.

When a Drilled Shaft Foundation includes a Rock Socket, the actual Bottom of Shaft Elevation in the field will be established by the shaft excavation encountering competent bedrock stratum, as determined by the Engineer or a geotechnical specialist. The required Rock Socket length will be verified by the Engineer, based on foundation design requirements. Reinforcing steel and shaft concrete shall not be placed until the Rock Socket length has been verified, and the drilled/cored socket completed.

If caving conditions are encountered, no further drilling will be allowed until a method of construction is employed that prevents excessive caving, and which is acceptable to the Engineer. If casing is proposed, the shell shall be clean and shall extend to the top of the drilled shaft excavation. The inside diameter of the casing shall be not less than the dimensioned size of the shaft on the Project Plans, unless approved by the Engineer. The outside diameter of the shaft shall not exceed the Project Plan dimension by more than 6 inches, unless the use of telescoping casing or surface casing is allowed by the installation plan.

If the Engineer determines that the amount of excavation caving is within acceptable limits and the Contractor elects to drill under the same methods and procedures, the shaft excavation shall be filled with concrete at no additional cost to the County, regardless of the extent. Any excavation beyond the dimensions shown on the plans where casings are not used shall be filled with concrete at no additional cost to the County.

If the use of drilling slurry is to be employed, either with or without the use of casing, the Contractor shall use a method of construction that allows completion of the drilled shaft in a continuous manner without any mixing between the shaft concrete and the drilling slurry.

Material excavated from drilled shafts, bell footings, and rock sockets, that is not placed elsewhere on the project, shall be disposed of as approved by the Engineer.

When the Project Plans indicate that Drilled Shaft Foundations are to be constructed within embankments, the embankments shall be constructed prior to drilling, except when approved otherwise by the Engineer.

After the completion of the drilled shaft excavation, and prior to the placement of the reinforcing steel cage and shaft concrete, all loose material shall be machine cleaned from the shaft. A flight auger or other equipment, approved by the Engineer, shall be used for cleaning dry excavations where slurry or ground water is not present. Where slurry or ground water is present, the excavation shall be cleaned with a clean-out bucket or similar type of equipment, as approved by the Engineer.

Each open shaft excavation shall be covered in a manner approved by the Engineer, at all times when there is no hole excavation activity and/or shaft construction activity at that hole.

Drilled shaft excavation inspections shall be performed by the Contractor and will be reviewed by the Engineer. The Contractor shall provide suitable facilities, equipment, and associated safety measures for required excavation inspections that enable the Engineer to safely and completely evaluate drilled shaft excavations for correct location, alignment, and dimensions.

Reinforcing steel cages and shaft concrete shall not be placed in the drilled shaft excavation until the Engineer has made an evaluation and given approval.

502.3.4 Drilling Slurry:

(A) General Requirements: The Contractor shall provide a specialist experienced in the slurry drilling process to design and monitor the slurry. The specialist shall be present at all times when the slurry method is used, and shall supervise the slurry inspection and testing required in Section 502-3.4(B). Commercially prepared mineral slurries shall be employed when slurry is used in the drilling process. Commercially prepared synthetic slurry may be used only when specifically approved by the Engineer. The mineral slurry shall have both a mineral grain size that will remain in suspension and sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. The percentage and specific gravity of the material used to make the suspension shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. During construction, the level of the mineral slurry in the shaft excavation shall be maintained at a level not less than 4 feet above the highest expected piezometric pressure head along the depth of the shaft. In the event of a sudden significant loss of slurry to the hole, the construction of that foundation shall be stopped, until either a method to stop slurry loss or an alternative construction procedure has been approved by the Engineer.

The mineral slurry shall be premixed thoroughly with clean, fresh water. Adequate time, as prescribed by the mineral manufacturer, shall be allotted for hydration prior to the introduction of the mineral slurry into the shaft excavation. Slurry tanks of adequate capacity shall be required for slurry circulation, storage, and treatment. No excavated slurry pits shall be allowed in lieu of slurry tanks. No mixing of slurry shall be allowed in the drilled shaft excavation. Slurry shall not stand for more than four hours in the shaft excavation without agitation. If this is not possible, excavation sidewalls shall be cleaned to remove filter cake, and the slurry tested for compliance with Table 502-3.4(A). Slurry density shall be increased by adding barite only when sodium bentonite is the slurry mineral.

Desanding equipment shall be provided by the Contractor as necessary to control slurry sand content within the acceptable values shown in Table 502-3.4(A) at any point in the bore hole. Desanding will not be required for setting casing. The Contractor shall take all steps necessary to prevent the slurry from "setting up" in the shaft. Such methods may include agitation, circulation and/or adjusting the properties of the slurry. The Contractor shall dispose of all slurry off site at an approved disposal site.

TABLE 502-3.4(A):

TABLE (Sodium Bentonite or Attapulgite in Fresh Water)			502-3.4(A)
Property, units	Range of Values*		Test Method
	At Time of Introduction of Slurry	In Hole at Time of Concreting	
Density, (pcf)	64.3 - 69.1	64.3 – 75.0**	Density Balance
Yield Point, psf	Bentonite 0.026 – 0.21	10 Maximum	Rheometer
Or	Attapulgite 0.042 – 0.31	15 Maximum	Rheometer
Viscosity, seconds/quart	28 – 45	28 - 45	Marsh Cone
pH	8 – 11	8 – 11	pH Paper or pH Meter
Sand Content, % by volume	0 – 4	0 – 10	API Sand Content Kit
* Above 68 degrees F			
** 85 pcf maximum when using Barite.			

(B) Slurry Inspection and Testing: The Contractor shall have suitable inspection and testing apparatus available at the site, including a sampling tool capable of extracting slurry samples at any depth within the drilled shaft excavations. All equipment required for tests specified in this Section shall be provided by the Contractor, and the tests shall be performed by the Contractor, under the observation of the Engineer.

Control tests using suitable apparatus shall be carried out by the Contractor on the mineral slurry to determine density, viscosity or yield point, pH, and sand content. A range of values for those physical properties is shown in Table 502-3.4(A); but in all cases, no less than the minimum values necessary to achieve and maintain stability of the drilled shaft excavation shall be used.

The Contractor shall do tests during the shaft excavation, in the presence of the Engineer, to determine slurry density, viscosity or yield point, and pH value, to establish a consistent working pattern. A minimum of four sets of tests shall be made during the first eight hours of slurry use. When the results show consistent behavior, the testing frequency may be decreased to one set every four hours of slurry use.

The Contractor shall ensure that heavily contaminated slurry suspension, which could impair the free flow of shaft concrete, has not accumulated in the bottom of the completed shaft excavation. Prior to placing concrete in the completed shaft excavation, the Contractor shall take slurry samples in the shaft excavation, from the base of the shaft excavation, and 10' (3.0m) above the base of the excavation. When

any slurry samples are found to be unacceptable, the Contractor shall take whatever action is necessary to bring the mineral slurry within specification requirements. Shaft concrete shall not be placed until re-sampling and testing results produce acceptable values for density, viscosity or yield point, pH, and sand content.

Reports of all tests required above, signed by an authorized representative of the Contractor, shall be furnished to the Engineer on completion of each drilled shaft.

502.3.5 Integrity Testing: All drilled shaft foundations shall be constructed to allow integrity testing by gamma ray density logging and by cross-hole sonic logging survey. Unless otherwise noted, the Contractor shall provide integrity testing using gamma ray density logging for all drilled shaft foundations. The gamma ray density logging shall be conducted and results submitted for each drilled shaft no later than three days after placement of the drilled shaft concrete. In addition all drilled shafts 4' diameter and larger constructed in wet conditions shall be tested using cross-hole sonic logging. All tests using cross-hole sonic logging shall be conducted no later than six days after placement of the drilled shaft concrete. When inconclusive or bad results are obtained from the gamma ray density test, the Contractor shall conduct, at no additional cost to the County, cross-hole sonic logging within six days after placement of the drilled shaft concrete.

The Contractor shall furnish and install 2½", Schedule 80 PVC pipe for integrity testing. Each logging pipe shall be joined to provide a clean and unobstructed pipe opening from the top of the drilled shaft foundation to within one foot of each shaft tip or as shown on the Project Plans. All logging pipes shall be capped top and bottom. Logging pipes shall be tied to the inside of the reinforcing cages in a longitudinal straight line, located as detailed on the Project Plans. The logging pipes shall be securely fastened to the reinforcing steel cage, to ensure that the pipes remain straight after handling and shaft concrete placement, to permit the logging device to pass from top to bottom of pipe. PVC pipes shall be filled with water prior to concrete placement. The Contractor shall provide the testing equipment, perform the inspection, and furnish test results to the Engineer.

If the testing indicates the presence of voids, intrusions, or zones of unconsolidated concrete in the Drilled Shaft Foundation, or if the Engineer determines that construction defects may have occurred, or if testing cannot be performed because of blockage of the tubes, the Contractor shall core-drill or otherwise determine the extent of any defects in the concrete, as approved by the Engineer. The Contractor shall repair, replace, or supplement the defective work in a manner approved by the Engineer, at no additional cost to the County.

In case the above described testing methods provide inconclusive or deficient results and the situation is difficult or impossible to repair, the geotechnical engineer shall assess the amount of loss to the drilled shaft safety factor*. Any drilled shaft with a safety factor less than 80% of the required value shall be replaced or repaired in a satisfactory manner at no additional cost to the County. Payment for drilled shafts with

safety factor between 80% and 100% of the required value shall be reduced as indicated in Table 502-1.

Table 502-1 Payment Factors for Defective Drilled Shafts	
Percentage of required value of Safety Factor*	Percent of Payment
100% and above	100%
<100% to 96%	95%
<96% to 92%	90%
<92% to 88%	85%
<88% to 84%	80%
<84% to 80%	75%
<80%	Replacement Required

* Safety factor, as used in section 502, is the reciprocal of the combined resistivity factor weighted for side friction and tip bearing capacities. For resistivity factors see AASHTO LRFD Bridge Design Specifications, Section 10.

After all inspection and testing has been completed, all holes and test pipes in all Drilled Shaft Foundations shall be filled with a grout approved by the Engineer.

502.3.6 Reinforcing Steel, Cage Construction and Placement: The reinforcing steel cage for the drilled shaft, consisting of longitudinal bars and spiral reinforcement or lateral ties, shall be completely assembled and placed in the shaft excavation as a unit. The reinforcing steel cage shall not be installed in the shaft excavation until immediately before the placement of shaft concrete is to be started. The reinforcing steel cage shall be positioned in accordance with the details shown on the Project Plans.

All reinforcing cages shall be fabricated and supported to avoid damage during lifting and installing the cages. All temporary bracing and supports shall be removed from reinforcing cages prior to the final placement in the shaft excavation.

The reinforcing steel cage shall be adequately supported and anchored from the top, to prevent movement from the required location during the placement of shaft concrete, and for four hours after completion of concrete placement. The reinforcing cage shall not rest directly on the bottom of the excavation. Spacers shall be at sufficient intervals along the shaft to ensure concentric location of the reinforcing cage for the entire length of shaft. Only noncorrosive, rolling spacers approved by the Engineer shall be allowed. In no case shall "dobies" or other rectangular "blocks" tied to the reinforcing cage or sliding reinforcing bar spacers be allowed.

If the Bottom of Shaft Elevation of a Drilled Shaft Foundation, with or without a Rock Socket, is lowered in accordance with Section 502.3.3, and the Project Plans indicate full depth reinforcement, the Engineer shall be notified to determine if extension and/or modification of the reinforcing cage is required. The Engineer will provide details for changes in the shaft reinforcing cage, if required. Such changes in the shaft reinforcing

steel cage will be paid for in accordance with Sections 109.4 and 109.5 of the Specifications.

If the Bottom of Shaft Elevation of the Drilled Shaft Foundation, with or without a Rock Socket, is raised in accordance with Section 502.3.3, the Engineer will determine if modification of the reinforcing steel cage is required.

The Contractor shall submit a written request to the Engineer for approval of any variation from the reinforcing steel splices specified in the contract documents.

502.3.7 Concrete Placement:

(A) General: The Contractor shall begin placement of shaft concrete within 24 hours after the completion of the drilled shaft excavation. All concrete shall be placed in accordance with Section 505 and as specified herein. If slurry-assisted excavation is used, concrete shall be placed the same day the excavation is completed.

Unless otherwise specified in the project Special Provisions, or as requested by the Engineer, the slump shall be between 5 and 6 inches for dry, uncased excavations. For all other shaft excavations, with water and/or using slurry and/or casing during excavation, the shaft concrete slump shall be 8 ± 1 inches at the time shaft concrete placement begins.

Prior to shaft concrete placement, the Contractor shall make all necessary arrangements to ensure the uninterrupted delivery of concrete, so that all Drilled Shaft Foundations will be constructed without cold joints. During shaft concrete placement, from start to finish, the rate of rise of the top of concrete in the drilled shaft shall be at least 40' / hour.

Tremie downpipes and pump pipes shall be made of steel; no aluminum shall be allowed. The inside diameter of the tremie pipe shall be at least 10 inches. The inside diameter of the pump pipe shall be at least 5 inches.

(B) Placement in Dry Excavations: For placement in dry excavations, shaft concrete may be placed by free fall, except in cohesionless soils or where other caving conditions exist. The Contractor shall place the shaft concrete so that during free fall, the concrete does not strike the reinforcing cage or the excavation sidewalls. Where free fall cannot be used, concrete shall be placed through a suitable, clean downpipe.

Vibration of the shaft concrete for the full height of the shaft is not required to achieve proper consolidation of the concrete. However, the shaft concrete shall be vibrated in the top 10' of the shaft.

(C) Wet Conditions, Placement under Slurry or Water: Shaft concrete placed under slurry or water shall be placed by tremie methods or by pumping. Care shall be taken to

ensure that all the fluid and suspended solids are expelled from the shaft excavation during concrete placement.

Where shaft concrete is conveyed and placed by mechanically applied pressure, the equipment shall be of suitable type and shall have adequate capacity for the work. The concrete shall not flow over or through any piping, fittings or equipment which is fabricated of aluminum or aluminum alloys. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. Excessive segregation due to high velocity discharge of the concrete will not be permitted. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or segregation of the ingredients. Standby equipment shall be readily available to replace initial pumping equipment should a breakdown occur.

The Contractor's Installation Plan shall demonstrate the procedures used to determine when the tremie pipe is to be raised during shaft concrete placement. The procedure shall ensure that the opening of the tremie pipe will be deeper than 5 feet below the surface of the concrete at all times, and that a void will not be created by lifting the tremie when there is an insufficient head of concrete. A rapid raising or lowering of the tremie will not be permitted.

To prevent contamination of the shaft concrete placed initially, the lower end of the pump or tremie pipe shall be provided with a valve, sealable cap, or plug ("pig"). The discharge end shall be placed at the bottom of the excavation prior to starting shaft concrete placement. If a plug is used, it shall be inserted at the top of the tremie pipe after the pipe has been set in place. Shaft concrete shall then be placed by pushing the plug ahead, with the plug separating the concrete from the drilling slurry/water. The bottom end of the tremie pipe shall not be lifted off the bottom of the shaft excavation until the pipe is completely filled with concrete. The first portion of the concrete flow that comes to the top of the shaft shall be displaced out of the shaft excavation until clean, fresh concrete is expelled.

Slurry ejected during shaft concrete placement may be reused provided that it is screened to remove gravel chips or other granular materials, and providing the slurry meets acceptance criteria. After use, slurry to be discarded shall be disposed of in a manner that complies with all applicable laws and requirements, including the National Pollutant Discharge Elimination System (NPDES) requirements.

Concrete placed under slurry or water shall not be vibrated, except that the top 5 feet of the shaft shall be vibrated after the slurry or water and contaminated concrete have been totally expelled from the shaft. If temporary casing is used, the vibration shall occur after the casing has been removed.

502.3.8 Casing Removal: During removal of any casing, a sufficient head of not less than 5 feet of fluid concrete in the tremie pipe shall be maintained above the level of concrete in the shaft (outside the tremie pipe), except at the top of the shaft. All

contaminated concrete shall be removed from the shaft. Temporary casings shall be removed while the concrete slump is not less than 4 inches. The Contractor shall maintain a minimum 5 foot head of concrete in the casing as it is being removed. Movement of the casing by exerting downward pressure and tapping to facilitate extraction, or extraction with a vibratory pile hammer will be permitted. Casing extraction shall be at a slow, uniform rate with the force in-line with the shaft axis.

Due care shall be exercised to prevent upward movement of the shaft concrete and reinforcing steel during casing extraction. Upward movement beyond one inch, excluding movement due solely to tension on the top anchoring system, may indicate serious concrete separation or necking problems at the bottom of the casing. The Contractor shall be responsible for corrective action which may include leaving the casing in place and compensating for the loss of frictional capacity in the resulting cased zone.

502.4 MEASUREMENT:

Drilled Shafts and accepted Confirmation Shafts will be measured to the nearest linear foot, from the top elevation of each completed Drilled Shaft Foundation to:

- (A) The elevation of the surface of the rock stratum, when Rock Sockets are used, or
- (B) The Bottom of Shaft Elevation shown on the Project Plans, or
- (C) The elevation of the shaft-bell juncture, when Bell Footings are used,

or as determined in the field by the Engineer or a geotechnical specialist.

The length of Rock Sockets will be measured to the nearest linear 0.1 foot from the actual surface elevation of the rock socket bedrock stratum to the actual Bottom of Shaft Elevation, as shown on the Project Plans, or as determined in the field by the Engineer or a geotechnical specialist.

Bell Footings will be measured by the unit each, for each configuration of Bell Footing constructed.

502.5 PAYMENT:

The accepted quantities of Confirmation/Drilled Shafts and Rock Sockets, measured as provided above, will be paid for at the contract unit price COMPLETE IN PLACE for placement in Dry Excavations. The contract unit price shall include all excavation; drilling; metal casing; steel reinforcing; portland cement concrete; any needed forming, curing and finishing; exposing in-place shaft concrete and the subsequent repair of shaft foundations; furnishing all materials, equipment, and labor for splicing of reinforcing steel; conduit for integrity testing and integrity testing.

No additional payment will be made for metal casing that is to remain in place, or for temporary casing left in place.

No supplemental payment will be made for Confirmation Shafts; the cost of the confirmation process is considered as included in the overall cost of constructing production Drilled Shaft Foundations, including all Confirmation Shafts.

Bell Footings will be paid for at the contract unit price per each, for each configuration of Bell Footing constructed and accepted.

Payment for Obstructions will be made in accordance with the provisions of Section 109.4. Obstructions are defined as either material or objects of excessive dimensions that could not be reasonably inferred from the Geotechnical and Foundation Report, including the Foundation Boring Logs. Drilling tools lost in shaft excavations will not be considered Obstructions.

Drilled Shaft Wet Conditions Extra Cost (Contingency Item) is an additional payment made for each drilled shaft installed under wet conditions. This contingency payment will only be made with the approval of the Engineer when warranted by ground water intrusion into the drilled hole, which requires application of special wet drilling methods such as those that use slurry. This payment will be in addition to the contract unit price for Drilled Shafts and shall be full compensation for all additional work and materials required for installation of drilled shafts under wet conditions.

SECTION 506

PRECAST PRESTRESSED CONCRETE MEMBERS

Section 506 is supplemented with the following:

506.1 DESCRIPTION:

Elastomeric Bearing Pads shall conform to the requirements of the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 18.2, and shall be Grade 3, 60 durometer elastomer, unless otherwise specified in the Special Provisions.

Prestressing of all precast concrete I-girder, box beam, voided and solid slab bridge members shall be by the pretensioning method only.

Prior to initiating girder fabrication, shop drawings for the proposed precast concrete members shall be submitted in accordance with Section 105.2, and approved by the Engineer.

506.2 CONCRETE:

506.2.1 Reinforcing Steel: Non-prestressed reinforcement shall conform to the provisions of Section 727; placement shall conform to the provisions of Section 505.5.

506.2.2 Dimensional Tolerances: Precast Prestressed Concrete Bridge Members that do not comply with the dimensional tolerances specified herein will be rejected. Precast members that show evidence of cracks, pop-outs, voids or other evidence of structural inadequacy, or imperfections that will reduce the aesthetics of the member after final placement, will be rejected.

- (1) Precast Prestressed Concrete I-girders: The maximum allowable tolerances or deviations from dimensions and details shown on the project plans and shop drawings shall be as follows:

Girder Length	$\pm 3/4"$
Width (flanges and fillets)	$+ 3/8", -1/4"$
Girder Depth (overall)	$+1/2", -1/4"$
Width (web)	$+ 3/8", -1/4"$
Depth (flanges and fillets)	$\pm 1/4"$
Bearing plates (center to center)	$\pm 1/8"$ per 10 feet but not greater than $\pm 3/4"$
Horizontal alignment (deviation from straight line parallel to centerline of girder)	$1/8"$ per every 10 feet in length
Stirrup bars (deviation from top of girder)	$+ 1/4", - 3/4"$
Position of strands	$\pm 1/4"$ for strands and center of gravity of strand group
Longitudinal position of deflection points for deflected strands	$\pm 10"$
Position of handling devices	$\pm 6"$
Bearing plates (center to end of girder)	$\pm 1/4"$
Side inserts (center to center and center to end of girder)	$\pm 1/2"$
Girder ends (deviation from square or designated skew)	Horz. $\pm 1/4"$ Vert. $\pm 1/8"$ per 12 foot of beam depth
Bearing area deviation from plane	$\pm 1/8"$
Stirrup bars (longitudinal spacing)	$\pm 1"$
Position of weld plates	$\pm 1"$

- (2) Precast Prestressed Concrete Box Beams, Voids Slabs, and Flat Slabs: The maximum allowable tolerances or deviations from dimensions and details shown on the project plans and shop drawings shall be:

Member Length	$\pm 3/4"$
Member Width (overall)	$\pm 1/4"$
Member Depth (overall)	$\pm 1/4"$
Width (web)	$\pm 3/8"$
Depth (top slab)	$\pm 1/4"$
Depth (bottom slab)	$+ 1/4", -1/8"$
Horizontal alignment (deviation from straight line parallel to centerline of member)	$1/8"$ per every 10 feet in length
Camber differential between adjacent members	Not greater than $3/4"$
Position of strands	$\pm 1/4"$ for center of gravity for strand group
Stirrup bars (longitudinal spacing)	$\pm 1"$
Position of handling devices	$\pm 6"$
Member void position	$\pm 1/2"$ from end of void to center of tie hole, $+ 1"$ adjacent to end block.
Member ends (deviation from square and/or designated skew)	$\pm 1/2"$
Bearing area deviation from plane (straight edge through middle half)	$\pm 1/8"$
Dowel tubes (spacing between centers of tubes, and centers of tubes to the ends and sides of members)	$\pm 1/2"$
Tie rod tubes (spacing between centers of tubes, and centers of tubes to ends of members)	$\pm 1/2"$
Tie rod tubes (spacing from centers of tubes to bottom of member)	$\pm 3/8"$
Position of side inserts	$\pm 1/2"$

506.3 PRESTRESSING STEEL:

Prestressing Steel Strand for precast concrete bridge members shall conform to the requirements of AASHTO Specification M 203 (ASTM A416) for Steel Strand, Uncoated Seven-Wire for Concrete Reinforcement, and shall be Low-Relaxation Strand, Grade 270.

506.6 PRESTRESSING:

Unless otherwise shown on the project plans, the stresses in the prestressing strands shall not exceed those specified in the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 10.10.

When concrete has not been placed within 72 hours of the tensioning of the prestressing strands, all strands shall be re-tensioned prior to placing concrete.

Prestressing steel at the end of the members shall be cut and bent in accordance with details on the project plans. Exposed strand ends shall not be coated, but shall be clean and free of all rust, corrosion, dirt, scale, oil, grease, and other deleterious substances, in accordance with Sections 506.3 and 506.7 of these Specifications, before encasement in the cast-in-place concrete pier and abutment diaphragms of the superstructure.

506.8 SAMPLES FOR TESTING:

Sampling and testing of prestressing strand for bridge members shall conform to the specifications of AASHTO M 203.

506.9 HANDLING:

Precast prestressed concrete bridge members shall not be transported from the fabricating yard to the bridge site until attaining full design compressive strength, and not less than seven (7) days after the total transfer of prestressing force.

506.10 PAYMENT:

A partial payment administered in accordance with the provisions of Section 109.7(A), will be allowed for stockpiled precast prestressed concrete bridge members that have been approved by the Engineer for conformance with the project plans and these specifications. The partial payment shall not exceed eighty percent of the contract complete in place unit price,

An adjustment in the contract unit price, to the nearest cent, will be made for precast prestressed concrete bridge members having cylinder strength test results less than the specified 28-day compressive strength. Strength tests will be conducted in accordance with Section 725.8. The adjustment in contract unit price, if the precast prestressed concrete bridge member is accepted, will be based on the schedule in Section 725.8.3 Table 725-2 using values for Class AA and Class A.

Part 500 add the following new Section:

SECTION 508

CATTLE GUARD

508.1 DESCRIPTION:

This work shall consist of furnishing all materials and labor to construct new cattle guards at the locations shown on the plans.

508.2 MATERIALS & CONSTRUCTION: Materials and construction requirements shall be in accordance with Section 906 Cattle Guards of the current Arizona Department of Transportation (ADOT) Standard Specifications for Road and Bridge Construction and the referenced ADOT Standard Drawing.

508.2.1 Beam Design: Cattle guards shall be constructed using beams designed for HS-20 or heavier loading.

508.2.2 Precast Units: Precast units may be used when fabricated in accordance with shop drawings approved by MCDOT. The precast option shall incorporate a proactive design acceptable to the County to ensure the gap space between adjacent grill units will be limited to 1/4 - inch plus or minus 1/16 - inch.

508.3 MEASUREMENT:

Cattle guards shall be measured as complete units in place for each size structure constructed. The size of cattle guards shall be noted by the number of grill units used in the installation.

508.4 PAYMENT:

Payment for cattle guards constructed and accepted will be made at the contract unit price for each structure, complete in place.

SECTION 601

TRENCH EXCAVATION, BACKFILLING AND COMPACTION

601.1 DESCRIPTION, add the following:

The work covered by this specification includes the backfilling of utility potholes.

601.4.5 Final Backfill, add the following:

Trenches within existing paved areas, roadway shoulders, and the travelled way of unpaved roadways shall use ½-sack CLSM or 1-sack CLSM for backfill unless use of an alternative material has received prior approval. Utility potholes in existing paved areas or within two feet of pavement shall use ½-sack CLSM or 1-sack CLSM for backfill unless use of an alternative material has received prior approval. For trenches and utility potholes within paved areas the CLSM backfill shall extend from twelve inches (12") above the top most conduit to the bottom of the aggregate base as defined for Trench Repair of MAG Detail 200. For trenches and utility potholes within unpaved areas the CLSM backfill shall extend from twelve inches (12") above the top most conduit to six (6) inches below the finished grade, material for the top six (6) inches shall match the existing surfacing.

Add the following new section:

601.4.12 Embedment Zone Material Requirements for HDPE Pipe: Controlled low strength material (CLSM) shall be used within the pipe embedment zone for HDPE pipe. The CLSM shall be ½-sack or 1-sack per Section 728. Placement of the CLSM shall be per Section 604 and extend from the trench foundation to 12 inches above the pipe crown.

Add the following new section:

601.4.13 Allowable Resistivity and pH Values for Material Placed within the Pipe Embedment Zone and Backfill: Material placed within the pipe embedment zone and final backfill area for pipes, pipe-arches, or arches made of metal shall have a value of resistivity not less than 2000 ohm-cm or of the value shown on the project Plans. When resistivity is not shown on the Plans, the material shall have a value of resistivity not less than that of the existing in-place material or 2000 ohm-cm, whichever is greater. Material for all metal pipe installations shall have a pH value between 6.0 and 9.0 inclusive. Material for all concrete or plastic pipe installations shall have a pH value between 6.0 and 12.0. Tests for pH and resistivity shall be in accordance with the requirements of Arizona Test Method 236.

Part 600 add the following new Section:

SECTION 635

CONCRETE LINED IRRIGATION DITCH

635.1 DESCRIPTION:

Work under this Section consists of constructing cast-in-place Concrete Lined Ditch (CLD) having a bottom width of three feet or less.

635.2 MATERIALS:

Concrete shall be air-entrained Class B portland cement concrete conforming to the requirements of Section 725. All other materials incorporated in the CLD installation shall conform to the project plans and Special Provisions.

635.3 CONSTRUCTION:

Subgrade for the concrete ditch shall be shaped to conform to the elevations and dimensions shown on the project plans. The subgrade shall be compacted to a minimum of 85% of maximum dry density in accordance with the requirements of Section 301.3.

The CLD shall be slip-formed, or cast as approved by the Engineer. Concrete construction shall conform to the details shown on the project plans and the applicable provisions of Section 505.

The finished surface of the concrete shall be free from rock pockets and surface voids, and shall be comparable to the finish obtained by the use of a long-handled steel trowel, as approved by the Engineer. Transverse grooves 1/8 inch in width and 5/8 inch in depth shall be made in the placed concrete lining at intervals of 10 feet, and maintained to the required dimensions until the concrete has set.

The placed concrete shall be cured by the use of a white pigmented membrane-forming compound (AASHTO M-148 Type 2) conforming to the requirements of Section 726.

635.4 MEASUREMENT:

Measurement for this work will be by the linear foot of Concrete Lined Ditch.

635.5 PAYMENT:

Payment for this work shall be made at the contract unit price for Concrete Lined Ditch. Such payment will be full compensation for the item, complete in place, including all necessary materials, excavation, subgrade preparation, concrete, labor, and equipment.

SECTION 702

BASE MATERIALS

702.1 GENERAL, add the following:

Except for roads that are classified as minor collector or local roads, the base material shall not contain reclaimed materials such as RCM or RAP unless specified by the project plans or special provisions.

SECTION 710

ASPHALT CONCRETE

710.2 MATERIAL:

710.2.3 Reclaimed Asphalt Pavement (RAP), Replace the third paragraph with the following:

RAP shall not exceed 20% contribution of the aggregate or binder in the base or intermediate courses of arterial streets. RAP shall not exceed 30% contribution of the aggregate or binder in the base or intermediate courses of collector streets. RAP shall not be used in the surface course for all roadway classifications.

710.3 MIX DESIGN REQUIREMENTS:

710.3.1 General, add the following:

710.3.1.1 Verification Testing: The Engineer may conduct tests to verify the laboratory air voids using the submitted target binder content and design gradation. If the resulting air voids is outside the required range, the Contractor shall make adjustments on the binder content to gain compliance with the air voids requirement. The Contractor shall make available samples of the proposed aggregate and binder to conduct verification testing by the Engineer.

SECTION 717

ASPHALT-RUBBER ASPHALT CONCRETE

717.2 MATERIALS

717.2.1 Asphalt-Rubber Binder (ARB)

717.2.1.3 ARB Proportions and Properties, add the following:

The maximum crumb rubber content in ARB shall be 24 percent by weight of total binder.

717.3 MIX DESIGN REQUIREMENT:

717.3.2 Mix Design Criteria, add the following:

The Engineer may conduct tests to verify the laboratory air voids using the target binder content and design gradation. If the resulting air voids is outside the required range, the binder content shall be adjusted to gain compliance with the air voids requirement. Samples of the proposed aggregate and binder shall be made available for verification testing by the Engineer.

SECTION 725

PORTLAND CEMENT CONCRETE

725.8 TESTS AND TEST METHODS:

725.8.2 Concrete Cylinder Test, add following:

A cylinder strength test for concrete with a design strength of 4,000 psi or higher shall be the average of the strengths of at least two 6 inch by 12 inch cylinders or at least three 4 inch by 8 inch cylinders made from the same sample of concrete and tested at 28 days.

SECTION 728

CONTROLLED LOW STRENGTH MATERIAL

728.4 MIXING, add the following:

The project identification used to obtain the Engineer's pre-approval for dry batched unmixed CLSM shall be on the batch weight records.

SECTION 738

HIGH DENSITY POLYETHYLENE PIPE & FITTINGS FOR STORM DRAIN & SANITARY SEWER

Section 738.1 is modified as follows:

HDPE pipe size shall be limited to sizes 8-inch through 60-inch diameter. Sizes greater than 60-inch diameter shall not be used within Maricopa County rights-of-way without specific written approval from MCDOT.

SECTION 740

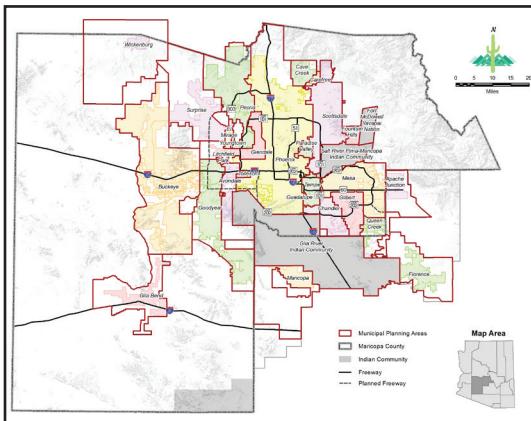
POLYPROPYLENE PIPE & FITTINGS FOR STORM DRAIN, IRRIGATION & SANITARY SEWER

Polypropylene pipe (PP) shall not be used within Maricopa County rights-of-way without specific written approval from MCDOT.



2015 Edition

Uniform Standard Specifications and Details for Public Works Construction



Sponsored and Distributed by the



January 2015

NEW IN THE 2015 REVISION

Uniform Standard Specifications and Details for Public Works Construction—2015 Edition

The MAG Standard Specifications and Details Committee, with assistance from five specialized working groups, considered 22 cases during the 2014 session. Of these, 18 were approved and included in this revision.

New Specifications:

- Section 607: Trenchless Installation of Smooth Wall Jacking Pipe
- Section 742: Precast Manhole

Specifications rewritten, or with major updates:

- Section 101: Abbreviations and Definitions
- Section 321: Placement and Construction of Asphalt Concrete Pavement
- Section 324: Portland Cement Concrete Pavement
- Section 325: Placement and Construction of Asphalt-Rubber Asphalt Concrete Pavement
- Section 405: Monuments
- Section 601: Trench Excavation, Backfilling and Compaction
- Section 610: Water Line Construction
- Section 611: Water, Sewer and Storm Drain Testing
(*was Disinfecting Water Mains*)
- Section 615: Sewer Line Construction
- Section 618: Storm Drain Construction
- Section 625: Manhole Construction and Drop Sewer Connections
- Section 710: Asphalt Concrete
- Section 735: Reinforced Concrete Pipe
- Section 775: Brick and Concrete Masonry Units (Blocks)

Specifications with minor updates:

- Section 107: Legal Regulations and Responsibility to Public
- Section 206: Structure Excavation and Backfill
- Section 211: Fill Construction
- Section 310: Placement and Construction of Aggregate Base Course
- Section 336: Pavement Matching and Surfacing Replacement
- Section 340: Concrete Curb, Gutter, Sidewalk, Sidewalk Ramps, Driveway and Alley Entrance
- Section 342: Decorative Pavement, Concrete Paving Stone
- Section 345: Adjusting Frames, Covers, Valve Boxes, Meter Boxes and Pull Boxes
- Section 355: Utility Potholes-Keyhole Method
- Section 616: Reclaimed Water Line Construction
- Section 717: Asphalt-Rubber Asphalt Concrete
- Section 726: Concrete Curing Materials
- Section 739: Steel Reinforced Polyethylene Pipe and Fittings for Storm Drain, Irrigation and Sanitary Sewer
- Section 740: Polypropylene Pipe and Fittings for Storm Drain, Irrigation and Sanitary Sewer
- Section 750: Iron Water Pipe and Fittings

Specifications that have been deleted:

- Section 603: Installation for High Density Polyethylene Pipe
(*Incorporated into Section 601.*)

New detail drawings:

- Detail 420-1: Concrete Sanitary Sewer Manhole
(*Replaces existing 420-1: Precast Concrete Sewer Manhole*)
- Detail 420-2: Precast Manhole Base
- Detail 420-3: Concrete Manhole Base
(*Replaces parts of existing 420-2 and adds details.*)

Details that have been updated:

- Detail 100-1: Index (Page 1 of 2)
- Detail 100-2: Index (Page 2 of 2)
- Detail 120: Survey Marker
- Detail 200-1: Backfill, Pavement and Surface Replacement
- Detail 200-2: Backfill, Pavement and Surface Replacement
- Detail 212: Utility Pothole Repair
- Detail 391-1: Valve Box Installation and Grade Adjustment
- Detail 391-2: Valve Box Installation and Grade Adjustment
- Detail 392: Debris Cap Installation
- Detail 421: Offset Manhole 8" to 30" Pipe
- Detail 422: Manhole Frame and Cover Adjustment
(*Deletes Brick Sewer Manhole drawing from existing Detail 422*)
- Detail 429: Industrial Waste Control Vault with Manhole
- Detail 522: Storm Drain Manhole Shaft
- Detail 552: Ford Crossing and Cut-off Walls

Details that have been deleted:

- Detail 428: Manhole Steps

The 2015 Edition also includes all the updates made in the 2014 and 2013 Revisions to the 2012 Edition. See the next page for details.

Changes made in the 2014 Revision

Uniform Standard Specifications and Details for Public Works Construction—2014 Revision to the 2012 Edition

The MAG Standard Specifications and Details Committee, with assistance from five specialized working groups, considered 26 cases during the 2013 session. Of these, 23 were approved and included in this revision.

New Specifications:

- Section 602: Trenchless Installation of Steel Casing (*Replaces Section 602: Encasement of Water of Sewer Pipe by Jacking or Tunneling Operation*)
- Section 739: Steel Reinforced Polyethylene Pipe (SRPE)
- Section 740: Polypropylene Pipe and Fittings for Storm Drain, Irrigation, and Sanitary Sewer

Specifications rewritten, or with major updates:

- Section 309: Lime Stabilization or Modification of Subgrade
- Section 321: Placement and Construction of Asphalt Concrete Pavement
- Section 337: Crack Sealing
- Section 340: Concrete Curb, Gutter, Sidewalk, Sidewalk Ramps, Driveway and Alley Entrance
- Section 345: Adjusting Frames, Covers, Valve Boxes, and Water Meter Boxes
- Section 610: Water Line Construction
- Section 711: Paving Asphalt
- Section 729: Expansion Joint Filler

Specifications with minor updates:

- Section 107: Legal Requirements and Responsibility to Public
- Section 108: Commencement, Prosecution and Progress
- Section 301: Subgrade Preparation
- Section 311: Placement and Construction of Cement Treated Subgrade
- Section 324: Portland Cement Concrete Pavement

- Section 415: Flexible Metal Guardrail
- Section 430: Landscaping and Planting
- Section 505: Concrete Structures
- Section 605: Subdrainage
- Section 725: Portland Cement Concrete
- Section 735: Reinforced Concrete Pipe
- Section 795: Landscape Materials

Specifications that have been deleted:

- Section 737: Asbestos-Cement Pipe and Fittings for Storm Drain and Sanitary Sewer

New detail drawing:

- Detail 120: Survey Marker (*Replaces Details 120-1 and 120-2*)

Details that have been updated:

- Detail 201: Asphalt Pavement Edge Details
- Detail 221: Curb and Gutter Transition Type A to Type C Integral Roll Curb, Gutter and Sidewalk
- Detail 230: Sidewalks
- Detail 250-1: Driveway Entrances with Detached Sidewalk
- Detail 270: Frame and Cover
- Detail 391-1: Valve Box Installation and Grade Adjustment
- Detail 501-5: Headwall Drop Inlet

Details that have been deleted:

- Detail 120-2: Survey Marker (for Unincorporated Maricopa County)

Changes made in the 2013 Revision

Uniform Standard Specifications and Details for Public Works Construction—2013 Revision to the 2012 Edition

The MAG Standard Specifications and Details Committee, with assistance from five specialized working groups, considered 20 cases during the 2012 session. Of these, 17 were approved and included in this revision.

New Specifications:

- None

Specifications rewritten, or with major updates:

- Section 107: Legal Regulations and Responsibility to Public
- Section 310: Placement and Construction of Aggregate Base
- Section 350: Removal of Existing Improvements
- Section 415: Flexible Metal Guardrail
- Section 701: Aggregate
- Section 702: Base Materials
- Section 710: Asphalt Concrete
- Section 711: Paving Asphalt

Specifications with minor updates:

- Section 108: Commencement, Prosecution and Progress
- Section 317: Asphalt Milling
- Section 321: Placement and Construction of Asphalt Concrete Pavement
- Section 332: Placement and Construction of Asphalt Emulsion Slurry Seal Coat
- Section 505: Concrete Structures

- Section 610: Water Line Construction
- Section 725: Portland Cement Concrete
- Section 728: Controlled Low Strength Materials
- Section 770: Structural and Rivet Steel, Rivets, Bolts, Pins and Anchor Bolts.

Specifications that have been deleted:

- Section 709: Reclaimed Asphalt Pavement
- Section 719: Recycled Asphalt Concrete Hot Mixed

New detail drawings:

- Detail 260: Alley Entrance (With Vertical Curb and Gutter)
- Detail 360-1: Dry Barrel Fire Hydrant Installation
- Detail 360-2: Wet Barrel Fire Hydrant Installation
- Detail 360-3: Fire Hydrant Installation Details

Details that have been updated:

- Detail 160: 6' Chain Link Fence and Gate
- Detail 201: Asphalt Pavement Edge Details
- Detail 250-2: Driveway Entrances with Sidewalk Attached to Curb

**UNIFORM STANDARD
SPECIFICATIONS
for
PUBLIC WORKS
CONSTRUCTION**

**SPONSORED and DISTRIBUTED
by the**



2015 Edition

ARIZONA

FOREWORD

Publication of these Uniform Standard Specifications and Details for Public Works Construction fulfills the goal of a group of agencies who joined forces in 1966 to produce such a set of documents. Subsequently, in the interest of promoting county-wide acceptance and use of these standards and details, the Maricopa Association of Governments accepted their sponsorship and the responsibility of keeping them current and viable.

These specifications and details, representing the best professional thinking of representatives of several Public Works Departments, reviewed and refined by members of the construction industry, were written to fulfill the need for uniform rules governing public works construction performed for Maricopa County and the various cities and public agencies within Maricopa County who could not afford to promulgate such standards for themselves. Agencies in other regions or climes that desire to use these specifications may need to make adjustments for local conditions.

A uniform set of specifications and details, updated and embracing the most modern materials and construction techniques will reduce conflicts, provide clarity and lower construction costs for the benefit of the public.

Use of these standards for projects outside of the right-of-way should be reviewed by professional engineers and architects and applied with care to insure relevance to the planned work.

Specifications and details should be incorporated into project plans and specifications after careful review by the design engineer or architect of specific project needs. Not all specifications contained herein will apply to all projects. Prepared plans and specifications should clearly call out only those specific uniform specifications and details required for the project.

Uniform specifications and details are not a substitute for good engineering judgment. Unique conditions will arise that are outside the scope of these standards. When this happens, professional engineers and architects are required to use their judgment to amend these standards to best meet site-specific project needs in accordance with the rules set forth by the State of Arizona and policy statements made by the Arizona State Board of Technical Registration.

The Uniform Standard Specifications and Details for Public Works Construction are revised periodically and reprinted to reflect the changing technology of the construction industry. To this end a Specifications and Details Committee has been established as a permanent organization to continually study and recommend changes to the Specifications and Details. Interested parties may address suggested changes and questions to:

Standard Specifications & Details Committee
c/o Maricopa Association of Governments
302 North First Avenue, Suite 300
Phoenix, Arizona, 85003

Suggestions will be reviewed by the committee and appropriate segments of the construction industry and revisions will be published the first of each year. A copy of this publication is available for review on the internet at the website listed below. Please follow the links to the publications page and look for *Uniform Standard Specifications for Public Works Construction* and/or *Uniform Standard Details for Public Works Construction*:

www.azmag.gov

In the interest of regional uniformity, it is hoped that all using agencies will adopt these standards with minimal changes. It is recognized that because of charter requirements and for other reasons, some agencies will find it necessary to modify or supplement certain requirements. In the interest of regional uniformity, it is strongly recommended that using agencies bring desired modifications to the MAG Committee for consideration and inclusion into these standards.

TABLE OF CONTENTS

PART 100 - GENERAL CONDITIONS

Section	Last Revised	Title	Page
101	2015	Abbreviations and Definitions	101-1
102	2008	Bidding Requirements and Conditions	102-1
103	1999	Award and Execution of Contract	103-1
104	2012	Scope of Work	104-1
105	2008	Control of Work	105-1
106	1998	Control of Materials	106-1
107	2015	Legal Regulations and Responsibility to Public	107-1
108	2014	Commencement, Prosecution and Progress	108-1
109	2011	Measurements and Payments	109-1
110	2000	Notification of Changed Conditions and Dispute Resolution	110-1

PART 200 - EARTHWORK

Section	Last Revised	Title	Page
201	1999	Clearing and Grubbing	201-1
205	1998	Roadway Excavation	205-1
206	2015	Structure Excavation and Backfill	206-1
210	2009	Borrow Excavation	210-1
211	2015	Fill Construction	211-1
215	1998	Earthwork for Open Channels	215-1
220	2012	Riprap Construction	220-1
230	2010	Dust Palliative Application	230-1

PART 300 - STREETS AND RELATED WORK

Section	Last Revised	Title	Page
301	2014	Subgrade Preparation	301-1
306	2010	Mechanically Stabilized Subgrade- Geogrid Reinforcement	306-1
309	2014	Lime Slurry Stabilization or Modification of Subgrade	309-1
310	2015	Placement and Construction of Aggregate Base Course	310-1
311	2014	Placement and Construction of Cement Treated Subgrade	311-1
312	2012	Cement Treated Base	312-1
315	1998	Bituminous Prime Coat	315-1
317	2013	Asphalt Milling	317-1
320	1999	Road-Mixed Surfacing	320-1
321	2015	Placement and Construction of Asphalt Concrete Pavement	321-1
324	2015	Portland Cement Concrete Pavement (PCCP)	324-1
325	2015	Placement and Construction of Asphalt-Rubber Asphalt Concrete	325-1
327	2012	Hot In-Place Recycling	327-1
329	1998	Tack Coat	329-1
330	1998	Asphalt Chip Seal	330-1
331	2009	Microsurfacing Specifications	331-1
332	2013	Placement and Construction of Asphalt Emulsion Slurry Seal Coat	332-1
333	2012	Fog Seal Coats	333-1
334	2012	Preservative Seal for Asphalt Concrete	334-1
335	2012	Placement and Construction of Hot Asphalt-Rubber Seal	335-1
336	2015	Pavement Matching and Surfacing Replacement	336-1
337	2014	Crack Sealing	337-1
340	2015	Concrete Curb, Gutter, Sidewalk, Curb Ramps, Driveway and Alley Entrance	340-1
342	2015	Decorative Pavement Concrete Paving Stone	342-1
343	1998	Exposed Aggregate Paving	343-1
345	2015	Adjusting Frames, Covers, Valve Boxes Meter Boxes and Pull Boxes	345-1
350	2013	Removal of Existing Improvements	350-1
355	2015	Utility Potholes-Keyhole Method	355-1
360	1998	Telecommunications Installation	360-1

PART 400 - RIGHT-OF-WAY AND TRAFFIC CONTROL

Section	Last Revised	Title	Page
401	1998	Traffic Control	401-1
405	2015	Survey Monuments	405-1
410	1998	Precast Safety Curbs	410-1
415	2014	Flexible Metal Guardrail	415-1
420	1998	Chain Link Fences	420-1
424	1998	Parkway Grading	424-1
425	1998	Topsoils	425-1
430	2014	Landscaping and Planting	430-1
440	1999	Sprinkler Irrigation System Installation	440-1

PART 500 - STRUCTURES

Section	Last Revised	Title	Page
505	2014	Concrete Structures	505-1
506	2012	Precast Prestressed Concrete Members	506-1
510	1998	Concrete Block Masonry	510-1
511	1998	Brick Masonry	511-1
515	1998	Steel Structures	515-1
520	2012	Steel and Aluminum Handrails	520-1
525	1998	Pneumatically Placed Mortar	525-1
530	2000	Painting	530-1

PART 600 – WATER, SEWER, STORM DRAIN AND IRRIGATION

Section	Last Revised	Title	Page
601	2015	Trench Excavation, Backfilling and Compaction	601-1
602	2014	Trenchless Installation of Steel Casing	602-1
604	2012	Placement of Controlled Low Strength Material	604-1
605	2014	Subdrainage	605-1
607	2015	Trenchless Installation of Smooth Wall Jacking Pipe	607-1
610	2015	Water Line Construction	610-1
611	2015	Water, Sewer and Storm Drain Testing	611-1
615	2015	Sanitary Sewer Line Construction	615-1
616	2015	Reclaimed Water Line Construction	616-1
618	2015	Storm Drain Construction	618-1
620	2012	Cast-in-place Concrete Pipe	620-1
621	1998	Corrugated Metal Pipe and Arches	621-1
625	2015	Manhole Construction and Drop Sewer Connections	625-1
630	2012	Tapping Sleeves, Valves and Valve Boxes on Water Lines	630-1
631	2012	Water Taps and Meter Service Connections	631-1

PART 700 - MATERIALS

Section	Last Revised	Title	Page
701	2013	Aggregate	701-1
702	2013	Base Materials	702-1
703	2012	Riprap	703-1
705	2012	Portland Cement Treated Base	705-1
708	2011	Asphalt Pavement Core Bonding Materials	708-1
710	2015	Asphalt Concrete	710-1
711	2014	Paving Asphalt	711-1
712	1999	Liquid Asphalt	712-1
713	2012	Emulsified Asphalts Materials	713-1
714	2012	Microsurfacing Materials	714-1
715	2012	Slurry Seal Materials	715-1

Section	Last Revised	Title	Page
716	2012	Cover Material	716-1
717	2015	Asphalt-Rubber Asphalt Concrete	717-1
718	2012	Preservative Seal for Asphalt Concrete	718-1
725	2014	Portland Cement Concrete	725-1
726	2015	Concrete Curing Materials	726-1
727	2008	Steel Reinforcement	727-1
728	2013	Controlled Low Strength Material	728-1
729	2014	Expansion Joint Filler	729-1
735	2015	Reinforced Concrete Pipe	735-1
736	2012	Non-Reinforced Concrete Pipe	736-1
738	2012	High Density Polyethylene Pipe And Fittings for Storm Drain And Sanitary Sewer	738-1
739	2015	Steel Reinforced Polyethylene Pipe And Fittings for Storm Drain, Irrigation And Sanitary Sewer	739-1
740	2014	Polypropylene Pipe And Fittings for Storm Drain, Irrigation And Sanitary Sewer	740-1
741	2011	Lining for Reinforced Concrete Sanitary Sewer Pipe	741-1
742	2015	Precast Manhole	742-1
743	1998	Vitrified Clay Pipe	743-1
744	1998	ABS Truss Pipe and Fittings	744-1
745	1998	PVC Sewer Pipe and Fittings	745-1
750	2015	Iron Water Pipe and Fittings	750-1
752	1998	Asbestos-Cement Water Pipe and Fittings	752-1
753	2000	Galvanized Pipe and Fittings	753-1
754	2012	Copper Pipe, Tubing and Fittings	754-1
755	2012	Polyethylene Pipe for Water Distribution	755-1
756	2008	Dry Barrel Fire Hydrants	756-1
757	1998	Sprinkler Irrigation System	757-1
758	2005	Concrete Pressure Pipe - Steel Cylinder Type	758-1
759	2002	Steel Pipe	759-1
760	1998	Coating Corrugated Metal Pipe and Arches	760-1
761	1998	Structural Plate Pipe, Arches, and Pipe Arches	761-1
770	2013	Structural and Rivet Steel, Rivets, Bolts, Pins, and Anchor Bolts	770-1
771	2005	Galvanizing	771-1
772	2012	Chain Link Fence	772-2
775	2015	Brick and Concrete Masonry Units (Blocks)	775-1
776	2012	Masonry Mortar and Grout	776-1
778	1998	Lumber	778-1
779	1998	Wood Preservatives	779-1
787	1999	Gray Iron Castings	787-1
790	1999	Paint	790-1
792	2010	Dust Palliative	792-1
795	2014	Landscape Material	795-1
796	2010	Geosynthetics	796-1
	2014	Index	Index-1

This Page Reserved for Future Use

PART 100

GENERAL CONDITIONS

Section	Last Revised	Title	Page
101	2015	<u>Abbreviations and Definitions</u>	101-1
102	2008	<u>Bidding Requirements and Conditions</u>	102-1
103	1999	<u>Award and Execution of Contract</u>	103-1
104	2012	<u>Scope of Work</u>	104-1
105	2008	<u>Control of Work</u>	105-1
106	1998	<u>Control of Materials</u>	106-1
107	2015	<u>Legal Regulations and Responsibility to Public</u>	107-1
108	2014	<u>Commencement, Prosecution and Progress</u>	108-1
109	2011	<u>Measurements and Payments</u>	109-1
110	2000	<u>Notification of Changed Conditions and Dispute Resolution</u>	110-1

This Page Reserved for Future Use

SECTION 101

ABBREVIATIONS AND DEFINITIONS

101.1 ABBREVIATIONS:

Wherever the following abbreviations are used in these specifications, standard details or on the plans, they are to be constructed the same as the respective expressions represented.

AASHTO	American Association of State Highway and Transportation Officials
AAN	American Association of Nurserymen
AB	Aggregate base
Aban	Abandon
ABC	Aggregate base course
AC	Asphalt cement or concrete
ACB	Asphalt concrete base
ACI	American Concrete Institute
ACP	Asbestos cement pipe
ACPA	American Concrete Pipe Association
ACWS	Asphalt concrete wearing surface
AFRB	Arizona Fire Rating Bureau
AGC	Associated General Contractors of America, Inc.
Agg	Aggregate
ADOT	Arizona Department of Transportation
ADA	Americans With Disabilities Act of 1990
ADEQ	Arizona Department of Environmental Quality
Ahd	Ahead
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APA	American Plywood Association
Approx	Approximate
APWA	American Public Works Association
AR	Aged residue
ARAC	Asphalt-Rubber Asphalt Concrete
ARIZ	Arizona Department of Transportation Test Method
ARS	Arizona Revised Statutes
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
Ave	Avenue
AWPA	American Wood Preservers Association
AWSC	American Welding Society Code
AWWA	American Water Works Association
Bbl	Barrel
BC	Beginning of curve
BCR	Beginning of curb return
Beg	Beginning
Bk	Book or Back
Blvd	Boulevard
BM	Bench Mark or Board Measure

Brg	Bearing
BST	Bituminous Surface Treatment
BTB	Bituminous Treated Base
BTU	British Thermal Units
BVC	Beginning of vertical curve
C	Centigrade or Curb
CB	Catch Basin
CBF&C	Catch basin frame & cover
CC or C/C	Center to Center
CE	City or County Engineer
Cem	Cement
CF	Curb face
cfs	Cubic Feet per second
CIP	Cast Iron pipe
CIPP	Cast-in-place concrete pipe
CL or C	Centerline
CLR	Clear
Cm	Centimeter
CMP	Corrugated metal pipe
CO	Clean out
Col	Column
Conc	Concrete
Const	Construct
CP	Concrete pipe (non-reinforced)
CTB	Cement Treated Base
Cu	Cubic
Deg	Degree
DF	Douglas Fir
DG	Decomposed granite
Dia	Diameter
Dim	Dimension
DIP	Ductile Iron Pipe
Div	Division
Dr	Drive
Drwg	Drawing
Dwy	Driveway
Ea	Each
Ease	Easement
E	East
EC	End of curve
ECR	End of curb return
El or Elv	Elevation
Equa or Eq	Equation
EVC	End of vertical curve
Ex or Exist	Existing
F	Fahrenheit
FB	Field book
F & C	Frame & cover
FH	Fire hydrant
FL or F	Floor line or flow line
Fl El	Floor Elevation
Fnd	Found
fps	Feet per second
FS	Finished surface
FSS	Federal Specifications and Standards
Ft	Foot or feet
G	Gutter

SECTION 101

Ga	Gage	NPI	Non pay item
Galv	Galvanized	NSC	National Safety Council
GL	Ground line	NSF	National Sanitation Foundation
Gpm	Gallons per minute	NTS	Not to Scale
		NW	Northwest
Gr	Grade	No	Number
H	High or height	OC	On Center
HC	House connection	OD	Outside Diameter
HH	Hand Hole	Oz	Ounces
Hdwl	Headwall	PC	Point of Curvature
Horiz	Horizontal	PCC	Point of Compound Curve or Portland Cement Concrete
Hwy	Highway	PI	Point of Intersection or Plastic Index
ICA	Industrial Commission of Arizona	PL	Property Line
ID	Improvement District or inside diameter	POC	Point of Curve
IE	Invert Elevation	POS	Point of Spiral
IEEE	Institute of Electrical and Electronic Engineers	PP	Power Pole
In	Inch	ppm	Parts per million
Inv	Invert	PRC	Point of Reverse Curve
IP	Iron Pipe	Prod	Produced
IPS	Iron Pipe Size	Prop	Proposed or Property
Irrig	Irrigation	psi	Pounds per square inch
Jt	Joint	psf	Pounds per square foot
JC	Junction Chamber	PT or POT	Point of Tangent
Jct	Junction	P&TP	Power and Telephone Pole
JS	Junction Structure	Pvmt	Pavement
L	Length	Q	Rate of flow
Lb	Pound	R	Radius
L&T	Lead and Tack	RC	Reinforced Concrete
LD	Local Depression	RCP	Reinforced Concrete Pipe
LF	Linear Feet	Rd	Road
LH	Lamp Hole	Rdwy	Roadway
Lin	Linear	Reinf	Reinforced, Reinforcing
Long	Longitudinal	Ret Wall	Retaining Wall
Lt	Left	RGRCP	Rubber Gasket Reinforced Concrete Pipe
M	Map or Maps	rpm	Revolutions Per Minute
MAG	Maricopa Association of Governments	Rt	Right
Max	Maximum	R/W	Right-of-way
MCR	Maricopa County Records	S	South or Slope
Meas	Measured	SAE	Society of Automotive Engineers
MH	Manhole	San	Sanitary
MHF&C	Manhole Frame and Cover	SC	Spiral to Curve
Min	Minutes or Minimum	SCCP	Steel Cylinder Concrete Pipe
Misc	Miscellaneous	SD	Storm Drain or Sewer District
ML or M	Monument Line	Sdl	Saddle
mm	Millimeter	Sec	Seconds
Mon	Monolithic or monument	Sect	Section
MTD	Multiple Tile Duct	SE	Southeast
N	North	Sht	Sheet
NBS	National Bureau of Standards	Spec	Specifications
NCPI	National Clay Pipe Institute	SPR	Simplified Practice Recommendation
NE	Northeast	Sp MH	Special Manhole
NEC	National Electric Code	Sq Ft Yd	Square Foot, Yard
NEMA	National Electrical Manufacturer's Association	SS	Sanitary Sewer
NFPA	National Fire Protection Association	St	Street
NP	Non-Plastic	Sta	Station
		Std	Standard

SECTION 101

Str gr	Structural grade
Struct	Structure or structural
SW	Southwest
SWPPP	Stormwater Pollution Prevention Plan
T	Tangent Distance
Tel	Telephone
Temp	Temporary
TH	Test Hole
TP	Telephone pole
Tr	Tract
Trans	Transition
TS	Traffic signal or Tangent to spiral
TSC	Traffic signal conduit
Typ	Typical
UL	Underwriters' Laboratories Inc.
USC & GS	United States Coast and Geodetic Survey
USGS	United States Geological Survey
V	Velocity of flow
VC	Vertical curve
VCP	Vitrified clay pipe
Vert	Vertical
W	West or width
WI	Wrought iron
WS	Wearing surface
Wt	Weight
Yd	Yard
'	feet or minutes
"	inches or seconds
°	degrees
%	percent
#	number or pound
@	at
/	per
=	equals

SECTION 101

101.2 DEFINITIONS AND TERMS:

Whenever in these specifications or in other contract documents the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

Addendum: A supplement to any of the Contract Documents issued, in writing, after advertisement of but prior to the opening of bids for a contract.

Advertisement: The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

Agency: The governmental agency for which the construction is being done, either by permit or contract.

Architect: The individual or firm who has accomplished the architectural services for the project, including his representatives.

Arizona Test Method: Arizona Department of Transportation Materials Testing Manual test method.

Award: The formal action of the governing body is accepting a proposal.

Backfill: Material placed in an excavated space to fill such space. For trenches, see definitions for Initial Backfill and Final Backfill.

Base Course: The upper course of the granular base of a pavement or the lower course of an asphalt concrete pavement structure.

Bedding: A material layer placed on top of the trench foundation to the bottom of the pipe, typically 4-6 inches in height. The bedding establishes the line and grade for a conduit and provides support that is firm, but not hard.

Bidder: Any qualified individual, firm, partnership, corporation or combination thereof, acting directly or through a duly authorized representative who legally submits a proposal for the advertised work.

Board of Supervisors: The Maricopa County Board of Supervisors acting under the authority of the laws of the State of Arizona.

Bond Issue Project: A project financed from bonds issued by the City or County pledging credit or a revenue resource.

Bridge: A structure, including supports, erected over a depression or an obstruction, as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of roadway of more than 20 feet between undercopings of abutments or extreme ends of openings for multiple boxes.

(Length) The length of a bridge structure is the over-all length measured along the line of survey stationing back to back of backwalls of abutments, if present, otherwise end to end of the bridge floor; but in no case less than the total clear opening of the structure.

(Roadway Width) The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom or curbs or guard timbers or in the case of multiple heights of curbs, between the bottoms of the lower risers.

Budget Project: A project financed by funds from General Tax levies and shared revenue funds set aside in the annual budget adopted by the Council or Board of Supervisors.

Building: Any structure built for the support, shelter, or enclosure of persons, animals, chattel or movable property.

Building Code: A regulation adopted by the governing body establishing minimum standards of construction for the protection of the public health, safety, and welfare in terms of measured performance rather than in terms of rigid specification of materials and methods.

Calendar Day: Every day shown on the calendar.

SECTION 101

Call for Bids: The standard forms inviting proposals or bids.

“Careful and prudent manner”: means conducting excavation in such a way that when it approaches within twenty-four inches of the underground facility located and marked by the owner or operator, by stakes, paint or in some customary manner, the exact location is manually determined, and the uncovered facility is supported and protected.

Change Order: A written order issued by the Engineer to the Contractor to make changes in the work or to perform extra work, and setting forth conditions for payment and/or adjustment in time of completion.

City: A municipal corporation, organized and existing under and by virtue of the laws of the State of Arizona.

City/County Clerk: The duly authorized person who performs the duties of clerk for the Contracting Agency.

Completion Time: The number of calendar days for completion of an act, including authorized time extensions. In case a calendar date of completion is shown in the proposal in lieu of the number of calendar days, the contract shall be completed by that date. The time within which an act is to be done shall be computed by excluding the first and including the last day; and if the last day be Sunday or a legal holiday, that shall be excluded.

Conflicting Utility: An existing utility, shown or not shown on the plans is conflicting when any part of the utility falls within the dimensions of the new installation, such that it would be in physical contact with the new installation.

Construction Project: The erection, installation, remodeling, alteration, of durable facilities upon, under, or over the ground. This shall include, but is not limited to buildings, roadways and utility pipes, lines, poles or other structures.

Contingent Bid Item: This is a minor bid item which is likely, but not certain, to occur during the course of work. If the Engineer determines that this work is required, the Contractor will accomplish the work and payment will be made based on the contingent unit bid price included in the proposal. Since the quantity listed in the proposal is primarily for bid comparison, the amount of work required by the Engineer may vary materially from this.

Contract: The written instrument executed by the Contractor and the Contracting Agency by which the Contractor is bound to furnish all labor, equipment, and materials and to perform the work specified, and by which the Contracting Agency is obligated to compensate the Contractor therefore at the prices set forth therein. The Contract Documents are herewith by reference made a part of the contract as if fully set forth therein.

Contract Documents: All the integral documents of the contract, including but not limited to, Call for Bids, Plans, Standard Specifications and Details, Special Provisions, Proposal, Addenda, Performance Bond, Payment Bond, Certificates of Insurance, Ordinance, Contract, and Change Orders.

Contracting Agency: The legal entity that has contracted for the performance of the work or for whom the work is being performed.

Contractor: The individual, firm, partnership, corporation or combination thereof entering into a contract with the Contracting Agency to perform the advertised work.

Council: The City Council which by law constitutes the Legislative Department of the City.

County: Maricopa County, organized and existing under and by virtue of the laws of the State of Arizona.

Culvert: Any structure not classified as a bridge, which provides an opening under or adjacent to the roadway.

Days: Unless otherwise designated, days will be understood to mean calendar days.

Emergency: Unforeseen occurrences and combinations of circumstances involving the public welfare or the protection of work already done under the Contract Documents, or which endanger life or property and call for immediate action or remedy.

Engineer: The person, appointed as City or County Engineer by the Council or the Board of Supervisors, acting directly or through his duly authorized representative.

SECTION 101

Equipment: (Construction) — All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of work. (Installed) — All material or articles used in equipping a facility as furnishings or apparatus to fulfill a functional design.

Extra Work: An item of work not provided for in the contract as awarded but found essential to the satisfactory completion of the contract within its intended scope.

Final Backfill: The material placed in a trench above the initial backfill to the top of the trench or to the bottom of the road base material.

Flooding: Flooding will consist of the inundation of the entire lift with water, puddle with poles or bars to insure saturation of the entire lift.

Force Account Work: Work done by personnel of the Contracting Agency as in-house work.

Foundation: For buildings or structures, this will be the substructure. For a trench, the foundation is the bottom of the required trench excavation. The foundation surface is either native material, or replacement material when unsuitable material occurs, and is removed and replaced at the bottom of the required trench excavation.

Full Depth Pavement: An asphalt concrete pavement structure in which the granular base and subbase are replaced by proportionate thicknesses of asphalt concrete.

Haunching: The area of a pipe trench between the bottom of the pipe and the springline of the pipe.

Improvement District Project: A project financed by assessments against the property included in a special assessment district authorized under, or implemented by an act of the legislature of the State and/or a procedural ordinance of the City or County.

Initial Backfill: The material placed in a trench between the springline and 12 inches above the crown of the conduit.

Inspector: The Engineer's authorized representative assigned to make detailed inspections of contract performance.

Jetting: Jetting is the densification of material, using a continuous supply of water, under pressure, transmitted to the material through a rigid pipe of sufficient length to reach the bottom of the lift being densified. In all cases, the entire lift will be completely saturated working from the top to the bottom.

Laboratory: The established materials testing laboratory of the Contracting Agency's Engineering Department, or other laboratories acceptable to and/or authorized by the Engineer to test materials and work involved in the Contract.

Major Item: A major item shall be the total of any item of work and/or materials specified in the bid schedule that exceeds the amount established in Table [109-1](#).

Materials: Any substance specified in the project, equipment and other material used or consumed in the performance of the work.

Median: The portion of a divided highway separating the roadways used by traffic going in opposite directions.

Non Pay Item: An item of work for which no separate payment will be made under the proposal, but which must be included as an incidental cost for payment on an associated item included in the proposal.

Notice of Award: A letter from the City or County Clerk advising the Contractor that he is the successful bidder and the Council or Board of Supervisors has accepted his proposal.

Notice to Proceed: A directive issued by the Engineer, authorizing the Contractor to start the work or improvements required in the Contract.

SECTION 101

Obligee: One to whom another is obligated.

Open Trench: The excavated area shall be considered as open trench until all the aggregate base course for pavement replacement has been placed and compacted or, if outside of a pavement area, until the excavated area is brought to finish grade or natural grade.

Owner: The City or County, acting through its legally constituted officials, officers or employees.

Pavement: Any surfacing of streets, alleys, sidewalks, courts, driveways, etc., consisting of mineral aggregate bound into a rigid or semi-rigid mass by a suitable binder such as, but not limited to, Portland cement or asphalt cement.

Pavement Structure: The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

Pay Item: A detail of work for which separate payments are to be made under the Contract, as specified in the proposal.

Payment Bond: The security provided by the Contractor solely for the protection of claimants, supplying labor and materials to the Contractor or his Subcontractors.

Performance Bond: The security provided by the Contractor solely for the protection of the Contracting Agency and conditioned upon the faithful performance of the contract in accordance with the plans, specifications and conditions thereof.

Permit: The license to do construction in public rights-of-way and/or easements; issued by an Agency to a Contractor working for another party.

Pipe Embedment Zone: The area of a trench consisting of the bedding, haunching, and initial backfill areas.

Plans: All approved drawings or reproductions thereof pertaining to the work and details therefore, which are made a part of the Contract Documents.

Plant: The Contractor's and/or subcontractor's facilities, including but not limited to small tools and mobile equipment, located on and/or offsite, necessary for preparation of materials and prosecution of work for the project.

Principal: The individual, firm or corporation primarily liable on an obligation, as distinguished from a surety.

Professional Engineer: A person who has a current engineering registration granted by the Arizona State Board of Technical Registration in one or more branches of engineering recognized by the board.

Profile Grade: The trace of a vertical plan intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

Project: A specific coordinated construction or similar undertaking identified by a single project number and bid and awarded as one contract. On occasion two or more projects may be bid and awarded as a single contract.

Proposal: The offer of a bidder on the prescribed form, to perform the work and to furnish the labor and materials at the prices quoted.

Proposal Form: The approved form on which the Contracting Agency requires bids to be prepared and submitted for the work.

Proposal Guarantee: The security furnished with a bid to guarantee that the bidder will enter into the contract if his bid is accepted.

Proposal Pamphlet: The book or pamphlet pertaining to a specific project, containing proposal forms, special provisions and other information necessary for and pertinent to the preparation of the proposal or bid.

Referred Documents: On all work authorized by the Contracting Agency, any referenced documents in the specification, i.e., Bulletins, Standards, Rules, Methods of Analysis or test. Codes and Specifications of other Agencies, Engineering Societies or Industrial Associations, refer to the Latest Edition thereof, including Amendments, which are in effect and published at the time

SECTION 101

of Advertising for Bids or the issuing of a permit for the work, unless otherwise stated.

Right-of-way: A general term denoting land, property, or interest therein, usually in a strip acquired for or devoted to a street, highway, or other public improvement.

Road: A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

Roadside: A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

Roadside Development: Those items necessary to the complete roadway which provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the roadway.

Roadway: The portion of the right-of-way intended primarily for vehicular traffic, and including all appurtenant structures and other features necessary for proper drainage and protection. Where curbs exist, it is that portion of roadway between the faces of the curbs.

Sewers: Conduits and related appurtenances employed to collect and carry off water and waste matter to a suitable point of final discharge.

Shop Drawings: Drawings or reproduction of drawings, detailing; fabrication and erection of structural elements, falsework and forming for structures, fabrication of reinforcing steel, installed equipment and installation of systems, or any other supplementary plans or similar data, which the Contractor is required to submit for approval.

Shoulder: The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

Sidewalk: That portion of the roadway primarily constructed for the use of pedestrians.

Special Provisions: The special conditions, requirements, additions, and/or revisions to the Standard Specifications, applicable to the work, to cover conditions or requirements peculiar to the project under consideration.

Specifications: The descriptions, directions, provisions, and requirement for performing the work as contained in the Contract Documents.

Standard Details: Uniform detail drawings of structures or devices adopted as Standard Details by the Engineer.

Standard Specifications: Uniform general specifications adopted as Standard Specifications by the Engineer.

Springline: The vertical location having a maximum horizontal dimension or in box sections, the mid-height of the vertical wall.

Storm Drain: Any conduit and appurtenance intended for the reception and transfer of storm water.

Street: Streets, avenues, alleys, highways, crossings, lanes, intersections, courts, places, and grounds now open or dedicated or hereafter opened or dedicated to public use and public ways.

Structures: Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, end walls, sewers, service pipes underdrains foundation drains, fences, swimming pools, and other features which may be encountered in the work and not otherwise classed herein.

Subbase: The lower course of the base of a roadway, immediately above the subgrade.

SECTION 101

Subcontractors: Those having direct contracts with the Contractor and those who furnish material worked into a special design according to the Plans and Specifications for the work, but not those who merely furnish material not so worked.

Subgrade: The supporting structures on which the pavement and its special undercourses rest.

Substructure: All of that part of the structure or building below the bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames, together with the backwalls, wingwalls and wing protection railings.

Superintendent: The Contractor's authorized representative in responsible charge of the work.

Superintendent of Streets: The person duly appointed by the Council of the Contracting Agency, as provided by the Arizona Revised Statutes.

Superpave Mix: Asphalt mix in compliance with the Gyrotory Mix design requirements of Section 710.3.2.2.

Superstructure: The entire structure or building except the substructure.

Supplemental Specifications: Additions and revisions to the Standard Specifications that are adopted subsequent to issuance of the printed book.

Supplementary General Conditions: Requirements, or revisions, to the Standard General Conditions, applicable to the work, and to cover conditions or requirements peculiar to the project under consideration.

Surety: The individual, firm or corporation, bound with and for the Contractor for the acceptable performance, execution, and completion of the work, and for the satisfaction of all obligations incurred.

Surface Course: The finished or wearing course of an asphalt concrete pavement structure.

Title or Headings: The titles or headings of the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

Township, City, Town or District: A subdivision of the County used to designate or identify the location of the proposed work.

Traveled Way: The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

“Underground Facility”: means any item which shall be buried or placed below ground for use in connection with the storage or conveyance of water, sewage, electronic, telephone or telegraphic communications, electric energy, oil, gas or other substances, and shall include, but not be limited to pipes, sewers, conduits, cables, valves, lines, wires, manholes, attachments and those portions of poles and their attachments below ground.

Utility: Pipe lines, conduits, ducts, transmission lines, overhead or underground wires, railroads, storm drains, sanitary sewers, irrigation facilities, street lighting, traffic signals, and fire alarm systems, and appurtenances of public utilities and those of private industry, businesses or individuals solely for their own use or use of their customers which are operated or maintained in, on, under, over or across public right-of-way or public or private easement.

Waterworks (Water Supply System): The reservoirs, pipe lines, wells, pumping equipment, purification works, mains, service pipes, and all related appliances and appurtenances utilized in the procurement, transportation and delivery of an adequate, safe, and palatable water supply for the Contracting Agency.

Work: Any or all of the improvements mentioned and authorized to be made, and the construction, demolition, reconstruction, and repair of all or any portion of such improvements, and all labor, services, incidental expenses, and material necessary or incidental thereto.

Working Day: A calendar day, exclusive of Saturdays, Sundays, and Contracting Agency recognized legal holidays, on which weather and other conditions not under the control of the Contractor will permit construction operations to proceed for the

SECTION 101

major part of the day with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time.

101.3 In order to avoid cumbersome and confusing repetition of expressions in these specifications, it is provided that whenever anything is, or is to be, done, if, as, or, when, or where contemplated required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected, or condemned, it shall be understood as if the expression were followed by the words by the Engineer or to the Engineer.

- End of Section -

SECTION 102

BIDDING REQUIREMENTS AND CONDITIONS

102.1 ELIGIBILITY AND PREFERENCE:

The employment of Contractors and Subcontractors on Public Works shall be governed by the provisions of Section 34-241 of the Arizona Revised Statutes.

102.2 CONTENTS OF PROPOSAL PAMPHLET:

The prospective bidder may examine and/or purchase plans, special provisions, and proposal pamphlets at the Engineering Office of the Contracting Agency advertising for bids.

The proposal pamphlet will state the location of the contemplated construction; give the description of the various quantities of work to be performed or materials to be furnished, and have a bid schedule of pay items for which unit bid prices are invited. In addition, it will state the form and amount of the proposal guarantee, the time in which the work shall be completed and include additional instructions not included in these specifications.

The plans, the standard specifications, the standard details, the special provisions, the contracting agency's supplements and all supplementary documents are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In a case of a discrepancy or conflict, the order in which the various documents shall govern is as follows from highest to lowest: addenda, special provisions, plans, agency's supplements to the standard specifications, agency's supplements to the standard details, standard specifications and standard details.

Each and every provision of law and clause required by law to be inserted in the contract shall be deemed to be inserted herein, and the contract shall be read and enforced as though it were included herein.

102.3 INTERPRETATION OF QUANTITIES IN PROPOSAL:

The quantities appearing in the proposal are approximate only and are to be used for the comparison of bids. Payment to the Contractor will be made only for the actual quantities of work performed and accepted or materials furnished in accordance with the contract at the unit bid price in the proposal.

After the contract is awarded the quantities of work listed by any pay item, or all pay items, may be increased or decreased a reasonable amount at the discretion of the Contracting Agency, without in any way invalidating the unit bid price.

102.4 EXAMINATION OF PLANS, SPECIAL PROVISIONS AND SITE OF WORK:

The Contracting Agency will prepare plans and special provisions in accordance with acceptable engineering standards, giving such direction as will enable any competent Contractor to carry them out.

The bidder shall examine the site of the proposed work and all documents pertaining to the work. It is mutually agreed that the submission of a proposal shall be considered prima facie evidence that the bidder has made such examination and is familiar with the character, quality and quantity of the work to be performed and material to be furnished.

Logs of the test holes, ground water levels, and any accompanying soil reports as furnished by the Contracting Agency are furnished for general information only. The field condition so set forth shall not constitute a representation or warranty expressed or implied that such conditions are actually existent. Bidders shall make their own investigations and form their own estimates of the site conditions.

After the submission of the proposal, no complaint or claim that there was any misunderstanding as to the quantities, conditions or nature of the work will be entertained.

SECTION 102

102.5 PREPARATION OF PROPOSAL:

The bidder shall submit his proposal on the forms obtained from the Contracting Agency. The bidder shall specify a unit bid price and extension in words, figures or both, whichever is required, for each pay item where units and approximate quantities are given.

The proposal total will be obtained by adding the extension amount or lump sum indicated for the individual pay items. If there is a conflict between words and figures, the words shall apply. If there is a conflict between the unit bid price and the extension for a particular pay item, the unit bid price shall govern. In either case, the Contracting Agency shall correct the discrepancy in accordance with the above procedure and the corrected proposal total will apply.

In addition, the following shall be completed by the bidder on the proposal:

(A) Acknowledge receipt of and agree that the proposal is based on the listed Addenda received with and/or after receipt of the proposal pamphlet.

(B) Note the bidders Arizona State Contractor's License number and classification.

(C) Signatures in ink and attested or witnessed as applicable.

102.6 SUBCONTRACTORS LIST:

When required, the List of Subcontractors form will be attached to the proposal pamphlet. The bidder shall submit this form with his proposal, in a separate sealed envelope, listing the firm name and business address of each specialty subcontractor to whom he proposes to subcontract any portion of the work. Only one name shall be listed for each category.

The bidder may list himself to perform one or more of the listed categories of work for which he has any requisite State licenses when required.

102.7 IRREGULAR PROPOSALS:

Proposals will be considered irregular and may be rejected for the following reasons:

(A) If the proposal is on a form other than that furnished by the Contracting Agency; or if the form is altered or any part thereof is detached.

(B) If there are unauthorized additions, statements, conditional or alternate bids, or irregularities of any kind.

(C) If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.

(D) If the proposal does not contain a unit price for each pay item listed except in the case of authorized alternate pay items.

(E) If, when required, the bidder fails to accomplish and submit the List of Subcontractors form.

102.8 PROPOSAL GUARANTEES

No proposal will be read unless accompanied by a proposal guarantee in the proper amount and in the form provided in the proposal pamphlet. The guarantee shall be made payable and acceptable to the Contracting Agency as a guarantee that the bidder, if awarded the contract, will execute the contract documents and furnish the required bonds and certificates of insurance to be forfeited if the Contractor fails or refuses to enter into a contract as required by the bid documents.

The proposal guarantee shall be in the form of a certified check, cashier's check, or surety bond for ten percent of the amount of the bid. The surety bond shall be executed solely by a surety company or companies holding a certificate of authority to

SECTION 102

Transact surety business in the State of Arizona issued by the Director of the Department of Insurance. The surety bond shall not be executed by an individual surety or sureties. In addition, said company or companies shall be rated "Best A-" or better as required by the Contracting Agency, as currently listed in the most recent Best Key Guide, published by the A.M. Best Company.

102.9 SUBMISSION OF PROPOSAL:

The proposal and proposal guarantee shall be submitted in a sealed envelope. The outside, lower right-hand corner of which shall be marked as follows:

Bid of _____, Contractor
For _____
_____ Project No. _____ Contracting Agency

Envelopes shall be mailed or delivered to the office of the Contracting Agency, and must be received before the time and date specified in the Call for Bids or any Addenda.

Proposals received after the time and date specified will be returned, unopened, to the bidder.

102.10 WITHDRAWAL OR REVISION OF PROPOSAL:

Any bidder may withdraw or revise a proposal after it has been deposited with the Contracting Agency, provided his request is received by the Contracting Agency, in writing or by telegram, before the time specified for opening proposals or as stipulated herein.

102.11 PUBLIC OPENING OF PROPOSALS:

Proposals will be opened and read publicly at the time and place specified in the Call for Bids or any Addenda. Bidders, their authorized agents and other interested parties are invited to be present.

When proposals for more than one project are to be opened at the same time, any bidder may, after the time set for the opening proposals, request to withdraw his second or succeeding proposal prior to the opening of proposals for that project. Should this occur, there will be a brief delay in the opening of proposals to permit the bidder to submit his request. Upon receipt of the bidder's written request, by the Contracting Agency, his proposal will be returned unopened.

102.12 DISQUALIFICATION OF BIDDERS:

Either of the following reasons may be considered as being sufficient for the disqualification of a bidder and the rejection of his proposal:

(A) Receipt of more than one proposal for the same work from an individual, partnership or corporation under the same or different names.

(B) Evidence of collusion among bidders or assistance from any officer of the Contracting Agency, or of any Department thereof.

102.13 SUCCESSFUL BIDDERS:

Unless otherwise specified in the proposal pamphlet, the successful bidder may obtain 7 sets of plans and special provisions, for the project from the Contracting Agency, at no cost.

- End of Section -

SECTION 103

AWARD AND EXECUTION OF CONTRACT

103.1 CONSIDERATION OF PROPOSALS:

After the proposals, for the contemplated work, have been opened and read as provided in these specifications, the respective totals will be checked and compared by the Contracting Agency. The basis of comparison will be to verify the accuracy of the total proposal by checking the extensions and additions. In the event of a discrepancy, in the amount bid for a pay item, the unit bid price will govern unless obviously in error. The results of such comparison will be considered public information.

The right is reserved to award the contract to the lowest and/or best responsible bidder, or to reject all proposals and to readvertise for any reason the Contracting Agency determines.

In case all proposals are rejected, any subsequent changes, additions, addenda, or new sets of plans and special provisions will be provided to all purchasers of the first issue of the plans and special provisions at no additional charge, except that out-of-town bidders will pay shipping charges.

103.2 RETURN OF PROPOSAL GUARANTEE:

All proposal guarantees, except those of: the two lowest responsible bidders on Bond Issue and Budget Projects; the lowest responsible bidder or the lowest responsible bidders of alternative plans and specifications on Improvement District Projects, will be returned immediately following the opening and checking of proposals. The retained proposal guarantee or guarantees will be returned immediately after the contract documents have been executed by all parties.

103.3 AWARD OF CONTRACT:

The Contracting Agency, through its duly authorized body or agent will award the contract to the lowest and/or best responsible bidder, or all proposals will be rejected, as soon as practicable after the date of opening proposals.

No proposal shall be withdrawn for a period of 50 days after opening without consent of the Contracting Agency through the body or agent duly authorized to accept or reject the proposal except that in the case of Federally-assisted projects, or other projects award of which is conditioned on the approval of an agency not under the control of the Contracting Agency, withdrawal shall be made within a period of 50 days after opening without such consent.

If written notice of the acceptance of a proposal is delivered to the successful bidder within the times noted above, or at any time thereafter before such proposal has been withdrawn, the bidder shall execute and deliver a contract in the prescribed form, within 10 days after receipt of such notice or his proposal guarantee shall be forfeited as provided elsewhere herein. Concurrently with the contract, the Contractor shall submit all documentation required to enable the agency to execute the contract.

The successful bidder will be furnished a Notice of Award on:

(A) Bond Issue or Budget Projects by letter, to the address shown on the proposal.

(B) Improvement District Projects by publication in accordance with the requirements of Arizona Revised Statutes, Section 9-681.

103.4 CANCELLATION OF AWARD:

The Contracting Agency reserves the right to cancel the award of any contract at any time before the execution of said contract by all parties, without any liability against the Contracting Agency.

103.5 REQUIREMENT OF CONTRACT BONDS:

Concurrently with the submittal of the contract, the Contractor shall furnish the Contracting Agency the following bonds, which shall become binding upon the award of the contract to the Contractor.

SECTION 103

(A) A Performance Bond in an amount equal to the full contract amount conditioned upon the faithful performance of the contract in accordance with plans, specifications and conditions thereof. Such bond shall be solely for the protection of the Contracting Agency awarding the contract.

(B) A Payment Bond in an amount equal to the full contract amount solely for the protection of claimants supplying labor or materials to the Contractor or his Subcontractors in the prosecution of the work provided for in such contract.

Each such bond shall include a provision allowing the prevailing party in a suit on such bond to recover as a part of his judgment such reasonable attorney's fees as may be fixed by a judge of the court.

Each such bond shall be executed by a surety company or companies holding a certificate of authority to transact surety business in the State of Arizona issued by the Director of the Department of Insurance. The bonds shall not be executed by an individual surety or sureties. The bonds shall be made payable and acceptable to the Contracting Agency. The bonds shall be written or countersigned by an authorized representative of the surety who is either a resident of the State of Arizona or whose principal office is maintained in this State, as by law required, and the bonds shall have attached thereto a certified copy of Power of Attorney of the signing official. In addition, said company or companies shall be rated "Best A-" or better as required by the Contracting Agency, as currently listed in the most recent Best Key Rating Guide, published by the A.M. Best Company.

103.6 CONTRACTOR'S INSURANCE:

103.6.1 General: The Contractor shall agree to carry all insurance which may be required by Federal and State Laws, County and City Ordinances, Regulations and Codes. Neither the Contractor nor any subcontractor shall commence work under a contract until the Contracting Agency has approved the insurance. The entire project covered by the contract will be at the Contractor's risk until final acceptance by the Contracting Agency.

Concurrently with the submittal of the contract, the Contractor shall furnish the Contracting Agency the following:

(A) **Public Liability and Property Damage Insurance:** The Contractor shall provide and maintain, during the life of the contract, General Liability, Automobile Liability, and Worker's Compensation Insurance as follows:

INSURANCE

MINIMUM LIMITS OF LIABILITY

GENERAL LIABILITY	\$1,000,000 Combined Single Limit —
Comprehensive Form	
Premises/Operations	
Underground Explosion	
and Collapse Hazard	
Exclusions Deleted	
(where applicable)	
Products/Completed	
Operations	
Contractual	
Independent Contractors	
(OCP)	
Broad Form Property Damage	
Personal Injury with Exclusion	
"C" Deleted	

SECTION 103

AUTOMOBILE LIABILITY	\$1,000,000 Combined Single Limit
Owned	
Hired	
Non-Owned	
EXCESS LIABILITY	As required
Umbrella Form	
WORKER'S COMPENSATION & EMPLOYERS' LIABILITY	Statutory Limits
BUILDER RISK/COURSE OF CONSTRUCTION	As required

The Contracting Agency shall have no responsibility or liability for such insurance coverage.

The Contractor shall furnish a Certificate of Insurance on a form approved by the Contracting Agency. The Certificate shall be issued by an insurance company authorized to transact business in the State of Arizona, or be named on the list of Unauthorized Insurers maintained by the Arizona Department of Insurance. Insurance coverage shall not expire until all the work has been completed and the project has been accepted by the Contracting Agency. If an insurance policy does expire during the life of the contract, the Contractor shall provide a renewal certificate of the required insurance coverage to the Contracting Agency not less than thirty (30) days prior to the expiration date.

(B) Worker's Compensation and Employer's Liability: A Letter of Certification, from the Industrial Commission of Arizona, that the Contractor is insured by the State Compensation Fund or is an authorized self-insurer or a Certificate of Insurance issued by an insurance company authorized by the Arizona Department of Insurance to provide Workmen's Compensation and Employer's Liability Insurance in the State of Arizona.

(C) Builders Risk/Course of Construction: When the project includes construction of a new building or addition to an existing building, the Contractor shall also obtain insurance coverage for at least, as a minimum, the perils of fire, extended coverage, vandalism and malicious mischief for the full amount of the contract. The Contractor shall be responsible for any deductibles, mutual waiver of subrogation and any co-insurance for the construction that is the subject of this contract.

(D) Additional Insured: The Contracting Agency, its officers, agents and employees shall be named as insurers on policies listed in (A) and (C) and this shall also be indicated on the Certificates of Insurance issued to the Contracting Agency. The Contractor's coverage shall be primary for any and all losses arising out of the performance of this contract.

(E) Owner Protective Policy: In addition to other insurance the Contractor is required herein to provide and maintain in its own name, the Contractor shall also provide and maintain a separate policy of insurance, at its sole cost and expense, naming the Contracting Agency as the insured and providing primary coverage for the Contracting Agency in an amount not less than One Million Dollars, or other minimum amount determined by the Agency, for personal injury or death, per person and per occurrence, and not less than \$500,000 for property damage for any damage or injury suffered as a result of any work performed by Contractor or its employees, representatives, contractors or subcontractors in connection with the Project or Permit. Such policy shall also provide the Contracting Agency coverage, in the amounts specified above, for any and all damages or injury suffered as a result of alleged acts or omissions of the Contracting Agency in connection with, directly or indirectly, the Project or Permit. Such policy shall be primary and not contributory to any insurance maintained by the Contracting Agency. The insurance company writing such policy must have a BEST rating of not less than "A-" and be licensed by the Arizona Department of Insurance to do business in the State of Arizona. The form of the policy must be approved by the Contracting Agency before the notice to proceed will be issued.

103.6.2 Indemnification of the Contracting Agency Against Liability: To the fullest extent permitted by law, the Contractor, its successors, assigns and guarantors, shall pay, defend, indemnify and hold harmless the Agency, its agents, representatives, officers, directors, officials and employees from and against all allegations, demands, proceedings, suits, actions, claims, damages, losses, expenses, including but not limited to, attorney fees, court costs, and the cost of appellate proceedings, all claim adjusting and handling expense, related to, arising from or out of or resulting from any actions, acts, errors, mistakes or omissions caused in whole or part by the Contractor relating to work or services in the performance of the

SECTION 103

Contract, including but not limited to, any Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable and any injury or damages claimed by any of the Contractor's and Subcontractor's employees.

103.7 EXECUTION AND APPROVAL OF CONTRACT:

The Contractor shall execute the contract with the Contracting Agency as follows:

(A) Bond Issue or Budget Projects within 10 calendar days after the date of Notice of Award of contract from the Contracting Agency.

(B) Improvement District Projects, not less than 15 or more than 20 calendar days after the date of the first publication of Notice of Award, if no objections have been filed.

The Contracting Agency will approve and execute the contract within 10 calendar days following receipt of signed contract and acceptable bonds and certificates of insurance.

No contract shall be considered in effect until it has been fully executed by all parties concerned.

Information relative to the execution of contract documents may be obtained from the Engineering Office of the Contracting Agency advertising for bids.

103.8 FORFEITURE OF PROPOSAL GUARANTEES:

If the Contractor fails or refuses to enter into the contract, within the time stated, then the Contracting Agency may declare a forfeiture of his proposal guarantee as liquidated damages for failure to enter into the contract.

- End of Section -

SECTION 104

SCOPE OF WORK

104.1 WORK TO BE DONE:

104.1.1 General: The Contractor shall perform all work as may be necessary to complete the contract in a satisfactory and acceptable manner in full compliance with the plans, specifications and terms of the contract.

In the event a conflict exists between Contract Documents the order of precedence listed in descending order shall be as follows:

- Change Orders
- Addenda
- Special Provisions
- Project Plans
- Contracting Agency's supplements to the MAG Uniform Standard Specifications and Details
- MAG Uniform Standard Specifications
- MAG Standard Details

Unless otherwise specified in the special provisions, The Contractor shall furnish all labor, materials, equipment, transportation, utilities, services and facilities required to perform all work for the construction of the project within the time specified.

104.1.2 Maintenance of Traffic: The Contractor's operations shall be in accordance with the traffic manual and/or policies of the appropriate public agency having jurisdiction over the project and Section [401](#). These operations shall cause no unnecessary inconvenience to the public and public access rights shall be considered at all times. Unless otherwise authorized in the specifications or on a temporary basis by the Engineer, traffic shall be permitted to pass through the work area. The Contractor shall coordinate with the various agencies both commercial and public, involved in the collection and removal of trash and garbage, so that adequate services are maintained.

Safe and adequate pedestrian and vehicular access shall be provided and maintained to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, motel, hospitals, fire stations, police stations, and establishments of a similar nature. Access to residential properties shall be in accordance with Section [107](#).

Grading operations, roadway excavation and fill construction shall be conducted and maintained in such a manner as to provide a reasonably satisfactory and safe surface for vehicular and pedestrian traffic. When rough grading is completed, the roadbed shall be brought to and maintained in a reasonably smooth condition, satisfactory and safe for vehicular traffic at the posted speed limit. Pedestrian walkways shall be provided and maintained in a like manner. The Contractor shall accomplish any additional grading operations and/or repairs, including barricade replacement or repairs during working and nonworking periods which, in the opinion of the Engineer, are required.

In the event of abnormal weather conditions, such as windstorms, rainstorms, etc., the Contractor shall immediately inspect his work area and take all necessary actions to insure that public access and safety are maintained.

The Contractor shall provide the Engineer with the emergency address of his representatives as required by Section [105](#).

104.1.3 Water Supply:

Water shall consist of providing a water supply sufficient for the needs of the project and the hauling and applying of all water required.

The Contractor shall make arrangements for and provide all necessary water for his construction operation and domestic use at his own expense.

SECTION 104

If the Contractor purchases water from a water utility at a fire hydrant on or near the project, all arrangements shall be made by him at his own expense and payment made direct to the water utility as agreed upon.

The Contractor shall use only those hydrants designated by the water utility in charge of water distribution and in strict accordance with its requirements for hydrant use.

The Contractor shall furnish all connections, wrenches, valves and small tools that may be necessary to meet the requirements of the water utility pertaining to hydrant use.

The tank truck and/or trailer shall meet all safety and licensing regulations and the water shall be applied by sprinkling with tank trucks equipped with spray bars and suitable apparatus.

No measurement will be made of water, unless otherwise provided for in the special provisions or proposal.

The cost of watering will be included in the proposal price for the construction operation to which such watering is incidental or appurtenant.

104.1.4 Cleanup and Dust Control: Throughout all phases of construction, including suspension of work, and until final acceptance of the project, the Contractor shall keep the work area clean and free from rubbish, excess materials and debris generated by Construction Activities.

At disposal sites and storage sites, other than agency landfills, the Contractor shall be responsible for all required dust control measures. This includes temporary yard or staging areas.

The Contractor shall take whatever steps, procedures or means required preventing any dust nuisance due to his construction operations. The dust control measures shall be maintained at all times to the satisfaction of the Engineer and in accordance with the requirements of the Maricopa County Bureau of Air Pollution Control Rules and Regulations.

Failure of the Contractor to comply with the Engineer's cleanup orders may result in an order to suspend work until the condition is corrected. No additional compensation or time will be allowed as a result of such suspension and the Engineer has the authority to take such other measures as may be necessary to remedy the situation. Subsection [104.2.5](#) applies.

104.1.5 Final Cleaning Up: Before final acceptance, all private or public property and grounds occupied by the Contractor in connection with the work shall be cleaned of all rubbish, excess materials, temporary structures and equipment, and all parts of the work area shall be left in an acceptable condition.

104.2 ALTERATION OF WORK:

***104.2.1 By the Contracting Agency:** The Contracting Agency reserves the right to make, at any time during the progress of the work, such alterations in the details of construction and such increases or decreases in quantities as may be found necessary or desirable. Such alterations and changes shall not invalidate the contract nor release the surety and the Contractor agrees to perform the work as altered, the same as if it had been a part of the original contract. The Engineer will issue Change Orders to cover unforeseen circumstances which make it impossible to carry out the work in accordance with the original contract plans and specifications.

If the alterations or changes made by the Contracting Agency increases or decreases the total cost of the contract or the total cost of any major item by more than 20 percent, either party may request an adjustment in payment in accordance with Section [109](#).

104.2.2 Due to Physical Conditions:

*(A) Should the Contractor encounter or discover during the process of the work, subsurface or latent physical conditions at the site differing materially from those indicated in the contract, or unknown physical conditions at the site of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract, the Engineer shall be promptly notified in writing of such conditions before they are disturbed. The Engineer will thereupon promptly investigate the conditions and, if he finds they do so materially differ and cause an increase or decrease

*Not applicable to Improvement District Projects.

SECTION 104

in the cost of or the time required for performance of the contract, an equitable adjustment will be made and the contract modified in writing accordingly.

*(B) If at the time of opening up any portion of the work, material from which the subgrade, backfill or bedding is to be constructed contains an excess of moisture so that the required compaction cannot be obtained without additional manipulation, the Engineer will determine the cause of such condition. If the cause of such condition is determined to have been unforeseeable and beyond the control of and without fault or negligence of the Contractor, the Engineer will determine whether the material shall be aerated or removed and replaced. Such work shall be done as directed and will be paid for as provided in Section [109](#).

*(C) Failure to notify the Engineer of the conditions described in A and B above prior to doing any work may be just cause to reject any claims for additional monies and/or time.

*(D) Material in ditches and ditch banks that contains moisture in an amount considered excessive by the Engineer shall be removed and shall be aerated to the extent required by the Engineer before compaction is affected. No measurement or direct payment for the removal and aeration of such material will be made.

*(E) After any portion of the work has been opened up, saturation of material caused by irrigation water, storm drainage, weather or such similar causes will be considered as within the responsibility of the Contractor.

***104.2.3 Due to Extra Work:** The Contractor shall perform unforeseen work, for which there is no unit bid price in the proposal, whenever it is deemed necessary or desirable by the Engineer in order to fully complete the work as contemplated. Such work shall be governed by all applicable provisions of the contract documents and payment will be made in accordance with the provisions set forth in Section [109](#).

Should the Contractor claim that any instructions received involve extra work under the contract, he shall give the Engineer written notice within two work days after receipt of such instructions, and in any event before proceeding to execute the work, except in emergencies endangering life or property. No claim shall be valid unless written notice is given.

If this extra work is performed by others, the Contractor agrees to cooperate fully with the other source accomplishing this work and agrees that this action shall not invalidate the Contract or release the surety.

104.2.4 At the Contractor's Request: Changes in the plans or specifications, which do not materially affect and are not detrimental to the work or to the interests of the Contracting Agency, may be granted to facilitate the work. Requests shall be in writing and submitted to the Engineer for approval. These changes, if approved and when resulting in a saving to the Contractor, will be made at an equitable reduction in cost or in no case at any additional cost to the Contracting Agency.

104.2.5 Due to the Failure of the Contractor to Properly Maintain the Project:

(A) If the Contractor fails to provide adequate Maintenance of Traffic or Cleanup and Dust Control or to correct deficiencies resulting from abnormal weather conditions, the Engineer has the authority to suspend the work wholly or in part until this condition has been corrected.

(B) If the Contractor fails to comply with the Engineer's written order to provide adequate maintenance of traffic, cleanup, dust control, or to correct deficiencies resulting from abnormal weather conditions, the Engineer has the authority to have this work accomplished by other sources.

(C) The Contractor agrees to cooperate fully with the other source accomplishing this work and agrees that this action shall not invalidate the Contract or release the surety.

- End of Section -

SECTION 105

CONTROL OF WORK

105.1 AUTHORITY OF THE ENGINEER:

The Engineer will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions which may arise as to the interpretation of the plans and specifications; all questions as to the acceptable fulfillment of the contract on the part of the Contractor. The Engineer's estimates and decisions shall be final and conclusive. In case any question should arise, relative to the Contract Documents, the determination or decision of the Engineer shall be a condition precedent to the right of the Contractor to receive final approval of the work being questioned under the contract.

In giving instructions, the Engineer may make minor changes in the work, not involving extra work and not inconsistent with the purpose of the work, except in emergencies endangering life or property.

The Engineer will suspend the work wholly or in part due to the failure of the Contractor; to correct conditions unsafe for the workmen or the general public; for failure to carry out provisions of the contract; for failure to carry out orders; for such periods as he may deem necessary due to unsuitable weather; for conditions considered unsuitable for the prosecution of the work or for any other condition or reason deemed to be in the public interest.

105.2 PLANS AND SHOP DRAWINGS:

The Contractor shall submit, for review, a proposed schedule of shop drawings and product data submittals. This schedule will include concrete and asphalt concrete mix designs unless they are previously approved supplier's mix design. The schedule will show the needed response date for each submittal and will indicate the relationship of the submittal to the project construction schedule.

Shop drawings for major temporary support structures such as falsework, shoring, soldier piles, and other major temporary structures that facilitate construction shall be prepared by and bear the seal and signature of a Professional Engineer. Temporary support structures for Minor Structures as defined in Section [505.1.1](#) are exempt from this requirement.

The Contractor shall submit five (5) copies of each shop drawing, product data or mix design to the Engineer for review. Each submittal shall be numbered sequentially and shall be submitted in accordance with the schedule established in conjunction with the Contracting Agency so as to cause no delay in the work schedule. The Contractor shall certify, by stamp or letter, that he has reviewed and approved the submittal and that it conforms to the requirements of the contract documents. If this certification is not included, the submittal will be returned without action.

At the time of each submittal, the Contractor shall define and delineate in writing, separate from the certification, any deviations from the contract documents. If the Engineer accepts this deviation, he will authorize the deviation by issuing a change order or if the deviation is minor by endorsement to the letter.

The Engineer will review and return the submittals in accordance with the previously established response date. The review will be only for conformance with the design concept of the work and for compliance with the information contained in the contract documents. The review of a specified item, as such, will not indicate review of the assembly in which the item functions. Review by the Engineer will not relieve the Contractor from responsibility for any errors or omissions in the submittals nor from his responsibility for complying with the contract documents. The only exception is deviations accepted in accordance with the preceding paragraph.

If the submittal is acceptable, one (1) copy with each page stamped "Furnish as Submitted" will be returned to the Contractor. The Contractor shall submit additional copies (as required) to the Engineer.

If the Engineer determines that the submittal requires corrections or is to be rejected, one (1) copy stamped "Furnish as Noted" or "Revise and Resubmit" will be returned to the Contractor. The Contractor will submit five (5) corrected or new copies.

The copy stamped "Furnish as Submitted," returned to the Contractor, will become a part of the contract documents and will be kept at the job site. Any work done prior to the receipt of this review will be at the Contractor's risk and expense.

SECTION 105

105.3 CONFORMITY WITH PLANS AND SPECIFICATIONS:

All work performed and all materials furnished shall be in conformity with the lines, elevations, grades, cross-sections, dimensions and material requirements, including tolerances, shown on the plans or indicated in the specifications.

In the event the Engineer finds the materials or the finished product in which the materials are used not in conformity with the plans and specifications, but that reasonably acceptable work has been produced, he shall then make a determination if the work shall be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials as he deems necessary to conform to his determination based on engineering judgment.

In the event the Engineer finds the materials or the finished product in which the materials are used or the work performed are not in conformity with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by the Contractor at no additional cost to the Contracting Agency.

In all instances wherein the items and/or specifications require installation or construction in accordance with either manufacturers' or suppliers' recommendations and/or instructions, said recommendations and/or instructions shall be submitted with the applicable portion clearly marked for approval prior to the commencement of work on that item or portions of the contract.

105.4 COORDINATION OF PLANS AND SPECIFICATIONS:

The Contractor shall take no advantage of any apparent error or omission in the plans or specifications. In the event the Contractor discovers such an error or omission, he shall immediately notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications.

105.5 COOPERATION OF CONTRACTOR:

The Contractor will be supplied with a minimum of seven sets of approved plans and special provisions, one set of which the Contractor shall keep available on the work site at all times.

The Contractor shall give the work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the Engineer, his inspectors, and other Contractors in every way possible.

The Contractor shall at all times be present at the work in person or represented by a competent superintendent. The superintendent shall be authorized to receive and fulfill instructions from the Engineer and who shall supervise and direct the work. No less than fourteen days prior to the scheduled/planned Notice to Proceed, the Contractor shall submit to the Engineer for review and approval, the name and qualifications of the proposed superintendent. When the superintendent is approved, he shall not be changed by the Contractor without written approval of the Engineer. Instructions and information given by the Engineer to the Contractor's superintendent shall be considered as having been given to the Contractor.

(A) All phases of the project such as concrete work, pipe work, etc., shall be under the direct supervision of a foreman or his designated representative on the site who shall have authority to accept instructions, with respect to that particular phase of the project, and take action required to properly carry out the work.

(B) In the event of noncompliance with the above, the Engineer may require the Contractor to stop work on that part of the project until the required supervision is present.

The Contractor shall file with the Engineer, the names, addresses, and telephone numbers of representatives who can be contacted, at any time, in case of emergency. These representatives must be fully authorized and equipped to correct unsafe or excessively inconvenient conditions on short notice.

SECTION 105

Emergencies may arise during the progress of the work which may require special effort or require extra shifts of men to continue the work beyond normal working hours. The Contractor shall be prepared in case of such emergencies from whatever cause, to do all necessary work promptly.

105.6 COOPERATION WITH UTILITIES:

The Contracting Agency will notify all utility companies, all pipe line owners, or other parties affected, and endeavor to have all necessary adjustments of the public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction, made as soon as practicable.

The Contractor shall comply with the requirements of Arizona Revised Statutes-40-360.21 through 40-360.29 (one call system, Blue Stake) in notification to the interested utility owners prior to start of construction. The Contractor shall resolve all problems with the utility owners concerned.

Where water user's association facilities obstruct construction of the work, the Contractor shall contact officials of the association relative to the shutdown of irrigation water and shall acquaint himself with and conform to the requirements of the association.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cableways, signals and all other utility appurtenances within the limits of the proposed construction which are to be relocated or adjusted are to be moved by the owners at their expense except as otherwise provided for in the special provisions or as noted on the plans. In the event an existing service is found to be in a materially different location than shown on the plans and requires additional or more costly work on the part of the Contractor, the procedures in Section [104](#), will apply.

It is understood and agreed that the Contractor has considered in his proposal all of the permanent and temporary utility appurtenances in their present or relocated positions as shown on the plans and that no additional compensation will be allowed for any delays, inconvenience, or damage sustained by him due to any interference from the said utility appurtenance or the operation of moving them. If delays are encountered because utility owners have not relocated or adjusted their facilities, the contract time will be adjusted in accordance with Section [108](#).

It shall be the responsibility of the Contractor to ascertain the need for bracing or shoring of utility poles during the construction of the project and no additional compensation will be allowed for such bracing or shoring.

In general, the contract will indicate various utility items, certain of which are to be relocated or adjusted by the utility owner and others by the Contractor. Any work performed by the Contractor for any utility company, separate from the contract shall be paid for by the utility company and will not be a part of the agency contract.

105.6.1 Notifications Requirement in the Event of Any Damage to or Dislocation of Underground Facilities: In the event of any damage to or dislocation of any underground facility, the Contractor responsible for the excavation operation shall immediately notify the owner of such facility and shall not attempt to repair any facility, except those intended for the conveyance or storage of water and sewage. The excavation shall be left open until the arrival of representatives of the owner. The owner will dispatch its representative promptly to examine the underground facility and, if necessary, make repairs.

105.6.2 Work Within a Railroad Right of Way: When a railroad right of way is included in the work, the Contractor shall:

(A) Comply with the rules and regulations of the railroad company relative to the required manner of constructing said portion of the work; and shall perform the work so as not to endanger or interfere with the safe operation of the track(s) and property of the railroad company and of the traffic moving on such track(s).

(B) Carry the kinds and amounts of insurance and bonds required by the railroad company for the period of time in which work is performed on or adjacent to the railroad company's property, and until such work has been satisfactorily completed and all tools, equipment and materials have been removed from the railroad company's property and such property is left in a clean and presentable condition.

SECTION 105

(C) Contact the railroad company at least 48 hours in advance of performing any construction within the right of way of any track(s).

105.7 COOPERATION BETWEEN CONTRACTORS:

The Contracting Agency reserves the right at any time to contract for and perform other or additional work on or near the work covered by the contract.

When separate contracts are let within the limits of any one project, each Contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the Contracting Agency from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by him because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. He shall join his work with that of others in an acceptable manner and shall perform it in proper sequence to that of the others.

The Contracting Agency will not honor any claim for extra compensation due to delays, extra work, or extension of time caused by any other Contractors working within the limits of the same project.

105.8 CONSTRUCTION STAKES, LINES AND GRADES:

The Engineer will set construction stakes establishing lines and grades for road work, curbs, gutters, sidewalks, structures and centerlines for utilities and necessary appurtenances as he may deem necessary, he will furnish the Contractor with all necessary information relating to the lines and grades. These stakes and marks shall constitute the field control by and in accordance with which the Contractor shall establish other necessary controls and perform the work.

The Contractor shall perform the work in accordance with the Engineer's stakes and marks, and shall be charged with full responsibility for conformity and agreement of the work with such stakes and marks.

The Contractor shall be held responsible for the preservation of all stakes and marks, and if the construction stakes or marks have been carelessly or willfully destroyed or disturbed by the Contractor, the cost for replacing them will be charged against him and will be deducted from the payment for the work.

The Contractor shall give notice to the Engineer not less than two working days in advance of when he will require survey services in connection with any portion of the work.

The Contractor shall set the construction stakes for buildings establishing lines, grades, and elevations to include necessary utilities and appurtenances and shall be responsible for their conformance with plans and specifications. The Engineer will establish or designate a control line or bench mark of known location and elevation for use as a reference.

105.9 DUTIES OF INSPECTOR:

The Engineer may provide the Inspector, assistants, and other field staff to assist the Engineer in observing performance of the work of the Contractor. Through onsite observations of the work in progress and field checks of materials and equipment, the Inspector shall endeavor to provide further protection for the Contracting Agency against defects and deficiencies in the work of the Contractor; but, the furnishing of such services will not make the Inspector responsible for or give the Inspector control over construction means, methods, techniques, sequences, or procedures or for safety precautions or programs, or responsibility for the Contractor's failure to perform the work in accordance with the contract documents.

SECTION 105

Inspectors employed by the Contracting Agency will be authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector will not be authorized to alter or waive the provisions of the contract. The inspector will not be authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

The inspector will, however, have the authority to reject work or materials until any questions at issue can be referred to and decided by the Engineer.

105.10 INSPECTION OF WORK:

Inspection of the work by the Engineer or his authorized representative shall not be considered as direct control of the individual workman and his work. The direct control shall be solely the responsibility of the Contractor's foreman and superintendent.

The Engineer shall be permitted to inspect all materials, and each part or detail of the work at any time for the purpose of expediting and facilitating the progress of the work. He shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

Any work done or materials used without supervision and inspection by an authorized Contracting Agency representative may be ordered removed and replaced at no additional cost to the Contracting Agency. Failure to reject any defective work or materials shall not in any way prevent later rejection when such defect is discovered nor obligate the Engineer to final acceptance.

When any unit of government or political subdivision is to pay a portion of the cost of the work covered by the contract, its representatives shall have the right to inspect the work. Such inspection shall in no sense make any unit of government or political subdivision a party to the contract, and shall in no way interfere with the rights of either party to the contract.

105.11 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK:

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner.

No work shall be done without lines and grades having been given by the Engineer. Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans, or as given, or any extra work done without authority, will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at no additional cost to the Contracting Agency.

105.12 MAINTENANCE DURING CONSTRUCTION:

The Contractor shall maintain the work during construction and until the project is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces to the end so that the roadway or structures are kept in satisfactory conditions at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations. All cost of maintenance work during construction and before the project is accepted shall be included in the unit bid price on the various pay items.

105.13 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE:

If the Contractor, at any time, fails to perform maintenance during construction, the Engineer will immediately notify the Contractor of such noncompliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Engineer may immediately proceed to maintain the project. The entire cost of this maintenance will be deducted from monies due or to become due the Contractor on his contract.

SECTION 105

105.14 PARTIAL USE OR OCCUPANCY:

Should an urgent or unforeseen need occur, the Contractor agrees to let the Contracting Agency use or occupy a unit or portion of the project, such as a structure, utility service, or a section of road or pavement, prior to final acceptance.

Prior to such use or occupancy the Contracting Agency will prepare a written agreement with the Contractor and accomplish a partial acceptance inspection. The written agreement will include a revised construction schedule, responsibilities for maintenance of the partial acceptance and continued construction of the original project to final acceptance, payments, insurance and bond requirements.

105.15 ACCEPTANCE:

(A) Partial Acceptance: If at any time during the prosecution of the project the Contractor substantially completes a unit or portion of the project, such as a structure, utility service, or a section of road or pavement, he may request the Engineer to make final inspection of that work. If the Engineer finds, upon inspection, that the work has been satisfactorily completed in compliance with the contract he may accept the work as being completed and the Contractor may be relieved of further responsibility for that work. Such partial acceptance shall in no way void or alter any terms of the contract.

(B) Final Acceptance: Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer will make an inspection. If all construction provided for and contemplated by the contract is found completed to his satisfaction, the inspection shall constitute the final inspection and the Engineer will make the final acceptance. The Contractor will be notified in writing of this acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed. In such event, the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of the final inspection.

- End of Section -

SECTION 106

CONTROL OF MATERIALS

106.1 SOURCE OF MATERIALS AND QUALITY:

All construction materials to be used on the work or incorporated into the work, equipment, plant, tools, appliances or methods to be used on the work shall be subject to the inspection and approval or rejection of the Engineer.

The materials used on the work shall meet all quality requirements of the contract. In order to expedite the inspection and testing of materials, the Contractor shall notify the Engineer of his proposed source of materials prior to delivery. At the option of the Engineer, materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce specified products the Contractor shall furnish materials from other sources.

Unless otherwise noted, all materials used in the project shall be new and unused. Additionally, any new materials used in this project that are damaged during the construction of the project and prior to final acceptance, as determined by the Engineer, shall be replaced by the Contractor with new material at no additional cost to the Contracting Agency.

106.2 SAMPLES AND TESTS OF MATERIALS:

All materials to be incorporated in the work may be subject to sampling, testing and approval, and samples furnished shall be representative of the materials to be used. The Engineer may select samples, or may require that samples be delivered by the Contractor to a laboratory designated by the Engineer.

The Contracting Agency will pay for the initial or normal test required by the Engineer to guard against unsuitable materials or defective workmanship. Additional tests, required due to failure of the initial or normal test(s), shall be paid for by the Contractor. The Engineer will designate the laboratory which will accomplish the additional test(s).

The procedures and methods used to sample and test materials will be determined by the Engineer. Unless otherwise specified, samples and tests will be made in accordance with either: the Materials Testing Manual of the Contracting Agency; the standard methods of AASHTO or ASTM, which were in effect and published at the time of advertising for bids.

The laboratory responsible for the test shall furnish at least one copy of the test results to the Contracting Agency or his designated representative, to the Contractor, and to the appropriate material supplier.

With respect to certain manufactured materials, the Engineer may permit the use of some materials prior to sampling and testing provided they are delivered with either a certificate of compliance or analysis or both, stating that the materials comply in all respects with the requirements of the specifications. These certificates shall be furnished in triplicate and clearly identify each delivery of materials to the work area. The certificates shall be signed by a person having legal authority to bind the supplier or manufacturer.

106.3 PLANT INSPECTION:

The Engineer may undertake the inspection of materials at the source. In this event, the following conditions shall be met:

(A) The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom he has contracted for materials.

(B) The Engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.

It is understood that the Contracting Agency reserves the right to retest all materials, prior to their use in the work, upon delivery.

SECTION 106

106.4 TRADE NAMES AND SUBSTITUTIONS:

Plans and specifications may contain references to equipment, materials or patented processes by manufacturer, trade name, make or catalog number. Unless the name is followed by words indicating that no substitution is permitted, such references shall be regarded as establishing a standard of quality, finish, appearance, performance or, as indicated, a selection based upon compatibility with existing equipment or materials.

The use of an alternate or substitute item or source may be permitted, subject to the following:

- (A) No consideration will be given to a substitution prior to the award of the contract.
- (B) Only substitutions submitted by the Contractor will be accepted for review. The substitution shall be submitted in writing to the Engineer.
- (C) The submittal shall certify that the substitution will perform the functions and achieve the results called for by the general design, be similar and of equal substance, and be suited to the same use as that specified.
- (D) The submittal shall state any required changes in the contract documents to adapt the design to the proposed substitution. This will include all changes required of other contractors/subcontractors affected by the resulting changes.
- (E) The submittal shall contain an itemized estimate of all costs and credits that will result directly or indirectly from the acceptance of such substitution, including costs of design, license fees, royalties, testing, Engineer's evaluation, claims of other contractors/subcontractors, etc. Also, the submittal shall include any adjustment in the contract time created by the substitution.
- (F) The Contractor, on request of the Engineer, shall submit samples or any additional information the Engineer may deem necessary to evaluate the acceptability of the substitution. The Engineer will evaluate the information provided, perform tests when necessary and make comparisons. The Engineer will then make the final decision as to the acceptability of the proposed substitution. The Contractor will be notified in writing by the Engineer as to whether his substitution has been accepted or rejected.
- (G) The submittal, for purposes of review, number of copies, etc., shall follow the procedures as outlined in Section [105.2](#), except in the case of response time. If the Engineer does not respond in a timely manner, which in turn, impacts the substitution, the Contractor shall continue to perform the work in accordance with the contract and the substitution will be considered rejected. Also, no adjustment in the contract time will be granted for nonacceptance of the substitution.
- (H) There will be no additional costs to the Contracting Agency for the substitution. If the substitution yields a net savings in the contract price, the amount of savings shall be divided between the Contracting Agency and the Contractor in a percentage established by the Contracting Agency.
- (I) If the substitution is accepted and an adjustment in the contract cost and/or contract time is in order, a change order will be issued to the Contractor for the changes.

106.5 STORAGE OF MATERIALS:

The Contractor shall provide storage facilities and exercise such measures as will insure the preservation of the quality and fitness of all materials and/or equipment to be used in the work. Stored materials and/or equipment, even though approved before storage, may again be inspected prior to their use in the work. Stored items shall be located so as to facilitate their prompt inspection. That portion of the right-of-way and easements not required for public travel may be used for storage purposes, when approved by the Engineer. Any additional storage area as required must be provided by the Contractor. Private property shall not be used for storage purposes without written permission of the owner or lessee. If requested, by the Engineer, copies of such written permission shall be made available.

SECTION 106

106.6 HANDLING MATERIALS:

All materials and/or equipment shall be handled in such a manner as to preserve their quality and fitness for the work.

106.7 UNACCEPTABLE MATERIALS:

All materials and/or equipment not conforming to the requirements of the specifications, whether in place or not, may be rejected. Rejected materials and/or equipment shall be removed immediately from the site of work unless otherwise permitted by the Engineer. No rejected material and/or equipment, the defects of which have been subsequently corrected, shall be used until approved in writing by the Engineer.

106.8 FURNISHED MATERIALS:

Materials and/or equipment, furnished by the Contracting Agency, will be delivered or made available to the Contractor as indicated in the special provisions. The cost of handling and placing shall be considered as included in the contract price for the pay item with which they are used.

The Contractor will be held responsible for all materials and/or equipment accepted by him and will make good any shortages, deficiencies and damages which may occur after such acceptance.

- End of Section -

SECTION 107

LEGAL REGULATIONS AND RESPONSIBILITY TO PUBLIC

107.1 COMPLIANCE WITH LAWS:

The Contractor shall keep fully informed of, observe and comply with all Federal and State laws, County and City ordinances, regulations, codes and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any way affect the conduct of the work. The Contractor warrants that all items supplied and work performed under the contract have been sold, produced, delivered and furnished in strict compliance with all such laws, ordinances, regulations, codes, orders and decrees to which the items, work and Contractor are subject. Upon request, Contractor shall execute and deliver to the Agency such documents as may be required by the Agency to evidence compliance with such laws, ordinances, regulations, codes, orders and decrees. The Contractor shall protect and indemnify the Contracting Agency and its representatives against any claim or liability arising from or based on the violation of such, whether by the Contractor or the Contractor's employees.

107.2 PERMITS:

Permits, bonding and insurance requirements shall be as required by statutes, codes, ordinances or regulations.

The Public Agency, when acting as the Contracting Agency, may obtain some of the required permits. It is the duty of the Contractor to determine that all necessary permits have been obtained. The Contractor shall, at the Contractor's own expense, obtain all the required permits which have not been furnished. The Contractor shall comply with all permit requirements until the Contract is completed or the permit is closed-out or transferred. The Contractor shall be responsible to close out all permits except those authorized by special provision to be transferred.

In all cases, the Contractor or the person supervising the authorized work shall notify the appropriate permit agency so as to insure proper inspection by the agency concerned.

107.3 PATENTED DEVICES, MATERIALS AND PROCESSES:

If the Contractor employs any design, device, material, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner. The Contractor and the surety shall indemnify and save harmless the Contracting Agency, any affected third party or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the Contracting Agency for any costs, expenses, and damages which it may be obligated to pay by reason of any infringement, at any time during the prosecution or after the completion of the work.

107.4 ARCHAEOLOGICAL REPORTS:

Attention is directed to Sections 41-844 and 41-865 Arizona Revised Statutes. In view of the above, it shall be a provision of every contract that when archaeological features are encountered or unearthed in the excavation of material pits or of the roadway prism, or other excavation, the Contractor shall report promptly to the Director of the Arizona State Museum and the Contracting Agency. The Contractor will be allowed extra time as appropriate in accordance with the provisions of Section [108](#).

107.5 SAFETY, HEALTH AND SANITATION PROVISIONS:

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the Arizona State Department of Health or as specified by the Maricopa County Health Department, Sanitary Code.

The Contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions, on his own responsibility or as the Engineer may determine, reasonably necessary to protect the life and the health of employees on the job, the safety of the public and to protect property in connection with the performance of the work covered by the contract.

Precaution shall be exercised by the Contractor at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws, pertaining to such protection including all Federal and State occupational safety and health acts, and standards and regulations promulgated there under.

SECTION 107

107.5.1 Asbestos Materials: If asbestos materials are encountered during any building remodeling/demolition work, the Contractor shall comply fully with the Arizona Administrative Code, A.A.C. R18-2-901 and notify the Engineer. An extension of contract time will be granted for any delay resulting from the asbestos material in accordance with Section [108](#).

107.5.2 Lead-Containing Paint: Paint and similar surface coating materials that contain lead compounds and in which the lead content exceeds 0.06 percent of the total weight of the non-volatile content of the paint or the weight of the dried paint film is declared a banned hazardous product and will not be used (Consumer Product Safety Act Part 1303 dated 9-1-77).

107.6 PUBLIC CONVENIENCE AND SAFETY:

The Contractor shall at all times so conduct his work as to assure the least possible obstruction to traffic and adjacent residents. The safety, convenience, and the protection of persons and property, of the general public and residents along the street, highway, and areas adjacent to the work area shall be provided for by the Contractor.

107.6.1 Contractor's Marshaling Yard: If the Contractor or his subcontractor utilizes property outside the limits of the project in the performance of the contract, the Contractor/subcontractor shall comply with the following:

107.6.1.1 Contractor's Marshaling Yard when the Agency is the Contracting Party:

(A) Prior to occupying the property, the Contractor shall provide written notification as to the number and location of all properties to be used. The notification shall specify in detail how the Contractor proposes to use each property and how he proposes to comply with (B) through (D) below. Also, the Contractor shall provide a statement, signed by the property owner(s), which gives the Contractor permission to use the property.

(B) The property(s) shall be adequately maintained to control dust, mud, trash and other pollutants from leaving the property.

(C) Work on the property(s) shall be scheduled so as to comply with the Agency Noise Ordinance.

(D) Use of the property(s) such as location of stored materials, service of equipment, etc., shall be conducted to minimize impact on adjacent properties.

(E) The Contractor shall leave the property in a condition, as determined by the Engineer, equivalent to that which existed prior to entry. In no case shall any use cause, or allow to remain, any negative impact to adjoining properties or right-of-way unless such impact existed prior to the Contractors' use.

(F) The Contractor shall obtain a written release signed and dated from each property owner after completion of use. Each release shall state that, at the time of signing, the owner accepts the property in its present condition from the Contractor and relieves the Contractor and the Agency from any or all claims for the use or damage to said property. A copy of each release shall be submitted to the Engineer.

(G) This Subsection also applies to all levels of subcontractors who will need to obtain marshaling yards for the project, which will be separate from that of the Contractor. It will be the responsibility of the Contractor to obtain copies of the various documents from the subcontractors, as required above, and provide them to the Engineer.

107.6.1.2 Contractor's Marshaling Yard when the Agency is not the Contracting Party (private development, utility work, subdivision construction, etc): All conditions will apply as in Subsection [107.6.1.1](#) except that the permit holder will be responsible for obtaining all documents. The permit holder will retain the documents and make them available to the Agency upon request.

107.6.2 The Contractor shall comply with the Agency Code concerning work hours and noise level during construction.

107.7 BARRICADES AND WARNING SIGNS:

The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs

SECTION 107

and other traffic control devices, and shall take all necessary precautions for the protection of the work and safety of the public. Roads, partially or fully closed to traffic, shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness. Suitable warning signs shall be provided to properly control and direct traffic.

The Contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road. Such warning signs shall be constructed and erected in accordance with the Traffic Barricade Manual prepared or adopted by the Contracting Agency's Traffic Engineering Department which is hereby made a part of these specifications.

107.8 USE OF EXPLOSIVES:

The use of explosives or blasting agents is controlled by the Uniform Fire Code, which is generally administered by the Fire Department of the Agency. The Contractor shall obtain a special permit from the Agency's Fire Department for the use of explosives. A copy of this permit shall be delivered to the Engineer prior to the use of explosives. If the Agency does not use the Uniform Fire Code or have a department for enforcement of this Code, the Contractor shall use explosives only when authorized in writing by the Engineer. The approval by the Engineer for the use of explosives shall not relieve the Contractor from his responsibilities for proper use and handling of the explosives or for any and all damages resulting from their use.

Explosives shall be transported, stored, handled and used in accordance with the provisions and requirements of all applicable laws, ordinances and regulations. Work shall be done in accordance with recommendations of the AGC Manual of Accident Prevention in Construction, the Institute of Makers of Explosives, and the Occupational Safety and Health Administration Regulations (29 CFR 1926.1(U)). In addition to the applicable regulations, the Contractor shall:

- (A) Exercise the utmost care not to endanger life or damage property.
- (B) Furnish and erect special signs to warn the public of his blasting operations. They shall be located and maintained so as to be clearly evident to the public during all critical periods of blasting operations.
- (C) Notify each public utility company, having structures adjacent to the work, of his intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to advise the Contractor of any precautions that should be taken to protect their structures from damage.
- (D) Make a survey of adjacent properties, before commencing blasting operations, locating on drawings and by photographs all existing cracks and damages to structures. A copy shall be filed with the Engineer, including a report.
- (E) Blasting shall be accomplished in such a manner that nearby buildings, structures, railways, highways, etc. will be safe from rocks and other projectiles. Adequate blasting mats or other means of protection shall be employed when blasting in congested area or close proximity to any of the above improvements. Steel mats shall not be allowed within 2,000 feet of power lines.
- (F) At the time of firing, the Contractor shall station men along the road at sufficient distance from the blasting operation to flag down any vehicles.

The Contracting Agency reserves the right to order the discontinuance of blasting operations at any time.

107.9 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE:

The Contractor shall be responsible for the preservation of all public and private property and shall protect carefully from disturbance or damage all land monuments and property marks until the Engineer has witnessed or otherwise referenced their location and shall not move them until directed.

SECTION 107

The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing the work, or at any time due to defective work or materials, and said responsibility will not be released until the project shall have been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the nonexecution thereof by the Contractor, he shall restore, at no cost to the Contracting Agency, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or he shall make good such damage or injury in an acceptable manner. Such damage will include but not be limited to landscaped areas. The contractor shall regrade the disturbed area as directed and restore the surface material to match existing in type and quality.

When construction is within temporary construction easements, the Contractor shall restore all disturbed areas to a condition equal to or better than the existing improvements. Such restoration will include but not be limited to asphalt, walkways, fences, lights, sprinklers, landscaping, etc. In the case of landscaping, the Contractor may remove and store sod and plant material. If, in the determination of the Engineer, the sod and/or plant material did not survive the transplanting in good condition, the Contractor shall replace the sod and/or plant material to match in type and quality. Also, the Contractor may salvage any sprinkler system materials, lighting materials, etc. In the event that it is not feasible to reinstall the salvaged material, new material shall be installed.

The Contractor shall not dump spoil or waste material on private property without first obtaining from the owner written permission for such dumping. All such dumping shall be in strict conformance with the Grading and Drainage Ordinance of the Contracting Agency.

Access to private property shall be maintained to keep inconvenience to the property owner to a minimum. Prior to any construction in front of driveways the Contractor shall notify the property owner 24 hours in advance. Inconvenience caused by construction across driveways and sidewalks shall be kept to a minimum by restoring the serviceability as soon as possible. If it is necessary to leave open excavation for a long period of time, the Contractor shall provide structurally adequate steel plates to bridge the excavation.

107.10 CONTRACTOR'S RESPONSIBILITY FOR WORK:

The Contractor shall properly guard, protect, and take every precaution necessary against injury or damage to all finished or partially finished work, by the action of the elements or from any other cause until the entire project is completed and accepted by the Engineer. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work before final acceptance at no cost to the Contracting Agency. Partial payment for completed portions of the work shall not release the Contractor from such responsibility.

In case of suspension of the work for any cause whatever, the Contractor shall be responsible for the project and shall take such precautions as may be necessary to prevent damage to the project and shall erect any necessary temporary structures, signs, or other facilities at no cost to the Contracting Agency.

107.11 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES:

At points where the Contractor's operations are adjacent to properties of utility firms or other property, damage to which might result in considerable expense, loss, or inconvenience, work shall not commence until all arrangements necessary for the protection thereof have been made.

The Contractor shall cooperate with the owners of any underground or overhead utilities in their removal and rearrangement operations in order that these operations may progress in a reasonable manner, that duplication of work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted.

If any utility service is interrupted as a result of accidental breakage, the Contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority.

SECTION 107

The Contractor shall expose all underground utilities and structures which might interfere with the construction of the project, in order to permit survey location prior to construction.

The Contractor shall assume full responsibility for damages to any underground facility/utility as a result of failing to obtain information as to its location, failing to excavate in a careful and prudent manner or failing to take measures for protection of the facilities/utilities. The Contractor is liable to the owner of the underground facility/utility for the total cost of the repair.

107.12 FURNISHING RIGHT-OF-WAY:

The Contracting Agency will provide right-of-way and easements for all work in advance of construction. Any exceptions will be indicated in the special provisions.

107.13 PERSONAL LIABILITY OF PUBLIC OFFICIALS:

In carrying out any provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the contract, there shall be no liability upon the Contracting Agency, Engineer, or their authorized representatives, either personally or as officials of the Contracting Agency, it being understood that in all such matters they act solely as agents and representatives of the Contracting Agency.

107.14 NO WAIVER OF LEGAL RIGHTS:

Upon completion of the work, the Contracting Agency will expeditiously make final inspection and notify the Contractor of acceptance. Such final acceptance, however, shall not preclude or stop the Contracting Agency from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Contracting Agency be precluded or stopped from recovering from the Contractor or his surety, or both, such overpayment as it may sustain, or by failure on the part of the Contractor to fulfill his obligations under the contract. A waiver on the part of the Contracting Agency of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the contract and in addition to any specific remedy provided the Contracting Agency in the contract documents, shall be liable to the Contracting Agency for latent defects, fraud or such gross mistakes as may amount to fraud, or as regards the Contracting Agency's rights under any warranty or guaranty or remedy required by law.

- End of Section -

SECTION 108

COMMENCEMENT, PROSECUTION AND PROGRESS

108.1 NOTICE TO PROCEED:

(A) On Bond Issue and Budget Projects, neither the Contractor nor any Subcontractor shall commence work on a project prior to receipt of the written Notice to Proceed from the Contracting Agency. The Contractor shall commence work as soon as practicable after the starting date specified in the Notice to Proceed. All work under the contract shall be completed within the number of calendar days stated in the proposal, plus extensions, beginning with the day following the starting date specified in the Notice to Proceed.

(B) On Improvement District Projects, the Contractor shall commence work within 10 days from the date of execution of the contract with the Contracting Agency. All work under the contract shall be completed within the number of calendar days stated in the proposal, plus any days extended on the contract, beginning with the day following the date of execution of the contract. The time set for completion of the project will be established by the Contracting Agency, in accordance with Arizona Revised Statutes Section 9-683.

The Contractor shall notify the Field Engineering Inspection Section 24 hours in advance of the time and place where work will begin and the Survey Section two working days in advance for staking.

108.2 SUBLETTING OF CONTRACT:

The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the contract or contracts, or of his right, title, or interest therein, without written consent of the Contracting Agency.

Subcontracts shall be in accordance with and the Contractor shall be bound by the following provisions:

(A) All subcontracts shall be subject to the approval of the Engineer.

(B) All subcontracts shall be in writing and shall provide that all work to be performed there under shall be performed in accordance with the terms of the contract.

(C) Subcontractors shall conform to the regulations governing employment of labor.

(D) The subcontracting of any portion of the work will in no way release the Contractor of his liability under the contract and bonds.

(E) On all contracts for pipeline construction, roadway construction or roadway maintenance, the Contractor shall perform, with his own organization, work amounting to not less than 50 percent of the total contract cost.

On other types of contracts the individual agency shall determine the percentage or waive this requirement.

108.3 CORRESPONDENCE TO THE CONTRACTOR:

A written notice, to the Contractor from the Contracting Agency, shall be considered delivered and the service thereof completed, when said notice is posted, by certified mail, to the said Contractor at his last given address, or delivered in person to the Contractor or his authorized representative on the work.

108.4 CONTRACTOR'S CONSTRUCTION SCHEDULE:

*For Improvement District Project: The words "superintendent of Streets" will be substituted for the word "Engineer." Any Extension contract time will be determined by the Superintendent of Streets with the consent of the governing body.

SECTION 108

The Contractor, when required, shall furnish the Engineer a construction schedule for his review. The Engineer's review of the Contractor's schedule is for purposes of: (1) the Contracting Agency's staffing the project as may be required; (2) to insure general compliance with the contract documents as it relates to the completion of all work; and (3) to monitor and evaluate the construction status for purposes of approving progress payments. In the event the schedule does not contain sufficient information to meet the above purpose, as determined by the Engineer, the Contractor shall resubmit a new schedule with the additional information requested by the Engineer. The right to determine the sequence of the work is a function vested solely in the Engineer and the construction schedule, when established, shall not be changed without the written consent of the Engineer. The orderly procedure of all work to be performed shall be the full responsibility of the Contractor.

Review of a submitted schedule by the Engineer shall in no way be construed as an affirmation or admission that the schedule is reasonable or workable which responsibilities remain the obligations of the Contractor. When the schedule shows a completion prior to the contract completion date, this extra time between the contract completion date and the scheduled completion date (float), may be used by the Contracting Agency without additional compensation to the Contractor. The Contracting Agency shall not be liable to the Contractor for any damages for delay if the Contractor completes the work prior to expiration of the original Contract completion date or as modified by approved change orders, if any.

108.5 LIMITATION OF OPERATIONS:

The Contractor shall conduct the work at all times in such a manner and sequence that will assure the least interference with traffic and inconvenience to the public. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

All traffic affected by the construction will be regulated in accordance with the current Traffic Barricade Manual prepared or adopted by the Contracting Agency's Traffic Engineering Department.

Except in emergencies endangering life or property, written permission shall be obtained from the Engineer to perform any work after regular working hours, on weekends, or legal holidays. Prior to the start of such work, the Contractor shall arrange with the Engineer for the continuous or periodical inspection of the work, surveys and tests of materials, when necessary.

If, in the opinion of the Engineer, the Contractor has fallen behind the approved progress schedule, the Contractor shall take such steps as may be required by the Engineer, including but not limited to, increasing the number of personnel, shifts, and/or overtime operations, days of work, and/or amount of construction equipment until such time as the work is back on schedule. He shall also submit for approval no later than the time of submittal of the next request for partial payment, such supplementary schedule or schedules as may be deemed necessary to demonstrate the manner in which the approved rate of progress will be regained, all at no additional cost to the Contracting Agency.

108.6 CHARACTER OF WORKMEN; METHODS AND EQUIPMENT:

The Contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by the specifications.

All workmen shall be competent and have sufficient skill, knowledge and experience in their class of work and in the operation of equipment required to perform all work properly and satisfactorily.

Any person employed by the Contractor or any Subcontractor who, in the opinion of the Engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed from the work by the Contractor or Subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the Engineer. The Contractor or Subcontractor shall keep the Contracting Agency harmless from damages or claims for compensation that may occur in the enforcement of this Section.

*For Improvement District Project: The words "superintendent of Streets" will be substituted for the word "Engineer." Any Extension contract time will be determined by the Superintendent of Streets with the consent of the governing body

SECTION 108

Should the Contractor or Subcontractor fail to remove such person as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until such orders are complied with.

All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that it will not damage property adjacent to the work area.

When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed, the Contractor is free to use any methods or equipment that he demonstrates to the satisfaction of the Engineer will accomplish the work in conformity with the requirements of the specifications.

When the specifications state the construction shall be performed by the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than those specified, he may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed to be used and an explanation of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing construction work in conformity with the specifications. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet the specifications, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining construction with the specified methods and equipment. The Contractor shall remove the deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the construction items involved nor in contract time as result of authorizing a change in methods or equipment under these provisions.

108.7 DETERMINATION AND EXTENSION OF CONTRACT TIME:

The number of calendar days allowed for the completion of the work included in the contract will be as stated in the proposal and will be known as the contract time.

When the contract time is on a calendar day basis it shall consist of the number of calendar days specified, including all weekends and legal holidays. All calendar days elapsing between the effective dates of any written notice from the Engineer to suspend work and to resume work following suspensions, not the fault of the Contractor, shall be excluded.

When the contract completion time is a fixed calendar date it shall be the date on which all work on the project shall be completed and meet final inspection.

If the Contractor finds it impossible for reasons beyond his control to complete the work within contract time as specified or as extended, he shall immediately submit a written request to the Engineer for an extension of time setting forth therein the reasons which he believes will justify the granting of his request. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Engineer* finds that the work was delayed because of conditions beyond the control and through no fault of the Contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect the same as though it were the original time for completion.

108.8 GUARANTEE AND WARRANTY PROVISIONS:

The Contractor shall guarantee the work against defective workmanship and materials for a period of one year from the date of its final acceptance under the contract, ordinary wear and tear and unusual abuse or neglect excepted.

Any omission on the part of the Engineer to condemn defective work or materials at the time of construction shall not be deemed an acceptance, and the Contractor will be required to correct defective work or materials at any time before final acceptance and within one year thereafter.

*For Improvement District Project: The words "superintendent of Streets" will be substituted for the word "Engineer." Any Extension contract time will be determined by the Superintendent of Streets with the consent of the governing body

SECTION 108

Should any defects develop within one year from the date of final acceptance due to faults in workmanship or materials the Contractor shall, within 14 calendar days of receipt of written notice from the Contracting Agency begin making the necessary repairs to the satisfaction of the Engineer. Such work shall include the repair or replacement of other work or materials damaged or affected by making the above repairs or corrective work, all at no additional cost to the Contracting Agency.

If defects develop which are determined by the Engineer to be an emergency, the Engineer shall notify the Contractor, via the most expeditious means, regarding the nature and condition of the defects. In turn, the Contractor shall immediately dispatch necessary forces to correct the defect or the emergency condition. If the Contractor, in his initial action, resolves the emergency condition but not the defect, a letter as discussed above will follow and normal procedures for corrections will be employed. If immediate or appropriate action, satisfactory to the Engineer, is not taken by the Contractor, or if the Contractor cannot be contacted, the Engineer will deploy necessary forces to correct and/or secure the deficiency. Costs of the Engineer's action shall be paid by the Contractor and/or his bonding agency. Should it later be determined that the defects requiring such emergency action are not the responsibility of the Contractor, the Contractor will be paid for all costs incurred as a result of these demands in accordance with Subsection [109.5](#). Such action by the Engineer will not relieve the Contractor of the guarantees required by this Section or elsewhere in the Contract Documents.

In case of work, materials, or equipment for which written warranties are required by the special provisions, the Contractor shall provide or secure from the appropriate Subcontractor or supplier such warranties addressed to and in favor of the Contracting Agency and deliver same to the Engineer prior to final acceptance of the work. Delivery of such warranties shall not relieve the Contractor from any obligation assumed under any other provisions of the contract.

The warranties and guarantees provided in this subsection of the contract documents shall be in addition to and not in limitation of any other warranties, guarantees or remedies required by law.

108.9 FAILURE TO COMPLETE ON TIME:

For each and every calendar day that work shall remain incompleted after the time specified for the completion of the work in the proposal, or as adjusted by the Engineer, the sum per calendar day shown in Table [108-1](#), unless otherwise specified in the proposal form, may be deducted from monies due to or to become due to the Contractor, not as a forfeit or penalty but as liquidated damages. This sum is fixed and agreed upon between the parties because the actual loss to the Contracting Agency and to the public caused by delay in completion will be impractical and extremely difficult to ascertain and determine.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time fixed for its completion may have been extended, will in no way operate as a waiver on the part of the Contracting Agency of any of its rights under the contract

TABLE 108-1		
LIQUIDATED DAMAGES		
Original Contract Amount		Daily Charges
From More Than	To and Including	Calendar Day or Fixed Date
\$ 0	\$ 25,000	\$ 210
25,000	50,000	250
50,000	100,000	280
100,000	500,000	430
500,000	1,000,000	570
1,000,000	2,000,000	710
2,000,000	5,000,000	1,070
5,000,000	10,000,000	1,420
10,000,000	—	1,780

SECTION 108

108.10 FORFEITURE AND DEFAULT OF CONTRACT:

It is further agreed to by the Contractor that if he:

- (A) Fails to begin the work under the contract within a reasonable time, or
- (B) Fails to perform the work with sufficient workmen and equipment or with sufficient materials to assure the prompt completion of said work, or
- (C) Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or
- (D) Discontinues the prosecution of the work, or
- (E) Fails to resume work which has been discontinued within a reasonable time after notice to do so, or
- (F) At any time colluded with any party or parties, or
- (G) Allows any final judgment to stand against him unsatisfied for a period of 14 calendar days, or
- (H) For any cause whatsoever, fails to carry on the work in an acceptable manner, the Engineer will give notice in writing to the Contractor and his surety of such delay, neglect, or default, and advise them that the work must be resumed immediately.

If the Contractor or surety, within a period of 14 calendar days after such notice, has not proceeded in accordance therewith, then the Contracting Agency will, upon written notification from the Engineer of the fact of such delay, neglect or default and the Contractor's failure to comply with such notice, have full power and authority without violating the contract, to take the prosecution of the work out of the hands of the Contractor. The Contracting Agency may appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of said contract in an acceptable manner.

All costs and charges incurred by the Contracting Agency, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due said Contractor. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the Contracting Agency the amount of such excess.

*108.11 TERMINATION OF CONTRACT

The Contracting Agency may terminate the contract or a portion thereof if conditions encountered during the progress of the work make it impossible or impracticable to proceed with the work or a local or national emergency exists.

When contracts, or any portion thereof, are terminated before completion of all work in the contract, adjustments in the amount bid for the pay items will be made on the actual quantity of work performed and accepted, or as mutually agreed for pay items of work partially completed or not started. No claim for loss of anticipated profits will be considered.

Termination of the contract or any portion thereof shall not relieve the Contractor of his responsibilities for the completed work nor the surety of its obligation for and concerning any just claims arising out of the work performed.

- End of Section -

*For Improvement District Project: The words "superintendent of Streets" will be substituted for the word "Engineer." Any Extension contract time will be determined by the Superintendent of Streets with the consent of the governing body

SECTION 109

MEASUREMENTS AND PAYMENTS

109.1 MEASUREMENT OF QUANTITIES:

All work completed under the contract will be measured by the Engineer according to United States standard measures. The methods of measurement and computation to be used in determination of quantities of materials furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice. A station, when used as a definition or term of measurement, will be 100 linear feet.

Unless otherwise specified, longitudinal measurements will be made along the grade line.

Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the Engineer.

The term ton will mean the short ton consisting of 2,000 pounds avoirdupois.

Unless otherwise specified, structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

In computing volumes of excavations or fill, the average end area method or other acceptable methods as determined by the Engineer will be used.

Volumes will be computed at 60 F, using ASTM D1250 for asphalt or ASTM D633 for tars.

Lumber will be measured by the thousand board foot measure actually used in the work. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term lump sum, when used as a pay item, will mean complete payment for the work described.

Sundry items which have a basis for measurement and payment herein and which are incidental to or required in the construction of the work but are not included as items in the fee schedule shall be considered an integral part of the contract, and all labor, materials, etc. required for such items shall be furnished by the Contractor and the cost of same included in the unit price.

Where the units of measurement shown on the proposal form or the methods of measurement specified in the project special provisions differ from the measurement and payment provisions of the Uniform Standard Specifications, the project documents shall have precedence.

109.2 SCOPE OF PAYMENT:

Measurement and payment for pay items in the proposal will be as indicated in the applicable standard specification or in the special provisions.

When payment is specified to be made on the basis of weight, the weighing shall be done by a licensed public weighmaster or the weighmaster's deputy on a device licensed or certified as defined by Arizona Revised Statutes Section 41-2091 and 41-2093. The Contractor shall furnish the Engineer with duplicate Weighmaster's Certificates showing the actual net weights together with the information required by the rules adopted by the Department of Weights and Measures as authorized by Arizona Revised Statutes Section 41-2065. The Contractor shall furnish the Engineer with duplicate Weighmaster's Certificates at the time of delivery unless the Engineer designates a different submittal time. The Contracting Agency will accept the certificates as evidence of the weight delivered.

Payment for the various items in the proposal will be made at the unit price in the proposal, and shall be compensation in full for furnishing all labor, materials, equipment and appurtenances necessary to complete the work in a satisfactory manner as shown on the plans and as required in the specifications, with all connections, testing, and related work completed. Each item, fixture, piece of equipment, etc., shall be complete with all necessary connections and appurtenances, for the satisfactory use and

SECTION 109

operation of said item. No additional payment will be made for work related to any item unless specifically called for in the proposal. This compensation shall also cover all risk, loss, damage or expense of whatever character arising out of the nature of the work or the prosecution thereof, subject to the provisions of Section [107](#).

The unit prices shall include all costs for salaries and wages, all payroll additives to cover employee benefits, allowances for vacation and sick leave, company portion of employee insurance, social and retirement benefits, all payroll taxes, contributions and benefits imposed by any applicable law or regulation and any other direct or indirect payroll-related costs. The unit prices shall also include all costs for indirect charges, overhead, mileage, travel time, subsistence, materials, freight charges for materials to Contractor's facility or project site, equipment rental, consumables, tools, insurance costs, all applicable taxes and fees, as well as Contractor's fee and profit. The unit prices shall further include all site clean-up costs, hauling of construction debris, and proper disposal in accordance with all laws and regulations and the project plans and specifications.

Payment will be made for only those items listed in the proposal. All materials and work necessary for completion of the project are included in proposal items. Work or materials not specifically identified by a proposal item are considered as included in the unit price of related proposal items.

Unless otherwise specified, payment will not be made for unused materials.

109.2.1 Taxes and Fees: Taxes are deemed to include all sales, use, consumer and other taxes that are legally enacted at the time of submittal of the project fee proposal, whether or not they are yet effective or merely scheduled to go into effect. Any such taxes shall be paid by Contractor and shall be included in the unit prices.

The Contractor shall also be responsible to contact all municipalities and other governmental agencies having jurisdictional authority over the project or the project area to determine if they will charge the Contractor other fees (e.g., permit fees) for the project work. Unless otherwise specified in the project documents or on the proposal form, the Contractor shall include the cost of such fees in the unit prices on the proposal form.

109.3 ASSIGNMENT OF PAYMENTS:

The Contractor shall not assign payments of a contract or any portion thereof without approval of surety and written consent of the Contracting Agency.

Claims for monies due or to become due the Contractor may be assigned to a bank, trust company, or other financing institution, and may thereafter be further assigned and reassigned to any such institution. Any such assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in such financing. Any assignment of money shall be subject to all proper setoffs and withholdings in favor of the Contracting Agency and to all deductions provided for in these specifications.

109.4 COMPENSATION FOR ALTERATION OF WORK:

All compensation due the Contractor for alteration of work shall be documented by a Change Order. Except in emergency situations or as otherwise directed by the Engineer, the Contractor shall not proceed with Change Order work until said Change Order has been approved by the Agency.

***109.4.1 By The Contracting Agency:**

(A) For a decrease greater than 20 percent in either the total cost of the contract or the total cost of a major item and when a reasonable cost analysis supports an increase in the pro rata share of fixed cost chargeable to this item in total, an increase adjustment in the monies due the Contractor may be made. This adjusted compensation will not exceed 80 percent of the

*Not applicable to Improvement District Projects

SECTION 109

original lump sum contract amount or, if for a unit price item, the adjustment will not exceed 80 percent of the original extended unit price. This does not apply to items labeled as contingent items in the proposal.

(B) For an increase greater than 20 percent in either the total cost of the contract or the total cost of a major item, any adjustment made will only apply to that cost in excess of 120 percent of the original total cost of the contract or, in the case of a major item, in excess of 120 percent of the original proposed extended unit price. If either party presents a reasonable cost analysis that shows a change in the pro rata share of fixed costs chargeable to this item in total, an increase or decrease adjustment will be made. This increase or decrease adjustment will be made on such basis as is necessary to cover a reasonable estimate of cost, plus an allowance, not to exceed 15 percent, for overhead and profit. If the parties are unable to reach an agreement, the Engineer has the authority to order the excess work done on an actual cost basis as specified in Section [109.5](#).

(C) For either an increase or decrease in cost, no claim shall be made by the Contractor for any loss of anticipated profits.

***109.4.2 Due to Physical Conditions:**

(A) If the Engineer, after his investigation of the site conditions, agrees that they materially differ from those indicated in the contract and would cause an increase in the Contractor's cost of accomplishing the work, new unit prices or a lump sum cost (for the additional work only) may be negotiated. If the parties are unable to reach an agreement on price, the Engineer has the authority to order this additional work accomplished on an actual cost basis as specified in Section 109.5.

(B) If the Engineer, after his investigation of the site conditions, finds that these conditions do not materially differ from those indicated in the contract, he has the authority to order the work to be accomplished at the original price(s).

***109.4.3 Due to Extra Work:** If the Contractor can present valid, factual evidence, satisfactory to the Engineer, that the work in question is an item not provided for in the contract as awarded then a unit price or lump sum cost, for this item only, may be negotiated. If the parties are unable to reach an agreement on price or cost, the Engineer has the authority to order the extra work accomplished on an actual cost basis as specified in Section [109.5](#).

109.4.4 Made at the Contractor's Request: Any alterations, if approved, will be a reduction in cost or at no additional cost to the Contracting Agency.

109.4.5 Due to Failure of Contractor to Properly Maintain the Project:

(A) For any suspension of work during normal working hours due to failure of the Contractor to properly maintain the project, there will be no additional compensation or time allowed.

(B) If the Engineer provides the Contractor with a written order to provide adequate maintenance of traffic, adequate cleanup, and adequate dust control or to correct deficiencies resulting from abnormal weather conditions and the Contractor fails to comply in the time frame specified, the Contracting Agency may have the work accomplished by other sources. The Contracting Agency will deduct the cost of accomplishing the work from monies due or to become due to the Contractor. Computation of the cost will be in accordance with Section [109.5.4.2](#).

109.4.6 Allowable Mark-Ups: Only the allowable mark-ups as defined in Section [109.5](#) shall be allowed. Additional compensation for other items, including extended overhead and conditions, shall not be considered or allowed.

***109.5 ACTUAL COST WORK:**

The compensation for actual cost work performed by the Contractor (Subcontractor) shall be determined by the Engineer in the following manner.

*Not applicable to Improvement District Projects

SECTION 109

109.5.1 Equipment: For all equipment, the use of which has been authorized by the Engineer, except for small tools and manual equipment, the Contractor will be paid in accordance with the latest Schedule of Equipment Rates used by the Arizona Department of Transportation. Payment for equipment will be made following the calculations in Section [109](#) of the Arizona Department of Transportation Standard Specifications for Road and Bridge Construction. The value of 0.933 shall be used for the adjustment factor F used in the rental rate formulas ($F = 0.933$).

109.5.2 Material: For all material, accepted by the Engineer and used in the work, the Contractor will be paid the actual cost of such material including transportation cost, to which total cost will be added a sum equal to 15 percent thereof.

109.5.3 Labor: For all labor and for the foreman, when he is in direct charge of the operation, the Contractor will be paid:

(A) The actual wages paid plus the current percentage thereof as determined by the Arizona Department of Transportation which is deemed to cover the Contractor's cost incurred as a result of payment imposed by State or Federal Law and payments that are made to, or on behalf of, the workman other than the actual wage. Actual wage is defined as the required current hourly rate paid to the labor classification concerned and does not include any fringe benefits or dislocation allowances. If the Contractor is not required to pay fringe benefits equivalent to the Current rates published in the Federal Register, an equitable deduction will be made from the current percentage established by the Arizona Department of Transportation.

(B) For the first \$50,000 of labor cost computed under paragraph (A) above, the Contractor will be paid an amount equal to (15) fifteen percent for overhead and profit.

(C) For all labor cost computed under paragraph (A) above, in excess of \$50,000 but not exceeding \$100,000, the Contractor will be paid an amount equal to (12) twelve percent for overhead and profit.

(D) For any labor cost computed under paragraph (A) above in excess of \$100,000 the Contractor will be paid an amount equal to (10) ten percent for overhead and profit.

109.5.4 Work Performed by Subcontractors or Other Sources:

109.5.4.1 Work Performed by Subcontractors: If it is determined by the Engineer that portions of the Actual Cost Work to be performed requires specialized labor or equipment not normally used by the Contractor and such work is then authorized to be performed by a subcontractor(s), the subcontractor(s) will be paid by the Contractor in accordance with the actual cost work procedures outlined herein. The Contractor will be paid by the Contracting Agency the full amount of the subcontract plus the following percentages for administration and supervision.

(A) For the first \$10,000 accumulated total of all change order work performed by subcontractors (less mark-up for overhead and profit), the Contractor will be paid an amount equal to 10 percent of the accumulated total for administration and supervision. If the accumulated total is \$3,000 or less, the Contractor will be paid \$300 for administration and supervision.

(B) For all change order work in excess of \$10,000 accumulated total performed by subcontractors (less mark-up for overhead and profit), the Contractor will be paid an amount equal to five percent of the accumulated total for administration and supervision.

109.5.4.2 Work Performed by Other Sources: If the Contracting Agency has work performed by other sources, in accordance with Section [109.4.5](#) (B), the Contracting Agency will deduct, from monies due or to become due to the Contractor, the full amount of the cost of accomplishing the work by other sources plus the following percentages for administration and supervision:

(A) For the first \$10,000 accumulated total of work performed by other sources, the Contracting Agency will deduct an amount equal to 10 percent of the accumulated total for administration and supervision. If the accumulated total is \$3,000 or less, the Contracting Agency will deduct \$300 for administration and supervision.

*Not applicable to Improvement District Projects

SECTION 109

(B) For all work in excess of \$10,000 accumulated total performed by other sources, the Contracting Agency will deduct an amount equal to 5 percent of the accumulated total for administration and supervision.

109.5.5 Documentation:

(A) Except in emergency situations, the Contracting Agency will not be liable for any Actual Cost Work performed by the Contractor prior to written authorization by the Engineer or prior to full execution of a written agreement by all parties concerned.

(B) Payment for work performed on an actual cost basis will not be made until the Contractor has furnished the Engineer, on forms agreed to by the Contracting Agency, duplicate itemized statements of such work, including subcontractor(s) costs, detailed as follows:

- (1) Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.
- (2) Designation, dates, daily hours, total hours, rental rates and extension for each unit of equipment, and machinery.
- (3) Quantities of material, prices, extension and transportation cost on a daily basis. These charges shall be substantiated by vendor invoices.

(C) The Engineer will compare his records with the statement furnished by the Contractor, resolving any differences and making the required adjustments. This statement when agreed upon and signed by both parties, shall be the basis of payment for the work performed.

109.5.6 Bonds and Insurance: The Contractor shall be paid for the actual cost plus (10%) ten percent for Administrative cost when the Contractor can provide evidence of payment for premiums on required payment and performance bonds, premiums on railroad and/or airport extended liability insurance, and premiums for property damage and/or public liability insurance. No duplication of payment for Contractor's costs included under Section [109.5.3](#) (A) will be allowed.

109.5.7 Authority of Engineer: The Engineer is in charge of Actual Cost Work and has the authority to direct which labor and equipment will be used, to suspend operations, and to refuse to pay for any labor or equipment which he feels is not doing productive work.

109.6 PAYMENT FOR IMPROVEMENT DISTRICT PROJECTS:

Payment to the Contractor shall be made in accordance with ARS Sections 48-523 to 48-613, both inclusive.

As soon as the Contractor has fulfilled his contract, the Superintendent of Streets shall estimate the benefits arising from the work and make assessments to cover the work performed and specified in the contract, including incidental expenses in accordance with ARS Section 48-589.

The Contractor agrees to accept payment in the form of Assessments with attached Warrants and/or Improvement Bonds at the rate of interest declared in the resolution of intention prepared by the Contracting Agency.

***109.7 PAYMENT FOR BOND ISSUE AND BUDGET PROJECTS:**

(A) Partial Payments: The Contracting Agency will make a partial payment to the Contractor on the basis of an estimate prepared by the Contractor or Engineer for work completed through the last day of the preceding calendar month. Payment will be within 14 calendar days after the estimate has been certified and approved by the Engineer and received by the owner.

*Not applicable to Improvement District Projects

SECTION 109

The Contracting Agency will retain 10 percent of all estimates as a guarantee for complete performance of the contract in accordance with Arizona Revised Statutes Section 34-221 or 34-607, unless the Contractor elects to deposit securities in accordance with Arizona Revised Statutes Section 34-221, Paragraph C.5. or 34-607, Paragraph B.5.

When the Contractor is fifty percent completed, one-half of the amount retained shall be paid to the Contractor provided he is making satisfactory progress on the contract and there is no specific cause or claim requiring a greater amount to be retained. After the contract is fifty percent completed, no more than five percent of the amount of any subsequent progress payments made under the contract will be retained providing the Contractor is making satisfactory progress on the project. Except that, if at any time the owner determines satisfactory progress is not being made, ten percent retention shall be reinstated for all progress payments made under the contract subsequent to the determination.

Any material or equipment which will become an integral part of the completed project will be considered for partial payment in the Contractor's monthly progress payments. The intent of making partial payments is to provide the Contractor payment for direct material or equipment purchased. The purpose is to minimize the effect of escalating costs by procuring key materials. It is not the intent to pay for all materials but only those meeting the following conditions.

- (1) A total value of all items requested for payment must be greater than \$20,000. No payment will be processed until the material or equipment has been observed, reviewed or verified by the Contracting Agent representative. Only the material or equipment meeting the requirements of the plans and specifications will be paid. Payment for material or equipment does not constitute final acceptance.
- (2) Materials or equipment must be stored or stockpiled either on site, in a warehouse, or secured storage area. The Contractor assumes all responsibility for protection of these materials or equipment and shall insure them to cover loss or damage to same without additional liability or added costs to the Agency for providing this security, insurance, and storage.
- (3) The Contractor will provide access to the storage area or warehouse upon request of the Contracting Agent's representative for the purpose of verifying the inventory of items paid for under this Section. None of the materials or equipment paid for under this Section will be removed from the storage site until incorporated into the work of the project. The storage site shall be within the general geographical area of the project.
- (4) The Contractor shall provide a paid invoice and/or lien waiver for items paid for under this Section. The Agency will not pay more than the invoice price for the item or items, less retention.
- (5) The Engineer may exclude individual payment requests which in the Engineer's judgment do not warrant storage and prepayment under the intent of this Section.

(B) Final Payment: When the project has been accepted as provided in Section [105](#), and within 30 calendar days after final inspection of the work completed under the contract, the Engineer will render to the Contracting Agency and the Contractor, a final estimate which will show the amount of work performed and accepted under the contract. All prior estimates and partial payments will be subject to correction in the final estimate for payment.

Within sixty (60) calendar days after final acceptance, the Contracting Agency will pay the Contractor all amounts due him under the contract, except that before final payment will be made, the Contractor shall satisfy the Contracting Agency by affidavit that all bills for labor and materials incorporated in the work have been paid. The Contractor's Affidavit may be obtained from the Engineering Office of the Contracting Agency.

If payment will be longer than 60 days after final completion and acceptance, the owner will provide the Contractor specific written findings for reasons justifying the delay in payment.

The acceptance of the project and the making of the final payment shall not constitute a waiver by the Contracting Agency/Owner of any claims arising from faulty or defective work appearing after the completion or from failure of the Contractor to comply with the requirements of the contract documents.

SECTION 109

109.8 PAYMENT FOR DELAY:

The procedures contained in this Section shall not be construed to void any provision of the contract which require notice of delays, provides for negotiation of other procedures for settlement or provide for liquidated damages.

109.8.1 Failure to Locate or Incorrect Location of Utilities: Arizona Revised Statutes 40-360.28 indicates that if a person (owner, operator, or agent) fails to locate or incorrectly marks the location of the underground facility in a timely manner, the person (owner, operator, or agent) becomes liable for resulting damages, costs and expense to the injured party.” The Contracting Agency will deny any claims for damages or delays if another owner or operator is at fault.

109.8.2 Contracting Agency Delays: Arizona Revised Statutes 34-221 states “A contract for the procurement of construction shall include a provision which provides for negotiations between the Agent and the Contractor for the recovery of damages related to expenses incurred by the Contractor for a delay for which the Agent is responsible, which is unreasonable under the circumstances and which was not within the contemplation of the parties to the contract.” In this case, if the Contractor sustains damages which could not have been avoided by the judicious handling of forces, equipment and plant or by reasonable revision in the Contractor's schedule of operation, the compensation for such damages will be negotiated. The Contractor shall notify the Engineer of the condition in writing by the next work day. Failure to notify the Engineer within this time may be just cause to reject any claims for such damages.

Compensation for such damages will be negotiated as follows:

(A) The Engineer shall be satisfied that the Contractor has made every reasonable effort to prosecute the work despite any delays encountered or revisions in the Contractor's scheduling of work.

(B) The Compensation paid to the Contractor shall be in accordance with Section [109](#).

109.8.3 Extension of Contract Time: For any such delays, the contract time will be adjusted in accordance with Section [108.7](#).

109.9 DOLLAR VALUE OF MAJOR ITEM:

TABLE 109-1	
DOLLAR VALUE OF MAJOR ITEM	
Original Contract Amount	Dollar Value of Major Item
\$0.00 to \$1,000,000.00	\$50,000 or 10% of original contract amount, whichever is less
\$1,000,000.00 to \$5,000,000.00	5.0% of original contract amount
\$5,000,000.00 or greater	\$250,000.00 or 2.5% of original contract amount, whichever is greater

109.10 PAYMENT FOR MOBILIZATION/DEMobilIZATION:

The Agency will compensate Contractor for a single round trip mobilization/demobilization of Contractor's personnel, equipment, supplies and incidentals, including establishment of offices, buildings and other facilities required for the performance of the work on the project, as well as preparatory work and operations prior to the commencement of the work on the project site.

Mobilization/demobilization will be measured for payment by the lump sum as a single complete unit of work. Payment for mobilization/demobilization will be made at the contract lump sum price. Payment shall be made in equal one-third portions. The first payment will be paid with the Contractor's initial billing. The second payment will be made when the total payments to the Contractor for the pay items, exclusive of payments for mobilization/demobilization, equal greater than one-half of the initial contracted amount, exclusive of mobilization/demobilization. The remaining one-third will be paid as part of the final payment due to the Contractor.

SECTION 109

When other contract items are adjusted as provided in Section [109](#), and if the costs applicable to such items of work include mobilization costs, such mobilization costs will be considered as recovered by Contractor in the lump sum price paid for mobilization, and will be excluded from consideration in determining compensation under Section [109](#).

If the Contractor performs a second or additional mobilization/demobilization of personnel, material and/or equipment at the Engineer's express written request, the Agency will compensate the Contractor for such expenses at the Contractor's actual costs. The Contractor shall provide all documentation for these costs at the request of the Engineer.

For projects that do not list mobilization/demobilization as a pay item, a single round trip mobilization/demobilization shall be considered a non-pay item for said projects, the cost of which shall be spread across other appropriate items. Should a second or additional mobilization/demobilization be required at the Engineer's express written request, compensation for such shall be handled as detailed in the foregoing paragraph.

- End of Section -

SECTION 110

NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION

110.1 GENERAL:

When changes are initiated by the Contracting Agency, or as a result of decisions rendered by the Agency, inaction of the Agency or changed conditions unknown to all parties at the time of bid, the Contractor may request an adjustment to the contract amount and/or contract time. This Section does not preclude the use of legal remedies in the event of claims or litigation brought by third parties. The procedure for this adjustment is a two step process, (1) Initial Notification and Dispute Resolution and (2) Administrative Process for Dispute Resolution, as discussed below:

110.2 INITIAL NOTIFICATION AND DISPUTE RESOLUTION:

110.2.1 Notification: As required by these Specifications or any time the Contractor believes that the action or decision of the Contracting Agency, lack of action by the Contracting Agency, or for some other reason will result in or necessitate the revision of the contract, the Engineer must be notified immediately. If within two working days the identified issue has not been resolved between the Contracting Agency and the Contractor, the Contractor shall provide a written notice. At a minimum, the written notice shall provide a description of the nature of the issue, the time and date the problem was discovered, and if appropriate, the location of the issue. After initial written notice has been provided, the Engineer will proceed in accordance with Subsection [104.2](#). In addition to proceeding in accordance with Subsection [104.2](#), the Contracting Agency and the Contractor must make every effort to resolve the issue identified in the initial notice. Only if the issue cannot be quickly resolved will it be necessary to proceed to the next step in this subsection.

110.2.2 Dispute Resolution: Once the above process has been exhausted or within seven calendar days of the date of the initial written notice, whichever is sooner, the following steps will be taken:

(A) The Contractor shall provide in writing the following information to the Engineer. If known, a cost analysis may be included with the information.

- (1) The date of occurrence and the nature and circumstances of the issue for which initial notice was given.
- (2) Name, title, and activity of each Contracting Agency or all other persons knowledgeable of the issue.
- (3) Identity of any documents and the substance of any oral communication related to the issue.
- (4) Basis for an assertion that the work required is a change from the original contract work or schedule.
- (5) Identity of particular elements of contract performance for which a change in compensation and/or time may be sought, including:
 - (a) Pay item(s) that have been or may be affected by the issue and any adjustments to unit price(s) that are required;
 - (b) Labor and/or materials that will be added deleted or wasted by the problem and what equipment will be idled or required;
 - (c) Delay and disruption in the manner and sequence of performance that has been or will be caused;
 - (d) Adjustments to delivery schedule(s), staging, and contract time due to the dispute and
 - (e) Estimate of the time within which the Contracting Agency must respond to the notice to minimize cost, delay, or disruption of issue.
- (6) Any other items or information germane to the dispute.
- (7) The Contractor's written certification, under oath, attesting to the following:
 - (a) The request is made in good faith.
 - (b) Supportive data is accurate and complete to the Contractor's best knowledge and belief.
 - (c) When provided, the amount requested accurately reflects the Contractor's actual cost incurred.

In complying with this request, the Contractor shall use the Contracting Agency's certification form.

(B) Within ten calendar days after the Contractor's submission in accordance with the above paragraph, the Engineer will respond in writing to the Contractor to:

- (1) Confirm that a supplemental agreement is necessary and, when necessary, give appropriate direction for further performance, or

SECTION 110

- (2) Deny that the contract has been revised and, when necessary, direct the Contractor to proceed with the contract work, or
- (3) Advise the Contractor that adequate information has not been submitted to decide whether (1) or (2) applies, and indicate the needed information and date it is to be received by the Engineer for further review. The Contracting Agency will respond to such additional information within ten calendar days of receipt from the Contractor.

110.2.3 Conditions: The failure of the Contractor to comply with the requirements of this subsection constitutes a waiver of entitlement to additional compensation or a time extension.

110.3 ADMINISTRATIVE PROCESS FOR DISPUTE RESOLUTION:

110.3.1 General: If the Contractor rejects the decision of the Engineer in Subsection [110.2.2](#) (B) above, the Contractor may begin the Administration Process to resolve the dispute.

The notice provision set forth in Subsection [110.2](#) is a contractual obligation assumed by the Contractor in executing the contract. It is understood that the Contractor will be forever barred from recovering against the Contracting Agency if the Contractor fails to give notice of any act or failure to act, by the Engineer, or the happening of any event, thing, or occurrence, in accordance with Subsection [104.2](#) Alteration of Work.

The administrative process for the resolution of disputes is sequential in nature and is composed of the following levels:

- Level I. (Representative reviewed by: *e.g. Construction Engineer*)
- Level II. (Representative reviewed by: *e.g. Assistant County/City Engineer*)
- Level III. (Representative reviewed by: *e.g. County/City Engineer*)

Note: The above stated titles may vary depending on the Contracting Agency's organization.

These three levels of review; the specific titles; the financial authority of each; and the names of people assigned to each level shall be provided at the preconstruction conference. The equivalent information regarding the Contractor's organization shall also be provided at the preconstruction conference.

Except as provided elsewhere herein, no dispute will be accorded a particular level of review unless the dispute has been reviewed at the preceding level and the Contractor rejects the decision in writing within the time period specified, or both parties agree that the decision for compensation is above that levels authority.

Unless specifically requested otherwise by the Contracting Agency, submission of additional information by the Contractor or Engineer, at any level of the review process shall cause the process to revert to Level I.

110.3.2 Required Information: At a minimum, the information described in Subsection [110.2](#) must accompany each dispute. If the following applies, it shall also be provided in addition to the information required by Subsection [110.2](#).

(A) If additional compensation is sought, the Contractor shall submit the exact amount sought as required by Subsection [110.2.2](#) (A) (5) broken down into the following categories:

- (1) Direct Labor
- (2) Direct Materials
- (3) Equipment
- (4) Job Overhead
- (5) General and Administrative Overhead
- (6) Subcontractor's Work (broken down as 1, 2, 3 and 4 above)
- (7) Other categories as specified by the Contractor.

(B) If additional time is sought, the Contractor shall provide a comprehensive time impact analysis showing the delay(s) and how they affect the critical path. The time impact analysis must include both the original and as-built critical path schedules and must be supported by documentation such as delivery schedules, invoices, correspondence, memoranda of telephone calls, payroll data, daily work schedules, etc. NOTE: The path of the longest

SECTION 110

duration of continuous and dependent work activities through the schedule network is identified as the Critical Path and is the minimum amount of time required to build the project as depicted by the schedule.

(C) The Contractor shall also notify the Contracting Agency's Level I Representative in writing that all documentation in support of the dispute has been provided and that the administrative review process should begin. No formal action will be taken by the Level I Representative until this written notification is received. The documentation provided to the Level I Representative shall serve as the basis for evaluating the Contractor's position regarding the dispute throughout the administrative process.

110.3.3 Process: The Contracting Agency's Level I Representative will render a written decision regarding the matter in dispute within two working days of receipt of the Contractor's notification that the dispute resolution process should begin.

The Contractor shall, upon receipt of the decision by the Level I Representative, either accept or reject the decision in writing. If the Contractor does not reject the Level I Representative's decision within two working days of its receipt, the Contractor will be deemed to have accepted the decision, the dispute will be considered withdrawn from the administrative process, and there will be no further remedy.

If the Contractor rejects the decision of the Level I Representative, the dispute will be forwarded by the Level I Representative to the Level II Representative. The Level II Representative will, within seven working days of receipt of the dispute information from the Level I Representative, schedule and hold a meeting to review the dispute with the Contractor. This time limit may be extended by mutual agreement of the parties. The Level II Representative will, within seven working days of the meeting, issue a written decision, with justification, regarding the dispute.

The Contractor shall, within seven working days of receipt of the decision, either accept or reject it in writing. If the Contractor does not reject the Level II decision within seven working days, the Contractor will be deemed to have accepted the decision and the dispute will be considered withdrawn from the administrative process and there will be no further remedy.

If the Contractor rejects the decision of the Level II Representative, the Level II Representative will forward the dispute to the Level III Representative. The Level III Representative will, within fourteen working days of receipt of the dispute information from the Level II Representative, schedule and hold a meeting with the Contractor. This time limit may be extended by mutual agreement of the parties. The Level III Representative will, issue a written decision within fourteen working days of the meeting, with justification, regarding the dispute.

The Contractor shall, within fourteen working days of the receipt of the decision of the Level III Representative, either accept or reject it in writing. If the Contractor does not reject the Level III Representative's decision within fourteen working days, the Contractor will be deemed to have accepted the decision, the dispute will be considered withdrawn from the administrative process, and there will be no further remedy.

If the Contractor rejects the decision of the Level III Representative, there will be no further administrative review of the dispute. The resolution will then proceed as follows:

(A) Mediation: Prior to filing for arbitration or litigation, the Contractor may request non-binding mediation by filing a request for mediation in writing with the Engineer. If agreeable, the Engineer will then arrange for a mutually agreeable mediator. Such request for mediation shall be made within thirty calendar days from the date of the Level III Representative's decision as provided for in this subsection.

In connection with the mediation, each party shall bear its own costs, attorney's fees, and expert fees. Any fees and expenses assessed by the mediator shall be borne equally by the parties.

(B) Dispute Review Board/Arbitration: The decision of the Level III Representative in relation to the claim shall be final unless the dispute review board or arbitration is chosen as follows:

- (1) Where the amount in controversy is less than or equal to the amount authorized in Subsection [110.3.4](#), the sole remedy shall be the Dispute Review Board as prescribed in Subsection [110.5](#) unless both parties mutually agree to utilize arbitration as prescribed in Subsection [110.4](#).

SECTION 110

(2) Where the amount in controversy is more than authorized in Subsection [110.3.4](#), the Contractor reserves the right to initiate litigation pursuant to Section 12-821 et seq. of the Arizona Revised Statutes, or if mutually agreed upon, the parties may choose to resolve the controversy utilizing either the Dispute Review Board as prescribed in Subsection [110.5](#) or Arbitration as prescribed in Subsection [110.4](#).

110.3.4 Amount of Dispute: For the purposes of this subsection, the amount in controversy may not exceed \$200,000.00. A claim for adjustment in compensation shall mean an aggregate of operative facts giving rise to the rights of the party for which it is seeking to enforce. That is to say, a claim under this subsection is defined as the event, transaction or set of facts that give rise to a claim for compensation, costs, expenses or damages.

In making a determination whether the amount in controversy is \$200,000.00 or less, the parties shall not consider, quantify or take into account any requested extensions of contract time, or the release or remission of liquidated damages assessed or accrued prior to the dispute in question, under Subsection [108.7](#) and [108.9](#) of the Specifications.

Any party having a claim, adjustment or dispute for an amount in excess of \$200,000.00 may waive or abandon the dollar amount of any such claim in excess of \$200,000.00 so as to bring the claim, adjustment or dispute within the scope and coverage of this subsection, provided that the amount allowed to any such party by the arbitration award shall not exceed \$200,000.00. Various damages claimed by the party for a single claim may not be divided into separate proceedings to create claims within the \$200,000.00 limit.

110.4 ARBITRATION:

If the parties mutually agree to pursue arbitration as prescribed in Subsection [110.3.3](#), then a Demand for Arbitration shall be filed in writing with the American Arbitration Association or United States Arbitration and Mediation of Arizona, and a copy served thereof upon the Level III Representative or Contractor, whichever applicable. Such Demand for Arbitration shall be made by the party within thirty calendar days of the date of the Level III Representative's decision as provided for in Section [110.3](#) above, unless a mediation process is already underway, in which case the Demand for Arbitration shall be made within thirty days of the termination of the mediation process. The scope of the arbitration proceeding shall be restricted and limited to the matters originally presented to the Level III Representative for decision or determination and shall include no other matters. All arbitration of claims shall be conducted in Phoenix, Arizona or other mutually selected location in accordance with the rules of the arbitration service hearing the dispute.

The claim shall be submitted to a single arbitrator who shall be selected by the parties from a list of arbitrators furnished by the arbitration service. Each party shall alternately strike names from the list until only one name remains. The person whose name thus remains on the list of arbitrators is their first choice, but if that person is not available to serve, the two persons whose names were last stricken are acceptable, with the one whose name was last stricken being the first alternate.

Unless agreed to otherwise, the parties shall select the arbitrator within ten calendar days after each has received a copy of the list of arbitrators.

Each party to the arbitration shall bear its own costs, attorney fees and expert fees. Any other costs and fees assessed by the arbitration service shall be divided equally between the parties to the arbitration.

The decision or award of the arbitrator shall be supported by substantial evidence and, in writing, contain the basis for the decision or award and findings of fact. The decision or award by the arbitrator when made shall be final and nonappealable except as provided in Section 12-1512, Arizona Revised Statutes. Both parties to the Contract shall be bound by the Arbitration Award for all purposes and judgment may be entered upon it in accordance with applicable law in the Superior Court of Arizona.

110.5 DISPUTE REVIEW BOARD:

If the Dispute Review Board is utilized as prescribed in Subsection [110.3.3](#), the Engineer shall be notified within thirty days after the Level III Representative decision. The Dispute Review Board is a three member board independent of the parties involved in the issue. The Agency and Contractor shall each select a member for this board. The third member shall be a mutually agreed upon independent member. This Review Board must be selected within fourteen calendar days after notice to

SECTION 110

the Level III Representative. Each member shall agree to impartially serve the Agency and Contractor. Fees and expenses of Board Members are to be shared equally by Agency and Contractor. The Dispute Review Board shall meet within thirty days of the selection of the board, unless, by mutual agreement, another date is selected. The scope of the Dispute Review Board shall be restricted and limited to the matters originally presented to the Level III Representative for decision or determination and shall include no other matters. The Board shall consider and evaluate the dispute and render a written decision that assigns financial responsibilities and allocates adjustments in the contract time, if applicable, within seven calendar days after the meeting. The decision of the dispute Review Board will be final.

110.6 FINAL DOCUMENTATION AND PAYMENT:

If at any step in the process a dispute is resolved, the Contractor must sign a supplemental agreement setting forth the resolution of the dispute and including an unconditional release as to any and all matters arising from the dispute. In addition, when the agreement results in a change in contract amount and/or time, a change order shall be prepared by the Contracting Agency for said changes and signed by both parties within 30 days from the date of the agreement. Payment of the change order will be made to the appropriate party(s) in accordance with Section [109](#).

- End of Section -

PART 200
EARTHWORK

Section	Last Revised	Title	Page
201	1999	Clearing and Grubbing	201-1
205	1998	Roadway Excavation	205-1
206	2015	Structure Excavation and Backfill	206-1
210	2009	Borrow Excavation	210-1
211	2015	Fill Construction	211-1
215	1998	Earthwork for Open Channels	215-1
220	2012	Riprap Construction	220-1
230	2010	Dust Palliative Application	230-1

This Page Reserved for Future Use

SECTION 201

CLEARING AND GRUBBING

201.1 DESCRIPTION:

This work shall consist of removing objectionable material from the right-of-way, easements and such other areas as may be specified in the special provisions. Clearing and grubbing shall be performed in advance of grading operations.

201.2 PRESERVATION OF PROPERTY:

Existing improvements, adjacent property, utilities and other facilities, and trees and plants not to be removed, shall be protected from injury or damage resulting from the Contractor's operations, see Section [107](#).

201.3 CONSTRUCTION METHODS:

The construction site and areas on each side of the roadway from centerline to the toe of an embankment, the top of a cut slope, the slope rounding limit or to a line 10 feet outside the edge of the surfaced area, whichever is greater, but not beyond the limits of the right-of-way, shall be cleared of all trees, stumps, brush, roots, rubbish, debris and other objectionable matter, except as follows.

All trees and shrubs found suitable for improvement and beautification, which will not interfere with excavation or embankment or cause disintegration of the improvements shall not be disturbed. In any event, the Contractor shall avoid, as far as practicable, injury to shrubbery, vines, plants, grasses and other vegetation growing outside of the clearing limits. The dragging and the piling of materials of various kinds and the performing of other work which may be injurious to vegetation shall, insofar as practicable, be confined to areas which have no vegetation or which will be covered by embankment or disturbed by excavation during grading operations.

For the full width of all water courses within the right-of-way lines, no stump, root or other obstruction shall be left higher than the natural stream bed.

From excavated areas, all stumps, roots and other obstructions 3 inches or over in diameter shall be grubbed to a depth of not less than 18 inches below finish grade.

In embankment areas or other areas to be cleared outside the road prism slope lines, all stumps, roots and other obstructions shall not be left higher than specified in Table [201-1](#).

TABLE 201-1	
EMBANKMENT CLEARING AND GRUBBING	
Height of Embankment Over Stump	Height of Clearing and Grubbing
0 Feet to 2 Feet	All stumps or roots 6 inches or over in diameter shall be grubbed to 18 inches below original grade. All others shall be cut flush with the ground.
2 Feet to 3 Feet	All stumps 1 foot and over in diameter shall be grubbed to 18 inches below original grade. All others shall be cut flush with the ground.
Over 3 Feet	No stumps shall be left higher than the stump top diameter, and in no case more than 18 inches.

Cavities left below subgrade elevation by removal of stumps or roots shall be carefully backfilled and compacted.

Tree branches extending over the roadway, which hang within 12 feet of the profile grade or that restrict sight distance shall be cut off close to the trunk or stem of the tree in a neat and workmanlike manner. The Contractor shall remove additional tree branches under the direction of the Engineer, in such a manner that the tree will present a balanced appearance. Scars resulting from the removal of branches shall be treated with a heavy coat of an approved tree sealant.

All tree trunks, stumps, brush, limbs, roots, vegetation and other debris removed in clearing and grubbing shall be removed to locations outside of and out of sight of the right-of-way, or otherwise disposed of so as to leave the construction site and adjacent areas in a neat and finished condition, free from unsightly debris.

SECTION 201

201.4 REMOVAL AND DISPOSAL OF SALVAGEABLE ITEMS:

Items and materials of salvage value as determined by the Engineer, unless incorporated in the new work, shall remain the property of the Contracting Agency and shall be stored in adjacent areas as directed by the Engineer. Such items and materials shall be carefully removed and in such a manner as to permit reuse.

201.5 PAYMENT, CLEARING AND GRUBBING:

Unless otherwise provided in the special provisions or bid proposal, no payment will be made for clearing and grubbing as such; the cost thereof shall be included in the bid price for the construction or installation of the items to which said clearing and grubbing are incidental or appurtenant.

201.6 MEASUREMENT, REMOVAL AND DISPOSAL OF TREES:

If the proposal includes separate estimates of quantities for the removal of trees, the tree will be classified by size as follows:

(A) Trees 12 inches or less in diameter at 1-foot above the original ground surface will be included in the bid price for clearing and grubbing or excavation and no additional compensation will be allowed therefore.

(B) Trees more than 12 inches in diameter at 1-foot above the original ground will be included as separate bid item and payment will be made at the unit bid price quoted in the proposal.

201.7 PAYMENT, REMOVAL AND DISPOSAL OF TREES:

Payment for removal of trees will be on a unit price for each tree measured and removed, in accordance with the above classifications, at the unit price stipulated in the proposal.

- End of Section -

SECTION 205

ROADWAY EXCAVATION

205.1 DESCRIPTION:

Roadway excavation shall consist of excavation involved in the grading and construction of roadways, except structure excavation, trench excavation and any other excavation separately designated.

205.2 UNSUITABLE MATERIAL:

Material shall be considered unsuitable for fill, subgrade, shoulders and other uses if it contains organic matter, soft spongy earth, or other matter of such nature that compaction to the specified density is unobtainable.

Material that is unsuitable for the intended use shall be excavated and removed from the site or otherwise disposed of as directed by the Engineer.

The removal and disposal of such unsuitable material will be paid for as roadway excavation.

205.3 OVERSHOOTING:

Material outside the authorized cross-section which may be shattered or loosened because of blasting shall be removed by the Contractor at no additional cost to the Contracting Agency. The Contractor shall discontinue any method of blasting which in the opinion of the Engineer leads to excessive overshooting or is dangerous to the public or destructive to property or to natural features.

205.4 SLIDES AND SLIPOUTS:

Material outside the planned roadway or ditch slopes which in the opinion of the Engineer is unstable and constitutes potential slides, material which has come into the roadway or ditch, and material which has slipped out of new or old embankments shall be excavated to designated lines or slopes either by benching or in such manner as directed by the Engineer. Such material shall be used in the construction of the embankments or disposed of as directed by the Engineer.

The removal and disposal of slide and slipout material as specified above, not resulting from overshooting as specified above, will be paid for at the contract prices for roadway excavation; however, if due to the character of the work, the removal and disposal of such material is not properly compensable at the contract prices for roadway excavation, the work may be paid for as extra work provided the Contractor requests in writing such payment prior to performing any such work.

Only those quantities of slide or slipout material which are actually removed as ordered by the Engineer will be paid for.

205.5 SLOPES:

Excavation slopes shall be finished in conformance with the lines and grades shown on the plans. Debris and loose material shall be removed. When completed, the average plane of the slopes shall conform to the slopes indicated on the plans and no point on the completed slopes shall vary from the designated plane by more than 6 inches measured at right angles to the slope, except where excavation is in rock no point shall vary more than 2 feet from the designated plane of the slope. In no case shall any portion of the slope encroach on the roadbed.

Tops of excavation slopes and ends of excavations shall be rounded as shown on the plans and these quantities will not be included in the quantities of excavation to be paid for. This work will be considered as a part of finishing slopes and no additional compensation will be allowed therefore.

Embankment slopes shall be finished in conformance with lines and grades shown on the plans. When completed the average plane of slopes shall conform to slopes indicated on the plans and no point on the completed slopes shall vary from the designated plane by more than 6 inches measured at right angles to the slope.

SECTION 205

205.6 SURPLUS MATERIAL:

Unless otherwise shown on the plans, specified in the special provisions, or approved by the Engineer, no surplus excavated material shall be disposed of within the right-of-way. The Contractor shall make all arrangements for disposal of the material at off-site locations as may be approved by the Engineer, and shall upon request file with the Engineer the written consent of the owner of the property upon which he intends to dispose of such material.

If the quantity of surplus material is shown on the plans or specified in the special provisions, the quantity shown or specified is approximate only. The Contractor shall satisfy himself that there is sufficient material available for the completion of the embankments before disposing of any indicated surplus material inside or outside the right-of-way. Any shortage of material caused by premature disposal of surplus material by the Contractor, shall be replaced by him and no compensation will be allowed the Contractor for such replacement.

205.7 MEASUREMENT:

The following earthwork operations will be measured as roadway excavation for the quantities of material involved.

Excavating the roadway prism including public and private road approaches, connections and driveways; excavating unsuitable material when shown on the plans or specified in the special provisions; excavating slides and slipouts not resulting from overshooting; excavating surplus material; excavating selected material and topsoil from within the limits of project and removing such materials from stockpiles when stockpiling is ordered; excavating ditches and excavating borrow.

The Engineer will compute the quantities of material excavated by a method which in his opinion is best suited to obtain an accurate determination.

Excavation in excess of the planned or authorized cross-section will not be paid for, except as provided above. The Contractor shall backfill and compact unauthorized excavated areas to the original ground elevation of authorized section at no additional cost to the Contracting Agency.

Material resulting from excavating ditches or channels may be used to construct roadway embankments, dikes, or for other purposes, or disposed of, as directed by the Engineer.

Care shall be exercised to prevent excavating below the grade for the bottom of the ditch and areas excavated below grade shall be filled with suitable material and compacted by the Contractor at no additional cost to the Contracting Agency.

205.8 PAYMENT:

Quantities of roadway excavation will be paid for at the contract unit price per cubic yard. Such price shall include excavating, sloping, rounding tops and ends of excavations, loading, depositing, conditioning, spreading, and compacting the material complete in place and disposal of surplus material.

When the proposal does not include a pay item for roadway excavation the cost thereof shall be considered as being included in the price bid for the construction or installation of the items to which such roadway excavation is incidental or appurtenant.

- End of Section -

SECTION 206

STRUCTURE EXCAVATION AND BACKFILL

206.1 DESCRIPTION:

Structure excavation shall consist of the removal of material for the construction of foundations for bridges, manholes, retaining walls, box culverts, head walls for culverts, and other structures, and other excavation designated on the plans or in these specifications or in the special provisions as structure excavation.

Structure backfill shall consist of furnishing material, if necessary, and placing and compacting backfill material around structures to the lines designated on the plans or specified or directed by the Engineer.

Structure excavation and structure backfill shall include the furnishing of all materials and equipment and the providing of other facilities which may be necessary to perform the excavations and place and compact the backfill, and the subsequent removal of these facilities, except where they are required or permitted by the plans, special provisions or Engineer to remain in place.

206.2 FOUNDATION MATERIAL TREATMENT:

When footing concrete or masonry is to rest upon rock, the rock shall be fully uncovered and the surface thereof shall be removed to a depth sufficient to expose sound rock. The rock shall be roughly leveled off or cut to approximate horizontal and vertical steps, and shall be roughened. Seams in the rock shall be grouted under pressure or treated as the Engineer may direct and the cost thereof will be paid for as extra work.

When no piles are used and footing concrete or masonry is to rest on an excavated surface other than rock, care shall be taken not to disturb the bottom of the excavation and final removal of the foundation material to grade shall not be made until just before the concrete or masonry is placed. Excavation below grade shall be replaced with the same class of concrete specified for the structure or with 1 ½ sack controlled low strength material as specified in Section 728. When the replacement material is structural concrete, the material shall be placed at the same time as the structure material. Placement of controlled low strength material shall be per Section 604 which will require a time lag between placement of the material and the structural concrete. The placement of the additional material shall be at no cost to the Agency except when over-excavation is directed by the Engineer.

The excavation for structures shall be completed to the bottom of the footings before any piles are driven therein, and excess material remaining in the excavation after pile driving shall be removed to the elevation of the bottom of the footings.

When piles are used and ground displacement results from pile driving operations, the Contractor shall at his expense excavate or backfill the footing area to the grade of the bottom of the footing as shown on the plans with structure backfill material.

206.3 INSPECTION:

When any structure excavation is completed, the Contractor shall notify the Engineer who will make an inspection of the excavation. No concrete or masonry shall be placed until the excavation has been approved by the Engineer.

206.4 STRUCTURE BACKFILL:

206.4.1 Preparation for Structure Backfill: Prior to the placement of structure backfill, the Contractor shall remove all loose, unstable materials from the sides of the structure excavation that may constitute a safety concern or impact proposed backfill operations. The Contractor shall then compact the bottom of the remaining open structure excavation to a uniform density of not less than 95 percent maximum dry density. With the approval of the compaction of the bottom of the open structure excavation by the Engineer, the Contractor may start the placement of the Structure Backfill.

206.4.2 Structure Backfill for Earth Retaining Structures: Structure Backfill to be placed against concrete structures designed to retain earth loads, such as bridge abutment backwalls and wingwalls, box culvert outside walls and wingwalls, and retaining walls:

SECTION 206

(A) Shall conform to the material and the gradation requirements for Select Material, Type A or B in Table [702-1](#) unless otherwise approved by the Engineer.

(B) Shall not be placed until the concrete has reached its full design strength.

(C) Shall be placed in layers not more than 8 inches in depth before compaction, when compacted by pneumatic or mechanical tamping devices.

(D) Shall be uniformly compacted to at least 95 percent of maximum density.

EXCEPTION: Catch basins constructed in accordance with standard details and having the outlet invert depth equal to or less than six feet may place structure backfill when the concrete has attained a minimum compressive strength of 2500 psi in compression as specified in Section [725](#) and in no case less than 72 hours after casting.

206.4.3 Structure Backfill for Structures Other than Earth Retaining: Structure Backfill placed against concrete structures not designed to retain earth loads:

(A) Shall not be placed until the concrete has attained a minimum compressive strength of 2500 psi in compression as specified in Section [725](#) and in no case less than 72 hours after casting.

(B) Shall be uniformly compacted to at least 95 percent of maximum density.

206.4.4 Structure Backfill for Structures within Paved Areas: Where a structure is located within an existing street, proposed street, or paved area shall be compacted to the minimum density specified in Table [601-2](#), for Type I or shall be filled with ½ sack or 1 sack controlled low strength material as specified in Sections [604](#) and [728](#).

206.4.5 Structure Backfill for Precast Minor Structures: Minor structures, as defined in Section [505.1.1](#), when furnished as precast structures, shall be placed on a compacted layer of Structure Backfill at least 6 inches in depth that conforms to the material requirements of Section [206.4.2](#). The layer shall be shaped to fit the bottom surface of the precast unit and compacted to not less than 100 percent maximum density. The Structure Backfill shall be at or near optimum moisture content, as approved by the Engineer. After the unit has been initially set in place and checked for line and grade, it shall be removed, and any defects in its bearing area or line and grade shall be corrected by trimming and by placing and compacting similarly moistened Structure Backfill and the unit reset in place. If in the opinion of the Engineer the bearing area or line or grade of a set precast unit is defective, the Contractor shall remove the unit, correct the bearing area and reset the unit at no additional cost to the Agency. Precast units shall be installed on compacted, shape-conformed Structure Backfill in reasonable conformity with the lines and grades shown on the project plans.

206.4.6 Relative Compaction: Unless otherwise provided in the plans and/or special provisions the maximum density shall be determined using procedures defined in Section [301](#).

206.5 PAYMENT:

Unless otherwise provided in the special provisions or proposal, no payment will be made for structure excavation and backfill as such; the cost thereof shall be included in the contract price for the construction or installation of the items to which such excavation and backfill are incidental or appurtenant.

When the Special Provisions identify Structure Excavation and/or Structure Backfill as pay items, the following methods of measurement and payment shall be used:

SECTION 206

206.5.1 Measurement

(A) **Structure Excavation:** Structure Excavation will be measured by the cubic yard, based on the volumes calculated from the measurement/pay limits shown on the Project Plans. If no limits are shown, the measurement for Structure Excavation shall be in accordance with the applicable details shown on the current Arizona Department of Transportation (ADOT) Standard Drawings B-19.30 and/or B-19.50.

No reduction in measurement for payment will be made when the Contractor elects to not excavate all material between the limits of the actual structure, and the pay limits shown on the Project Plans and/or the above referenced ADOT Standard Drawings.

No additional measurement for payment will be made for excavation resulting from lack of side support for structure excavations, nor due to carelessness of the Contractor.

(B) **Structure Backfill:** Structure Backfill will be measured by the cubic yard, based on the volumes calculated from the measurement/pay limits shown on the Project Plans. If no limits are shown, the measurement for Structure Backfill shall be in accordance with the applicable details shown on the current ADOT Standard Drawings B-19.40 and/or B-19.50.

206.5.2 Payment

Structure Excavation and Structure Backfill: The accepted quantities of Structure Excavation and the accepted quantities of Structure Backfill will be paid for at their respective contract unit prices.

Hauling, placing, and compacting surplus Structure Excavation in embankments, or otherwise disposing of the material, shall be included in the contract price paid for Structure Excavation.

- End of Section -

SECTION 210

BORROW EXCAVATION

210.1 LOCAL BORROW:

Local borrow shall consist of material excavated and used in the construction of fills or for use as selected material or for other construction purposes. Local borrow shall be obtained by widening cuts or by excavating from other sources outside the planned or authorized cross-section within the right-of-way and within the limits of the project. Local borrow shall be excavated to the lines and grades established by the Engineer.

210.2 IMPORTED BORROW:

Imported borrow shall consist of material required for construction and unless otherwise designated in the special provisions, the Contractor shall make arrangements for obtaining imported borrow and shall pay all costs involved. When designated sources for imported borrow are indicated on the plans, in the special provisions, the material shall be assumed approved by the Engineer.

Borrow material for fill within the roadway prism shall meet the following requirements:

The Plasticity Index (PI) (AASHTO T-90) and the percent passing the number 200 sieve (Minus 200) (ASTM C136) when used in the equation below, shall give a value of X that does not exceed 62.

$$X = (\text{Minus 200}) + 2.83 (\text{PI})$$

When the percentage of the Minus 200 material is greater than 30, the PI for the soil shall be at least 5 and at the same time in compliance with the X value requirement.

The material shall be free from wood, vegetation, or other deleterious matter. The maximum size of this material shall not be greater than 2/3 the compacted thickness of the course placed in the subgrade.

The Contractor shall notify the Engineer sufficiently in advance of opening any material sites so that cross-section elevations and measurements of the ground surface after stripping may be taken and sufficient time for testing and material will be allowed.

Borrow pits shall be excavated to regular lines to permit accurate measurement; depth of excavation throughout the area of borrow pits shall be as uniform as practicable and the side slope shall be dressed to such slope as may be directed, leaving the borrow pit area in a clean and safe condition.

210.3 PLACING AND COMPACTING:

Local borrow and imported borrow shall be placed and compacted as specified in Section [211](#).

The Contractor shall satisfy himself that there is sufficient space available in fill locations for placing any excavated material, before placing borrow. Any excess excavation which develops as a result of placing borrow in advance of completing excavations shall be disposed of by the Contractor at no additional cost to the Contracting Agency in accordance with the provisions in Section [205](#) and a corresponding reduction in the quantity of borrow to be paid for will be made, for which the Contractor will have no claim for compensation.

210.4 MEASUREMENT:

Quantities of borrow will be measured as specified for roadway excavation in Section [205](#).

Material excavated at the borrow site and not used on the work will be deducted from the computed quantities and will not be paid for.

SECTION 210

210.5 PAYMENT:

Quantities of borrow excavation will be paid for at the contract unit price per cubic yard. Such price shall include excavating, sloping and cleaning of borrow area, hauling, depositing, spreading and compacting the material complete in place, and disposal of surplus material, unless an alternate basis of payment is stipulated in the proposal.

- End of Section -

SECTION 211

FILL CONSTRUCTION

211.1 DESCRIPTION:

Fill construction shall consist of constructing embankments except as may otherwise be specified, including the preparation of the areas upon which they are to be placed; the construction of dikes; the placing and compacting of approved material within areas where unsuitable material has been removed; and the placing and compacting of material in holes, pits, and other depressions.

211.2 PLACING:

Rocks, broken concrete, or other solid material, which are larger than 4 inches in greatest dimension, shall not be placed in fill areas where piles are to be placed or driven.

When fill is to be made and compacted on hillsides or where new fill is to be compacted against existing fill or where embankment is built ½ width at a time, the slopes of original hillsides and old or new fills shall be benched a minimum of 4 feet horizontally as the fill is placed. A new bench shall be started where ever the vertical cut of the next lower bench intersects the existing ground. Material thus cut out shall be recompacted along with the new embankment material by the Contractor at no additional cost to the Contracting Agency, unless the width of the bench required exceeds 4 feet, in which case the excavated material in excess of 4 feet will be measured and paid for as excavation.

Clods or hard lumps of earth of 6 inches in greatest dimension shall be broken up before compacting the material in embankment, except as provided in the following paragraph:

When the fill material includes large rocky material, or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, such material shall be well distributed throughout the fill. Sufficient earth or other fine material shall be placed around the larger material as it is deposited so as to fill the interstices and produce a dense, compact fill. However, such material shall not be placed within 2 feet of the finished grade of the fill.

211.3 COMPACTING:

Fill shall be constructed in compacted layers of uniform thickness and each layer shall be compacted in accordance with the requirements herein specified with the following exception.

Where fills are to be constructed across low, swampy ground which will not support the weight of hauling equipment, the lower part of the embankment may be constructed by dumping successive loads of suitable materials in a uniformly distributed layer of thickness not greater than that necessary to support the equipment while placing subsequent layers, after which the remainder of the embankment shall be constructed in layers and compacted as specified.

Unless specified herein, or in the special provisions, the construction of dikes, the placing and compacting of approved material within the right-of-way where unsuitable material has been removed, and the filling of holes, pits and other depressions within the right-of-way, shall conform to all of the requirements herein specified for compacting fills. Trenches, holes, depressions and pits outside of areas where fills are to be constructed shall be graded to provide a presentable and well-drained area.

Areas over which fills are to be placed shall be cleared and scarified to a depth of 6 inches to provide a bond between the existing ground and the material to be deposited thereon. Unless otherwise specified, the original ground area upon which fills are to be constructed shall be compacted to a uniform density of not less than 95 percent.

The loose thickness of each layer of fill material before compacting shall not exceed 8 inches, except as provided in the following paragraph for rocky material. Each layer shall be compacted in accordance with the following requirements to a uniform density of not less than 90 percent, except that where a new or widened roadway and appurtenances are required, density of the upper 2 feet and when the fill is within 2 feet of the above shall be not less than 95 percent.

SECTION 211

When fill material contains by volume over 25 percent of rock larger than 6 inches in greatest dimension, the fill below a plane 3 feet below finished grade may be constructed in layers of a loose thickness before compaction not exceeding the maximum size of rock in the material but not exceeding 3 feet in thickness.

The interstices around the rock in each layer shall be filled with earth or other fine material and compacted. Broken Portland cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the fill with the following limitation:

- (A) The maximum dimension of any piece used shall be 6 inches.
- (B) Pieces larger than 4 inches shall not be placed within 12 inches of any structure.
- (C) Pieces larger than 2 ½ inches shall not be placed within 12 inches of the subgrade for paving.
- (D) Nesting of pieces will not be permitted.

At the time of compaction, the moisture content of fill material shall be such that the specified relative compaction will be obtained and the fill be firm and unyielding. Fill material which contains excessive moisture shall not be compacted until the material is dry enough to obtain the required relative compaction. Full compensation for any additional work involved in drying fill material to the required moisture content shall be considered as included in the contract price paid and no additional compensation will be allowed therefore.

Embankments shall be constructed so that each layer shall have a cross fall of at least 2 percent but no more than 5 percent.

211.4 TESTS:

Unless otherwise provided in the plans or special provisions the fill shall be thoroughly compacted to not less than the stated densities when tested and determined by AASHTO T-99, Method A, and T-191 or ASTM D6938 with the percent of density adjusted in accordance with the rock correction procedure for maximum density determination, standard detail, to compensate for the rock content larger than that which will pass a No. 4 sieve.

211.5 MEASUREMENT:

The quantities of fill construction used to construct embankments or dikes will be those of the complete bid item, in place, within the limits of dimensions shown on the plans.

The Engineer will compute the quantities of fill by a method which in his opinion is best suited to obtain an accurate determination.

211.6 PAYMENT:

Quantities of fill construction will be paid for at the contract unit price per cubic yard of fill as stipulated in the proposal. Such price shall include placing and compaction and all related work as specified above, unless an alternate basis of payment is stipulated in the proposal.

Unless otherwise provided in the special provisions, no payment will be made for fill construction to replace unsuitable material or for fill for holes, pits, and other depressions. The cost thereof shall be included in the price bid for the construction of the items to which such fill is incidental or appurtenant.

- End of Section -

SECTION 215

EARTHWORK FOR OPEN CHANNELS

215.1 DESCRIPTION:

Earthwork for open channels shall consist of clearing, stripping, excavation, fill, backfill, grading and disposal of excavated and removed material.

Open channels for the purpose of this Section shall mean open rectangular concrete channels and lined or unlined trapezoidal channels.

215.2 STRIPPING:

When stripping is indicated on the plans or specified in the special provisions, the Contractor shall strip the soil from the designated areas to the depths shown or specified or as directed by the Engineer.

The material obtained from stripping operations shall be disposed of away from the site unless otherwise specified, shown on the plans or authorized by the Engineer.

Soil loosened below the stripping depth specified or designated by the Engineer, shall be compacted. Soil removed below stripping depth shall be replaced with approved material and compacted up to the designated grade. All such filling and compacting shall be done by the Contractor at no additional cost to the Contracting Agency.

215.3 EXCAVATION:

Excavation in open cut for lined channels may be made so as to place concrete directly against the excavated surfaces providing the faces of the excavation are firm and unyielding; are such as will stand or can be made to stand without sloughing and are, at all points outside the concrete lines shown on the plans.

Excavation to provide a subgrade for lined channels, or subdrainage material, shall be to the lines indicated on the plans; and, excavation made below subgrade shall be backfilled and compacted to a uniform density of not less than 90 percent or, if approved by the Engineer, with concrete or other materials being placed. However, no payment will be made for such over-excavation or material used for such backfill.

Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, the voids remaining after the removal of such boulders or interfering objects shall be backfilled as specified below, or as otherwise approved by the Engineer.

(A) When the void is below the subgrade for reinforced concrete channel, it shall be filled with suitable material, as approved by the Engineer, and compacted to a uniform density of not less than 90 percent. With the approval of the Engineer, concrete of the same mix as used in the concrete channel, may be used.

(B) When the void is in the side of the excavation, it shall be filled with suitable material as approved by the Engineer, placed in the manner and to the same uniform density as the backfill in the vicinity of the void. With the approval of the Engineer, concrete of the same mix as used in the concrete channel may be used. If concrete is placed prior to lining, a lower grade concrete may be used only if approved by the Engineer.

It shall be understood that the removal of boulders or other interfering objects and the backfilling of voids caused by such removals shall be done by the Contractor at no additional cost to the Contracting Agency. The cost of such work shall be included in the prices bid for the various items of work.

If during the progress of excavation, material is encountered, which, in the opinion of the Engineer, is unsuitable for subgrade for the channel to be constructed on, the Engineer may direct the Contractor to excavate beyond the pay lines shown on the plans. However, the suitability of subgrade shall be determined by the Engineer on the basis of its ability to withstand the load of the proposed channel and not upon the capacity to withstand the loads which may be placed upon it by the Contractor's equipment. Should the Contractor be directed to excavate beyond the pay lines shown on the plans, said pay lines will be extended to include such ordered excavation; and the pay lines for subdrainage material, if used, will be adjusted accordingly.

SECTION 215

Materials used or work performed by the Contractor, to stabilize the subgrade so it will withstand loads which may be placed upon it by his equipment shall be accomplished by the Contractor at no additional cost to the Contracting Agency.

215.4 FILL AND BACKFILL:

Unless otherwise specified in the special provisions, material obtained from the project excavations may be presumed to be suitable for use as fill or backfill provided that all organic material, rubbish, debris, and other objectionable material is first removed. However, stone, broken Portland cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the backfill or fill with the limitations as specified in Section [211](#).

Unless otherwise specified in the special provisions, the density of fills and backfills shall be at least 90 percent.

215.5 GRADING:

Grading of unlined channels, levees and access roads shall conform to the following tolerances:

(A) A vertical tolerance of none above and 3 inches below the specified grade will be allowed on:

- (1) Channel bottom
- (2) Channel side slopes in both cut and fill
- (3) Levee and access road side slopes in cut

(B) A vertical tolerance of none below and 3 inches above the specified grade will be allowed on:

- (1) Top surface of levee and access road in both cut and fill
- (2) Levee and access road side slopes in fill

Regardless of the construction tolerances specified, excavation and grading shall be performed so that finished surfaces are in uniform planes with no abrupt breaks in the surface.

Construction tolerances specified above for grading are solely for purposes of field control.

215.6 TESTS:

Density tests shall be made in accordance with Section [211](#).

215.7 MEASUREMENT:

If compensation for stripping is included in the price paid for other items of work the Contractor shall notify the Engineer sufficiently in advance of excavation or other work so that cross-section elevations and measurements of the ground surface may be taken upon completion of stripping.

The Engineer will compute the quantity of excavation by a method which in his opinion is best suited to obtain an accurate determination.

215.8 PAYMENT:

Earthwork for open channels will be paid for on a lump sum basis or at the contract unit price per cubic yard of excavation as stipulated in the proposal. Such price shall include clearing, stripping, excavation, fill, backfill, compaction, grading, hauling, removal and disposal of excess excavated material and debris unless an alternate method of payment is stipulated in the proposal.

- End of Section -

SECTION 220

RIPRAP CONSTRUCTION

220.1 DESCRIPTION:

Riprap construction shall consist of furnishing and placing stone, with or without grout, and underlain with filter material of granular filter blankets or erosion control geosynthetic fabric. The depth and type of riprap shall be as shown on the plans or in the special provisions.

220.2 MATERIALS

Riprap shall conform to the requirements of Section [703](#).

Erosion control geosynthetic fabric shall conform to the requirements of Table [796-3](#) in Section [796](#).

Waste or sacked concrete shall not be permitted for use as riprap.

The Contractor, at no additional cost, shall provide mechanical equipment, a sorting site, and labor needed to assist in checking riprap gradation.

Granular filter blankets shall consist of processed natural material conforming to the requirements of Section [701](#), with the gradation and thicknesses as specified on the plans or in the special provisions.

220.3 PREPARATION OF GROUND SURFACES

The bed for placement of riprap shall be shaped and trimmed to provide even surfaces.

220.4 PLACEMENT OF EROSION CONTROL GEOSYNTHETIC FABRIC:

Fabric shall be placed at the locations shown on the project plans. The Contractor shall provide a surface free of obstructions, depressions, debris, and soft yielding surfaces prior to the placement of fabric. The fabric shall be loosely laid (not in a stretched condition), aligned and placed with no fold over wrinkles.

The fabric shall be placed to provide a minimum 24-inch of overlap for each joint. On horizontal joints, the uphill fabric shall overlap the downhill fabric. On vertical joints, the upstream fabric shall overlap the downstream fabric.

Bedding material shall be placed uniformly on the fabric to the depth specified on the plans and shall be free of mounds, dips, and windrows. Bedding material shall not be compacted.

220.5 RIPRAP PLACEMENT:

Riprap shall be carefully placed on filter material consisting of a granular filter blanket or the bedding material on erosion control geosynthetic fabric. Placement shall not damage the underlying filter blanket or geosynthetic fabric. If the Engineer determines that the placement of stone has damaged or displaced the filter material to the extent that it cannot function as intended, the Contractor, at his expense, shall remove the placed riprap stone and properly correct the damage to, and/or the displacement of, the filter material. Such correction may include the removal of the filter material, re-grading the affected area, and subsequent replacement of the filter material and riprap stone as required by the Engineer.

Riprap shall be placed in a manner which will produce a dense, reasonably well-graded mass without segregation and with a minimum amount of voids. The larger stone shall be evenly distributed through the riprap mass. The individual placement of larger riprap stones may be required to obtain a uniform distribution of stone size. The riprap placement shall be supplemented by such hand methods as are required to obtain a uniform finished surface. Allowable tolerance from the slope lines and grades shown for the finished riprap surfaces shall not exceed a distance equal to 1/3 of the nominal D_{50} size above or below the design surfaces. The final surface elevations shall be lower than any adjacent apron or pipe invert elevations and shall not obstruct the operation of adjacent structures. The flow line within riprap shall provide positive drainage with minimal ponding. Individual stones shall depress below the finished grades no lower than a distance equal to 1/2 of the nominal D_{50} size. Special care shall be exercised in placing riprap within 3 feet of structures to avoid damage to such structures.

SECTION 220

220.6 GROUTED RIPRAP:

Place riprap as specified in Section [220.5](#), excluding the use of filter material and secure in place with Portland cement grout meeting the requirements of Table [220-1](#). Place grout to the depth as shown on the plan but in no case less than 70 percent of the depth of riprap. Consolidate grout into place with suitable spades, trowels or other approved means to provide a dense stone and mortar layer with all voids and interstices filled. After grout has been placed, the rocks shall be thoroughly brushed so that their top surfaces are exposed. If required, use water pressure to clean stone faces after the mortar has achieved sufficient strength. The outer rocks shall project 1/3 to 1/4 their diameter above the grouted surface.

TABLE 220-1			
Grout for Riprap			
Minimum Cementitious Material (lbs)	Maximum W/CM Ratio	Slump (in)	Air Content (%)
850	0.60	9 +/- 2	0 % - 8 %

The cementitious materials shall meet the requirements of Section [725.2](#). Up to 25 percent by weight of the Table [220-1](#) minimum cementitious materials requirements may be an approved fly ash or natural pozzolan. The aggregates shall meet the applicable requirements of ASTM C33, #8 (3/8") coarse aggregate grading and fine aggregate (sand) grading. All Ready Mixed Grout volume calculations shall be based on "absolute volume" with the total volume per cubic yard equal to 27 cubic feet. Coarse aggregate volume shall be a maximum of 35% of the total aggregates volume. All mixing shall be in accordance with the applicable requirements of Section [725.7](#).

The amount of slump shall be the minimum amount needed to permit gravity flow into the interstices with limited spading and brooming. The consistency of the grout shall be as approved by the Engineer.

220.7 MEASUREMENT:

The completed, in place riprap construction within the limits of the dimensions shown on the plans shall be measured. Measurement will be in cubic yards rounded to the nearest cubic yard.

No separate measurement will be made for erosion control geosynthetic fabric, bedding material, or grout.

220.8 PAYMENT:

Payment for riprap will be made for the accepted complete in-place riprap construction at the contract unit price. Riprap construction shall include excavation, ground surface preparation, erosion control geosynthetic fabric (if used for the project), bedding material, riprap stone, grout (if used for the project) and backfilling.

Payment for riprap shall be full compensation for furnishing all material, labor and equipment for riprap construction.

- End of Section -

SECTION 230

DUST PALLIATIVE APPLICATION

230.1 DESCRIPTION:

This Section shall govern the application of dust control palliatives (agents) on unpaved roads, traffic surfaces, vacant lots, construction sites and road shoulders. Dust palliatives may also be used to protect erosion of slopes, embankments, sediment control and re-vegetated areas.

Dust palliatives may be applied as topical treatments to penetrate an undisturbed surface, or may be applied to larger areas using mixing methods that blend the product with surface material and then compact the mixture to provide a stabilized, dust resistant, surface course.

230.2 MATERIALS:

Materials to be used as dust palliatives shall conform to the requirements of Section [792](#). The specific dust palliative to be used shall be as shown on the plans or as directed by the Engineer.

Water used for diluting dust palliatives and for pre-wetting of treated subgrade shall be either potable or from a source compatible with dust palliative ingredients.

230.2.1 Product Verification: The Contractor, in the presence of the Engineer or his designee, shall obtain samples of the bulk, undiluted liquid dust palliative/stabilizer product as it is delivered to the job site. Samples shall be taken from each bulk tanker that delivers the liquid dust palliative/stabilizer for product verification testing purposes. If the bulk undiluted liquid dust palliative/stabilizer is delivered in containers, a sample must be taken from each container delivered to the job site. The Engineer will select the exact locations and times of sampling. The obtained liquid dust palliative/stabilizer samples will be split in three equal portions (minimum 2 ounce each), whereby the Contractor may retain one sealed portion for verification testing, and the Engineer will retain two sealed portions. One portion of the Engineer's samples will be provided to an AASHTO accredited test lab chosen by the Contractor. The other sample will be held for backup until the testing is completed. Sample containers will be labeled and sealed under the supervision of the Engineer.

The accredited lab will test the product in accordance with ASTM D2834 to confirm that the liquid dust palliative/stabilizer meets the requirements of Section [792.2](#) for active solids. Contractor is responsible for the cost of product verification testing.

If the test reports indicate that the minimum acceptable active solids content value as specified in Section [792.2](#) is not met, the quality of the liquid dust palliative/stabilizer product shall be deemed deficient by the Engineer. The delivery and application of a deficient product shall be stopped. Work shall not resume until all product verification testing is complete or the Contractor replaces the product and initial tests on the new material show compliance.

The Contractor may perform additional verification testing on the split samples. In case of dispute where the verification tests produce different results by the Contractor than the Engineer, the Engineer will hire a different independent AASHTO accredited testing laboratory to perform a third round of testing. Such testing and the results of the testing shall be considered final by both the Engineer and Contractor for verification.

230.3 COMPLIANCE:

At least two weeks prior to the start of work, the Contractor shall provide the Engineer the following Applicator qualifications: (a) Information showing that the Applicator has at least three years of experience within the last five years serving as either a primary contractor or subcontractor in delivering and applying dust palliative/stabilizer product services, (b) A minimum 3 local references (including company/organization name, contact person and telephone number) to demonstrate that the Applicator is familiar with local environmental and permitting requirements associated with soil stabilization and dust palliative, and (c) Copy of the Applicator's State of Arizona Registrar of Contractors License.

SECTION 230

At least two weeks prior to the start of work, the Contractor shall provide the Engineer the proposed application methods and equipment for the project. The information provided shall include: (a) curing time for each application method required for the project, (b) application and dilution rates proposed for the project, and (c) equipment to be used during all phases of application that are in conformance with Section [230.4](#).

Prior to the commencement of any work, the Contractor shall provide copies of all required environmental/dust control permits, any required notices of intent, and the current Material Safety Data Sheet (MSDS) for the dust palliative/stabilizer product. The MSDS must include all chemical compounds present in concentrations greater than 1% for dust palliative/stabilizer product.

230.4 EQUIPMENT:

The Contractor shall provide all equipment necessary to complete the work. The equipment may include but not be limited to motorized graders, distribution trucks, mixing and pulverizing equipment, pneumatic-tired rollers, sprinkler systems, etc. All equipment used for this work is subject to approval by the Engineer. Equipment which fails to provide an acceptable application of properly diluted dust palliative/stabilizer product or does not perform satisfactorily shall be removed from the job and replaced with acceptable equipment meeting the requirement of this specification.

Distributor trucks shall be designed, equipped, maintained and operated so that dust palliative/stabilizer product may be applied uniformly on variable widths of surface up to 16 feet at readily determined and controlled rates from 0.03 to 1.0 gallons per square yard, with uniform pressure, and with an allowable transverse variation from any specified rate not to exceed 10% or 0.02 gallon per square yard, whichever is less. The maintenance and calibration of this vehicle shall be checked periodically. The record of maintenance and calibration shall be submitted to the Engineer for review upon request.

Distributor trucks proposed for use shall have been tested within 6 months from the date of spreading to determine the rate of the transverse spread. If requested, the Contractor shall furnish the Engineer with evidence that the transverse spread of the distributor truck, when the trucks were approved for use, was as uniform as practicable and under no condition was there a variance on any of the test pads greater than the allowable transverse variation; however, the Engineer may require that each distributor truck be tested to determine the rate of the transverse spread. The rate of the transverse spread shall be determined in accordance with the requirements of Arizona Test Method 411.

230.5 PREPARATION OF SURFACE:

All surface preparation shall be in conformance with Maricopa County Rule 310 and 310.01 as applicable.

230.5.1 Topical Preparation: Prior to the application of the dust palliative, the surface shall be graded to provide drainage.

Dust palliatives shall not be applied when the surface is excessively wet or saturated. Surfaces shall be pre-moistened only if required by the product manufacturer.

230.5.2 Surface Course Preparation: Areas to receive dust palliative shall be graded and scarified to at least the minimum depth and width shown on the plans. The soil shall be scarified/loosened by tilling, disking, ripping, or by other soil preparation methods, which achieves uniform results to the minimum depth shown on the plans. The material shall be damp at time of scarification to reduce dust and aid in pulverization. Soil clods shall be pulverized until all material, exclusive of gravel or stone, will pass a 2-inch sieve.

All debris, weeds, organic material, stone larger than 4 inches, etc., shall be removed from the site. Surface gravel or stones shall be removed or thoroughly mixed with the surrounding soils to obtain a homogeneous mixture.

If pre-wetting is required, ample amount of water shall be added and mixed with the in-place material to obtain a moisture content near optimum. This moisture content shall be established prior to and maintained until the application of the dust palliative. The methods to establish and maintain the moisture shall be done in accordance with manufacturer's recommendations. The moisture must be uniformly distributed throughout the surface course and over the underlying undisturbed soil. Dust palliatives shall not be applied when the soil is excessively wet or saturated. Moisture content shall be determined in accordance with either ASTM D6938 or ASTM D4944.

SECTION 230

230.6 APPLICATION:

230.6.1 General: The dust palliative shall be applied by a pressure type distributor vehicle equipped with a power unit for the pump, full circulation spray bars adjustable laterally and vertically, and computer controls. The distribution vehicle shall be calibrated to ensure a controlled application method. Spray bars and extensions shall be of the full circulating type. Valves which control the flow from nozzles shall be of a positive active design so as to provide a uniform, unbroken spread of dust palliative on the surface.

Corners or surface that cannot be accessed by the distributor truck shall be hand sprayed by means of hoses or bars pressurized by a gear pump or air tanks.

Distributor equipment shall be equipped with a tachometer and pressure gauge. To provide for accurate, rapid determination and control of the amount of dust palliative being applied, distributor equipment shall include one or more of the following: accurate volume measuring devices, a calibrated tank, and/or a certified meter or weight tickets and calibration charts relating to the specific gravity of the concentrate and/or dilution.

The dust palliative shall be applied at the dilution ratio and application rate specified in accordance with Section [792](#), unless otherwise directed by the Engineer. The Contractor shall dilute the dust palliative product as needed, with the dilution ratio adjusted within the ranges specified in Section [792](#), to bring the mixture to the desired moisture content. Products may be applied in multiple passes at reduced application rates to meet the total application rate specified and/or assure uniform coverage.

The Contractor shall notify the Engineer a minimum of 5 working days prior to any application of dust palliative.

230.6.2 Topical Application: Topical applications shall be rolled only when recommended by the manufacturer. Complete penetration of palliative will be required prior to the surface rolling. Complete penetration occurs when the compaction equipment will not track or pick up the dust palliative and/or the top layer of the surface material.

230.6.3 Surface Course Application: The stabilization product shall be applied, incorporated and thoroughly blended into the soil until the homogeneous mixture is obtained to the full depth of treatment. Mixing shall be done in-place using mixing equipment or by motorized grader (blade mixing). The blending methods utilized shall result in a uniformly treated mixture of soil and dust palliative at or near optimum moisture content (minus any post-compaction dust palliative top coat application quantity). The dilution ratio may be adjusted to bring the mixture to the desired moisture content. The amount of area treated each day shall be limited to that which the Contractor can thoroughly mix and compact within that work day.

Complete penetration of palliative will be required prior to compaction. Complete penetration occurs when the compaction equipment will not track or pick up the blended material.

The blended material shall be shaped to the required grade line and cross-section shown on the plans and be compacted at least 95% of maximum density in accordance with ASTM D698, unless otherwise directed by the Engineer. The final surface shall be rolled to a smooth and even grade. Sufficient grading shall be done to provide reasonable drainage within the limits of existing drainage patterns. Immediately after the compaction, a top coat of dust palliative shall be applied.

230.7 CURING:

No equipment or traffic will be permitted on the treated surface for 24 hours unless otherwise approved by the Engineer. Once cured, the dust palliative final coat shall form a skin at the surface or a crusted surface. For purpose of this work, a “skin” on the surface will be a formation of any palliative on the surface of the soil that cannot be dislodged from the soil by winds. Any formation of the palliative on the soil surface must adhere to the underlying soil to a depth of 1/8th inch when applied topically.

230.8 WEATHER CONDITIONS:

Dust palliative/stabilizer product shall be applied only when the ambient temperature is above 50°F. Application should be avoided during high wind or when there is the chance of rain within the next 8 hours. The Contractor shall be responsible to retreat at no additional cost if the application is degraded by weather within the first 24-hours of placement.

SECTION 230

230.9 QUALITY CONTROL

The Contractor must provide manufacture-trained personnel for on-site technical assistance during initial delivery and application. This technical assistance is to assure that the dust palliative/stabilizer product is applied at proper dilution ratios and application rates on various soil, and subgrade types for optimum results.

At the start of each work day, the bulk tanker will be measured to verify the gallons of liquid dust palliative/stabilizer product brought to the job site. At the end of the day, the bulk tanker will be measured to verify the gallons of liquid dust palliative/stabilizer product remaining at the job site. The distributor truck shall be inspected to insure it is empty at the end of the day. The total gallons of liquid dust palliative/stabilizer product used for the day will be established by the start and end of day measurements of the bulk tanker.

A daily "Gallon Use Report" will be filled out by the distributor truck driver. The report will also identify the size of area treated for the day. It will be verified and signed by the Engineer or his designee. This report will be used to verify application rate and total product used. If the report indicates that the minimum application rate was not achieved, the work shall be deemed deficient by the Engineer.

230.10 DEFICIENCIES AND WARRANTY

If applied product active solids content is found deficient per Section [230.2.1](#), the Engineer may allow the Contractor to apply to any surfaces already treated by the deficient product additional topical coats of the dust palliative/stabilizer product to remedy the deficiency. Otherwise, the Contractor shall be required to repeat all work as directed by the Engineer with a different approved liquid dust palliative/stabilizer product that is compatible with the original product and will not result in adverse effects. The Contractor shall bear the cost of all remediation work for deficient product.

If the application rate as determined by the methods described in Section [230.9](#) or as agreed to in the contract documents is found to be deficient, the Contractor shall apply additional product within 24-hours of the original application to bring the total application rate to at least the minimum specified amount. If liquid dust palliative/stabilizer product was used as a soil stabilizer per Section [230.6.3](#), as directed by the Engineer, the Contractor shall re-scarify the stabilized section to its full depth and re-apply product at the original application rate. The Contractor shall bear the cost of all remediation work for deficient application rate.

For non-traffic areas (less than 150 vehicle trips per day), application of the dust palliative/stabilizer product placed in accordance with this Section shall provide a surface meeting the stabilization requirements of Maricopa County Rule 310 Section 302 and Maricopa County Rule 310.01 Section 302 for a minimum of 12 months from acceptance by the Engineer.

During the warranty period, the Contractor shall provide and install the product free of charge if the finished product fails to meet the performance requirement and specification/criteria outlined under this technical specification. The Contractor shall provide additional applications when within five working days of notification from the Engineer of performance failure.

230.11 MEASUREMENT:

Dust palliative surface course application shall be measured by the square yard, in place, treated, compacted, to the proper depth and accepted.

Dust palliative materials will be measured by the ton of undiluted material. Any conversion from volumetric quantities shall be done with Contractor-supplied calibration charts relating to the specific gravity of the concentrate and/or dilution.

230.12 PAYMENT:

Payment will be made for the applicable items at the Contract unit price and shall constitute full compensation for the item complete in place.

- End of Section -

This Page Reserved for Future Use

PART 300

STREETS AND RELATED WORK

Section	Last Revised	Title	Page
301	2014	Subgrade Preparation	301-1
306	2010	Mechanically Stabilized Subgrade-Geogrid Reinforcement	306-1
309	2014	Lime Slurry Stabilization or Modification of Subgrade	309-1
310	2015	Placement and Construction of Aggregate Base Course	310-1
311	2014	Placement and Construction of Cement Treated Subgrade	311-1
312	2012	Cement Treated Base	312-1
315	1998	Bituminous Prime Coat	315-1
317	2013	Asphalt Milling	317-1
320	1999	Road-mixed Surfacing	320-1
321	2015	Placement and Construction of Asphalt Concrete Pavement	321-1
324	2015	Portland Cement Concrete Pavement (PCCP)	324-1
325	2015	Placement and Construction of Asphalt-Rubber Asphalt Concrete	325-1
327	2012	Hot In-Place Recycling	327-1
329	1998	Tack Coat	329-1
330	1998	Asphalt Chip Seal	330-1
331	2009	Microsurfacing Specifications	331-1
332	2013	Placement and Construction of Asphalt Emulsion Slurry Seal Coat	332-1
333	2012	Fog Seal Coats	333-1
334	2012	Preservative Seal for Asphalt Concrete	334-1
335	2012	Placement and Construction of Hot Asphalt-Rubber Seal	335-1
336	2015	Pavement Matching and Surfacing Replacement	336-1
337	2014	Crack Sealing	337-1
340	2015	Concrete Curb, Gutter, Sidewalk, Curb Ramps, Driveway and Alley Entrance	340-1
342	2015	Decorative Pavement Concrete Paving Stone	342-1
343	1998	Exposed Aggregate Paving	343-1
345	2015	Adjusting Frames, Covers, Valve Boxes Meter Boxes and Pull Boxes	345-1
350	2013	Removal of Existing Improvements	350-1
355	2015	Utility Potholes-Keyhole Method	355-1
360	1998	Telecommunications Installation	360-1

This Page Reserved for Future Use

SECTION 301

SUBGRADE PREPARATION

301.1 DESCRIPTION:

This Section shall govern the preparation of natural or excavated areas prior to the placement of sub-base material, pavement, curbs and gutters, driveways, sidewalks or other structures. It shall include stripping and disposal of all unsuitable material including existing pavement and obstructions such as stumps, roots, rocks, etc., from the area to be paved.

301.2 PREPARATION OF SUBGRADE:

With the exception of areas where compacted fills have been constructed as specified in Section [211](#), in the areas where new construction is required, the moisture content shall be brought to that required for compaction by the addition of water, by the addition and blending of dry, suitable material or by the drying of existing material. The material shall then be compacted to the specified relative density. If pumping subgrade should become evident at any time prior to paving, the Engineer may require proof rolling with a pneumatic-tire roller or other approved equipment in order to identify the limits of the unacceptable area. The proof rolling will be performed at no additional cost to the Contracting Agency.

Subgrade preparation shall also include preparing the subgrade to the required line and grade for paved or unpaved shoulders, tapers, turnouts, and driveways, and at all other project locations where aggregate base and/or select material courses are used in accordance with the Project Plans.

301.2.1 The Contractor may use removed existing asphalt concrete and other existing bituminous roadway surfacing materials originating on the project site, as embankment fill. All materials used shall be thoroughly crushed to sizes not exceeding four inches, or as approved by the Engineer. These asphalt/bituminous materials shall be placed not less than two feet below finished subgrade elevation.

Project earthwork quantities when included as separate contract pay items will include removed asphalt/bituminous material volumes, unless otherwise specified in the Special Provisions.

All unsuitable material and all excess material shall be disposed of in accordance with the requirements of Sections [205.2](#) and [205.6](#), respectively. When additional material is required for fill, it shall conform to Section [210](#).

301.3 RELATIVE COMPACTION:

The subgrade shall be scarified and loosened to a depth of 6 inches. Rock 6-inches or greater in size that becomes exposed due to scarification shall be removed from the scarified subgrade. When fill material is required, a layer of approximately 3 inches may be spread and compacted with the subgrade material to provide a better bond. The subgrade cut and fill areas shall be constructed to achieve a uniform soil structure having the following minimum compaction, measured as a percentage of maximum dry density when tested in accordance with AASHTO T-99, Method A, and T191 or ASTM D6938 with the percent of density adjusted in accordance with the rock correction procedures for maximum density determination, ARIZ-227c¹ to compensate for the rock content larger than that which will pass a No. 4 sieve. Unless otherwise noted in the project plans or project specifications, compaction shall be performed within 2 percentage points of the optimum moisture content.

- | | |
|---|------------|
| (A) Below pavement, curb and gutter, attached sidewalk, roadway shoulders, and other areas within right-of-way subject to vehicular traffic | 95 percent |
| (B) Below detached sidewalk not subject to vehicular traffic | 85 percent |

301.4 SUBGRADE TOLERANCES:

Subgrade upon which pavement, sidewalk, curb and gutter, driveways, or other structures are to be directly placed shall not vary more than 1/4 inch from the specified grade and cross-section. Subgrade upon which sub-base or base material is to be placed shall not vary more than 3/4 inch from the specified grade and cross-section. Variations within the above specified tolerances shall be compensating so that the average grade and cross-section specified are met.

⁽¹⁾Arizona Department of Transportation test method.

SECTION 301

301.5 GRADING OF AREAS NOT TO BE PAVED:

Areas where grade only is called for on the plan shall be graded to meet the tolerances for the subgrade where subbase or base material is to be placed. The surface shall be constructed to a straight grade from the finished pavement elevations shown on the plans to the elevation of the existing ground at the extremities of the area to be graded.

301.6 PROTECTION OF EXISTING FACILITIES:

The Contractor shall exercise extreme caution to prevent debris from falling into manholes or other structures. In the event that debris should fall into a structure it shall immediately be removed.

301.7 MEASUREMENT:

Measurement for Subgrade Preparation will be by the square yard. The area to be measured will be the total accepted area of new asphalt concrete pavement and new portland cement concrete pavement (PCCP), including paved shoulders, tapers, turnouts, and unpaved roadway shoulders. Subgrade Preparation area measured will also include the accepted surface area of driveways that are surfaced with aggregate base, or select materials and non-surfaced areas designated for vehicle traffic.

Except for PCCP, the area under portland cement concrete surfaces such as concrete curb and gutter, sidewalk, concrete driveways and driveway entrances, and concrete alley entrances will not be included in the Subgrade Preparation measurement.

Project earthwork quantities for Roadway Excavation, Borrow Excavation, and Fill Construction shall not be separately measured when they are not listed as separate line items on the fee proposal form. In such case, unless otherwise specified, payment for said earthwork items shall be included in the unit price for Subgrade Preparation.

301.8 PAYMENT:

Payment for Subgrade Preparation will be made only when it is performed for street or roadway paving projects.

Payment shall be compensation in full for stripping, scarifying, grading, excavating, hauling, filling, compacting, and disposing of excess or unsuitable materials, together with all costs incidental thereto.

- End of Section -

⁽¹⁾Arizona Department of Transportation test method.

SECTION 306

MECHANICALLY STABILIZED SUBGRADE - GEOGRID REINFORCEMENT

306.1 DESCRIPTION:

Mechanically stabilized subgrade shall consist of furnishing and placing a geogrid material within or below untreated base to provide a stabilized platform on which paving materials are placed. Geogrid type, fill thickness, pavement cross-section and associated details, shall be as shown on the contract drawings.

306.2 MATERIALS:

The geogrid material shall be supplied in accordance with and conform to the material requirements of Section [796](#) and Table [796-4](#).

306.3 SUBGRADE PREPARATION:

The geogrid shall not be placed when weather or surface conditions do not meet the manufacturer's recommendations for installation.

306.3.1 Placing Geogrid on Soft Subgrade: Prior to placement of geogrid material, soft subgrade shall be lightly proof rolled to provide a firm surface, brought to grade and shaped to conform to the typical sections, lines and grades as shown on the plans. The surface on which the geogrid will be placed shall be free of rock and other material that could damage the geogrid. The placement of the geogrid shall be approved by the Engineer before placement of overlaying materials.

Subgrade tolerances shall be in accordance with MAG Section [301.4](#).

306.3.2 Placing Geogrid Within Untreated Base: Subgrade shall be prepared in accordance with MAG Section [301](#).

306.4 EQUIPMENT:

Mechanical or manual laydown equipment shall be capable of laying the geogrid properly and smoothly, in compliance with the manufacturer's recommendations.

306.5 GEOGRID PLACEMENT:

The geogrid shall be installed in accordance with the installation guidelines provided by the manufacturer or as directed by the Engineer.

The geogrid may be temporarily secured in place with ties, staples, pins, sand bags or acceptable fill material as required by fill placement procedures, weather conditions, or as directed by the Engineer. A 12-inch minimum secured overlap is required at all joints (both transverse and longitudinal). At transverse joints, the preceding roll shall overlap the following roll in the direction that the aggregate base will be placed. The geogrid shall be rolled out along the alignment in the direction of advancing construction. All wrinkles and folds shall be removed.

The geogrid shall be tensioned by hand and anchored to the ground at the edges, including overlaps, and in the center of the roll at 30-foot intervals along the roll length, at the corners if applicable, or as directed by the Engineer. Securing locations may be reduced or eliminated if it can be shown to the satisfaction of the Engineer that an alternative installation process will provide satisfactory results.

Geogrid shall be placed to obtain full coverage of the indicated area. Placement of geogrid on irregular shaped areas and radii may require cutting of the geogrid material and the use of diagonal overlapping joints. Buckling of geogrid material will not be allowed.

SECTION 306

306.6 PLACING AND COMPACTING AGGREGATE FILL:

The aggregate shall be back dumped and spread in a uniform lift maintaining the design aggregate thickness at all times. The aggregate material shall be bladed on the geogrid in such a manner that the aggregate rolls forward onto the grid ahead.

When underlying substrate is trafficable with minimal rutting, rubber-tired equipment may pass over geogrid reinforcement at slow speeds (less than 10 mph). Sudden stops and turning by trucks shall be avoided on the geogrid. Traffic shall not be allowed onto coated geogrid materials. A minimum loose fill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid. Turning of tracked vehicles shall be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

Any ruts which develop during spreading or compacting aggregate fill shall have additional aggregate added rather than bladed from surrounding areas. Placing additional aggregate into the rutted areas limits disturbance to the underlying geogrid keeping it intact.

Untreated base shall be compacted as specified in Section [310](#). Untreated base material shall not be mixed or processed on the geogrid. Base materials will be uniformly blended and sampled for acceptance prior to placement on the geogrid material. Contamination and segregation of base materials during placement shall be minimized.

306.7 REPAIR:

Any geogrid material damaged before, during or after installation shall be replaced by the contractor at no additional cost to the Agency.

Replacement of geogrid reinforcement shall consist of removal and replacement of the geogrid and aggregate fill from the defective area. The aggregate fill shall be removed at least 3 feet beyond the limits of the defective area. The replacement geogrid shall be installed with proper overlaps. Aggregate fill replacement shall not commence until placement of the geogrid material has been inspection and approved.

306.8 PAYMENT:

The surface area of accepted in-place geogrid reinforcement will be measured to the nearest square yard.

Payment for geogrid reinforcement at the contract unit price shall be full compensation for furnishing all labor, material, equipment, and installing complete in place the geogrid as shown on the project plans.

- End of Section -

SECTION 309

LIME STABILIZATION OR MODIFICATION OF SUBGRADE

309.1 DESCRIPTION:

This section shall consist of constructing a mixture of soil, lime and water for the stabilization or modification of subgrade soils. The work shall be performed in conformity with the lines, grades thickness, and typical cross sections shown on the plans.

According to the National Lime Association, "Stabilization: When adequate quantities of lime and water are added, the pH of the soil quickly increases to above 10.5, which enables the clay particles to break down. Determining the amount of lime necessary is part of the design process and is approximated by tests such as the Eades and Grim test (ASTM D3276). Silica and alumina are released to react with calcium from the lime to form calcium-silicate-hydrates (CSH) and calcium-aluminate-hydrates (CAH). CSH and CAH are cementitious products similar to those formed in Portland cement. They form the matrix that contributes to strength of lime-stabilized soil layers. As this matrix forms, the soil is transformed from a sandy, granular material to a hard, relatively impermeable layer with significant load bearing capacity. The process begins within hours and can continue for years in a properly designed system. The matrix formed is permanent, durable, and significantly impermeable, producing a structural layer that is both strong and flexible."

Lime modification may be used to "Dry-up of wet soil at a construction sites" or "include treating fine-grained soils or granular base materials to construct temporary haul roads or construction platforms."

309.2 MATERIALS:

309.2.1 Soil or Subgrade: For lime stabilization applications, the soil or subgrade material used for this work shall consist of materials on the site or imported, and shall be free of roots, sod, weeds and stones larger than 3 inches and have a plasticity index (PI) greater than 10, when tested in accordance with AASHTO T-146 Method A, AASHTO T-89 Method A, and T-90. For lime modification applications, the allowable soil or subgrade properties will be determined by the Engineer.

309.2.2 Quicklime and Hydrated Lime: Lime used shall be either quicklime or hydrated lime and shall conform to the requirements of ASTM C977. All lime shall come from a single source. If a source change is requested, a new mix design shall be submitted using lime from the proposed new source. The new design must be approved by the Engineer prior to use.

309.2.3 Lime Slurry: Lime slurry shall be a pumpable suspension of solids in water. The solids portion of the mixture, when considered on the basis of solids content, shall consist principally of hydrated lime of a quality and fineness sufficient to meet Section [309.2.2](#) requirements. A certificate of compliance shall be provided to the Engineer for each load of lime applied at the project.

309.2.4 Water: Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Water shall be tested in accordance with and shall meet the suggested requirements of AASHTO T-26. Water known to be of potable quality may be used without test.

309.3 COMPOSITION:

309.3.1 Lime Stabilization Mix Design: Before commencing lime treatment work, the Contractor shall submit for approval by the Engineer, a proposed mix design. The proposed mix design shall be prepared by a testing laboratory under the direction and control of a registered professional engineer. The mix design shall be determined using the soils or subgrade material to be stabilized and lime from the proposed supplier, and shall determine the following:

For soil stabilization applications, the mix design shall report and comply with the following requirements:

Untreated Soil:

- (a) Sulfates: Tested per ARIZ 733, AASHTO T-290, or ASTM C1580.
- (b) Moisture-Density Relationship (Proctor): Tested per ASTM D698A.
- (c) Plasticity Index: Test method AASHTO T-146 Method A, AASHTO T-89 Method A, and T-90.
- (d) Sieve Analysis and Minus No. 200 Wash: Test methods ASTM C136 and ASTM D1140.

SECTION 309

Lime Treated Soil:

- (a) pH: Lime saturation content per ASTM C977 APPENDIX or ASTM D6276.
- (b) Plasticity Index: Less than 3, per AASHTO T-146 Method A, AASHTO T-89 Method A, and T-90.
- (c) Swell Potential: Maximum expansive potential of 1.0 per ARIZ 249 using passing No. 4 sieve material. The maximum expansive potential shall be determined on a sample compacted to approximately 95 percent of the ASTM D698A maximum dry density at approximately 2% below optimum moisture content. The sample should be confined under a 100 psf surcharge and inundated.
- (d) Unconfined Compressive Strength: Minimum 160 psi per ASTM D5102 Procedure A, after five days curing at 100°F, sealed in air-tight condition.
- (e) Mellowing time and mellowing moisture content for treated soil sections b and c to be determined by design engineer. Mellowing time and mellowing moisture content for treated soil section d determined by ASTM D5102.
- (f) Hydrated Lime Content: The design engineer shall designate the minimum percentage of lime by dry weight of the dry soil to satisfy the criteria for Section [309.3.2](#) requirements. The percentage of lime specified shall be sufficient to allow for expected variations during the mixing process. A minimum of 5.0% hydrated lime by dry weight of the dry soil is required for all mix designs.

309.3.2 Lime Modification: For soil modification purposes only, the Engineer shall specify the minimum amount of hydrated lime or lime slurry required to meet the desired improved soil properties.

309.4 CONSTRUCTION:

309.4.1 General: It is the primary requirement of this specification to secure a completed subgrade containing a uniform lime mixture free from loose segregated areas, of uniform density and moisture content, well bound for its full depth, and with a smooth surface suitable for placing subsequent courses.

Prior to beginning any lime stabilization or modification, the subgrade shall be constructed and brought to grade and shall be shaped to conform to the typical sections, lines and grades as shown on the plans.

Lime shall be applied at the mix design rate for the depth of subgrade stabilization or modification shown on the plans or requested by the Engineer.

When the design requires treatment to a depth greater than 12 inches, the subgrade soil shall be treated in equal layers. The top layer(s) of soil shall be removed and stockpiled. The lower layer of soil to be treated shall then be treated and allowed to cure in place. After final mixing, the lower layer shall be compacted in maximum 12 inch thick compacted lifts. The stockpiled soil shall then be placed, treated, mixed and compacted in successive maximum 12 inch thick compacted lifts.

309.4.2 Weather Limitation: Lime treated subgrade shall not be constructed if the ambient temperature is below 40° F or when conditions indicate that temperatures may fall below 40° F within 24 hours.

309.4.3 Equipment: Contractor shall provide all equipment necessary to complete the work including grading and scarifying equipment, a spreader of the lime, mixing and pulverizing equipment, sheepsfoot and pneumatic rollers, sprinkling equipment and trucks. Gravity feed or tailgate spreading, defined as not having automatic controls, will not be permitted. The spreader shall demonstrate the ability to maintain a consistent spread rate over variable travel speeds. All equipment used for this work is subject to approval by the Engineer.

309.4.4 Application: Lime shall be spread only on that area where the mixing operation can be completed during the same working day. The lime application rate shall be at the design content to +0.5%, based on weight of dry soil. The Engineer reserves the right to vary the rate of application of lime from the mix design during the progress of construction as necessary to maintain a pH of the lime/soil mixture above 12.0 and the desired characteristics of the treated subgrade.

For all lime applications, the Contractor shall provide the Engineer with daily application quantities.

309.4.4.1 Quicklime Application: Quicklime shall only be applied by approved spreader trucks equipped with operating dust collectors to minimize dust issues while loading. Additionally, dust control measures must be utilized during the spreading and soil mixing of quicklime. Contractor shall exercise safety measures when mixing quicklime with water.

SECTION 309

309.4.4.2 Dry Hydrated Lime Application: Hydrated lime shall only be applied by approved spreader trucks equipped with operating dust collectors to minimize dust issues while loading. Additionally, dust control measures must be utilized during the spreading and soil mixing of dry lime.

309.4.4.3 Lime Slurry Application: Lime slurry shall be mixed in a portable mixing unit and spread with trucks equipped with an approved distribution system. Lime slurry shall be applied at a rate that will yield the required lime percentage determined by the mix design.

309.4.5 Mixing: The full depth of the treated subgrade shall be mixed with an approved mixing machine. The use of disc plows or blades are strictly prohibited except in areas specified by the Engineer. To insure a complete chemical reaction of the lime and soil or subgrade, water shall be used as required to maintain moisture content at optimum to +4% above the optimum of the lime treated mix design proctor, prior to beginning compaction. During the interval of time between application and mixing, lime that has been applied, unmixed and exposed to the open air for 10 hours or more will not be accepted. No traffic other than the mixing equipment will be allowed to pass over the spread of lime until after completion of mixing.

After mixing and prior to compaction, clay lumps shall meet the following criteria:

	<u>Percent</u>
Minimum of clay lumps passing 1-1/2 inch sieve	100
Minimum of clay lumps passing No. 4 sieve	60

309.4.6 Compaction: Compaction of the mixture shall begin after final mixing and shall be accomplished in accordance with the design specifications. Areas inaccessible to conventional rolling equipment shall be compacted to the required density by methods approved by the Engineer. Mellowing time and mellowing moisture content shall be specified by the mix design and performed prior to final compaction.

The material shall be aerated or watered as necessary to provide and maintain required moisture content. A composite of treated soil or subgrade materials from a minimum of five (5) random locations, per soil type, within the area to be stabilized shall be used to determine the maximum dry density and optimum moisture content in accordance with ASTM D698. The field density of the compacted mixture shall be at least 95 percent of the maximum dry density of the field sampled proctor. The in-place compacted field density shall be determined in accordance with ASTM D1556, sand cone, or ASTM D6938, nuclear gauge. In the event of disputed results, the nuclear gauge density shall be correlated to the referee sand cone density while the nuclear water content shall be correlated to the referee ASTM D2216 water content. The adjustment for rock larger than the no. 4 sieve shall be performed in accordance with ASTM D4718.

After each section is completed, tests will be made by the Engineer. If the material fails to meet the density requirements and finished requirements, it shall be reworked to meet requirements at no additional cost to the Contracting Agency.

309.4.7 Thickness: The thickness of the lime treated subgrade shall be determined by visual inspection and/or by depth tests taken at intervals so that each test shall represent no more than 1000 square yards per layer. If more than one layer, the method used to remove material to determine the depth of lime treatment may be by shovel and/or pick, coring or other method approved by the Engineer. Phenolphthalein solution shall be used to detect the presence of lime. When the grade deficiency is more than 1 inch, the Contractor shall correct such areas in a manner satisfactory to the Engineer. Contractor shall replace, at no cost to the Contracting Agency, the material where depth tests are taken.

All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required, and reshaping and recompacting. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until other work is placed thereupon or the work is accepted. Compaction and finishing shall be done in such a manner as to produce a smooth dense surface free of compaction planes, cracks, ridges or loose materials.

Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion, shall be smooth and shall conform with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density, and finish before the next course is placed or the work is accepted, it shall be recompacted and refinished at no cost to the Agency.

309.4.8 Finishing and Curing: After the final layer or course of lime treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the plans. The completed section shall then be finished by rolling with a pneumatic or other suitable roller.

SECTION 309

Each layer of lime treated subgrade shall be maintained in a moist condition until the next layer of pavement structure is placed. If required, a fog seal for curing, in compliance with Section [333](#), shall be furnished and applied to the surface of the final layer of the lime stabilized material as soon as possible after the completion of final rolling and before the temperature falls below 40° F. Curing seal shall be applied at a rate between 0.10 and 0.20 gallons per square yard of surface. The exact rate will be determined by the Engineer.

After curing begins, all traffic, except necessary construction equipment shall be kept off the lime stabilized subgrade for a minimum of 7 days or until the final pavement structure layer(s) are placed. As an alternative, the Contractor may place a loose lift of aggregate base course over the curing subgrade. The aggregate base course should be kept moist during the curing process.

309.4.9 Maintenance: The Contractor shall maintain, at his/her own expense, the entire lime treated subgrade in good condition from the start of work until all the work has been completed, cured and accepted by the Engineer.

309.5 MEASUREMENT:

The quantity of lime slurry treated soils shall be measured by the square yard, measured in place, treated, compacted, to the proper depth, and accepted.

The quantity of curing seal shall be measured by the ton.

309.6 PAYMENT:

The lime treated soils measured as provided above, will be paid for at the contract price per square yard, which price shall be full compensation for the item complete, as herein described and specified.

The Owner or Engineer reserves the option to pay for the lime separately. Should this option be chosen, the lime treated soils measured as provided above will be paid for at the contract price per square yard which shall include full compensation for the item less lime, as herein described and specified. The lime materials will be paid for by the contract price per ton based on hydrated lime. If quicklime in slurry form is used there will be an additional pay factor of 1.3 applied to determine the actual amount of hydrated lime placed.

Payment for curing seal will be by the ton, based on the rate of application as requested by the Engineer.

- End of Section -

SECTION 310

PLACEMENT AND CONSTRUCTION OF AGGREGATE BASE COURSE

310.1 DESCRIPTION:

Aggregate base course shall comply with Section [702](#) unless the use of a different type of material is specifically authorized in the special provisions.

310.2 PLACEMENT AND CONSTRUCTION:

The compacted lift thickness shall not exceed 6 inches, unless approved by the Engineer. Based on the type of material, type of equipment and compaction methods used, the Contractor may propose a greater lift thickness to the Engineer for approval.

After distributing, the aggregate base course material shall first be uniformly watered and then graded to a uniform layer that will net, after compacting, the required thickness. The grading operation shall be continued to such extent as may be necessary to minimize segregation. The quantity of water applied shall be that amount which will assure proper compaction resulting in the density required by Section [310.3](#).

After placement, the aggregate base course surface shall be true, even and uniform conforming to the grade and cross-section specified. In no case shall the aggregate base course vary by more than ½ inch above or below required grade.

310.3 COMPACTION

The contractor is responsible for providing appropriate equipment and techniques to achieve the compaction results required by this specification. The aggregate base course shall be compacted in lift thicknesses as allowed by Section [310.2](#).

The laboratory maximum dry density and optimum moisture content for the aggregate base course material shall be determined in accordance with AASHTO T-99. (Note: when testing base materials – use method “C” or “D” as required based upon the gradation of the material.) Field ‘one-point’ maximum dry density and optimum moisture procedures shall only be allowed upon approval of the Engineer.

The in-place density shall be determined in the field by nuclear density testing in accordance with AASHTO T-310 or sand cone density testing in accordance with AASHTO T-191. In the event nuclear density testing is selected, and density results are in question, a sand cone correlation will be performed by the accepting agency at the contractor’s request, not to exceed one sand cone for each ten nuclear density tests.

A rock correction, to compensate for rock content larger than the #4 or ¾ inch sieves (as required by the laboratory maximum dry density and optimum moisture procedure selected), shall be performed in accordance with AASHTO T-224. Care should be taken to account for the specific gravity of the oversize particles particularly if recycled materials are utilized for aggregate base course. The specific gravity shall be determined in accordance with ARIZ-227c, as applicable.

For roadway construction, a minimum of one field density test shall be performed per lift per 660 feet per lane. For other aggregate base course applications, a minimum of one field density test shall be performed for each 800 square yards.

Unless otherwise noted in the project plans or project specifications, the moisture content of the aggregate base course at the time of compaction shall be the optimum moisture content +/- 3%.

The following percent compaction is required:

(A) Below asphalt concrete pavement	100%
(B) Below Portland cement concrete pavement, driveways, curb & gutter, sidewalks, and roadway shoulders	95%
(C) All other areas not subject to vehicular traffic	85%

SECTION 310

Areas which fail initial testing for density and/or moisture content shall be reworked until passing tests for density and/or moisture content are achieved. Lower moisture content percentages at the time of field density testing may be allowed if significant time has passed since the time of compaction and the required density has been achieved.

310.4 THICKNESS AND/OR PLASTICITY INDEX DEFICIENCY:

When in the opinion of the Engineer there is reason to believe that a deficiency in thickness, or an excess of plasticity exists, measurements or samples will be taken in the same pattern as that defined in Section 321. If the base has been covered or it is otherwise impractical to correct the deficiency, the corrective measures in Table 310-1 shall be taken by the Contractor at no additional cost to the Contracting Agency.

TABLE 310-1		
THICKNESS AND PLASTICITY DEFICIENCY		
Type	Deficiency	Corrective Measure
I	Less than 1/2 inch of the required thickness	No corrective measure required.
II	1/2 inch or more but less than 1 inch of the required thickness	(1) The contractor may choose to add additional material and rework the grade to meet the specification requirements. (2) The contractor may choose to increase the thickness of asphalt concrete by the amount of the aggregate base course thickness deficiency at no additional cost to the Owner. Required grade shall be met.
III	Thickness deficiency by greater than 1 inch	(1) The contractor will remove the aggregate base course and regrade the subgrade to allow the required aggregate base course layer thickness to be constructed. (2) If grades allow, the contractor may propose that the thickness of asphalt concrete be increased by the amount of the aggregate base course deficiency at no additional cost to the Owner.
IV	A plasticity index of 6 to 7 inclusive or gradation deficiency	(1) An Engineering Analysis (EA) that includes R-value testing may be prepared by the contractor to evaluate the expected performance of the aggregate base course layer. The EA may provide mitigation options for the Engineer to consider. If the Engineer accepts the plasticity index as a result of the EA, the material will be accepted at full payment. If the Engineer rejects the EA, the contractor will perform either option 2 or 3 below. (2) The contractor may choose to reprocess or treat the existing material to bring it within specification limits or remove deficient material from affected area and replace with material complying with the specifications. (3) If grades allow, the contractor may increase the thickness of asphalt concrete by 1/2-inch at no additional cost to the Owner.
V	A plasticity index of over 7	(1) The contractor may choose to reprocess or treat the existing material to bring it within specification limits or remove deficient material from affected area and replace with material complying with the specifications.

SECTION 310

310.5 PAYMENT:

Payment for aggregate base course will be made on the basis of the contract unit price per ton unless an alternate basis of payment is provided in the proposal.

- End of Section -

SECTION 311

PLACEMENT AND CONSTRUCTION OF CEMENT TREATED SUBGRADE

311.1 DESCRIPTION:

This item shall consist of a cement treated subgrade composed of a mixture of local soil, Portland cement, and water compacted at optimum moisture content.

311.2 MATERIALS:

Portland cement and water shall comply with Sections [725](#). The soil for the mixture shall consist of the material in the area to be paved. The material shall not contain more than 5 percent gravel or stone retained on a 3 inches sieve. It shall be demonstrated by laboratory tests that the plasticity and strength characteristics as defined in Section [311.4.5](#) of the soil will be adequately modified by the specified cement content.

311.3 EQUIPMENT:

An ample number of machines, combination of machines and equipment shall be provided and used to produce the complete soil cement treated layer meeting the requirements for soil pulverization, cement distribution, water application, incorporation of materials, compaction, finishing, and for application of the curing material as provided in these specifications.

Mixing shall be accomplished by means of multiple-pass soil-cement mixer, single-pass soil-cement mixer or central plant mixer.

Water may be applied through the mixer or with the water trucks equipped with pressure sprays. Water trucks providing fine fog-type sprays shall be furnished for finishing and curing. Properly adjusted garden type nozzles on a pressure bar may be used to produce fog spray if approved by the Engineer.

Cement spreader shall be a specially constructed device to distribute bulk cement at the specified rate. The spreader shall have the ability to maintain a consistent spread rate over variable travel speeds.

311.4 CONSTRUCTION METHODS:

Prior to construction, the contractor shall remove all deleterious material, organic material, and particles retained on the 3 inch sieve from the area to be treated. The soil shall be brought to a compacted condition, true to line and grade as directed by the Engineer or as shown on the plans. The compacted soil and surface shall be approved by the Engineer prior to proceeding with mixing.

The material shall be scarified, pulverized, mixed with water and cement, compacted, finished and cured in lengths permitting the full roadway width to be complete in not more than 4 hours from the time that cement is exposed to water. Such lengths will generally be not less than 600 feet or the length of one City block and preferably more. Where a gutter section exists the material shall be pulled back from the gutter face for the full depth of the course before processing.

311.4.1 Pulverizing: Prior to application of cement, soil to be processed shall be scarified to depth of base. The material shall be damp at time of scarifying to reduce the dust generation and to aid in pulverization. Soil shall be pulverized until not less than 80 percent, exclusive of gravel or stone, will pass a No. 4 sieve.

311.4.2 Application of Cement: The quantity of cement shall be by weight as a percentage of the dry weight of the soil as determined by the laboratory and/or as directed by the Engineer and shall be applied uniformly on the soil in a manner satisfactory to the Engineer. The allowable deviation in uniformity shall not exceed 10 percent. The entire operation of spreading and mixing shall be conducted in such a manner as will result in a uniform soil cement and water mixture for the full design width and depth.

The percentage of moisture in the soil, at the time of cement application, shall not exceed the quantity that will permit a uniform and intimate mixture of the soil and cement during mixing operations, and it shall not exceed the specified optimum moisture content for the soil cement mixture.

SECTION 311

311.4.3 Mixing: Mixing with addition of water as required shall be continued until the product is uniform in color and at optimum moisture content to +4% of optimum moisture content as determined in accordance with ASTM D558. Any mixture of soil and cement which has not been compacted and finished shall not remain undisturbed for more than 30 minutes but shall be agitated by remixing.

311.4.4 Optimum Moisture: Optimum moisture requirements and field tests of moisture density shall be determined in accordance with ASTM D558, and D6938, with moisture content periodically corrected in accordance with AASHTO T-217 on representative samples of soil cement mixture obtained from the area being processed. At the time of compaction, the moisture content shall not be below optimum moisture, and shall be less than that quantity which will cause the base course to become unstable during the compaction and finishing process. Any area which becomes so unstable shall be removed and replaced with new cement stabilized material.

311.4.5 Compressive Strength: Laboratory compressive strength testing of the cement treated subgrade is required to evaluate the proposed amount of cement and/or verify the compressive strength achieved during construction. Laboratory compressive strength testing shall be done in accordance with ARIZ-241.

311.4.6 Compaction: After mixing is complete, the mixture shall be carefully placed in a uniform loose depth which will provide a surface true to grade and section when compacted. Unless otherwise directed by the Engineer, initial compaction shall be by means of a tamping, grid, or pneumatic roller. After the tamping roller has partially walked out, pneumatic rollers shall be used. Density of final product shall be not less than 95 percent as determined by ASTM D6938 as specified above.

311.4.7 Finishing: As compaction nears completion, the surface of the base course shall be shaped to required lines, grades and cross-section. When required, the surface shall be lightly scarified with spike tooth harrows or other approved equipment to remove imprints left by equipment or to prevent slippage planes. During the finishing process the surface shall be kept moist by means of fog-type sprays. Surface finish and final compaction shall be completed in not more than 2 hours from the time the cement is exposed to water. The completed base course shall be true to line, grade, cross-section and shall not vary more than ½ inch in thickness and not more than 1 inch in surface tolerance when tested with a 10 foot straight edge. It shall be free of surface cleavage planes, cracks, or loose material. As a final operation, the surface shall be very lightly scalped with a motor grader, wet with a fog spray and rolled with a pneumatic roller as directed by the Engineer.

311.4.8 Thickness Deficiency: The Engineer may choose to have cores obtained to evaluate the thickness of the treated cement stabilized subgrade layer. Should the thickness of the treated layer not meet the project specifications, the Engineer may require the contractor to submit an Engineering Analysis (EA) to address the pavement section. The EA will provide an opinion as to the anticipated performance of the pavement section as a result of the reduced cement treated layer thickness and make recommendations on possible corrective actions. The Engineer shall determine what corrective actions, if any, are required.

311.4.9 Curing: Each layer of cement treated subgrade shall be maintained in a moist condition until the next layer of pavement structure is placed. If required, a fog seal for curing in compliance with MAG Section [333](#), shall be furnished and applied to the surface of the final layer of the cement stabilized material as soon as possible after completion of final rolling and before the ambient temperature falls below 40° F. Curing seal shall be applied at a rate between 0.10 and 0.20 gallons per square yard of surface. The exact rate shall be determined by the Engineer.

After curing begins, all traffic, except necessary construction equipment shall be kept off the cement stabilized subgrade for a minimum of 7 days or until the final pavement structure layer(s) are placed. As an alternative, the contractor may place a loose lift of aggregate base course over the curing subgrade. The aggregate base course shall be kept moist during the curing process.

311.4.10 Construction Joints: At the end of each day's work, a construction joint shall be made transverse to the centerline of the road by cutting back into the work to provide a full depth vertical joint. Except where specifically authorized by the Engineer, no other construction joints will be permitted. Where authorized, such joints shall be full depth vertical joints.

311.4.11 Maintenance: The Contractor shall maintain the surface until it has been covered with the designated bituminous wearing course. In case it is necessary to replace any soil cement, it shall be for the full depth. No skin patches or soil cement will be permitted. Minor surface pits may be filled with compacted bituminous surfacing, if authorized by the Engineer. Immediately prior to the placing of the bituminous wearing course, the surface shall be broomed to remove all loosened material from the surface.

SECTION 311

311.5 MEASUREMENT:

Measurement of soil cement will be the number of square yards constructed to the required depth, completed and accepted.

Measurement of Portland cement will be the number of tons of cement mixed with local soil.

311.6 PAYMENT:

Payment will be made for the applicable items at the contract unit prices bid in the proposal, and shall constitute full payment for furnishing all material, equipment, tools, labor and incidentals necessary to complete the work and for carrying out the maintenance provisions.

No measurement or payment will be made for any imported earth materials.

- End of Section -

SECTION 312

CEMENT TREATED BASE

312.1 DESCRIPTION:

Cement treated base shall consist of a combination of base material and Portland cement as specified in Section [705](#).

312.2 GENERAL:

When the mixing of cement treated base in a stationary mixer is required, it will be so specified. Otherwise, cement treated base may be mixed in either a traveling plant or in a stationary plant, at the option of the Contractor.

If the cement treated aggregate is mixed in a central plant, it shall not contain moisture in excess of 1 percent above or below optimum at the time of delivery on the grade. Certain types of transit mixers will not discharge such material unless it is greatly in excess of optimum moisture. Use of such mixers will not be permitted.

If the material is mixed in place, the machine or combination of machines used shall be capable of thoroughly mixing the cement and aggregate, when using the granular material specified, in a single pass. No lift thickness shall exceed 8 inches. If the thickness required is in excess of 8 inches, it shall be mixed in 2 separate lifts of equal thickness.

312.3 CONSTRUCTION METHODS:

Mixing of materials, regardless of the type of mixer used or method employed shall be continued until the cement and water are evenly distributed throughout the aggregate, and a mixture of uniform appearance is obtained.

The amount of cement used shall conform to requirements of Section [705](#). Cement delivered in standard sacks from commercial producers will be assumed to weigh 94 pounds per sack and need not be weighed. Bulk cement or fractional sacks of cement shall be weighed.

The amount of water used shall be that required to give optimum moisture content. A portion of the required water may be added to the aggregate prior to the addition of the cement, if approved. Moisture content of the material delivered to the grade shall be checked for moisture content a minimum of four times per shift using AASHTO T-217. Batch adjustments shall be made as necessary to correct for deficiencies.

After spreading, the cement treated base shall be compacted to a density of at least 95 percent of the maximum density as determined by the mix design. Density testing shall be performed using ASTM D6938, with moisture content periodically corrected in accordance with AASHTO T-217.

Compressive strength of the cement treated base material shall be tested a minimum of twice per shift using Arizona ARIZ-241. Strength specimens shall be compacted on site and protected from moisture loss or disturbance by any practical means. Specimens shall be kept in this manner on site for 18-24 hours inside a hard outer shelled container that will protect the specimens from external environmental elements. The specimens shall be carefully transported to the laboratory for moist curing after this initial 18-24 hour cure.

After compaction, the surface of the cement treated base course shall not deviate at any point more than 3/8 inch from the lower edge of a 10-foot straightedge laid parallel to the centerline of the roadway.

A construction joint shall be made at the end of each day's construction by trimming the end of the compacted mixture to a straight vertical plane, normal to the centerline of the roadway and with the vertical edge in thoroughly compacted material.

Cement shall not be added to more material than will be mixed, compacted and sealed the same day. Cement treated base shall not be mixed or placed when either the aggregate or subgrade is frozen. The air temperature shall be at least 40°F. in the shade and rising at the time of mixing.

In areas which are inaccessible to the mixing, spreading or compacting equipment designated herein, other methods and equipment acceptable to the Engineer may be utilized.

The mixed material shall not remain undisturbed on the subgrade for more than 30 minutes and not more than 3 hours shall elapse between the time water is added to the mixture and final compaction is accomplished.

SECTION 312

The mixed materials shall be spread for the full width of the base under construction, either by one spreader or by several spreaders operating in a staggered position across the subgrade, unless permission is granted to do part-width construction. Should permission be granted for part-width construction, not more than 30 minutes shall elapse between the times of placing the material in adjacent lanes at any location, and the longitudinal joint against which additional mixed material is to be placed shall be trimmed to a straight vertical plane parallel to the centerline of the roadway. Trimming shall be done in such a manner as to cause the least possible loosening of the compacted base material and to leave no loose material on the subgrade. The material cut away in trimming may be used in the construction of the shoulders or the adjacent lanes if approved, or shall be disposed of in a satisfactory manner.

During mixing, spreading and compacting and until the application of the curing seal, any moisture lost by evaporation shall be replaced by the addition of water by means of a light fog or fine spray.

The mixed base materials shall be covered as soon as possible after final compaction and shall be cured in accordance with this specification.

312.4 TRAVELING PLANT MIXING:

312.4.1 Placing Aggregate: The aggregate to be treated shall be placed on the roadway either as a uniform layer which, when compacted, will produce a base of the depth and width shown on the plans or as one or more windrows which, when spread, will yield a uniform layer which will compact to the prescribed dimensions. If the aggregate is placed in one or more windrows, a windrow sizer will be required. The number and size of the windrows may vary, depending on the width and depth of treatment and on the capacity of the machine, but regardless of size, the windrow shall be uniform in cross-section and shall not be larger than can be handled by the plant.

Care shall be exercised during the placement of the aggregate to prevent segregation of the fine and coarse portion of the aggregate.

312.4.2 Placing Cement: Cement shall be added to the uniform layer or windrow of aggregate by means of mechanized equipment which will spread the cement in correct and uniform quantities. For any section of roadway, the quantity of cement placed by mechanical spreaders shall not deviate more than 10 percent from the computed quantity for the section. When cement is applied to a windrow, the top of the windrow shall be slightly trenched to retain the spread of cement.

If storm winds cause a loss of spread cement, spreading operations shall be halted until such winds subside and, at the first indication of losses, prompt action shall be taken to avoid further losses. If cement losses are deemed excessive, the deficient quantity shall be furnished and added in the proper amount by the Contractor at no additional cost to the Contracting Agency.

312.4.3 Mixing: Mixing shall be accomplished by means of an approved single pass traveling continuous mixing machine, or combination of machines, of the pug or auger type. The machine shall be so constructed that the device for picking up or mixing the aggregate can be controlled and during the mixing operations it shall be set to mix the aggregate, cement and water to the design depth without cutting into or disturbing the subgrade or picking up any material other than that material to be processed. The machine shall be equipped so that water may be introduced at the time of mixing through a metering device which will accurately and uniformly control and measure the amount of water being used.

The cement and aggregate shall be mixed in the machine simultaneously with the adding, through the machine, of the additional amount of water required.

The material shall be spread immediately after mixing, in reasonably close conformity to the lines, grades and dimensions established or shown on the plans.

312.4.4 Stationary Plant Mixing: If the stationary plant method of mixing is employed, the aggregate, cement and water shall be mixed at a central plant using either a batch pug mill type or a continuous type mixer. Dead areas in the mixer, in which the material does not move or is not sufficiently agitated, shall be corrected, either by a reduction in the weight of materials or by other adjustments.

312.4.5 Batch Mixing: If a batch pug mill type mixer is used, the aggregate and cement shall be proportioned by batch weights. Cement shall be weighed on separate scales from the aggregate batching scales.

SECTION 312

The weight of the charge in a batch mixer shall not exceed that which will permit complete mixing of all materials. The period of mixing shall not be less than 30 seconds from the time all materials are in the mixer. Water may be proportioned by volume or by weight.

312.4.6 Continuous Mixing: If a continuous type mixer is used, the materials shall be proportioned by volume.

The continuous type mixer shall be equipped with metering devices and feeders which will introduce the cement, aggregate and water into the mixer in the specified proportions. The water pump shall be equipped with a means of varying the rate of delivery. The metering devices and feeders shall be interlocked and so synchronized as to maintain a constant ratio of cement and water to the aggregate.

The rate of feed to a continuous type mixer shall not exceed that which will permit complete mixing of all the material.

312.4.7 Spreading: The treated material shall be transported from the plant to the prepared subgrade in approved equipment.

The surface on which the material is to be placed shall be thoroughly moistened and kept moist, but not excessively wet, until covered by the material.

Plant mixed cement treated base shall be spread by approved spreader boxes or finishing machines. The machines shall be constructed and operated so as to produce a layer of uniform density and cross-section in sufficient quantity to provide a compacted base reasonably conforming to the lines, grades and cross-sections established or shown on the plans.

312.4.8 Compacting: Initial compaction shall begin immediately after mixing and spreading. Successive passes of compacting equipment shall overlap the previous adjacent pass by at least 25 percent of its width. Following initial compaction and before final compaction, the treated material shall be bladed with a motor grader or a Planning machine to obtain a surface reasonably true to the lines, grades and cross-sections established or shown on the plans. During and immediately following the shaping operations, if required, the Contractor shall lightly scarify the surface with a nail drag or other approved equipment to prevent the formation of surface compaction planes.

Extreme care shall be exercised by the Contractor during the blading operation so that no more material than is necessary is disturbed and so that this operation can be completed as quickly as possible. Material thus cut shall be wasted if so directed. Compaction shall proceed without interruption, except as stated above, until the required degree of compaction is obtained.

312.5 INVERTED SECTION:

Where the cement treated base is to be covered with an aggregate base material to prevent shrinkage crack reflection and overloading of the cement treated base, the minimum thickness of the aggregate base shall be 4 inches, unless otherwise specified in the special provisions. In order to provide for free internal drainage of the aggregate base course overlaying the cement treated material, it shall be non-plastic and the percentage of material passing the No. 200 sieve shall not exceed 8. The cement treatment shall be held back approximately 1 foot from each curb line so as to permit drainage of any water that may become trapped between the cement treated base material and the bituminous surfacing.

312.6 CURING:

The mixed cement treated base materials shall be covered as soon as possible after final compaction with a bituminous curing seal. Application shall be by means of a pressure distributor in accordance with the requirements of Section [330](#). The approximate quantity of bituminous material to be used shall be as specified; however, the exact amount will be determined by the Engineer at the time of application.

After the bituminous curing seal has been applied, the cement treated base course shall be kept free of equipment and traffic for a period of at least 7 days or until it will not pick up under traffic. Curing seal shall conform to the requirement of Section [712](#) or [713](#) for the type specified.

In lieu of the curing seal, the Contractor may, at his option, keep the surface of the compacted base continuously moist until overlaid with the aggregate base course. The aggregate base or the surfacing may be placed as soon as the cement treated base has been compacted. The spray equipment on the water truck shall be approved by the Engineer prior to the use of this equipment to spray the soil cement base course. The spray equipment must produce a fine, even spray to prevent washing of the

SECTION 312

surface of the base course. A cement treated section may be opened to all traffic immediately after placement and compaction of the surfacing.

312.7 DEFICIENCY:

When, in the opinion of the Engineer, there is reason to believe that a deficiency in thickness exists in the cement treated base, cores will be taken in the same pattern as that defined in Section [321](#). If the base has been covered or it is otherwise impractical to correct the deficiency of ½ inch or more in thickness, the corrective measure listed in Table [310-1](#) for Type II deficiency shall be taken by the Contractor at no additional cost to the Contracting Agency.

312.8 PAYMENT:

Payment for the Portland cement will be made by the tons of cement complete in place.

Payment for base material will be made by the tons of aggregate complete in place including mixing, spreading, and compacting.

No separate payment will be made for curing.

- End of Section -

SECTION 315

BITUMINOUS PRIME COAT

315.1 DESCRIPTION:

Bituminous prime coat shall consist of furnishing bituminous material and applying this bituminous material to a prepared base course, in accordance with these specifications.

315.2 MATERIALS:

Bituminous material shall conform to the requirements of Section [712](#) for the type and grade specified.

315.3 CONSTRUCTION METHODS:

315.3.1 Preparation of Surface: The surface on which the bituminous prime coat is to be placed shall be uniformly smooth and firm and reasonably true to grades and cross-sections as shown on the plans, and shall be so maintained throughout the period of placing the prime coat. In no event shall a prime coat be placed on a soft, uneven base. Any holes, depressions or irregularities shall be repaired by the removal of all loose and unsuitable material and replacement by suitable material, which shall be compacted to produce a dense surface conforming to the adjacent area. Uniformity of surface texture is of the utmost importance.

When required, the surface on which the prime coat is to be placed shall be lightly bladed and rolled immediately prior to the application of bituminous material.

315.3.2 Application of Bituminous Material: Bituminous material shall be applied only when the surface is either slightly damp or dry. For extremely dry areas, a light application of water may be required prior to the application of bituminous material.

The approximate quantity of bituminous material to be used will be specified; however, the exact amount used will be determined by the Engineer at the time of application. The bituminous material shall be uniformly applied to the prepared surface at the rate so designated and in one application.

The application of bituminous material and distributing equipment shall conform to the requirements of Section [330](#).

When it is deemed necessary, areas having excess bituminous material shall be blotted with material as directed.

When so directed, the surface of the complete prime coat shall be rolled with a pneumatic-tired roller.

315.3.3 Maintenance of Surface: Traffic shall be kept off the bituminous material until it has penetrated the base or subgrade and cured sufficiently.

The integrity of the prime coat shall be maintained at all times until the next course is placed or until the final acceptance. In the event traffic has caused holes or breaks in the surface, such holes or breaks shall be satisfactorily repaired by the Contractor.

315.4 MEASUREMENT:

The accepted quantities of bituminous material for bituminous prime coat will be measured by the ton undiluted for the bituminous material used.

No measurement or direct payment will be made for rolling.

Materials necessary for repair of holes or breaks in the surface after the prime coat has been accepted, when such holes or breaks are caused by traffic other than that of the Contractor, will be measured for payment under the respective contract item for the materials used.

SECTION 315

315.5 PAYMENT:

Payment for the bituminous material will be on the basis of the price bid per ton, undiluted, complete in place. Payment for furnishing, applying and removing blotter material will be paid for as an extra work item.

- End of Section -

SECTION 317

ASPHALT MILLING

317.1 DESCRIPTION:

The work under this section shall consist of **milling** existing asphalt concrete pavement where shown on the Plans or requested by the Engineer.

317.2 CONSTRUCTION REQUIREMENTS

Contractor is responsible for locating all milling hazards on and below the surface within the areas to be milled including areas requiring special milling. Special milling is not a separate pay item and shall be paid for as Asphalt Milling.

The milling cut depth shall be the depth indicated on the Plans plus or minus 1/8 inch. The milling machine shall have electronic grade controls. Contractor shall remove the milled material and sweep the roadway clean with a power pick-up broom to the satisfaction of the Engineer.

Asphalt pavement adjacent to manholes, valve boxes, small radius curbs and other fixed objects that produce confined area shall be removed with milling equipment specifically designed to operate in constricted areas. The equipment shall be capable of removing asphalt concrete of the specified thickness without damage to, or displacement of, the adjacent object(s).

The Contractor shall be responsible for continually checking the milling operation to determine that the proper depth of milling has been achieved, that the proper profile and cross slope are achieved, and that the surface texture is (a) free from longitudinal ridges, and (b) has a uniform pattern.

The Contractor shall immediately notify the Engineer when:

- The existing pavement thickness is found to be less than anticipated and breaking of the underlying material occurs.
- Delamination of underlying material occurs.

The work shall result in a clean milled surface to the specified depth for the area indicated by the construction documents including the areas immediately around and next to any individual hazard within the area to be milled. The edge of milled area shall form a straight clean cut line.

For milled surfaces on major streets (arterial and collector streets) that will be subject to traffic prior to overlay, a tack coat per Section [329](#) may, when authorized by the Engineer, be applied to the milled surface as a dust control measure. The tack coat shall be applied after sweeping and prior to allowing traffic on the milled surface. The tack coat application rate shall be half of the prescribed tack rate or contract amount or an alternate rate as prescribed by the Engineer. The Contractor shall be responsible for clean-up of any tack coat tracking that occurs.

317.3 MEASUREMENT AND PAYMENT:

Measurement for Asphalt Milling will be by the square yard and shall only include area milled to the required depth and cross-section.

Payment for Asphalt Milling at the contract unit price shall be full compensation for the work, complete-in-place, including all asphalt milling, milling around structures, removal and disposal of milled materials, and sweeping.

Engineer approved tack coat applied for dust control will be paid at the contract rate for tack coat. No additional payment for the application of dust control tack coat shall be made.

- End of Section -

SECTION 320

ROAD-MIXED SURFACING

320.1 DESCRIPTION:

Road-mixed surfacing shall consist of a mixture of mineral aggregate and bituminous binder mixed on the roadbed or other area, spread and compacted on a prepared subgrade or base course in conformity with the lines, grades, and dimensions shown on the plans or typical cross-section, or as specified in the special provisions.

320.2 MATERIALS:

Materials shall conform to the requirements of Sections [710](#) and [712](#) for the type and grade specified on the special provisions.

320.3 PRIME COAT:

When a prime coat is required, it shall be applied as specified in Section [315](#).

320.4 SPREADING AGGREGATE:

The mineral aggregate shall be deposited in a windrow along one side of the roadbed by means of approved spreader box equipped with a readily adjustable strike off device or other suitable equipment. The maximum lift for blade mixing and laying shall not exceed 1 cubic yard per running foot. If the mineral aggregate is delivered to the roadbed in separate sizes, each size of aggregate shall be spread in a windrow of the required quantity for that size of material, after which the windrows of various sizes shall be blended into one windrow alongside of the roadbed.

The aggregate shall be so spread that the windrows will be uniform and equal in size and will contain the proper quantity of material to provide surfacing of the required width and thickness. Care shall be exercised to prevent the aggregate from becoming mixed with earth or shoulder material. Preparatory to applying the liquid asphalt, a portion of the material from the windrow shall be spread uniformly over one-half the width of the roadbed.

Unless permitted by the Engineer, no more aggregate shall be spread on any one day than can be mixed with liquid asphalt within 72 hours. If traffic conditions require, the Engineer may require spread or flattened windrows.

320.5 APPLICATION OF LIQUID ASPHALT:

The temperature of the liquid asphalt, when applied, shall be in accordance with Section [712](#), and 16 to 22 gallons shall be applied for each cubic yard of road-mix material, in not less than 2 approximately equal applications.

Unless otherwise approved by the Engineer, no liquid asphalt shall be spread when weather conditions are unsuitable, or when the moisture content of the mineral aggregate exceeds 3 percent by weight of the dry aggregate. When the aggregate is unusually porous, the permissible moisture content may be increased and liquid asphalt spread at the discretion of the Engineer, when laboratory tests indicate that such increased moisture content will not produce an unstable mixture.

Liquid asphalt shall be prevented from spraying upon adjacent pavements, structure, guard rails, guide posts, culvert markers, trees and shrubbery, adjacent property and improvements, and other highway improvements or facilities not specifically mentioned herein, or that portion of the traveled way being used by traffic.

320.6 MIXING:

Immediately following each successive application of liquid asphalt, the surfacing material shall be thoroughly mixed by means of a blade. After the final application, the material shall be bladed into a windrow and the windrow bladed back and forth between the center and the edge of the area to be surfaced with a heavy blade grader having a wheel base not less than 16 feet long, until a satisfactory mixture of uniform appearance is obtained.

Should the mixture show an excess or deficiency of liquid asphalt, or uneven distribution thereof, prior to spreading and compacting, the condition shall be corrected by adding mineral aggregate or liquid asphalt, as the need may be, and remixing the material to produce a satisfactory mixture. If necessary, all compressed masses of material shall be broken up.

SECTION 320

After mixing, the material shall be placed in a windrow prior to spreading.

After the material has been mixed as above specified all of the mixed material shall be bladed into a single windrow in the center of the roadbed and the entire mass of treated material turned not less than 4 complete times by blading first to one side of the road and then to the other.

In lieu of mixing the material as above specified, a road-mixing machine or any equipment other than that required above may be employed which will produce a completed mixture equal to that which would be produced by means above specified. The Engineer reserves the right to order the use of any equipment discontinued which, in his opinion, fails to produce a satisfactory mixture.

Road-mixing machines shall be of the pug mill or auger type or other suitable equipment capable of picking up the loosened material completely from the roadbed, leaving practically no loose material on the ground, and which will introduce the liquid asphalt through a metering device at the time of mixing. The machine shall be equipped with the positive control of the amount of liquid asphalt introduced into the mix which can be readily adjusted to changes in grading of the road material.

The rate of movement of the machine along the roadway, the amount of material mixed and the amount of mixing shall be so regulated that a uniform mixture of unchanging appearance is obtained and all particles of aggregate are thoroughly coated with liquid asphalt. Before mixing on the roadbed the loosened material shall be placed in windrows or in a blanket of uniform cross-section and of such size that all the material in the windrow or blanket can be passed through the mixing machine at each mixing operation. Sufficient material, as determined by the Engineer, shall be placed in windrows or in a blanket in advance of mixing.

No mixed material shall be spread and compacted until the mixture has been approved by the Engineer.

The amount of material mixed on any one day shall not be more than can be spread and compacted on the following day, except that when directed by the Engineer mixed material shall remain in the windrow for a longer period.

Mixing the liquid asphalt with the mineral aggregate prior to delivery on the roadbed will be permitted, provided that the complete mixture is uniform in character and the same consistency with respect to grading, asphalt content and moisture as that specified for road-mixing.

Liquid asphalt added to mineral aggregate at a central mixing plant shall be accurately weighed by means of dial scales or other approved weighing devices. Liquid asphalt added to mineral aggregate in a traveling mixing plant shall be accurately measured by means of meters or other approved measuring device. Weighing or measuring liquid asphalt being added to mineral aggregate at mixing plants in accordance with the above specified methods shall be for the purpose of properly proportioning the material and not for determining the pay quantities of liquid asphalt.

320.7 SPREADING AND COMPACTION:

Spreading shall be in increments not exceeding 1 inch in thickness.

Rolling shall be continuous throughout the spreading operations until all the loose material has been laid and consolidated.

Segregation of coarse or fine particles shall be avoided and the surfacing as spread shall be free from lumps or pockets of coarse or fine material. Segregated materials or lumps shall be remixed by blading.

After spreading on the roadbed, should the moisture content of the mixture exceed 3 percent it shall be reduced by blading and reblading the mixture and allowing it to dry before the final spreading. Should blading and reblading of the mixture fail to reduce the moisture content below that above specified, the mixture shall be scarified, turned and respread until the moisture content does not exceed 3 percent by weight of the dry aggregate, with the exception, however, that in certain special cases, when the mineral aggregate is unusually porous the permissible moisture content may be increased at the discretion of the Engineer, when laboratory tests indicate that such increase will not result in an unstable mixture.

During blading and rolling, all lumps or compressed masses of the mixture shall be remixed and again rolled. On completion of the blading operations all loose stones shall be swept to the outside of the surfaced area and incorporated with the shoulder material or picked up and disposed of.

SECTION 320

The edges of the completed surfacing shall be trimmed uniformly to the required cross-section and width before the shoulders are finally rolled and shaped.

The completed surface, when ready for acceptance, shall be thoroughly compacted, smooth and even, true to grade and cross-section, and free from ruts, humps, depressions, or irregularities. When a 10 foot straightedge is laid on the finished surface and parallel with the center line of the road, the surface shall vary in no place more than 1/8 inch from the lower edge of the straightedge.

Should pneumatic-tired roller be used, the final finishing shall be done with a tandem roller. Sufficient blading and rolling equipment shall be furnished.

Where shown on the plans or specified in the special provisions, road-mixed material shall be placed and compacted around spillway assemblies, drop inlets and manholes outside the area to be surfaced, upon road approaches and connections, over gutter, ditch and dike areas, and over other areas, to the thickness shown on the plans or ordered by the Engineer.

At locations where the surfacing is to be placed over areas inaccessible to the required spreading and compacting equipment or over areas where the use of required spreading and compacting equipment would be impractical, the mixed material may be spread and compacted by other methods when approved or so ordered by the Engineer. Road-mixed surfacing placed on road approaches and connections shall be placed to the thickness and as specified for surfacing to be placed on the roadbed.

After final rolling the finished surface course shall have a density of at least 92 percent of the theoretical maximum density possible to obtain with the same materials in like proportions when computed without voids by specific gravity tests.

320.8 MEASUREMENT:

Measurements for determining the area to be paid for will be made horizontally unless otherwise specified.

320.9 PAYMENT:

Payment for road-mixed surfacing will be made on the basis of the price bid per square yard unless an alternate basis of payment is provided in the proposal. The price bid per square yard shall include the furnishing of all labor, materials, tools, compaction, asphalt and the dressing of the subgrade, or base course necessary to complete the work. Prime coat, when required, will be paid for by the ton, undiluted, complete in place.

- End of Section -

SECTION 321

PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

321.1 DESCRIPTION:

This section is to provide specifications for furnishing all materials, mixing at a plant, hauling and placing a mixture of aggregate materials, mineral admixture and asphalt binder to form a pavement course for placement upon a previously prepared base or sub base.

321.2 MATERIALS AND MANUFACTURE:

The materials shall conform to Section [710](#) for the type specified. Warm Mix Asphalt (WMA) technologies may be used within the mixture provided all requirements of the specifications are met, and the technology is on the ADOT Approved Product list. The specific required mix type shall be called out in the contract documents or as directed by the Engineer.

321.3 WEATHER AND MOISTURE CONDITIONS:

Asphalt concrete shall be placed only when the surface is dry, and when the atmospheric temperature in the shade is 40 degrees F. (50 degrees F for Asphalt Concrete lift less than 2 inch thick) or above. No asphalt concrete shall be placed when the weather is foggy or rainy, or when the base or sub base on which the material is to be placed is unstable. Asphalt concrete shall be placed only when the Engineer determines that weather conditions are suitable.

321.4 APPLICATION OF TACK COAT:

A tack coat shall be applied to all existing and to each new course of asphalt concrete prior to the placing of a succeeding lift of asphalt concrete. The tack coat may be deleted when a succeeding layer of asphalt concrete is being applied over a freshly laid course that has been subjected to very little traffic when approved by the Engineer.

The application of the tack coat shall comply with Section [329](#). The grade of emulsified asphalt shall be SS-1h or CSS-1h as specified in Section [713](#).

The same material that is specified above for the tack coat shall be applied to the vertical surfaces of existing pavements, curbs, and gutters, against which asphalt concrete is to be placed.

The surface to be covered may require repair or patching as directed by the Engineer. This shall be addressed in the project specifications prior to the bidding of the project.

321.5 MIX DESIGN:

The mix design shall be submitted to the Engineer at least five working days prior to the start of asphalt concrete production. Mix designs provided by the agency may be utilized on projects at the Engineer's discretion. The Engineer will review and approve the mix design to assure it contains all of the required information as outlined in Section [710.3.1](#). If WMA technologies are used within the mix design, the type of WMA technology used shall be indicated on the mix design. The target values for gradations, binder contents, and air voids will be established as the accepted Job Mix Formula (JMF) based upon the mix design. Mix designs not containing all of the information will be returned within five working days of receipt of all mix design information, for action and resubmission by the contractor.

Once the mix design has been approved by the agency and the mixing plant selected, the Contractor and/or his supplier shall not change plants nor utilize additional mixing plants without prior approval of the Engineer.

If the contractor elects to change its source of material, the contractor shall furnish the Engineer with a new mix design, which meets the requirements of Section [710](#), as amended by the Project Specifications.

SECTION 321

The contractor may make self-directed target changes to the approved mix design within the limits shown below. Requests for self-directed target changes shall be made in writing and acknowledged by the Engineer prior to the start of production of a lot and will remain in effect until such time as any additional changes are implemented. The self-directed target changes must meet the contract requirements for mix design criteria and gradation limits.

TABLE 321-1 ALLOWABLE SELF-DIRECTED TARGET CHANGES	
MEASURED CHARACTERISTICS	ALLOWABLE SELF-DIRECTED TARGET CHANGES
Gradation (Sieve Size)	
3/8 inch	$\pm 4\%$ from mix design target value
No 8	$\pm 4\%$ from mix design target value
No 40	$\pm 2\%$ from mix design target value
No 200	$\pm 0.5\%$ from mix design target value
Binder Content	$\pm 0.2\%$ from mix design target value
Effective Air Voids	None

The contractor may propose target changes, other than self-directed changes, to the approved mix design for the approval of the Engineer. The Engineer will determine if the proposed target change will result in mix production that meets the contract requirements for mix design criteria and gradation limits. The target changes will not be retroactive for the purpose of acceptance.

321.6 MIX PRODUCTION:

All materials shall be proportioned by weight in a hot mix asphalt plant in the proportions required by the mix design to provide a homogeneous and workable mass. Each hot mix asphalt plant shall be inspected in accordance with the provisions contained in the 'Hot Mix Asphalt Production Facilities' by the Arizona Rock Products Association and shall have a current inspection certificate. All measuring devices shall be calibrated at least annually by a technician licensed by the Arizona Bureau of Weights & Measures. Mixing plants shall conform to the requirements of AASHTO M-156, except as modified herein. If WMA technology is being used, any equipment associated with the production of hot mix asphalt shall be calibrated and in proper working order according to the WMA equipment specifications. If there are any deviations in the production or compacting temperatures of the hot mix asphalt with WMA technology, the mix design shall state the differences.

In drum mix plants the mineral admixture shall be added and thoroughly mixed with the mineral aggregate by means of a mechanical mixing device prior to the mineral aggregate and mineral admixture entering the dryer. The moisture content of the combined mineral aggregate shall be a minimum of three percent by weight of the aggregate during the mixing process.

For drum-mix plants, the mineral admixture shall be weighed across a weight belt, or other approved alternative weighing system, with a weight totalizer prior to entry into the mechanical mixing device. The mechanical mixing device shall be a pugmill type mixer that is in good working condition. The rate of the aggregate feed shall not exceed the mixing device's capacity in ton per hour. The mixer shall be constructed to minimize the loss of mineral admixture and shall be located in the aggregate delivery system at a location where the mixed material can be readily inspected. The mixing device shall be capable of effective mixing in the full range of the asphalt concrete production rates.

The hot plant and equipment shall be constructed and operated to prevent loss of mineral admixture through the dust collection system of the plant.

A positive signal system shall be provided and utilized during production whereby the mixing shall automatically be stopped if the mineral admixture is not introduced into the mineral aggregate. The plant will not be permitted to operate unless the signal system is in good working condition.

The introduction of bituminous material shall be controlled by an automated system fully integrated with the controls or the mineral aggregate and mineral admixture. The production of the plant shall be controlled by the rate required to obtain a uniform mixture of all components. Drying and heating shall be accomplished in such a manner as to preclude the mineral admixture from becoming coated with un-spent fuel. The completed asphalt concrete may be held in storage for up to 12 hours in insulated or heated silos, providing the minimum temperature noted herein for placement and compaction is met behind the placement device. If the Engineer determines that there is an excessive amount of heat, heat loss, drain down, segregation

SECTION 321

and/or oxidation of the mixture due to temporary storage, use of surge bins or storage bins will be discontinued.

The temperature of the asphalt concrete, with unmodified binders, upon discharge from the mixer shall not exceed 335 degrees F. The discharge temperature may be increased on the recommendation of the binder supplier, when approved by the Engineer. If the asphalt concrete is discharged from the mixer into a hopper, the hopper shall be constructed so that segregation of the asphalt concrete will be minimized.

321.7 TRANSPORTATION:

Petroleum distillates or other substances that will have a detrimental effect on the asphalt concrete shall not be used as a release agent.

The beds of all transportation units shall be clean and smooth to allow the free flow of material into the paving machine's hopper.

Tarpaulins shall be furnished on all trucks and used when weather condition warrant, or if directed by the Engineer.

321.8 PLACEMENT:

Placement of asphalt concrete pavement shall not commence until authorized by the Engineer. The Engineer's authorization to allow commencement of asphalt concrete paving will generally require all newly constructed valley gutters, curbing, and curb and gutters which new pavement is to be placed against to be in-place and in an acceptable condition. While it is preferred to have all newly constructed concrete items against which new pavement is to be placed be in an acceptable condition, the Engineer may allow paving to commence based on weather, the amount of defective concrete, or other considerations.

321.8.1 Placing: All courses of asphalt concrete shall be placed and finished by means of a self-propelled paving machine equipped with an automatically actuated control system, except under certain conditions or at locations where the Engineer deems the use of a self-propelled paving machine impracticable.

The control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other end indirectly either through controlling the transverse slope or alternatively when directed, by controlling the elevation of each end independently.

The control system shall be capable of working with one of the following devices:

- (a) Ski or non-contact device of not less than 30 feet in length, supported throughout its entire length
- (b) Taut stringline or wire set to grade
- (c) Short ski or sonar sensing units from curb control
- (d) Joint matching shoe

Failure of the control system to function properly shall be cause for the suspension of asphalt concrete production. In order to achieve a continuous operation, the speed of the paving machine shall be coordinated with the hot mix plant and transport units.

If the asphalt concrete is dumped from the hauling vehicles directly into the paving machine, care shall be taken to avoid jarring the machine or moving it out of alignment. No vertical load shall be exerted on the paving machine by the truck.

If asphalt concrete is dumped upon the surface being paved and subsequently loaded in the paving machine, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the asphalt concrete shall be picked up and loaded into the paving machine.

Self-propelled paving machines shall spread the mixture without segregation or tearing, true to line, grade and crown indicated on the Project plans. Pavers shall be equipped with hoppers and augers that will distribute the mixture uniformly in front of an adjustable floating screed. The raising of the hopper wings must be minimized and the paving machine will not be operated when in an empty condition.

Screeds shall include any strike-off device operated by tamping or vibrating action which is effective, without tearing, shoving or gouging the mixture and which produces a course with a uniform texture and density for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required. In the

SECTION 321

case of the screed, auger extensions and vibrators shall be installed wherever the screed is extended more than one (1) foot beyond the end of the base auger or auger extension. However, when placing material against an extremely uneven curb or edge over a short distance, the Engineer may waive the auger extensions and vibrators.

At any place not accessible to the roller, the mixture shall be thoroughly compacted with tampers to provide a uniform and smooth layer over the entire area compacted in this manner.

321.8.2 Joints: Transverse joints, before a surface course is placed in contact with a cold transverse construction joint, the cold existing asphalt concrete shall be trimmed to a vertical face for its full depth exposing a fresh face. The fresh face shall be tack coated prior to placement of the new asphalt concrete. After placement and finishing the new asphalt concrete, both sides of the joint shall be dense and the joint shall be smooth and tight. The surface in the area of the joint shall not deviate more than 1/4 inch from a 12-foot straightedge, when tested with the straightedge placed across the joint, parallel to the centerline.

Longitudinal joints of each asphalt course shall be staggered a minimum of 6 inches with relation to the longitudinal joint of the immediate underlying course's cold longitudinal construction joint.

Longitudinal joints with existing or cold (more than 32 hours old) asphalt concrete shall require the existing pavement to be trimmed to a vertical face for its full depth exposing a fresh face. The fresh face shall be tacked prior to placement of the adjacent course. Longitudinal joints with an existing asphalt pavement that is less than 32 hours old that has had its edge protected from damage may have adjacent new asphalt concrete placed after applying the required tack coat. After placement and finishing of longitudinal joints, both sides of the joint shall be dense and the joint shall be smooth and tight. The surface in the area of the joint shall not deviate more than 1/4 inch from a 12-foot straightedge, when tested with the straightedge placed across the joint, in any direction.

321.8.3 Asphalt Leveling Course: A leveling course shall be used when specified, or as directed in writing by the Engineer, to bring existing pavement to a uniform grade prior to placing an overlay or other course. If a leveling course is being applied on an Asphalt surface, a tack coat shall be applied. The compaction requirements contained in Section [321.10](#) do not apply to leveling courses.

321.8.4 Compaction; Asphalt Base Course and Surface Course: It is the contractor's responsibility to perform Quality Control monitoring and/or testing during compaction operations to achieve the required compaction. The temperature of the asphalt concrete immediately behind the laydown machine shall meet the minimum requirements of Table [321-2](#) unless WMA technology is being used. If WMA technology is being used then the minimum requirements will be stated within the mix design recommended by the WMA manufacturer. A probe type electronic thermometer with a current calibration sticker attached will be used to measure the temperature of the asphalt concrete mixture. When measuring the temperature of the mat, the probe shall be inserted at mid-depth and as horizontal as possible to the mat. The minimum temperatures in Table 321-2 do not guarantee that the asphalt mix will be compacted to the required density. The contractor is responsible to achieve the required compaction.

TABLE 321-2						
MINIMUM ASPHALT CONCRETE PLACEMENT TEMPERATURE						
Base ⁽¹⁾ Temp (°F)	Mat Thickness (inches)					
	1/2	3/4	1	1 1/2	2	3 and greater
40 – 50	---	---	310	300	285	275
50 – 60	---	310	300	295	280	270
60 – 70	310	300	290	285	275	265
70 – 80	300	290	285	280	270	265
80 – 90	290	280	270	270	265	260
+90	280	275	265	265	260	255

(1) Base on which mix is to be placed

Asphalt compaction equipment shall be of sufficient size and weight to accomplish the required compaction. All compaction equipment shall be operated and maintained in accordance with the manufacturer's recommendations and the project requirements. During the rolling operation, the speed of the roller shall not exceed 3 miles per hour, unless otherwise approved by the Engineer.

SECTION 321

Pneumatic tired compactors shall be equipped with skirt-type devices mounted around the tires so that the temperature of the tires will be maintained during the compaction process.

The Engineer will determine the acceptability of the pavement compaction in accordance with Section [321.10](#).

321.8.5 Smoothness: The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than one-fourth (1/4) inch from the lower edge of a 12-foot straightedge when the straightedge is placed parallel to the centerline of the roadway.

321.8.6 Asphalt Concrete Overlay: Asphalt concrete overlay consists of the placing and compacting plant mix asphalt concrete over existing pavement. The mix design and thickness of the overlay shall be as shown on the plans or as specified in the special provisions.

Except when the existing asphalt surface is to be preheated and remixed, pavement surfaces shall be prepared as follows:

- (a) Areas designated for pavement repair by the contract documents (which may include severely raveled areas, severely cracked areas, over-asphalted areas, and other defects) shall be cut out and replaced. Pavement repairs shall be completed and approved before placing asphalt concrete overlay.
- (b) Before placing asphalt concrete overlay, milling shall be done as shown on the plans or specified in the special provisions and shall be in accordance with Section [317](#).
- (c) After pavement repairs and milling have been completed the entire surface shall be cleaned with a power broom.
- (d) After surfaces have been prepared to the satisfaction of the Engineer, they shall receive a tack coat per Section [321.4](#). Traffic will not be permitted to travel over surfaces which have received a tack coat, except when tack coat is applied to milled surfaces in compliance with Section [317.2](#) for dust control purposes. When the overlay is to extend onto a concrete gutter, the gutter shall be thoroughly cleaned of loose dust and cement particles and shall be tack coated.

Asphalt concrete overlay shall be placed as specified in Section [321.8.1](#) and compacted as specified in Section [321.8.4](#). The surface smoothness shall meet the tolerances specified in Section [321.8.5](#).

Frames and covers of manholes, survey monuments, valve boxes, clean-outs and other existing structures shall be adjusted in accordance with Section [345](#) to set flush with the finished surface of the new pavement. During adjustment if pavement or base materials are removed or disturbed, they shall be replaced with approved materials installed in a manner acceptable to the Engineer.

On roads without curb and gutter, the existing unpaved shoulder elevation shall be adjusted by the Contractor to match the elevation at the edge of the new overlay and slope away from the new pavement surface at a rate that the existing quantity of shoulder material will allow. Shoulder material shall be compacted to a minimum of 95% of maximum density, determined in accordance with Section [301.3](#). Shoulder adjustment to match the new pavement surface elevation shall not be measured. The cost of shoulder adjustment shall be included in the price paid for the asphalt concrete overlay or other related pay items. When the Engineer determines an insufficient amount of material is available for shoulder adjustment, the Engineer may require the Contractor to provide additional material. Acceptable material for shoulders includes the existing shoulder material, millings, untreated base materials, or a granular material approved by the Engineer. Engineer requested imported material for shoulder adjustment is not included in the price paid for the asphalt concrete overlay.

321.8.7 Pavement Fabric Interlayer: Pavement fabric interlayer shall be used only when specified on the plans or in the specifications.

Pavement fabric interlayer shall be in accordance with Table [796-1](#) and be the class designated on the plans or in the specifications.

Asphalt binder coat used to bond the fabric to the pavement shall be paving asphalt PG 70-10 asphalt cement conforming to the requirements of Section [711](#). The application and distributing equipment for the asphalt binder shall conform to the requirements of Section [330](#). The asphalt binder coat shall be uniformly spray applied to the prepared pavement surface at the rate of 0.20 gallons per square yard for Class B fabric or at the rate of 0.25 gallons per square yard for Class A fabric. Some underlying surfaces may require a higher or lower application rate. A test strip may be necessary to determine the proper

SECTION 321

application rate. The width of liquid asphalt cement application shall be the fabric width, plus six inches.

Neither the asphalt binder coat or fabric interlayer shall be placed when weather conditions, in the opinion of the Engineer, are not suitable. The asphalt binder and fabric interlayer shall only be placed when the pavement is dry, the ambient air temperature is 50 degrees F and rising, and pavement temperature is 40 degrees F and rising.

Equipment for placing the fabric shall be mechanized and capable of handling full rolls of fabric. The equipment shall be able to lay the fabric smoothly to maximize pavement contact and remove air bubbles. Stiff bristle brooms shall be used to smooth the fabric. The equipment used to place the fabric shall be in good working order and is subject to approval by the Engineer.

Pavement fabric interlayer shall not be placed if the in-place binder is hotter than 325 degrees F or has cooled to 180 degrees F or below (as determined by non-contact thermometer).

Pavement fabric interlayer shall be placed onto the asphaltic binder with the heat bonded side up with a minimum amount of wrinkling or folding. Remaining wrinkles or folds 1-inch and larger shall be removed or slit and shingle-lapped in the direction of paving. Burning or torching of wrinkles is not allowed. Fabric shall overlap three to six inches to insure full closure of the joint. Transverse joints shall be shingle-lapped in the direction of paving to prevent edge pickup by the paver. A second application of hand-placed asphalt binder may be required at laps and repairs as determined by the Engineer to ensure proper binding of the narrow double fabric layer.

All areas where fabric has been placed shall be paved with asphaltic concrete during the same workshift. Placement of the asphaltic concrete shall closely follow fabric lay down. The temperature of the asphaltic concrete immediately behind the laydown machine shall not exceed 325 degrees F, unless modified by the WMA technology being used. If WMA technology is being used then the minimum requirements will be stated within the mix design recommended by the WMA manufacturer. In the event that the asphalt binder coat bleeds through the fabric causing construction problems before the overlay is placed, the affected areas shall be sanded with a sand blotter in compliance with Section [333](#). Excess sand shall be removed before beginning the paving operation. In the event of rainfall prior to the placement of the asphaltic concrete, the fabric shall be allowed to dry before the asphalt concrete is placed.

Turning of the paving machine or of other vehicles on the fabric shall be gradual and kept to a minimum to avoid damage to the fabric. Should equipment tires stick to the fabric during pavement operations, small quantities of paving asphalt concrete shall be broadcast on the fabric to prevent pick-up. Decrease of binder rate in order to minimize pick-up on tires is not allowed.

321.8.8 Thickened Edge: When the depth of the thickened edge extends four inches or more below the bottom of the asphalt pavement, the portion of the thickened edge extending below the asphalt pavement shall be placed and compacted prior to placement of the asphalt pavement. Placement of tack coat on the surface of the compacted thickened edge asphalt may be omitted when additional asphalt pavement is placed on the same day and the Engineer agrees that the surface of the thickened edge asphalt has remained clean.

When the depth of the thickened edge extends less than four inches below the bottom of the asphalt pavement, the portion below the asphalt pavement may be placed and compacted with the asphalt pavement in a single operation.

321.8.9 Safety Edge: The finished safety edge slope shall be planar forming a $30^{\circ} \pm 5^{\circ}$ angle with the adjacent roadway surface and extend a minimum of five inches (5") below the roadway pavement's finished surface.

The safety edge shall be constructed with the top or final paving lift of a new pavement or overlay using a device that is mounted to or is a part of the screed portion of the laydown machine. The safety edge device shall be capable of constraining the asphalt concrete material to increase density of the extruded profile by reducing the volume. A conventional single strike-off plate is not acceptable. Compaction obtained from the extruded safety edge shall be acceptable when the extruded shape conforms to the specified shape.

During laydown operations if the extruded safety edge does not conform to the specified shape, the Contractor shall take immediate actions to correct the deficiency and to repair all non-compliant sections of safety edge. The Contractor shall stop paving operations until corrections to the laydown operation have been made and resumption of paving is approved by the Engineer or his designated representative.

SECTION 321

321.8.10 Protection for Asphalt Base Course: Arterial roadway traffic shall not be allowed on a new asphalt base course that is less than five inches (5") in thickness without the written consent of the Engineer.

321.9 QUALITY CONTROL:

It is the contractor's responsibility to perform Quality Control monitoring and/or testing during asphalt concrete production to achieve the required compaction and to perform Quality Control monitoring and/or testing during asphalt concrete production to achieve the required mix properties. The Engineer may obtain samples of any portion of any material at any point of the operations for his own use. Also, the Engineer may order the use of any drying, proportioning and mixing equipment or the handling of any material discontinued which, in his/her opinion, fails to produce a satisfactory mixture.

The asphalt concrete produced shall conform to the requirements of the production tolerances established in section [321.10](#). When the asphalt concrete does not conform to the production tolerances, it shall be reported to the Engineer, and corrective quality control measures shall be implemented, or production shall cease immediately at no additional cost to the contracting Agency.

Requests for Referee Testing as described in 321.11 will only be considered based on quality control test results performed by a laboratory accredited by the AASHTO Accreditation Program (AAP) for the tests being performed or a laboratory listed in the current ADOT Directory of Approved Materials Testing Laboratories for the set of tests in question. The laboratory shall use properly certified technicians in accordance with ASTM D3666, Section 7 (Personnel Qualifications).

321.10 ACCEPTANCE:

321.10.1 Acceptance Criteria: Asphalt concrete will be divided into lots for the purpose of acceptance. A lot shall be one day's production. Each lot shall be divided into sublots of 500 ton or fraction thereof. Tests used to determine acceptance will be performed by a laboratory accredited by the AASHTO Accreditation Program (AAP) for the tests being performed. The contracting agency shall provide an appropriately accredited laboratory or laboratories to perform the acceptance testing. Laboratories shall use properly certified technicians in accordance with ASTM D3666, Section 7 (Personnel Qualifications). The acceptance laboratory will take representative samples of the asphalt concrete from each subplot to allow for testing of gradation, binder content, air voids, pavement thickness and compaction of base and surface courses. Acceptance of each subplot will be based on the test data from the sample(s) from that subplot. All acceptance samples shall be taken using random locations or times designated by the Engineer in accordance with ASTM D3665.

321.10.2 Gradation, Binder Content and Air Voids: The acceptance laboratory will take a sample of the asphalt concrete in accordance with the requirements of Section 2 or 4 of Arizona Test Methods 104 or AASHTO T-168 from each subplot. The minimum weight of the sample shall be 45 pounds. Asphalt binder content and gradation shall be determined in accordance with AASHTO T-308 using the ignition furnace for each subplot. The acceptance laboratory is responsible for obtaining the necessary materials and performing an ignition furnace calibration as outlined in AASHTO T-308 for each asphalt concrete mixture utilized on the project. The correction factor used for each test shall be clearly indicated on the report. The bulk density for Marshall Mix designs shall be tested in accordance with AASHTO T-245. The bulk density for Gyratory mix designs shall be determined in accordance with AASHTO T-312. The maximum theoretical density shall be determined in accordance with the requirements of AASHTO T-209 including fan drying per AASHTO T209 Section 15. Effective voids of the laboratory compacted specimens will be determined at a minimum of once per lot in accordance with the requirements of AASHTO T-269. Should the testing for effective air voids not meet the "Full Payment" or "No Corrective Action" requirements of Table [321-5](#), additional testing for laboratory air voids on the remaining sublots will be performed as necessary to determine the extent of the deficiency. Acceptance testing results will be furnished to the contractor and the supplier within five working days of receipt of samples by the acceptance laboratory.

During production, the allowable deviations from the mix design gradation targets are listed in the tables below. The allowable production tolerances may fall outside of the mix design gradation bands.

SECTION 321

TABLE 321-3A				
GRADATION ACCEPTANCE LIMITS FOR MARSHALL MIXES				
Sieve Size	3/8 inch Mix	1/2 inch Mix	3/4 inch Mix	Base Mix
1 inch	---	---	---	±7%
3/4 inch	---	---	±7%	±6%
1/2 inch	---	±7%	---	---
3/8 inch	±7%	±6%	±6%	±6%
No. 8	±6%	±6%	±6%	±6%
No. 40	±4%	±4%	±4%	±4%
No. 200	±2%	±2%	±2%	±2%

TABLE 321-3B			
GRADATION ACCEPTANCE LIMITS FOR GYRATORY MIXES			
Sieve Size	3/8 inch Mix	1/2 inch Mix	3/4 inch Mix
3/4 inch	---	---	±7%
1/2 inch	---	±7%	±6%
3/8 inch	±7%	±6%	---
No. 8	±6%	±6%	±6%
No. 40	±4%	±4%	±4%
No. 200	±2%	±2%	±2%

If the results from a single acceptance sample fall outside of the acceptance limits in Table [321-3A](#) or [321-3B](#) as applicable, a second sample shall be taken and if the second acceptance sample is also outside of the acceptance limits the Contractor shall cease production of asphalt concrete. Production shall not begin again until calibration test results verify that adjustments made to materials or proportions yield a gradation that falls within acceptance limits in Table [321-3A](#) or [321-3B](#) as applicable.

If the asphalt binder content is within $\pm 0.40\%$ of the mix design target value, the asphalt concrete will be paid for at the contract unit price. If the asphalt binder content deviates by more than $\pm 0.40\%$ from the mix design target value, the deficient area will be evaluated within the subplot by coring at maximum intervals of 100 feet from the deficient sample. The asphalt content of the original deficient sample will be averaged with the asphalt binder content of the cores taken for re-evaluation to determine compliance with the acceptance requirements. If the resulting average of the asphalt binder content deviates by more than $\pm 0.40\%$ from the mix design target value, then Table [321-4](#) shall apply to the subplot. Additional cores may be required to define the limits of the deficient area, and shall not be used for re-evaluating acceptance.

SECTION 321

TABLE 321-4		
ASPHALT BINDER CONTENT ACCEPTANCE AND PENALTIES		
Deviation from that permitted	When the contracting agency is the owner: Payment Reduction (\$ per ton of asphalt concrete)	When the contracting agency is not the owner (i.e. permits): Corrective Action
Over 0.2% <u>above</u> that permitted	Removal* or EA	Removal* or EA
Over 0.1% to 0.2% <u>above</u> that permitted	\$6.00	EA
Over 0.0% to 0.1% <u>above</u> that permitted	\$2.00	EA
Within permitted range	Full Payment	No Corrective Action
Over 0.0% to 0.1% <u>below</u> that permitted	\$2.00	EA
Over 0.1% to 0.2% <u>below</u> that permitted	\$6.00	EA
Over 0.2% <u>below</u> that permitted	Removal* or EA	Removal* or EA

NOTES: *The Contractor shall remove and replace the entire subplot that is deficient.

EA = Engineering Analysis per Section 321.10.6

If the laboratory air voids fall within a range of 2.8% to 6.2%, the asphalt concrete will be paid for at the contract unit price. If the laboratory air voids are outside of this range, the deficient area will be evaluated within the subplot by coring at maximum intervals of 100 feet from the deficient sample. The laboratory air voids of the original deficient sample will be averaged with the laboratory air voids obtained from each of the cores taken for re-evaluation to determine compliance with the acceptance requirements. If the resulting average of the laboratory air voids is outside the indicated range, then Table [321-5](#) shall apply to the subplot. Additional cores may be required to define the limits of the deficient area, and shall not be used for re-evaluating acceptance.

TABLE 321-5		
LABORATORY VOIDS ACCEPTANCE AND PENALTIES		
Laboratory Air Voids (Measured at N _{des} or 75 blows as applicable)	When the contracting agency is the owner: Payment Reduction (\$ per ton of asphalt concrete)	When the contracting agency is not the owner (i.e. permits): Corrective Action
Less than 1.5%	Removal* or EA	Removal* or EA
1.5-2.0%	\$5.00	EA
2.1-2.7%	\$2.00	EA
2.8-6.2%	Full Payment	No Corrective Action
6.3-6.9%	\$2.00	EA
7.0-8.0%	\$5.00	EA
Greater than 8.0%	Removal* or EA	Removal* or EA

NOTES: *The Contractor shall remove and replace the entire subplot that is deficient

EA = Engineering Analysis per Section [321.10.6](#)

Removal for In-place Air Voids Greater than 11.0% is not eligible for Section [321.10.6](#).

SECTION 321

If an agency or Engineer is purchasing asphalt concrete directly from a commercial material supplier, the agency or Engineer will use Section [321.10](#), and specifically Tables [321-3A](#) or [321-3B](#) as applicable, [321-4](#) and [321-5](#) from Section [321.10](#), when determining the acceptance of the asphalt concrete with the material supplier.

321.10.3 Surface Testing: If directed by the Engineer surface drainage test shall be performed. The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than 1/4 inch from the lower edge of a 12-foot straightedge when the straightedge is placed parallel to the centerline of the roadway. The straightedge shall be furnished by the contractor and shall be acceptable to the Engineer.

All streets shall be water tested for drainage in the presence of the Engineer or designated representative before final acceptance. Any areas not draining properly shall be corrected to the Engineer's satisfaction at the Contractor's expense. Water for this testing shall be provided and paid for by the Contractor.

When deviations in excess of the above tolerance are found, humps or depressions shall be corrected to meet the specified tolerance, or shall be cut out along neat straight lines and replaced with fresh hot mixture and thoroughly compacted to conform with and bond to the surrounding area. Materials and work necessary to correct such deviations shall be at no additional cost to the Contracting Agency.

321.10.4 Asphalt Pavement Thickness: Asphalt Pavement thickness will be determined from cores secured from each lift of each subplot. Such cores will be taken and measured by the Asphalt Concrete Coring Method. This method can be found in Section [321.14](#). Each core location will be patched by the party responsible for the testing.

Acceptance or assessment of penalties for asphalt pavement thickness will be based on the combined total thickness of all asphalt concrete layers omitting all layers of asphalt-rubber asphalt concrete. If the final total pavement thickness exclusive of all ARAC layers is deficient from the target thickness by 0.25 inches or less, it will be paid for at the contract unit price.

If the pavement thickness deficiency is greater than 0.25 inches and the contracting agency is not the owner (i.e. permits) the following steps will apply:

- (1) If the thickness deficiency of the pavement exceeds 0.25 inch, the limits of the deficient area will be evaluated by coring at maximum intervals of 100 feet from the deficient core. The thicknesses of the original deficient core will be averaged with the thicknesses of the cores taken from 100 feet on each side of it to determine compliance with the acceptance requirements. If the resulting average thickness deficiency is greater than 0.25 inch, additional cores may be required to define the limits of the deficient area, and shall not be used for re-evaluating acceptance.
- (2) If the pavement thickness from step one above deviates from the target thickness by more than 0.25 inch but not more than 0.50 inch, corrective action will be required. This corrective action will consist of application of a Type II slurry seal coat in accordance to Section [715](#). The Contractor may present an engineering analysis outlining other proposed remedial measures for the consideration of the Engineer. The Engineer will review the engineering analysis and decide within 30 working days whether to accept the proposed remedial measures.
- (3) If the pavement thickness from step one above deviates from the target thickness by more than 0.50 inch, corrective action will be required. The deficient area shall be overlaid with no less than a 1 inch thick lift, for the full width of the pavement to meet or exceed the designed thickness, with appropriate end and edge milling, with a mixture approved by the Engineer. The Contractor may present an engineering analysis outlining other proposed remedial measures for the Engineer's consideration. The Engineer will review the engineering analysis and decide within 10 working days whether to accept the proposed remedial measures. If the Engineer chooses to reject the engineering analysis, the indicated overlay will be constructed by the Contractor at no additional cost to the Owner.

If the contracting Agency is the owner and the pavement thickness deficiency is greater than 0.25 inches but less than 0.50 inches Table [321-6](#) will apply. If the pavement thickness deficiency is greater than 0.5 inches the deficient area shall be overlaid with no less than a 1-inch thick lift for the full width of the pavement to meet or exceed the designed thickness using an asphalt mixture approved by the Engineer. The Contractor shall provide appropriate end and edge milling. The overlay and milling shall be accomplished by the Contractor at no additional cost to the Contracting Agency.

SECTION 321

TABLE 321-6	
ASPHALT PAVEMENT THICKNESS PAYMENT REDUCTION	
For Thickness Deficiency of More Than 0.25 inches and less than 0.50 inches	
Total Specified Asphalt Pavement Thickness exclusive of ARAC (if any)	Reduction in Payment Applied to asphalt concrete Except ARAC layers (if any)
Less than 1.5 inches	50%
1.50 inches to 1.99 inches	33%
2.00 inches to 2.49 inches	25%
2.50 inches to 2.99 inches	20%
3.00 inches and over	17%

321.10.5 Density:

321.10.5.1 Pavement 1-1/2 Inches or Less in Nominal Thickness:

Compaction shall consist of a “Rolling Method Procedure” using an established sequence of coverage with specified types of compactors. A pass shall be defined as one movement of a compactor in either direction. Coverage shall be the number of passes as are necessary to cover the entire width being paved.

The rolling sequence, the type of compactor to be used, and the number of coverages required shall be as shown in Table [321-7](#).

TABLE 321-7				
ROLLING SEQUENCE FOR LIFT THICKNESS 1½" OR LESS				
Rolling Sequence	Type of Compactor		No. of Coverages	
	Option No. 1	Option No. 2	Option No. 1	Option No. 2
Initial	Static Steel	Vibrating Steel	1	1
Intermediate	Pneumatic Tired	Vibrating Steel	4	2- 4*
Finish	Static Steel	Static Steel	1-3	1-3
* Based on the roller pattern which exhibits the best performance.				

The Contractor shall select the option for compaction and, when pneumatic-tired compactors are used will designate the tire pressure. Steel wheel compactors shall not be used in the vibratory mode for courses of one inch or less in thickness nor when the temperature of the asphaltic concrete falls below 180 degree F. Initial and intermediate compaction shall be accomplished before the temperature of the asphaltic concrete falls below 200 degree F.

Compaction will be deemed to be acceptable on the condition that the asphaltic concrete is compacted using the type of compactors specified, ballasted and operated as specified, and with the number of coverages of the compactors as specified.

321.10.5.2 Pavement Greater than 1-1/2 Inches in Nominal Thickness:

Achieving the required compaction is the responsibility of the contractor. The number and types of rollers is the contractor's responsibility and shall be sufficient to meet these requirements.

In-place air voids shall be determined in accordance with AASHTO T-269 utilizing cores taken from the finished pavement. The maximum theoretical density used in the determination of in-place air voids will be the average value from the acceptance samples determined for the Lot as outlined in [321.10.1](#).

The Engineer will designate one random test location for each subplot and the acceptance laboratory will obtain one core from that location. Regardless of subplot quantities or boundaries, a minimum of one core will be obtained per residential street and a minimum of one core per travel lane for collector and arterial streets. The outside one foot of each pass of the pavement course

SECTION 321

or any unconfined edge will be excluded from testing. The Engineer may exclude areas from the compaction lot that are not accessible by normal compaction equipment.

The Contractor will provide the traffic control to facilitate any coring operations necessary for compaction acceptance.

Cores will be taken per the Asphalt Concrete Coring Method. This method can be found in Section [321.14](#). Acceptance testing results will be furnished to the contractor within five working days of receipt of samples by the acceptance laboratory.

If the pavement density has in-place voids of 8.0% or less, the asphalt concrete will be paid for at the contract unit price. If the pavement density has in-place voids greater than 8.0%, the deficient area will be evaluated within the subplot by coring at maximum intervals of 100 feet from the deficient core(s). If both cores in a subplot are deficient, 3 to 4 additional cores may be necessary to re-evaluate acceptance. The in-place voids of all the original core(s), whether deficient or acceptable, will be averaged with the in-place voids of the cores taken for re-evaluation to determine compliance with the acceptance requirements. If the average of the in-place voids is greater than 8.0% then Table [321-8](#) shall apply to the subplot. Additional cores may be required to define the limits of the deficient area, and shall not be used for re-evaluating acceptance.

TABLE 321-8		
PAVEMENT DENSITY PENALTIES		
Limits of In-place Air Voids for design lift thicknesses 1.5 inches and greater	When the contracting agency is the owner: Payment Reduction (\$ per ton of asphalt concrete)	When the contracting agency is not the owner (i.e. permits): Corrective Action
Below 3.0%	Removal* or EA	Removal* or EA
3.0% to below 4.0%	\$10.00	EA and Type II Surry Seal
4.0% to 8.0%	Full Payment	No Corrective Action
Greater than 8.0% to less than 9.0%	\$6.00	EA
9.0% to 10.0%	\$10.00	EA and Type II Surry Seal
Greater than 10.0%	Removal* or EA	Removal* or EA

NOTES: *The Contractor shall remove and replace the entire subplot that is deficient.

EA = Engineering Analysis per Section [321.10.6](#)

Removal for In-place Air Voids greater than 11.0% is not eligible for Section [321.10.6](#).

321.10.6 Engineering Analysis (EA): Within 10 working days after receiving notice that a lot or subplot of asphalt concrete is deficient and is found to fall within the “Removal or EA” band per Table(s) [321-4](#), [321-5](#), and/or [321-8](#) the contractor may submit a written proposal (Engineering Analysis) to accept the material in place at the applicable penalties along with possible remediation(s) listed in the “Removal or EA” category. Engineering Analysis can also be proposed for non-removal categories of “Corrective actions” when the contracting agency is not the owner (i.e. permits).

The Engineering Analysis shall contain an analysis of the anticipated performance of the asphalt concrete if left in place. The Engineering Analysis shall also detail the effect of any proposed corrective action to the material(s) in place as it relates to the in-place material’s performance. The Engineering Analysis shall be performed by a professional engineer experienced in asphalt concrete testing and mix designs.

If a lot or subplot is accepted for referee testing and the referee test results still show a deficiency, the contractor shall have ten working days to submit an engineering analysis beginning upon notification of referee test results.

SECTION 321

When an Engineering Analysis recommends that a specific lot or subplot should not be removed, the Engineering Analysis will recommend that the following penalties (Table [321-9](#)) be paid when the contracting agency is the owner, for the specific criteria being reviewed by the EA.

TABLE 321-9		
ENGINEERING ANALYSIS PENALTIES for REMOVAL* LOTS/SUBLOTS LEFT IN-PLACE		
Acceptance Criteria	Acceptance Limits	Penalty When Contracting Agency is the Owner (\$/Ton)
Asphalt Binder Content	Over 0.2% points from that Permitted	\$9.00
Laboratory Air Voids (Measured at N_{des} or 75 blows as applicable)	Less than 1.5% or Greater Than 8.0%	\$7.50
Limits of In-place Air Voids	Less than 3% or Greater than 10.0%	\$15.00

Within 15 working days, the Engineer will determine whether or not to accept the contractor's proposed Engineering Analysis.

321.11 REFEREE:

If the Contractor has reason to question the validity of any of the acceptance test results, the Contractor may request that the Engineer consider referee test for final acceptance. Any request for referee testing must describe the contractor's reasons for questioning the validity of the original acceptance test results and must clearly describe which set of acceptance tests are in question. The engineer may either accept or reject the request for referee testing. When referee testing is accepted the Contractor (at the Contractor's own expense) will engage an independent laboratory accredited by the AAP or a laboratory listed in the current ADOT Directory of Approved Materials Testing Laboratories as appropriate the acceptance tests that are being questioned. The independent referee laboratory shall use properly certified technicians in accordance with ASTM D3666, Section 7 (Personnel Qualifications). For the set of test results in question the referee laboratory shall perform a new set of acceptance tests (as required by Section [321.10](#) representing the area for the set of tests in question). The referee tests will replace the original acceptance tests that were in question.

These tests may include asphalt binder content, aggregate gradation, Marshall or Gyratory unit weight, maximum theoretical unit weight, laboratory air voids and in-place air voids (compaction). Samples for referee testing shall come from representative samples obtained from the completed pavement, as directed by the Engineer.

The number of samples taken will be the same as specified in Section [321.10](#). The independent laboratory shall compile the test results and transmit them to both the Engineer and the contractor. The independent laboratory shall include a report sealed and signed by an Engineer registered in the State of Arizona, who is experienced in asphalt concrete testing and mix design development. The signed report shall give an opinion that the material evaluated does or does not comply with project specifications, shall clearly describe any deficiencies, and the results will be binding between all parties.

321.12 MEASUREMENT:

Asphalt concrete pavement will be measured by the ton, or by the square yard, for the mixture actually used as allowed above, which shall include the required quantities of mineral aggregates, asphalt binder, and mineral admixture. Measurement shall include any tonnage used to construct intersections, roadways, streets, or other miscellaneous surfaces indicated on the plans or as directed by the Engineer.

321.13 PAYMENT:

The asphalt concrete measured as provided above will be paid for at the contract price per ton or square yard, as adjusted per Section [321.10](#), which price shall be full compensation for the item complete, as herein described and specified.

Payment for tack coat will be by the ton diluted, based on the rate of application, as directed by the Engineer.

SECTION 321

No payment will be made for any overrun in quantity of asphalt concrete in excess of 10 percent based on actual field measurement of area covered, design thickness, and the mix design unit weight. The calculations and payment for overrun will be by individual pay item. To compensate or adjust for a thickness deficiency in an underlying asphalt concrete course, the Engineer may authorize a quantity increase in excess of 10 percent for a subsequent asphalt concrete course. In such cases, the quantity in excess of 10 percent will be paid for at the lowest unit price.

Agency required repairs of existing pavement prior to roadway overlay operations will be paid for as a separate pay item.

Except as otherwise specified, no separate payment will be made for work necessary to construct miscellaneous items or surfaces of asphalt concrete.

321.14 ASPHALT CORE METHOD: Core Drilling of Hot Mix Asphalt (HMA) for Specimens of 4" or 6" diameter

321.14.1 Scope: This method is to establish a consistent method of the use of a diamond bit core to recover specimens of 4 or 6 inch diameter for laboratory analysis and testing. The method will require the use of: water, ice (bagged or other suitable type), dry ice, and a water-soap solution to be utilized when coring asphalt rubber concrete. Individuals doing the specimen recovery should be observing all safety regulations from the equipment manufacturer as well as the required job site safety requirements for actions, and required personal protective equipment.

321.14.2 Core Drilling Device: The core drilling device will be powered by an electrical motor, or by an acceptable gasoline engine. Either device used shall be capable of applying enough effective rotational velocity to secure a drilled specimen. The specimen shall be cored perpendicularly to the surface of pavement, and that the sides of the core are cut in a manner to minimize sample distortion or damage. The machinery utilized for the procedure shall be on a mounted base, have a geared column and carriage that will permit the application of variable pressure to the core head and carriage throughout the entire drilling operation. The carriage and column apparatus shall be securely attached to the base of the apparatus; and the base will be secured with a mechanical fastener or held in place by the body weight of the operator. The core drilling apparatus shall be equipped with a water spindle to allow water to be introduced inside of the drill stem while operating. The cutting edge of the core drill bit shall be of hardened steel or other suitable material with embedded diamond chips in the cutting surface. The core barrel shall be of sufficient diameter to secure a specimen that is a minimum of four or six inches or whichever is prescribed for necessary testing. The core barrel shall not be missing more than one of the teeth used for cutting; if so it shall be discarded and another barrel shall be used. The core barrel shall also be a minimum of two inches longer than the anticipated depth of pavement in accordance with project paving plans.

321.14.3 Accessory Equipment: A sufficient supply of ice and dry ice shall be provided to sufficiently cool the pavement prior to securing the samples from the designated areas in the pavement. The ice should also be used to adjust the temperature of the water used to cool the core bit. A water supply (usually a plastic 35 – 55 gal drum) with sufficient hose to introduce the water into and through the spindle of the coring device by gravity feed. The drum should be white or light in color to minimize excessive thermal heating of the water (*for coring of asphalt rubber cores see Note 1*). At no time shall the water utilized in the coring operation exceed 65° F during the coring operation. Ice shall be utilized to ensure the temperature control of the water being introduced during the cutting operation. An ice chest or other suitably insulated container that can maintain a temperature of less than 70° F shall be used to secure the specimens during transport. The container will be equipped with flat shelving that will support the drilled cores throughout the entire specimen dimension during transport back to the testing facility.

Miscellaneous hand tools to remove the drilled specimen from the drill hole or the core barrel taking great care in not disturbing the specimen more than necessary (refer to fig. 1 in ASTM D5361).

321.14.4 Process: The pavement surface at the time of coring shall not exceed a temperature of 90° F; the pavement shall be conditioned with ice or dry ice to ensure that this requirement is met. Immediately after it has been ensured that the pavement has dropped to the required temperature, core drilling shall begin. The operator will then apply an even and continuous pressure (Note 2) to penetrate through the full depth of the pavement. The operator will concurrently ensure that enough water is moving over the core surface as to adequately remove any and all cuttings that could damage the drilled core. After the pavement thickness has been penetrated the core shall be carefully removed from either the drill hole or the core barrel and be immediately transferred to an ice chest or other suitable container. Each individual core shall be placed on a shelf in the cooler with the exposed side of the specimen facing down, or the "top side" down. If the specimen is a two lift core, the only acceptable means of separating lifts is with a power or other acceptable wet saw type of equipment (conforming to ASTM D5361); however, at no time shall cores be split using a mallet and screwdriver or metal straight edge when being tested for bulk density. Perpendicularity of the specimen shall be checked in the field after the specimen has been extracted from the

SECTION 321

surface. The core operator shall hold the core up to eye level and place the core top side down in a “speed square” or small carpenters square. The specimen placed in the square shall not depart from perpendicular to the axis more than 0.5° (approximately equivalent to 1/16 of an inch in 6 inches). If the specimen is outside of this distance from square it shall be discarded in the field and another sample cored that falls within tolerance. The cores upon arriving at the laboratory for testing shall be carefully cleaned and measured for thickness in accordance with ASTM D3549. A speed square shall be utilized to measure perpendicularity as compared to a 90° degree angle and shall not depart from perpendicular to the axis more than 0.5° (approximately equivalent to 1/16 of an inch in 6 inches). All remaining testing shall be done within the parameters of the current project and / or agency required specification.

*Note 1 – It should be noted that when the material to be cored is a rubberized asphalt mixture a wetting agent such as liquid dish soap shall be added to the water barrel to hinder the material from sticking or allowing the binder to spread during coring.

*Note 2 – This refers to pressure exerted on the core barrel and machine during the coring process. Too much pressure can cause damage to the core barrel and the motor; and too little pressure can cause a glazing of the diamonds, reducing cutting efficiency and premature wear of the barrel.

- End of Section -

SECTION 324

PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

324.1 DESCRIPTION:

This item shall consist of construction of a pavement composed of plain jointed portland cement concrete on a prepared subgrade. The Contractor shall furnish all labor, materials and equipment necessary for the construction of the pavement in accordance with these specifications and in reasonably close conformity to the lines, grades, thicknesses and details indicated by the plans or as established by the Engineer. All tests shall be performed by a laboratory approved by the Engineer.

324.2 MATERIALS:

324.2.1 Portland Cement Concrete: Portland cement concrete shall conform to the applicable requirements of Section 725 and the additional requirements of this section.

Concrete shall comply with Table 725-1 for Class AA, 4000 psi unless otherwise specified by the Engineer.

The maximum concrete slump shall be as determined by the approved mix design in accordance with Section 725.9(A)(1).

324.2.2 Reinforcement: Tie bars shall be deformed billet steel reinforcing bars conforming to the requirements of ASTM A-615, Grade 40.

Dowel or load transfer bars shall conform to the requirements of ASTM A-615, Grade 40. An approved support system shall be used to hold bars in position.

324.2.3 Curing Materials: Materials for curing concrete shall conform to the requirements of Section 726.

324.2.4 Joint Materials: Joint sealant shall be poured type, conforming to the requirements of Section 729.2 or as approved by the Engineer. Preformed expansion joint filler shall conform to the requirements Section 729.1 or as approved by the Engineer.

324.3 CONSTRUCTION METHODS:

324.3.1 General: Pavement shall be constructed with mechanical equipment utilizing stationary side forms or by the use of slipform paving equipment without stationary side forms. Manual methods of placing and finishing concrete with stationary side forms may be permitted by the Engineer for areas inaccessible for mechanical equipment.

All curb and gutter shall have the same class of concrete as the adjacent PCCP. Gutter sections shall have the same thickness as the PCCP section. All curbs or combined curb and gutter joints shall align with roadway joints.

324.3.2 Equipment: Design, capacity, and mechanical condition of equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer. Equipment shall be at the jobsite sufficiently ahead of the start of concrete paving operations to permit thorough examination and approval by the Engineer prior to start of concrete paving.

Equipment used to place concrete may consist of one or more machines, shall be capable of uniformly distributing and consolidating the concrete as it is placed without segregation and shall be capable of producing concrete pavement which will conform to the required cross-section with a minimum of hand work. The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to the concrete delivery rate.

Vibrators shall be used to consolidate concrete; the rate of vibration shall be not less than 3,500 cycles per minute for surface vibrators and not less than 8,000 cycles per minute for internal vibrators. Power to vibrators mounted on mechanical equipment shall be so connected that vibration ceases when forward or backward motion of the machine is stopped. Contractor shall furnish a tachometer or other suitable device for measuring and indicating the frequency of vibration.

Slipform pavers shall be equipped with high frequency internal vibrators mounted with axes either parallel or normal to pavement alignment for the full paving width. Vibrators mounted with axes parallel with pavement alignment shall be spaced at intervals not to exceed 24 inches, measured center-to-center. Vibrators mounted with axes normal to pavement alignment shall be spaced so that lateral clearance between individual vibrating units does not exceed 6 inches.

SECTION 324

Slipform paving equipment which will be wholly or partially supported on subgrade shall be equipped with traveling side forms of sufficient dimensions, shape and strength to support the concrete at free edges laterally for a sufficient length of time during placement to produce pavement of the required cross-section, and shall be equipped and operate with automatic sensing and control devices such that the machine automatically senses deviations from the established guideline and performs the necessary corrective maneuvers to overcome variations from correct grade and alignment.

When concrete will be placed adjacent to existing pavement or curb and gutter, that part of the equipment supported on the existing pavement or curb and gutter shall be equipped with protective pads on crawler tracks or rubber-tired wheels with bearing surfaces offset a sufficient distance from the edge of the pavement or curb and gutter to avoid edge damage, or the surface of the existing pavement or curb and gutter shall be otherwise protected against such damage in a manner approved by the Engineer.

324.3.3 Subgrade and Base Preparation: Subgrade and base shall conform to the applicable compaction requirements of Section 601 and elevation tolerances specified for the material involved, shall be kept smooth and compacted, and shall be free of all loose and extraneous material when concrete is placed.

The surface of the subgrade shall be uniformly moist when concrete is placed. The surface of the subgrade shall be moistened immediately prior to placement of concrete, if necessary to produce a uniformly moist condition. Any excess water standing in pools or flowing on the surface shall be removed prior to placing concrete.

324.3.4 Stationary Side Forms and Setting of Forms: Side form sections shall be straight, free from warps, bends, indentations or other defects. Side forms shall be of metal, have a base width of at least four inches and a minimum depth equal to the thickness of the pavement. No section shall show a variation from a true plane greater than 1/8 inch in ten feet on the top of the form or more than 1/4 inch in ten feet on the inside face. Flexible or curved forms of proper radius shall be used for curves of 100 feet radius or less. Suitable materials other than metal may be used to form end closures or at other locations where use of metal forms is not practical. Forms shall be thoroughly cleaned and oiled each time they are used.

Forms shall be of such cross section and strength and so secured and supported on the subgrade as to resist the pressure of the concrete when placed and the impact and vibration of any equipment they are to support without springing or settlement. The method of connection between sections shall be such that the joints shall not move in any direction.

Subgrade under forms shall be compacted and cut to grade so that the form when set will be uniformly supported for its entire length at the specified elevation. Forms shall be so supported and secured during the entire operation of placing and finishing that they will not deviate vertically at any point more than 1/8 inch from the proper elevation. Forms shall be set to the required lines and grades well in advance and for a distance sufficient to prevent delay in placing concrete, and shall be approved by the Engineer prior to placing concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

Side forms shall remain in place until the day after placing concrete, and in all cases until the edge of the pavement no longer requires the protection of the forms. Forms shall be carefully removed in such a manner as to avoid damage to the pavement. Use of pry bars between the pavement and the forms will not be permitted.

324.3.5 Placing, Spreading and Compacting: Construction equipment shall not operate on the subgrade in the paving lane when conditions of the job will permit operation from outside the lane. When job conditions make it necessary to operate equipment on the subgrade in the paving lane, suitable runways or other precautions shall be taken to prevent rutting or displacement of subgrade material. The grade shall be checked and corrected immediately ahead of concrete placement and all disturbed grade shall be properly recompact. Except when otherwise approved by the Engineer, concrete shall be deposited on the subgrade and spread full width using mechanical methods that result in minimal handling and segregation. Necessary hand spreading shall be done with shovels, not rakes. Placement shall be continuous between transverse joints without the use of intermediate bulkheads.

The Contractor shall make adequate advance arrangements for preventing delay in delivery and placing of concrete. An interval of more than 15 minutes between placing of any two consecutive batches shall constitute cause for stopping operations, and Contractor shall remove all concrete placed beyond the last scheduled joint or install a joint of the type and at the location as directed by the Engineer.

Concrete shall be deposited as near to expansion and construction joints as possible without disturbing them but shall not be dumped onto a joint assembly. Concrete shall be thoroughly consolidated against and along the faces of all forms, adjacent

SECTION 324

pavement or curb and gutter, and on both sides of all joint assemblies. Vibrators shall not be permitted to come in contact with joint assemblies, the grade, or side forms, and shall not be operated longer than 15 seconds in any one location.

Manual methods of placing, spreading, and compacting may be used in the construction of pavement lanes of irregular width or widths less than 10 feet, and sections of intersections or other locations with complex variable surface configurations when permitted by the Engineer. Workmen shall not be allowed to walk in the freshly placed concrete.

324.3.6 Shaping and Initial Finishing: Concrete shall be struck off, consolidated, and float-finished with a slipform paver, mechanical finishing machine, vibrating screed, or by hand finishing methods when approved by the Engineer so that the complete pavement will conform to the thickness and cross section requirements of the plans and specifications. When the pavement being constructed is contiguous to existing parallel concrete pavement or curb and gutter, the elevation of the new pavement surface shall conform as closely as possible to the elevation of the existing pavement or gutter surface in a manner which will prevent ponding. The difference in elevation shall not exceed 1/4 inch.

Water shall not be applied to the pavement surface during screeding and finishing operations in excess of the amount lost by evaporation. Adding water to the surface of the concrete to assist in finishing operations shall not be permitted. When applications of water to the surface are required to prevent rapid evaporation of water from the surface during finishing operations, it shall be applied as a fog spray and with approved spray equipment.

(A) Slipform Supported on Subgrade Method: When concrete pavement will be placed with slipform paving equipment which will be supported and operate on the subgrade, the subgrade and slipform paver track area shall be brought to proper grade and cross section by means of a properly designed and operated machine. The equipment shall spread, consolidate, screed and float-finish the concrete in one complete pass of the machine. The machine shall be operated with as nearly a continuous forward movement as possible and all paving operations shall be so coordinated as to provide uniform progress with stopping and starting of the paver held to a minimum. Sliding side forms shall be rigidly held together to prevent spreading. Any edge slump of the pavement, exclusive of edge rounding, in excess of 1/4 inch shall be corrected.

No abrupt changes in longitudinal alignment of the pavement will be permitted. The horizontal deviation shall not exceed one inch from the alignment established by the Engineer.

While concrete is being spread, compacted and shaped, vibrating units shall be operated within fresh concrete so that the longitudinal axis, at the center of each unit, is not more than 6 inches above the top of the subgrade. Amplitude of vibration shall be sufficient to be perceptible on the surface of concrete along the entire length of vibrating units and for a distance of at least one foot.

(B) Mechanical Equipment Supported on Fixed Form Method: When concrete is spread without the use of internal vibration, the finishing machine shall be equipped with vibrating equipment that will internally vibrate the concrete for the full paving width and with not less than two oscillating or reciprocating screeds. Concrete shall be struck off and consolidated so that the surface will conform to the finished grade and cross section shown on the project plans and with sufficient material on the surface for floating operations.

After the concrete has been struck off and consolidated, it shall be floated with a longitudinal float of a type approved by the Engineer.

A slipform paver or a single machine which will effectively spread, consolidate, screed, and float in one operation may be used in lieu of separate finishing and floating equipment.

(C) Manual Methods with Fixed Forms: Concrete shall be deposited, spread and struck off to such an elevation that, when properly consolidated, the surface will conform to the required lines and grades. Concrete shall be consolidated by internal vibration as it is struck off with a screed. A slight excess of concrete shall be kept in front of the screed at all times during the strike-off operation.

After consolidation and screeding, concrete shall be tamped to the proper surface elevation and cross section using either a heavy plank with a length in excess of the width of pavement being placed by one foot or more, or with a mechanical vibrating unit spanning the full width between forms. The tamping plank, if used, shall be stiffened as necessary to prevent sag and shall have the lower tamping edge shod with metal. The tamping plank shall be moved forward with a combined vertical tamping and longitudinal screeding motion so that the concrete will be thoroughly consolidated and the surface screeded to the required elevation. A small surplus of concrete shall be kept in front of the tamper or vibrating unit.

SECTION 324

Tamping or vibrating shall continue until the specified cross section is obtained and the mortar flushed slightly to the surface. On grades in excess of 5 percent a second strike board shall follow from 25 to 50 feet behind the tamper or vibrating unit and shall be used in the same manner to remove waves caused by the flow of concrete behind the first strike board.

Methods other than the tamping plank may be utilized for screeding when approved by the Engineer.

Pavement shall be finished smooth and true to grade with suitable manually operated floats or powered finishing equipment.

324.3.7 Final Finishing: After the pavement has been float-finished, it shall be scraped with a 10-foot long straightedge equipped with a handle to permit operations from the edge of the pavement, and excess water and laitance shall be removed from the surface. The straightedge shall be operated parallel to the centerline of the pavement and shall be moved forward one-half length after each pass. Irregularities shall be corrected by adding or removing concrete, and disturbed places shall be again straight-edged.

Long-handled floats shall be used only in areas not accessible to finishing equipment and in emergencies, and use of such floats shall be confined to a minimum.

The addition of water to the surface of the concrete to assist in finishing operations shall not be permitted unless approved by the Engineer. When the evaporation rate on the concrete surface exceeds the rate of bleeding of the concrete, measures shall be taken to prevent the rapid evaporation of water from the surface during finishing operations. When allowed by the Engineer, the addition of water to the surface may be permitted when applied as a fog spray with approved spray equipment immediately after screeding and/or between finishing operations. A commercial evaporation reducer that forms a monomolecular film may also be sprayed onto the concrete surface in accordance with the Manufacturer's recommendations. When either of these methods is approved and used it does not take the place of proper curing methods per Section 324.3.8.

Pavement edges and joints shall be edged in accordance with details shown on the project plans or as directed by the Engineer.

In advance of curing operations, pavement shall be textured. Texturing shall be performed with an artificial turf drag with a board added to assure the weight needed to obtain an approved surface. Artificial turf shall be a molded composite structure with polyethylene face, nylon and polyester backing, a pile height of 0.85 inches, and total weight of 75 oz./sq. yd. The surface obtained during initial surface texturing shall be subject to approval by the Engineer. The texturing approved on the initial construction shall not be changed without the Engineer's approval. Each time the construction is stopped or causes the texturing to stop, the artificial turf must be shaken clean before continuing.

324.3.8 Curing: Curing shall begin immediately following surface texturing and edging. Before concrete placement begins, Contractor shall have at hand and ready to install the materials and equipment needed for adequate curing.

After finishing operations have been completed, the newly placed concrete shall be cured by moist curing methods, by application of a white pigmented liquid membrane compound conforming to the requirements of Section 726, or by a combination of these methods. All surfaces not covered by reasonably waterproof forms shall be kept damp by applying water with a nozzle that so atomizes the flow of water that a fog mist and not a spray is formed until the surface is covered with liquid membrane compound, the surface has hardened sufficiently to permit sprinkling of the surface, or moist curing by covering with wet burlap or other approved materials can be initiated. Moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow and erode the surface. Moist curing shall be continued until liquid membrane curing compound or other type of curing membrane is applied.

Membrane curing compound shall be applied to all pavement by automatic mechanical method from a construction bridge.

The edges of concrete slabs exposed by the removal of forms shall be protected immediately to provide these exposed surfaces with continuous curing treatment equal to the method selected for curing the pavement surface.

The membrane method of curing may be applied behind the final finishing operation after all free water has disappeared from the surface. Complete and uniform coverage at the rate of one gallon per 100 square feet, or as otherwise recommended by the manufacturer, shall be required. Compound shall be kept agitated to prevent pigment from settling.

324.3.9 Joints: Joints shall be provided in the pavement of the type, dimensions and at the locations as indicated in the plans or as specified herein.

SECTION 324

Joints in concrete pavement will be designated as transverse expansion joints, longitudinal or transverse construction joints, longitudinal or transverse weakened plane joints, or isolation joints. The faces of all joints shall be perpendicular to the pavement surface. Joints shall be constructed in accordance with the details shown or referenced in the plans and in accordance with the following provisions.

At all times prior to acceptance of the construction, joints shall be maintained clean and free of soil, gravel, and other foreign material except approved types of joint filler materials.

(A) Longitudinal Joints: Longitudinal joints shall be weakened plane or construction joints. Longitudinal weakened plane joints shall be constructed by sawing or by insertion of a parting strip in the plastic concrete to be left in place. Longitudinal construction joints shall be constructed with tie bars or keyways as indicated in the plans.

(B) Transverse Joints: Transverse joints shall be weakened plane, construction or expansion joints. All transverse weakened plane joints will be constructed by sawing and in accordance with the details shown in the project plans. Transverse construction joints shall be constructed in accordance with the details shown or referenced in the project plans. Transverse expansion joints shall be constructed in accordance with the details shown or referenced in the project plans.

Dowel bars when required shall be supported with an approved support system.

(C) Joint Location: Longitudinal and transverse joints shall be constructed at locations as indicated in the project plans.

Isolation joints shall be provided around manholes, catch basins, or other elements which extend into or project through the pavement and act as point of restraint to horizontal or vertical movement of the pavement. Isolation joints shall be located in accordance with Detail 224 or as directed by the Engineer.

324.3.9.1 Construction of Joints:

(A) Sawed Joints: Sawed joints shall be constructed by cutting a groove in the pavement using a single or multiple-blade power saw. The groove shall be cut to the dimensions shown on the project plans. Suitable guidelines or devices shall be used to ensure joints are cut true to the lines as shown on the project plans.

If joints are sawed in stages, the initial saw cut shall be of the minimum width specified and sawed to the required depth. The depth of the initial saw cut in the construction of weakened plane joints shall be a minimum of 1/4 of slab thickness.

Sawing of weakened plane joints shall be done before uncontrolled cracking takes place, and after the concrete has hardened to the extent that tearing or raveling of the edges of the saw cut is not excessive. The exact time for all sawing shall be determined by the Contractor when not otherwise specified.

Any procedure for sawing joints that result in premature, uncontrolled cracking shall be revised immediately. The Contractor shall be responsible for replacing or repairing areas containing uncontrolled cracking and for repairing spalled or chipped concrete along the edges of sawed joints to the satisfaction of the Engineer.

After saw cutting of the joint and just prior to sealing the joint, the internal joint surfaces shall be cleaned of all dirt, curing compound residue, laitance and other foreign materials. The internal joint surface shall be defined as the sawed portion of the joint and the resultant crack for the full depth of the pavement.

Sealing of sawed joints where required shall be completed prior to the opening of the pavement to traffic unless otherwise approved by the Engineer. When delayed sealing of sawed joints is permitted, saw cuts and formed recess to be filled with sealant shall be protected to ensure thorough curing of the concrete along the edges of the joint recesses and to prevent entry of foreign materials into the joint. At the Contractor's option, inert compressible joint filler material such as plastic backer rod or upholstery cord may be inserted into joints immediately after sawing or forming of the joint recess to provide curing protection and prevent entry of foreign material. If absorptive filler material is used, it shall be thoroughly moistened either before or immediately after installation in the sawed groove. When filler material is rope, or similar material which does not fill the entire depth of sawed groove, it shall be depressed not less than 1/2 inch below the pavement surface before the pavement is opened to traffic.

(B) Expansion and Construction Joints: Longitudinal and transverse expansion and construction joints shall be as required by the project plans.

SECTION 324

(C) Isolation Joints: Isolation joints unless otherwise detailed in construction documents shall be 1/2 inch wide expansion joints in accordance with Detail 224 or as directed by the Engineer.

(D) Sealing of Joints: Sealant shall be applied in accordance with the sealant manufacturer's recommendations. A primer shall be furnished and applied after the joint has been cleaned and prepared to receive sealant when indicated in the manufacturer's recommendations.

Prior to the application of the sealant, an approved type of inert, compressible joint filler material such as plastic backer rod or upholstery cord, or an approved type of bond breaker, shall be inserted along the joint in accordance with the details shown on the project plans. The joint shall then be filled with sealant to a level not less than 1/8 inch or more than 1/4 inch below the elevation of the pavement surface adjacent to the joint edge.

The equipment used to apply sealant shall be as recommended by the sealant manufacturer. Sealant shall not be spilled on the surface of the concrete pavement, and Contractor shall remove any sealant inadvertently spilled on the pavement surface.

(E) Repair of Cracks, Spalls, Raveling and Tearing: Contractor shall be responsible for replacing or repairing all areas of pavement containing uncontrolled cracking, surface spalls, or other types of surface. Repairs when authorized shall be made and completed by methods acceptable to the Engineer.

324.4 TESTS OF FINISHED PAVEMENT:

324.4.1 Smoothness: The pavement surface including pavement in intersections will be tested with a ten-foot straight-edge placed parallel to the centerline of the pavement in each lane. Ordinates measured from the face of the straight-edge to pavement surface shall at no place exceed one-quarter inch. Areas that do not meet the required surface accuracy as determined by straight-edge testing shall be marked, and Contractor shall at his own expense and as required by the Engineer either:

- (1) Grind down areas higher than 1/4 inch but not more than 1/2 inch above the correct surface.
- (2) Correct areas lower than 1/4 inch but not lower than 1/2 inch below the correct surface by grinding down the adjacent areas.
- (3) Remove and replace pavement when the deviation exceeds 1/2 inch from the correct surface. Area replaced shall be of a length, width and depth as required to allow formation of a new slab of the required quality. The area replaced shall be compatible with the joint layout shown on the project plans as determined by the Engineer.

After grinding, the finished surface of the ground area shall be provided with a uniform texture acceptable to the Engineer. The method of texturing shall be approved by the Engineer.

324.4.2 Pavement Thickness: Concrete pavement shall be constructed in accordance with the thickness requirements of the plans and specifications. Tolerances for base and subgrade construction and other provisions of these specifications which may affect thickness shall not be construed to modify such thickness requirements.

Pavement thickness testing shall begin after achieving pavement smoothness compliance. For the purpose of determining acceptability for thickness, cores shall be drilled by the Contractor at the locations specified by the Engineer. Cores shall have a minimum diameter of four inches. Length of cores will be determined in accordance with the requirements of AASHTO T-148.

In calculating average length, cores which have a length in excess of the thickness specified by more than 0.25 of an inch will be deemed to have a length of the specified thickness plus 0.25 of an inch. Field length measurements will be acceptable in lieu of average length measurement in accordance with the requirements of AASHTO T-148, provided the original core in any secondary unit meets or exceeds the specified thickness. Measurements in accordance with the requirements of AASHTO T-148 will be required on any questionable thickness measurements and on the three cores used to determine the average length for payment, regardless of length.

A primary unit of pavement shall be the area of pavement placed in each day's paving operation. Each intersection or special section shall be considered as a primary unit.

Revised 2015

SECTION 324

A secondary unit of pavement shall consist of 1,000 linear feet, or fraction thereof, of each traffic lane. Each 1,300 square yards of pavement in intersections, etc., shall be considered a secondary unit regardless of when the concrete was placed.

One core shall be drilled in each secondary unit. If the length of that core is not deficient by more than 0.25 of an inch, that secondary unit will be measured for payment at 100 percent. If the length of that core is deficient by more than 0.25 of an inch but less than 1.0 inch, two additional cores shall be drilled within that secondary unit and the length of the three cores averaged. If the average length is not deficient by more than 0.25 of an inch, that secondary unit will be measured for payment at 100 percent. If the average length of the three cores is deficient by more than 0.25 of an inch, that secondary unit will be measured for payment in accordance with the requirements of Table 324-1.

If the core in the secondary unit is deficient by more than 1.00 inch, that core will not be used in determining the average thickness of that secondary unit. Additional cores shall be drilled at intervals not to exceed ten feet in each direction from the deficient core, parallel to the main-line centerline, until one core is obtained in each direction which is not deficient by more than 1.00 inch. The pavement between these two cores will be evaluated separately from the balance of the pavement in that secondary unit. The limits for evaluation shall be between the longitudinal weakened plane or construction joint on each side of the core and between the next transverse weakened plane, construction, or expansion joint beyond each of the last two cores. Unless the Engineer allows the pavement to remain, it shall be removed and replaced with pavement of the specified thickness and no payment will be made for the removed pavement.

If the pavement in the deficient area is removed, either by the order of the Engineer or at the option of the Contractor, it shall be removed between the limits of the evaluation. After the pavement has been replaced, one core shall be drilled at random in that secondary unit after deducting the area of the replaced pavement and one core shall be drilled in the new pavement. Pavement represented by the core drilled in the secondary unit, less the replaced pavement, will be measured for payment as hereinbefore specified. The core drilled in the replaced pavement shall be not less than the specified thickness; otherwise that pavement will not be measured or paid for.

At all locations where cores have been drilled, the resulting holes shall be filled with concrete in a manner satisfactory to the Engineer.

324.5 PROTECTION OF PAVEMENT:

The Contractor shall be responsible for taking adequate steps to protect concrete placed during rain, or hot or cold weather as defined in ACI Standards. Any concrete damaged by rain or extreme temperatures shall be removed and replaced at the Contractor's expense.

When ordered by the Engineer, pavement crossings shall be constructed for the convenience of public traffic. Where motor vehicles are encountered, a temporary bridge to span the newly placed concrete will be provided.

No traffic or Contractor's equipment, except as hereinafter provided, will be permitted on the pavement until the concrete has developed a compressive strength of 3500 psi.

Equipment for sawing joints will be permitted on the pavement when, in the Contractor's judgment, the concrete has developed sufficient strength to support the equipment without damage to the concrete. In case of visible cracking or other damage to the pavement, operation of the equipment on the pavement shall be immediately discontinued.

Any damage to the pavement resulting from early use of pavement by the Contractor's equipment shall be repaired by the Contractor at his expense.

324.6 METHOD OF MEASUREMENT:

Portland Cement Concrete Pavement will be measured by the square yard. Any opening in excess of one square yard will not be measured for payment.

324.7 BASIS OF PAYMENT:

The accepted quantities of Portland Cement Concrete Pavement, measured as provided for herein, will be paid for at the contract unit price complete in place, except that where the average length of cores indicates pavement deficient in thickness by more than 0.25 of an inch but not more than 1.00 inch, payment will be made as specified in Table 324-1. Payment will be made to the nearest cent.

SECTION 324

No additional payment will be allowed for pavement constructed in excess of the thickness specified on the project plans.

TABLE 324-1	
PAVEMENT THICKNESS PAYMENT REDUCTION (PCCP)	
Core Thickness, Less Than Specified Thickness, Inches	Percent of Contract Unit Price Allowed
0.00 to 0.25	100
0.26 to 0.35	93
0.36 to 0.45	85
0.46 to 0.55	75
0.56 to 0.75	63
0.76 to 1.00	50

End of Section -

SECTION 325

PLACEMENT AND CONSTRUCTION OF ASPHALT-RUBBER ASPHALT CONCRETE

325.1 DESCRIPTION:

Asphalt-rubber asphalt concrete (ARAC) consists of supplying, placing and compaction of plant-mixed, gap-graded ARAC over asphalt surfaces. The thickness of the finished ARAC overlay shall be within the range of one to two inches as shown on the plans or as specified in the special provisions.

325.2 MATERIALS:

ARAC shall consist of a mixture of aggregate, mineral admixture and asphalt-rubber binder (ARB) as specified in Section [717](#).

325.2.1 Mixing of Asphalt-Rubber Binder: Mixing of asphalt-rubber binder (ARB) may take place in a dedicated blending and storage unit connected to the hot plant or at the asphalt binder supplier's facility. In either case, the temperature of the asphalt cement shall be between 375° F and 425° F prior to the addition of crumb rubber. No agglomerations of crumb rubber particles in excess of 2 inches in the least dimension shall be allowed in the mixing chamber. The crumb rubber and asphalt cement shall be accurately proportioned in accordance with the ARB design as identified in [717.2.14](#) and thoroughly mixed prior to the beginning of the one hour reaction period. Reaction time may be decreased to 45-minutes if documentation is provided that the physical properties of the mix design requirements are consistently met using a 45-minute reaction period. The Contractor or supplier shall document that the proportions are accurate and that the crumb rubber has been uniformly incorporated into the mixture. Additionally, the Contractor or supplier shall demonstrate that the crumb rubber particles have been thoroughly mixed into the base asphalt cement. The occurrence of crumb rubber floating on the surface or agglomerations of crumb rubber particles shall be evidence of insufficient mixing. The temperature of the ARB immediately after mixing shall be between 350° F and 400° F. Reaction time shall start after all of the material for the batch has been mixed and the minimum reaction temperature of 350° F has been achieved.

Prior to use, the viscosity of the ARB shall be tested by the use of a rotational viscometer, which is to be furnished by the Contractor or supplier. The Contractor or supplier shall provide a qualified person to perform the testing.

325.2.2 Handling of ARB: Once the ARB has been mixed, it shall be kept thoroughly agitated during periods transport and use to prevent settling of the crumb rubber particles. During the production of ARAC the temperature of the ARB shall be maintained between 325° F (163°C) and 400° F (204°C). However, in no case shall the ARB be held for more than 10 hours at these temperatures. It may be allowed to cool to a temperature of 250° F (121°C) or lower and held at that temperature for not more than four days. The process of cooling and reheating shall not be allowed more than one time for a batch of ARB.

For each load or batch of ARB, the Contractor or supplier shall provide the Engineer with the following documentation:

- (A) The source, grade, amount and temperature of the asphalt cement prior to the addition of crumb rubber.
- (B) The source, type and amount of crumb rubber and the rubber content expressed as percent by the weight of total ARB.
- (C) Times and dates of the crumb rubber additions, resultant viscosity test, and the elapsed reaction time at which the viscosity test was taken.
- (D) A record of the temperature, with time and date reference for each load or batch. The record shall begin at the time of the addition of crumb rubber and continue until the load or batch is completely used. Readings and recordings shall be made at every temperature change in excess of 20° F, and as needed to document other events which are significant to batch use and quality.

325.3 WEATHER AND MOISTURE CONDITIONS:

ARAC shall be placed only when the surface is dry, and when the atmospheric temperature in the shade is 55° F or higher. No ARAC shall be placed when the weather is foggy or rainy. ARAC shall be placed only when the Engineer determines that weather conditions are suitable.

SECTION 325

325.4 APPLICATION OF TACK COAT:

A tack coat shall be applied to all existing and to each new course of ARAC prior to the placing of a succeeding lift of ARAC. The tack coat may be deleted when a succeeding layer of ARAC is being applied over a freshly laid course that has been subjected to very little traffic when approved by the Engineer.

The application of the tack coat shall comply with Section [329](#). The grade of emulsified asphalt shall be SS-1h or CSS-1h as specified in Section [713](#).

The same material that is specified above for the tack coat shall be applied to the vertical surfaces of existing pavements, curbs, and gutters, against which asphalt concrete is to be placed.

The surface to be covered may require repair or patching as directed by the Engineer. This shall be addressed in the project specifications prior to the bidding of the project.

325.5 MIX PRODUCTION:

All materials shall be proportioned by weight in a hot mix asphalt plant in the proportions required by the mix design to provide a homogeneous and workable mass. Each hot mix asphalt plant shall be inspected in accordance with the provisions contained in the 'Hot Mix Asphalt Production Facilities' by the Arizona Rock Products Association and shall have a current inspection certificate. All measuring devices shall be calibrated at least annually by a technician licensed by the Arizona Bureau of Weights & Measures. Mixing plants shall conform to the requirements of AASHTO M-156, except as modified herein.

In drum mix plants the mineral admixture shall be added and thoroughly mixed with the mineral aggregate by means of a mechanical mixing device prior to the mineral aggregate and mineral admixture entering the dryer. The moisture content of the combined mineral aggregate shall be a minimum of three percent by weight of the aggregate during the mixing process.

For drum-mix plants, the mineral admixture shall be weighed across a weigh belt, or other approved alternative weighing system, with a weight totalizer prior to entry into the mechanical mixing device. The mechanical mixing device shall be a pugmill type mixer that is in good working condition. The rate of the aggregate feed shall not exceed the mixing device's capacity in ton per hour. The mixer shall be constructed to minimize the loss of mineral admixture and shall be located in the aggregate delivery system at a location where the mixed material can be readily inspected. The mixing device shall be capable of effective mixing in the full range of the ARAC production rates.

The hot plant and equipment shall be constructed and operated to prevent loss of mineral admixture through the dust collection system of the plant.

A positive signal system shall be provided and utilized during production whereby the mixing shall automatically be stopped if the mineral admixture is not introduced into the mineral aggregate. The plant will not be permitted to operate unless the signal system is in good working condition.

The introduction of ARB shall be controlled by an automated system fully integrated with the controls for the mineral aggregate and mineral admixture. The production of the plant shall be controlled by the rate required to obtain a uniform mixture of all components. Drying and heating shall be accomplished in such a manner as to preclude the aggregate or mineral admixture from becoming coated with un-spent fuel. The completed ARAC may be held in storage for up to 12 hours in insulated or heated silos, providing the minimum temperature noted herein for placement and compaction is met behind the placement device. If the Engineer determines that there is an excessive amount of heat, heat loss, drain down, segregation and/or oxidation of the mixture due to temporary storage, use of surge bins or storage bins will be discontinued.

The temperature of the ARAC, with unmodified binders, upon discharge from the mixer shall not exceed 350° F. The discharge temperature may be increased, when approved by the Engineer. If the ARAC is discharged from the mixer into a hopper, the hopper shall be constructed so that segregation of the ARAC will be minimized.

SECTION 325

325.6 TRANSPORTATION:

Petroleum distillates or other substances that will have a detrimental effect on the asphalt concrete shall not be used as a release agent.

The beds of all transportation units shall be clean and smooth to allow the free flow of material into the paving machine's hopper.

Tarpaulins shall be furnished on all trucks and used when weather condition warrant, or if directed by the Engineer.

325.7 PLACEMENT:

325.7.1 Surface Preparation:

Before placing ARAC on existing pavements, severely raveled areas or cracked areas that are depressed more than 3/4" from the adjoining pavement shall be cut out and patched at least 48 hours prior to the resurfacing operation. Over-asphalted (bleeding or flushing) areas or rough high spots shall be removed by burning or blading. Large shrinkage cracks shall be filled with asphalt sealing compound acceptable to the Engineer. The entire surface shall be cleaned with a power broom. Raveled areas that do not require removing shall be cleaned by hand brooming. The above surface cleaning requirements are included as part of the ARAC paving operations, and the cost thereof shall be included in the ARAC pay item. Pavement repairs and crack sealing when required are to be compensated for by other appropriate contract pay items.

Prior to placing the ARAC on milled surfaces, pot-holes left by the milling operation shall be repaired by the Contractor, as a related non-pay item and as required by the Engineer. The milled area shall be swept.

After surfaces have been prepared to the satisfaction of the Engineer, they shall receive a tack coat as specified in Section [325.4](#).

Traffic will not be permitted over surfaces which have received a tack coat. When the overlay is to extend onto a concrete surface, the concrete surface shall be thoroughly cleaned of loose dust and cement particles and shall be tack coated.

325.7.2 Placing and Construction Methods:

All courses of ARAC shall be placed and finished by means of a self-propelled paving machine equipped with an automatically actuated control system, except under certain conditions or at locations where the Engineer deems the use of a self-propelled paving machine impracticable.

The control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other end indirectly either through controlling the transverse slope or alternatively when directed, by controlling the elevation of each end independently.

The control system shall be capable of working with one of the following devices:

- (A) Ski or non-contact device of not less than 30 feet in length, supported throughout its entire length
- (B) Taut stringline or wire set to grade
- (C) Short ski or sonar sensing units from curb control
- (D) Joint matching shoe

Failure of the control system to function properly shall be cause for the suspension of asphalt concrete production. In order to achieve a continuous operation, the speed of the paving machine shall be coordinated with the hot mix plant and transport units.

The ARAC shall be dumped from the hauling vehicles directly into the paving machine, unless otherwise approved by the Engineer.

Care shall be taken to avoid jarring the machine or moving it out of alignment. No vertical load shall be exerted on the paving machine by the truck.

SECTION 325

If ARAC is dumped upon the surface being paved and subsequently loaded in the paving machine, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the ARAC shall be picked up and loaded into the paving machine. If ARAC is placed in a windrow during paving, the windrow shall not exceed a distance greater than 150 feet in front of the paving machine.

Self-propelled paving machines shall spread the mixture without segregation or tearing, true to line, grade and crown as indicated on the project plans. Pavers shall be equipped with hoppers and augers that will distribute the mixture uniformly in front of an adjustable floating screed. The raising of the hopper wings shall be minimized and the paving machine shall not be operated when in an empty condition.

Screeds shall include any strike-off device operated by tamping or vibrating action which is effective, without tearing, shoving or gouging the mixture and which produces a course with a uniform texture and density for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required. In the case of the screed, auger extensions and vibrators shall be installed wherever the screed is extended more than one (1) foot beyond the end of the base auger or auger extension. However, when placing material against an extremely uneven curb or edge over a short distance, the Engineer may waive the auger extensions and vibrators.

325.7.3 Compaction: It is the contractor's responsibility to perform any desired Quality Control monitoring and/or testing during compaction operations to achieve the required compaction. The temperature of the ARAC immediately behind the laydown machine shall be at least 275° F. A probe type electronic thermometer with a current calibration sticker attached will be used to measure the temperature of the asphalt concrete mixture. When measuring the temperature of the mat, the probe shall be inserted at mid-depth and as horizontal as possible to the mat. When the pavement lift is less than 1.5-inches, the temperature of the material shall be measured in the truck by inserting a calibrated probe type electronic thermometer, or other approved measuring device, to a point at least 6" below the surface of material.

Asphalt compaction equipment shall be of sufficient size and weight to accomplish the required compaction. All compaction equipment shall be operated and maintained in accordance with the manufacturer's recommendations and the project requirements. Pneumatic tired compactors shall not be used.

The Engineer will determine the acceptability of the pavement compaction in accordance with Section [325.9](#). At any place not accessible to the roller, the mixture shall be thoroughly compacted with tampers to provide a uniform and smooth layer over the entire area compacted in this manner.

325.7.4 Lime Water: An application of lime water shall be applied by the Contractor to the compacted ARAC surface after final compaction, prior to opening the roadway to traffic, or when requested by the Engineer to cool the pavement to prevent tracking and pick-up. The lime water solution shall be applied at the rate of approximately ½ gallon/square yard. The lime shall be mixed using a minimum of one (1) 50-pound bag per 3,000 gallons of water.

325.7.5 Adjustments: After installation of an overlay course all necessary frame and cover adjustments for manholes, valve boxes, survey monuments, sewer clean-outs, etc., shall be completed by the Contractor within the given segments being surfaced.

On roads without curb and gutter, the existing shoulder elevation shall be adjusted by the Contractor to match the elevation at the edge of new overlay and slope away from the new pavement surface at a rate that the existing quantity of shoulder material will allow. Shoulder material includes the existing shoulder, millings, untreated base materials, or a granular material approved by the Engineer. Shoulder material shall be compacted to a minimum of 95% of maximum density, determined in accordance with Section [301.3](#).

325.8 QUALITY CONTROL:

It is the contractor's responsibility to perform Quality Control monitoring and/or testing during ARAC production to achieve the required compaction and the required mix properties. The Engineer may obtain samples of any portion of any material at any point of the operations for his own use. Also, the Engineer may order that the use of any drying, proportioning or mixing equipment or the handling of any material be discontinued which, in his/her opinion, fails to produce a satisfactory mixture.

The ARAC produced shall conform to the requirements of the production tolerances established in Section [325.9](#). When the ARAC does not conform to the production tolerances, it shall be reported to the Engineer, and corrective quality control

SECTION 325

measures shall be implemented, or production shall cease immediately at no additional cost to the contracting Agency or Engineer.

325.9 ACCEPTANCE:

325.9.1 Acceptance Criteria: The ARAC will be divided into lots for the purpose of acceptance. A lot shall be one day's production. Each lot shall be divided into sublots of 500 tons or fraction thereof. Tests used to determine acceptance will be performed by a laboratory accredited by the AASHTO Accreditation Program (AAP), for the tests being performed. The contracting agency shall provide an appropriately accredited laboratory or laboratories to perform the acceptance testing. The acceptance laboratory will take representative samples of the ARAC from each subplot to allow for determination of gradation, binder content, and air voids. Each subplot will be accepted based on the test data from the sample(s) from that subplot. All acceptance samples shall be taken using random locations or times designated by the Engineer in accordance with ASTM D3665. The laboratory shall use properly certified technicians in accordance with ASTM D3666, Section 7 (Personnel Qualifications).

325.9.2 Gradation and Binder Content: Acceptance testing for gradation and binder content will be performed in one of the following ways; A) Plant-based testing of the mineral aggregate and binder content using cold feed samples and a nuclear asphalt content gauge or B) End-product testing of the ARAC using an ignition furnace with the gradation being performed on the resulting aggregate. The specifics of these methods are detailed in the following subsections.

During production, the allowable deviations from the mix design gradation targets are listed in Table [325-1](#) below. The allowable production tolerances may fall outside of the mix design gradation bands.

TABLE 325-1		
GRADATION ACCEPTANCE LIMITS FOR ASPHALT-RUBBER MIXES		
Sieve Size	1" & 1 1/2" Lift Thickness	2" Lift Thickness
1 inch	100%	100%
3/4 inch	100%	92-100%
1/2 inch	92-100%	±6%
3/8 inch	±6%	±6%
No. 4	±6%	±6%
No. 8	±6%	±6%
No. 30	±4%	±4%
No. 200	±2%	±2%

325.9.2.1 Plant-Based Sampling and Testing

325.9.2.1.1 Mineral Aggregate Gradation: The acceptance laboratory will take a sample of the mineral aggregate in accordance with the requirements of Arizona Test Method 105 on a random basis for each subplot. For batch plants, the sample shall be taken from the hot bins. For plants other than batch plants, the sample shall be taken from the cold feed belt. Samples will be taken by means of a sampling device which is capable of obtaining representative samples. The device, which shall be approved by the Engineer, shall be furnished by the contractor. In any shift that the production of ARAC is less than 500 tons, at least one sample will be taken.

Samples will be tested for conformance with the mix design gradation, with or without mineral admixture as appropriate, in accordance with the requirements of Arizona Test Method 201. If the results from a single acceptance sample fall outside of the acceptance limits in Table [325-1](#) a second sample shall be taken and if the second acceptance sample is also outside of the acceptance limits in Table [325-1](#) the Contractor shall cease production of asphalt concrete. Production shall not begin again until calibration test results verify that adjustments made to materials or proportions yield a gradation that falls within acceptance limits in Table [325-1](#).

325.9.2.1.2 Binder Content: During production of ARAC, the contractor shall maintain at the plant site a nuclear asphalt content gauge calibrated and operated in accordance with Arizona Test Method 421. At the discretion of the Engineer, the

SECTION 325

Owner may choose to prepare the calibration samples for use by the contractor. Under the observation of the Engineer, the contractor shall determine the ARB content by means of the nuclear asphalt content gauge a minimum of four times per full shift. The Engineer shall determine the times that the samples are taken. The contractor's technicians performing the testing, including the calibration of the nuclear gauge, shall meet the technician requirements given in the Arizona Department of Transportation (ADOT) System for the Evaluation of Testing Laboratories. The requirements may be obtained from ADOT Materials Group, 1221 North 21st Avenue, Phoenix, AZ 85009.

Production of ARAC shall cease immediately and the plant and/or the nuclear asphalt content gauges re-calibrated if any single test result varies by an amount greater than $\pm 0.60\%$, or the average of three consecutive test results varies by an amount greater than $\pm 0.40\%$, from the mix design target. Material that has already been produced may be used on the project if the single test value representative of that material varies by an amount from $\pm 0.61\%$ to $\pm 0.75\%$, inclusive, from the mix design target. Material that has already been produced may not be used on the project if the single test value representative of that material varies by an amount greater than $\pm 0.75\%$ from the mix design target unless, by retesting, the material is found to be acceptable.

When there is cause to question the ARB content being obtained via nuclear asphalt content gauge, or if approved by the Engineer, the ARB content may be determined using inventory data provided by the supplier as detailed in the following paragraphs. This will only apply for plants providing ARAC exclusively for the subject project or if an asphalt cement tank is dedicated for the shift of ARAC production.

The determination of the actual ARB content by inventory methods may include weighing of asphalt cement deliveries, invoice quantities, volumetric tank measurements using a calibrated rod (tank stickings) corrected for temperature, computerized mass-flow meter, and accounting for wasted materials. If a computerized mass-flow meter is used, documentation of its calibration shall be submitted to the Engineer prior to ARAC production. At any time during ARAC production, the Engineer may require that a new calibration of the mass-flow meter be performed.

If there is a difference of greater than 0.2% ARB between the ARB content measured by nuclear asphalt content gauge testing and the actual ARB content as determined by inventory, the contractor may request that the ARB content be determined by inventory. The contractor must make such a request in writing within two working days after receiving the test results for the first day of ARAC production.

325.9.2.2 End Product Sampling and Testing

325.9.2.2.1 Mineral Aggregate Gradation and Binder Content: The acceptance laboratory will take a sample of the asphalt concrete in accordance with the requirements of Section 2 or 4 of Arizona Test Methods 104 or AASHTO T-168 from each subplot. The minimum weight of the sample shall be 45 pounds. Asphalt binder content and gradation shall be determined in accordance with AASHTO T-308 using the ignition furnace for each subplot. The acceptance laboratory is responsible for obtaining the necessary materials and performing an ignition furnace calibration as outlined in AASHTO T-308 for each asphalt concrete mixture utilized on the project. The correction factor used for each test shall be clearly indicated on the report.

During production, the allowable deviations from the mix design gradation targets are listed in Table [325-1](#) above. The allowable production tolerances may fall outside of the mix design gradation bands.

If the results from a single acceptance sample fall outside of the acceptance limits in Table [325-1](#) a second sample shall be taken and if the second acceptance sample is also outside of the acceptance limits in Table [325-1](#) the Contractor shall cease production of asphalt concrete. Production shall not begin again until calibration test results verify that adjustments made to materials or proportions yield a gradation that falls within acceptance limits in Table [325-1](#).

If the asphalt binder content is within $\pm 0.60\%$ of the mix design target value, the asphalt concrete will be paid for at the contract unit price. If the asphalt binder content deviates by more than $\pm 0.60\%$ from the mix design target value, the deficient area will be evaluated within the subplot by coring at maximum intervals of 100 feet from the deficient sample. The asphalt content of the original deficient sample will be averaged with the asphalt binder content of the cores taken for re-evaluation to determine compliance with the acceptance requirements. If the resulting average of the asphalt binder content deviates by more than $\pm 0.60\%$ from the mix design target value, then Table [325-2](#) shall apply to the subplot. Additional cores may be required to define the limits of the deficient area, and shall not be used for re-evaluating acceptance.

SECTION 325

TABLE 325-2

ARB CONTENT ACCEPTANCE AND PENALTIES

Deviation from that permitted	(\$ per ton of asphalt concrete)
Over 0.2% <u>above</u> that permitted	Removal* or EA
Over 0.1% to 0.2% <u>above</u> that permitted	\$6.00
Over 0.0% to 0.1% <u>above</u> that permitted	\$2.00
Within permitted range	Full Payment
Over 0.0% to 0.1% <u>below</u> that permitted	\$2.00
Over 0.1% to 0.2% <u>below</u> that permitted	\$6.00
Over 0.2% <u>below</u> that permitted	Removal* or EA

NOTES: *The Contractor shall remove and replace the entire subplot that is deficient.

EA = Engineering Analysis per Section [325.9.6](#)

325.9.3 Marshall Air Voids: For purposes of determining Marshall air voids, the acceptance laboratory will designate one sample of the ARAC in accordance with the requirements of Section 2(h) of Arizona Test Methods 104 or AASHTO T-168 for each day's production or as directed by the Engineer's. The minimum weight of the sample shall be 45 pounds. The bulk density shall be tested in accordance with AASHTO T-245. The maximum theoretical density shall be tested in accordance with the requirements of AASHTO T-209, including fan drying per AASHTO T-209 Section 11. Effective voids determined on the laboratory compacted specimens will be determined in accordance with the requirements of AASHTO T-269. Should the testing for effective air voids not meet the "Full Payment" or "No Corrective Action" requirements of Table [325-3](#), additional testing for laboratory air voids on additional samples will be performed as necessary to determine the extent of the deficiency.

TABLE 325-3

LABORATORY VOIDS ACCEPTANCE AND PENALTIES

Marshall Air Voids (Measured at 75 blows) Deviation from Mix Design Target	When the contracting agency is the owner: Payment Reduction (\$ per ton of asphalt concrete)	When the contracting agency is not the owner (i.e. permits): Corrective Action
± 0% to 2.0%	Full Payment	No corrective action
± 2.1% to 2.9%	\$1.00	EA (see 325.9.5)
± 3.0% to 4.0%	\$2.50	EA (see 325.9.5)
± Greater than 4.0%	Removal* or EA per 325.10.4	Removal* or EA per 325.9.5

325.9.4 Requests for Referee Testing as described in 325.10 will only be considered based on quality control test results performed by a laboratory accredited by the AASHTO Accreditation Program (AAP) for the tests being performed or a laboratory listed in the current ADOT Directory of Approved Materials Testing Laboratories for the set of tests in question. The laboratory shall use properly certified technicians in accordance with ASTM D3666, Section 7 (Personnel Qualifications).

325.9.5 Density: The temperature of ARAC just prior to compaction shall be at least 275° F. The Engineer may change the rolling procedure if in the Engineer's judgment the change is necessary to prevent picking up of the ARAC.

325.9.5.1 Equipment: Asphalt compaction equipment shall be of sufficient size and weight to accomplish the required compaction. All compaction equipment shall be operated and maintained in accordance with the manufacturer's

SECTION 325

recommendations and the project requirements. The compactors shall be self-propelled and shall be operated with the drive wheel in the forward position. The compactors shall weigh not less than eight tons. Compactors shall not be used in the vibratory mode for courses of one inch or less in nominal thickness. The wheels of compactors shall be wetted with water, or if necessary soapy water, or a product approved by the Engineer to prevent the ARAC from sticking to the steel wheels during rolling.

325.9.5.2 Compaction Procedures

325.9.5.2.1 Pavement Lift Thickness 1½ Inches or Less: Achieving the required compaction is the responsibility of the contractor. A minimum of three static steel-wheel compactors shall be provided; however, sufficient compactors must be provided so that the drums of the compactors when staggered will cover the entire width of the paving machine on the initial forward pass while a static compactor remains to complete final rolling. The roller(s) for final compaction shall follow as closely behind the initial breakdown as practical, such that a uniformly smooth surface is achieved. As many passes as are possible shall be made with the compactors before the temperature of the ARAC falls below 220° F.

At the Engineer's discretion, cores may be taken and used to evaluate thickness.

325.9.5.2.2 Pavement Lift Thickness Greater than 1½ Inches: Achieving the required compaction is the responsibility of the contractor. The number and types of rollers is the contractor's responsibility and shall be sufficient to meet these requirements. Initial breakdown rollers shall follow as closely behind the paving machine as practical. The roller(s) for final compaction shall follow as closely behind the initial breakdown as practical, such that a uniformly smooth surface is achieved.

Compaction will be determined using a correlated nuclear density gauge and will be monitored for acceptability continuously during construction. The density of the compacted mixture shall not be less than 95% of the laboratory unit weight composed of the same mixture compacted by the 75 blow method of AASHTO T-245 at the job mix design specified compaction temperature. The outside one foot of each pass of the pavement course or any unconfined edge will be excluded from testing. The Engineer may exclude areas from the compaction lot that are not accessible by normal compaction equipment.

Nuclear Density Gauge Correlation - During placement of the test strip or on the first day of paving, the pavement surface shall be tested with a nuclear density gauge at a minimum of four locations. These same locations shall then be cored, using a 4-inch diameter core barrel, and tested for bulk density (AASHTO T-166A, or T-275) and a correlation value developed between the nuclear density gauge and the asphalt cores.

At the Engineer's discretion, cores may be taken and used to evaluate density and/or thickness.

325.9.5.3 Compacting Miscellaneous Items and Surfaces: ARAC used in the construction of miscellaneous items and surfaces shall be compacted using compactors, hot-hand tampers, smoothing irons, mechanical vibrating hand tampers, or with other devices to the extent considered necessary by the Engineer.

325.9.6 Engineering Analysis (EA): Within 10 working days after receiving notice that a lot or subplot of ARAC is deficient and is found to fall within the "Removal or EA" band per Table(s) [325-2 or 325-3](#), the contractor may submit a written proposal (Engineering Analysis) to accept the material in place at the applicable penalties along with possible remediation(s) listed in the "Removal or EA" category. An Engineering Analysis can also be proposed for non-removal categories of "Corrective actions" when the contracting agency is not the owner (i.e. permits).

The Engineering Analysis shall contain an analysis of the anticipated performance of the ARAC if left in place. The Engineering Analysis shall also detail the effect of any proposed corrective action to the material(s) in place as it relates to the in-place material's performance. The Engineering Analysis shall be performed by a professional engineer experienced in asphalt concrete testing and mix designs. If the lot or subplot is submitted for referee testing by the contractor, the ten working days allowed to prepare an engineering analysis will begin upon notification of referee test results.

When an Engineering Analysis recommends that a specific lot or subplot should not be removed, the Engineering Analysis will recommend that the following penalties (Table [325-4](#)) be paid when the contracting agency is the owner, for the specific criteria being reviewed by the EA.

SECTION 325

TABLE 325-4		
ENGINEERING ANALYSIS PENALTIES for REMOVAL* LOTS/SUBLOTS LEFT IN-PLACE		
Acceptance Criteria	Acceptance Limits	Penalty When Contracting Agency is the Owner (\$/Ton)
Laboratory Air Voids (Measured at 75 blows)	Deviation from Target Greater Than $\pm 4.0\%$	\$3.75

Within 15 working days, the Engineer will determine whether or not to accept the contractor's proposed Engineering Analysis.

325.10 REFEREE:

In the event the contractor elects to question the acceptance test results for laboratory air voids, the Contractor may make a written request for additional testing of the affected material. Any request for referee testing must describe the contractor's reasons for questioning the validity of the original acceptance results and must clearly describe which set of acceptance tests are in question. The Contractor will engage an independent laboratory (at the Contractor's own expense) who is accredited by AAP in all of the acceptance test methods. The independent laboratory shall be acceptable to the Engineer and shall perform a new set of acceptance tests as required by Section [325.9.2.3](#) representing the area or set of tests in question. The results of these determinations will be binding on both the contractor and the agency.

These tests will include Marshall unit weight, maximum theoretical unit weight, and laboratory air voids. Samples for referee testing shall come from representative samples obtained from the completed pavement, as directed by the Engineer.

The number of samples taken will be the same as specified in Section [325.9.2.3](#). The independent laboratory shall compile the test results and transmit them to both the Engineer and the contractor. The independent laboratory shall include a report signed by an Engineer registered in the State of Arizona, who is experienced in asphalt concrete testing and mix design development. The signed report shall give an opinion that the material evaluated either does or does not comply with project specifications, shall clearly describe any deficiencies, and the results will be binding between all parties.

325.11 MEASUREMENT:

ARAC shall be measured by the ton, for the mixture actually used, which shall include the required quantities of mineral aggregates, filler material, asphalt-rubber binder and admixture.

Application of lime water shall be measured by the square yard. The measured area shall be the area of ARAC pavement to which the lime water is applied. The measured area shall only be counted one time regardless of the number of applications applied to the ARAC pavement section.

Shoulder adjustment to match the new pavement surface elevation shall not be measured. The cost of this work shall be included in the price paid for ARAC or other related pay items.

325.12 PAYMENT:

Payment for asphalt milling will be as specified in Section [317](#).

Payment for tack coat will be by the ton diluted, based on the rate of application, as directed by the Engineer.

Payment for ARAC will be at the contract unit price, complete in place.

Application of Lime Water as approved by the Engineer will be paid at the contract unit price.

Payment for frame and cover adjustments will be at the contract unit prices specified in the proposal.

- End of Section -

SECTION 327

HOT IN-PLACE RECYCLING

327.1 DESCRIPTION

This work shall consist of rehabilitating the surface layer of existing asphalt concrete pavement. Rehabilitation shall be accomplished with specially designed equipment in a simultaneous multistep process of heating, scarifying, applying an asphalt recycling agent and thoroughly remixing and reshaping the old asphalt concrete surface to an average depth of 1", and then placing an overlay of new hot mix asphalt concrete in compliance with the lines, grades, thickness and typical cross-sections shown on the plans (typically 1" to 2"). NOTE: This work shall be performed with a single machine that heats, scarifies, recycles and spreads new asphalt concrete hot mix, all in one continuous pass. Additional preheaters may be utilized to achieve specified depth and temperature.

327.2 MATERIALS:

Asphalt Recycling Agent used to restore the existing pavement shall be approved by the Engineer prior to use. A manufacturer's certification shall be submitted for each load of recycling agent delivered to the project.

Hot Mix Asphalt Concrete (HMAC) shall meet the requirements of Section [710](#) or Section [717](#).

327.3 EQUIPMENT

The Contractor shall specify, in the bid proposal, the type of equipment intended for use. The equipment shall be on the project in operating condition a minimum of 2 days before beginning operations to allow evaluation by the Engineer. The Engineer reserves the right to reject equipment deemed not suitable for the intended purpose, at no additional cost to the Agency.

The recycling equipment shall meet the following minimum requirements:

Repaver: The equipment for this work shall be a self-contained, self-propelled, automated unit capable of heating, scarifying (or milling), mixing, redistributing and leveling the existing asphalt concrete pavement to the specified depth, all in a single pass.

It shall have a means of automatically applying an asphalt recycling agent at a uniform rate as shown on the plans, special provisions, or as requested by the Engineer. It shall be capable of applying a new HMAC layer over the hot, partially compacted recycled mixture.

Heating Unit: This unit shall be hooded to prevent damage to adjacent property, including trees and shrubs. It shall be capable of heating the pavement surface to a temperature high enough (375° - 400° F.) to allow scarification to the required depth without breaking aggregate particles or charring the pavement surface.

Scarifying or Milling Units: The scarifiers or rotary millers shall be able to penetrate the pavement surface to a depth shown, up to a maximum of one inch in one pass. Scarifiers or millers shall be equipped with separate, automatic height adjustments which allow clearance over manholes and other obstructions.

Recycling Agent Applicator: This system shall automatically add recycling agent to the scarified material at a uniform rate as shown on the plans, special provisions or as requested by the Engineer. The application rate shall be synchronized with the machine's forward speed to maintain a tolerance, within 5% of the specified rate.

Conveying System: Shall consist of a receiving hopper and conveying system to collect and transport new hot mix asphalt concrete material to the finishing unit.

Recycling Unit: A system that mixes, distributes and levels the scarified material over the width processed to produce a uniform cross-section of recycled material.

Finishing Unit: This unit shall have automatic screed controls to produce a surface conforming to that shown on the plans. The unit shall be capable of producing a uniform slope, grade and texture.

Revised 2012

SECTION 327

327.4 CONSTRUCTION METHODS:

The contractor shall be responsible to clean the pavement to be treated shall be cleaned of trash, debris, earth or other deleterious substances present in sufficient quantity to interfere with the work to be performed.

The heating shall be sufficient to soften the pavement to the extent that it can be scarified or milled to the depth specified. Due to the varying properties of the existing asphalt pavement, depth of the scarification material may be varied, if requested by the Engineer. Heating shall be done in a manner that will assure uniform softening and will not char the asphalt.

The Contractor shall be responsible for protecting the area adjacent to the work from heat damage. If damage occurs, the Contractor shall replace all damaged areas, landscape, curb, parked vehicles, etc. at no cost to the Agency.

To provide a welded longitudinal joint, the standing edge of the adjoining asphalt pavement shall be fully heated to a width at least 2 inches beyond the width to be scarified and recycled.

Immediately following heating, the pavement surface shall be scarified (or milled) to the specified depth. The scarified material shall have a temperature between 225° F. and 265° F. unless otherwise requested by the Engineer. The material shall be leveled, mixed and treated with a recycling agent. The application rate shall be as shown on the plans, special provisions or as requested by the Engineer. Application rate for the recycling agent may be adjusted as necessary to maintain a uniform mixture.

The reclaimed material shall be gathered by a leveling device and spread to a uniform depth over the width being processed. After it is placed and while it still has a residual temperature of at least 190° F., a layer of new HMAC conforming to the job mix formula shall be placed over it. The application rate of new material shall be sufficient to provide the required pavement thickness.

Construction, compaction and smoothness of the surface shall be in accordance with Section [321](#) except as modified in this Section.

327.5 WEATHER CONDITIONS:

This work shall not be done when it is raining or if there is a threat of rain. The ambient temperature shall be at least 50° F. and rising and the application shall cease when the temperature reaches 55° F. and falling.

327.6 AIR QUALITY:

The equipment and process shall meet all Arizona Department of Environmental Quality (ADEQ) and County air quality regulations and the Contractor shall have the appropriate ADEQ air quality control permit prior to the issuance of the notice to proceed.

327.7 MEASUREMENT:

Pavement Recycling will be measured by the square yard completed and accepted. Recycling Agent will measure by the gallon of actual material used in place. Hot Mix Asphalt Concrete (HMAC) will be measured by the ton in place.

327.8 PAYMENT:

The accepted quantities of pavement recycling will be paid at the contract unit price per square yard. Payment shall include cleaning the existing pavement surface and heating, scarifying, redistributing, leveling and compacting HMAC pavement. Asphalt Recycling Agent will be paid for by the gallon used in place. Hot Mix Asphalt concrete (HMAC) will be paid for by the ton in place.

- End of Section -

SECTION 329

TACK COAT

329.1 DESCRIPTION:

Tack coat for bituminous paved surfaces shall consist of the application of emulsified asphalt as specified in Section [713](#).

329.2 PREPARATION OF SURFACE:

Surfaces to be treated shall be cleaned of all loose material as specified in Section [330](#).

329.3 APPLICATION:

Tack coat shall be diluted in the proportion of 50 percent water and 50 percent emulsion and applied at the rate of 0.05 to 0.10 gallons per square yard. Application shall be made in advance of subsequent construction as ordered by the Engineer.

329.4 EQUIPMENT:

Tack coat shall be applied by distributor trucks designed, equipped, maintained and operated in accordance with Section [330](#). Hand spray by means of hose or bar through a gear pump or air tank shall be acceptable for resurface work, corners or tacking of vertical edges. Care shall be taken to provide uniform coverage. Equipment that performs unsatisfactory shall be removed from the job.

329.5 PROTECTION FOR ADJACENT PROPERTY:

According to Section [333](#).

329.6 MEASUREMENT:

Bituminous emulsion that is diluted prior to application will be measured by the ton of diluted material. Any conversion from volumetric quantities shall be in accordance with Section [713](#).

329.7 PAYMENT:

Payment for the emulsified bituminous tack coat will be by the ton, diluted.

- End of Section -

SECTION 330

ASPHALT CHIP SEAL

330.1 DESCRIPTION:

This work shall consist of the application of a bituminous material followed by the application of a cover material.

330.2 MATERIALS:

330.2.1 Asphalt: The type of grade of the bituminous material will be specified in the contract documents.

Paving grade asphalt shall meet the requirements to Section [711](#).

Liquid Grade asphalt shall meet the requirements of Section [712](#).

Emulsified asphalt shall meet the requirements of Section [713](#).

330.2.2 Aggregate: The cover material (chips) shall meet the requirements of Section 716. Gradation of the chips shall be as specified in Table [716-1](#) or Table [716-2](#).

330.3 TIME OF APPLICATION AND WEATHER CONDITIONS:

Chip seal shall not be applied for at least 7 days after completion of new bituminous paving.

The chip seal shall be placed only when the roadway surface is dry and there is no imminent threat of rain. The ambient temperature must be at least 60°F. and rising.

Caution should be exercised in the placement of asphalt chip seal between the dates of Oct. 1 and April 1.

330.4 CONSTRUCTION METHODS:

330.4.1 Preparation of surfaces: Immediately before applying the bituminous material, the area to be surfaced shall be cleaned of dirt and other objectionable material. In urban areas, the surface shall be cleaned with a self-propelled pickup sweeper. In rural areas, power brooms may be used. When necessary, cleaning shall be supplemented by hand brooms.

The bituminous material shall not be applied until an inspection of the surface has been made by the Engineer and he has determined that it is suitable.

For chip seals using paving grade asphalt as the binder, a bituminous tack coat shall be applied prior to sealing. The tack coat shall comply with Section [329](#). The exact rate shall be determined by the Engineer.

330.4.2 Application of Bituminous Material: The bituminous material shall be applied as soon as possible after preparation of surfaces. At the time of application, temperatures of the asphalt shall be within the ranges specified in Table [330-1](#) and Table [330-2](#) or in Sections [711](#), [712](#) and [713](#) for each specified asphalt type. The Engineer may require a specific temperature within the ranges.

The quantity of liquid or emulsified asphalts will be between the range of 0.20 and 0.40 gals. /sq. yd. The quantity of paving grade asphalt will be between the range of 0.17 and 0.31 gals. /sq. yd. The exact rate of application will be determined by the Engineer.

The bituminous material shall be placed using a distributor as specified in Section [330](#). Application methods shall insure that a uniform distribution is obtained over the area to be sealed.

The chips shall be spread before the bituminous material sets. The maximum distance that the bituminous material is applied in advance of the chips will be determined by the Engineer.

SECTION 330

TABLE 330-1		
APPLICATION TEMPERATURES OF LIQUID ASPHALTS		
All types of Liquid Asphalt	Distributor Application Temperature, Degree F.	
	Min.	Max.
70	105	175
250	140	225
800	175	255
3000	215	290

TABLE 330-2		
APPLICATION TEMPERATURE OF EMULSIFIED ASPHALTS		
Grade of Emulsified Asphalts	Distributor Application Temperature, Degree F.	
	Min.	Max.
RS-1, CRS-1, CRS-1h	75	140
RS-2, CRS-2, CRS-2h	125	185
SS-1, CSS-1	75	130
SS-1h, CSS-1h	75	130

The surfaces of structures, trees and shrubbery adjacent to the areas being seal coated shall be protected in such manner as to prevent their being spattered with bituminous material or marred. The Contractor shall be responsible for all damage to such structures or landscaping.

330.4.3 Application of Cover Material: Immediately following the application of the bituminous material, the chips shall be spread with a self-propelled mechanical spreader. The chip spreading equipment shall be capable of applying a uniform application of cover material. The self-propelled requirement may be waived for projects under 10,000 sq. yds.

At the time of application, precoated aggregate shall be within the temperature range of 250 degrees F. and 350 degrees F. measured at a point 6 to 12 inches below the top of the load.

At the time of application, uncoated chips shall not contain moisture in excess of a saturated, surface dry condition when liquid or paving grade asphalt are used as the seal coat binder.

At the time of application, chips shall be surface wet but free from running water when emulsified asphalt is used as the seal coat binder.

The precise application rate for cover material will be determined by the Engineer within the ranges of 15 to 25 pounds per square yard for the 1/4 in. size and 20 to 30 pounds per square yard for the 3/8 in. size.

When so directed by the Engineer and within 48 hours after application of the precoated chips, all chipped surfaces on major streets shall receive a flush coat in accordance to Section [333](#). The exact rate of application shall be as directed by the Engineer.

330.4.4 Rolling: Immediately following the application of the cover material, the surface shall be rolled with self-propelled pneumatic-tired rollers. Three coverages shall be made with a pneumatic roller. Each roller shall carry a minimum of 2,000 pounds on each wheel and a minimum of 60 psi in each tire. The roller shall not travel in excess of 12 miles per hour. A minimum of 3 self-propelled pneumatic rollers shall be required for projects over 10,000 sq. yds. On projects under 10,000 sq. yds. one roller may be used provided it performs the same number of coverages.

330.4.5 Joints: All joints shall be constructed as approved by the Engineer such that there will be a uniform application of cover material and bituminous material.

SECTION 330

330.4.6 Surplus Aggregate Removal: Surplus aggregate shall be removed from the surface using methods specified in Subsection [330.4.1](#) and stockpiled in the location indicated on the plans or as directed by the Engineer. In no event shall surplus aggregate be left on the pavement for more than one day (24 hours).

330.4.7 Distributing Equipment: Distributor trucks shall be of the pressure type with insulated tanks. Gravity distributors will not be permitted.

Spray bars and extensions shall be of the full circulating type. The spray bar shall be adjustable to permit varying height above the surface to be treated.

The nozzle spacings, center to center, shall not exceed 6 inches. The valves shall be operated so that one or all valves may be quickly opened or closed in one operation. The valves which control the flow from the nozzles shall be of a positive acting design so as to provide a uniform, unbroken spread of bituminous material on the surface.

The distributor shall be equipped with devices and charts to provide for accurate, rapid determination and control of the amount of bituminous material being applied. The distributor shall be equipped with a tachometer of the auxiliary wheel type registering speed in feet per minute. The distributor shall also be equipped with pressure gauges and an accurate thermometer for determination of the temperature of bituminous material. The spreading equipment shall be designed so that uniform application of a bituminous material can be applied in controlled amounts ranging from 0.05 to 2.0 gallons per square yard. Transverse variation rate shall not exceed ten (10) percent of the specified application rate. The distributor shall be equipped with a hose and nozzle attachment to be used for spotting skipped areas and areas inaccessible to the distributor. Distributor and booster tanks shall be maintained as to prevent dripping of bituminous material from any part of the equipment.

Equipment that fails to perform satisfactorily shall be removed from the job.

330.5 TRAFFIC:

Traffic will not be permitted on the surface until the cover aggregate has set. Traffic control shall be in accordance with Section [401](#) as supplemented by the Contracting Agency.

When using paving grade or liquid grade asphalt chip seal, the speed limit must be maintained at 25 mph for all equipment and traffic until the cover material is swept.

When using emulsified asphalt chip seals, only emergency or local access traffic will be allowed until the seal coat has had time to set.

330.6 MEASUREMENT:

Certified weight slips of all material shall be delivered to the Engineer before the materials are applied. Certified weight slips of any material being weighed back in for credit shall be delivered to the Engineer the next day.

330.7 PAYMENT:

Quantities of materials for this work will be paid for at the contract unit price.

(A) Asphalt Cement, Liquid Asphalt, Emulsion, Diluted Emulsion	Ton
--	-----

(B) Chips	Ton
-----------	-----

There will be no payment for materials not placed in accordance with this specification.

- End of Section -

SECTION 331

MICROSURFACING SPECIFICATIONS

331.1 GENERAL:

The work covered by this specification consists of furnishing all labor, equipment, and materials for the application of a "quick traffic solid/polymer microsurface."

This specification covers the equipment and construction procedures for rut filling and/or resurfacing of existing paved surfaces. The microsurface shall be a mixture of cationic polymer modified asphalt emulsion, mineral aggregates, mineral filler, water and other additives properly proportioned, mixed and spread on the pavement surface.

331.2 MATERIALS:

The Contractor shall supply all materials necessary for the performance of the work in accordance with the specifications. The asphalt emulsion, aggregate, and mineral filler shall be as specified in Section [714](#). Materials shall be approved by the Engineer prior to the start of construction. Certificates of Compliance shall accompany each delivery of emulsion.

The Contractor shall be responsible for the safety of all materials of which he has taken delivery until they are in place on the road, and shall take all necessary precautions to avoid loss by fire or theft, or damage by water, and shall bear the cost of replacing any such material that is lost, spilt, destroyed or damaged after delivery.

331.3 PROPORTIONING:

The microsurface shall be proportioned in accordance with the mix design. Calibrated sign flowmeters shall be provided to measure both the addition of water and additives to the pugmill. Emulsion and cement flow shall be tied directly to aggregate flow. All additive flows shall be calibrated.

331.3.1 Performance: The microsurface mixture shall be proportioned per the mix design to ensure:

(A) Trafficability - the material will permit controlled traffic without damage to the surface within thirty (30) minutes and uncontrolled traffic without damage within sixty (60) minutes, per Section [331.4.2.2](#).

(B) Prevent development of bleeding, raveling, separation or other distress for seven (7) days after placing the microsurface.

331.4 MIX DESIGN:

331.4.1 General:

331.4.1.1: The Contractor shall provide a job mix formula from an approved laboratory and present certified test results for the Engineer's approval. Compatibility of the aggregate and polymer modified emulsion shall be certified by the emulsion manufacturer. All the materials used in the job mix formula shall be representative of the materials proposed by the Contractor for use in the project.

331.4.1.2: All the products used in the construction shall have certifications from the suppliers and they shall be given to the Engineer upon delivery to the project.

331.4.1.3: Mix design and proportioning will be approved by the Engineer prior to the start of the project.

331.4.2: Specifications:

331.4.2.1: The Engineer shall approve the mix design prior to use. The specification limits are as follows:

Residual Asphalt	(ASTM D244)	6% - 11.5% by dry weight of aggregate
Mineral Filler	(ASTM C136)	0.1% - 1% by dry weight of aggregate
Polymer Content/Type		4% min. (see Section 714.4)

SECTION 331

Additive	As required for mix properties
Water	As required for mix properties
Aggregate Grading	Meets Section 331.4.2.4
Consistency (ISSA T-106)	2.5 to 3.0 cm
Traffic Time	See Section 331.4.2.2
Abrasion Loss (ISSA TB-100)	75 g/ft ² maximum
Adhesion (ISSA TB-114)	90% minimum
Loaded Wheel Sand Adhesion	See Section 331.4.2.3

331.4.2.2 Modified Cohesion Test (ISSA TB-139): Furnish laboratory test data showing the mix design to be trafficable thirty (30) minutes after application at 77 F conforming to the following criteria in accordance with test methods described in the applicable specifications.

Set Time Test: 30 minutes 12 kg-cm minimum.

Early Rolling Traffic Time: 60 minutes 20 kg-cm minimum.

331.4.2.3 Loaded Wheel Sand Adhesion Test (ISSA TB-109): Furnish laboratory test data showing the mix design conforming to the following criteria in accordance with test methods described in the appropriate specifications.

<u>Vehicles/day</u>	<u>Minimum Sand Adhesion</u>
0-30	70 g/ft ²
250-1500	60 g/ft ²
1500-3000	55 g/ft ²
greater than 3000	50 g/ft ²

331.4.2.4 The laboratory shall further report the quantitative effects of moisture content in the unit weight of the aggregate (bulking effect). The report must clearly show the theoretical recommended proportion of aggregate, mineral filler (Min. & Max.), water (Min. & Max.), additive(s), and asphalt, and how the proportions are based (dry aggregate weight, total mix, etc.).

331.5 TESTING: Samples for quality assurance will be taken throughout the project per ISSA TB101 for testing by an approved laboratory as required by the Engineer. Materials with test results not meeting these specifications shall be corrected immediately. Testing shall be at the expense of the Agency for the following:

- (A) Asphalt content
- (B) Aggregate gradation
- (C) Percent polymer content and type—certified by supplier

331.6 EQUIPMENT:

331.6.1 General: All equipment, tools and machines used in the performance of this work shall be maintained in satisfactory working condition at all times to ensure a high quality product.

SECTION 331

331.6.2 Mixing Equipment: The mixing machine shall be a self-propelled or truck mounted mixing machine which shall be able to accurately deliver and proportion the aggregate, mineral filler, water, additive, and polymer-modified asphalt emulsion to a revolving multi-blade mixer capable of minimum speeds of 200 RPM and discharge the product on a continual flow basis. The machine shall have sufficient storage capacity for aggregate, polymer modified asphalt emulsion, mineral filler, water, and additive to maintain an adequate supply to the proportioning controls.

331.6.3 Material Control:

331.6.3.1 Calibration: Each mixing unit to be used in the performance of the work shall be calibrated prior to construction. Calibration data, if done within the calendar year, using the same material, may be used, providing a verification of the aggregate feed agrees.

Individual volume or weight controls for proportioning each material to be added to the mix shall be provided, and shall be accessible to the Engineer. Each material control device shall be calibrated prior to work and documented for inspection by the Engineer.

331.6.3.2 Aggregate Feed: The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time.

331.6.3.3 Emulsion Pump: The emulsion pump shall be the positive displacement type with a jacketed housing for uniform heating. A revolution counter or similar device shall be fitted so that the amount of emulsion used may be determined at any time.

331.6.3.4 Fines Feeder: An approved fines feeder is required that will provide a uniform, positive, accurately metered range of 0 to 1 percent by dry aggregate weight. The fines feeder shall have a counter so the amount of mineral filler can be determined at any time.

331.6.3.5 Liquid Additive: The mixing machine shall be equipped with a liquid additive system that provides a pre-determined amount of additive to the mixing chamber. This additive system must be equipped with a counter that can determine the amount used at any time.

331.6.3.6 Water System: The mixing machine shall be equipped with a water system that provides a pre-determined amount of water to the mixing chamber. This water system must be equipped with a counter that can determine the amount used at any time.

331.6.4 Operator Controls: Controls will allow the operator to sequence and proportion the material per the mix design.

331.6.5 Spray Bars: The mixing machine shall be equipped with a water pressure system that provides a water spray immediately ahead of and outside the spreader box.

331.6.6 Spreading Equipment:

331.6.6.1: The paving mixture shall be spread uniformly by means of mechanical type laydown box attached to the mixer, equipped with agitation, to spread the materials throughout the box without any dead zones. The paddles shall be designed and operated so all the fresh mix will be agitated. Flexible seals, front and rear, shall be in contact with the road surface to prevent loss of mixture from the box. The spreader box shall be equipped with hydraulic cylinders for controlling the thickness of the spread mixture.

331.6.6.2: The rut filling spreader box shall have 6 to 8 skids to provide for leveling and filling uneven depressed areas. Two adjustable steel strike-off plates are required. The rear flexible seal shall act a final strike-off and shall be adjustable. The steel strike-offs shall be controlled by hydraulic cylinders placed at the rear of the spreader box.

331.6.6.3 The spreading equipment shall be maintained free from build-up of the mixture on the paddles or side walls. Skips, lumps, or tears will not be allowed in the finished product.

SECTION 331

331.7 APPLICATION:

331.7.1 General: The microsurface shall be of the desired consistency when deposited in the spreader box and nothing more shall be added to it. The mixing time shall be sufficient to produce a complete and uniform coating of the aggregate and the mixture shall be chuted into the moving spreader box at a sufficient rate to maintain an ample supply across the full width of the strike-off squeegee at all times.

331.7.2 Weather: Microsurfacing shall not be placed if either the pavement or air temperature is below 50 degrees F and falling, but may be applied if both the air and pavement temperature are at least 45 degrees F and rising, and it is not raining.

331.7.3 Protection of Existing Surfaces: The Contractor shall take all necessary precautions to prevent microsurface or other material used from entering or adhering to gratings, hydrants, valve boxes, manhole covers, bridge or culvert decks, and other road fixtures. Immediately after resurfacing, the Contractor shall clean off any such material and leave any grating, manholes, etc. in a satisfactory condition.

331.7.4 Fogging Pavement: The surface shall be pre-wetted by Fogging ahead of the spreader box. The rate should be adjusted as dictated by the pavement temperature, surface texture, humidity, and dryness of existing pavement.

331.7.5 Mix Stability: The mix shall possess sufficient stability so that premature breaking of material in the spreader box does not occur. The mixture shall be homogeneous during mixing and spreading; it shall be free of excess water or emulsion, and free of segregation of the emulsion and aggregate fines from the coarser aggregate.

331.7.6 Application Rate: The application rates, pounds per square yard of mix specified, are average rates; the surface texture variation throughout the work will dictate the actual spreading rates. The strike-off squeegee shall be adjusted to provide a microsurface thickness which will completely fill the surface voids and provide an additional thickness not exceeding one and one-half times the largest top-size stone. The requirement of 1-1/2 stone depth does not apply to rut filling operations as these depths vary greatly according to the surface irregularities.

331.7.7 Joints: No excessive build-up or unsightly appearance shall be permitted on longitudinal or transverse joints. A maximum of 4.0" overlap will be permitted on longitudinal joints. The Contractor shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the work. Half passes and odd width passes will be used in minimal amounts. If half passes are used, they cannot be the last pass on any area. Care shall be taken to ensure straight lines along curbs and shoulders. No runoff will be permitted on these areas. Construction joints shall be neat in appearance and shall be tapered or feathered to conform to the existing surface. All excess material shall be removed from the surface upon completion of each run.

331.7.8 Handwork: Approved squeegees and lutes shall be used to spread the mixture in areas inaccessible to the spreader box and in other areas where hand spreading may be required.

331.7.9 Protection of the Microsurface: Adequate means shall be provided by the Contractor to protect the uncured product. Any damage done to the product shall be repaired at the Contractor's expense.

331.7.10 Damage to the Microsurface: The Contractor's responsibility to replace microsurface damaged by unexpected rain after spreading shall be limited to the period within four (4) hours of placement of the microsurface.

331.8 PAYMENT:

The micro-surfacing shall be paid for by the weight of the aggregate and weight of emulsified asphalt, as shown on certified weight tickets from the supplies delivered to the project, less weigh backs. The price shall be full compensation for furnishing, mixing and applying all materials; and for all labor, equipment, tools, design tests, and incidentals necessary to complete the job as specified herein.

- End of Section -

SECTION 332

PLACEMENT AND CONSTRUCTION OF ASPHALT EMULSION SLURRY SEAL COAT

332.1 DESCRIPTION:

The work covered by this specification consists of furnishing all labor, equipment, and materials necessary to perform all operations required for the application of an asphalt emulsion slurry surface.

NOTE: THESE SPECIFICATIONS DO NOT COVER THE APPLICATION OF COAL TAR SLURRY SEALS.

332.2 MATERIALS:

The asphalt emulsion material, mineral aggregate and mineral filler shall be as specified in Section [715](#).

332.3 EQUIPMENT:

332.3.1 General: When requested by the Engineer, descriptive information on the slurry seal mixing and applications equipment to be used will be submitted for approval no less than 7 days before the work starts.

332.3.2 Self Contained Slurry Machine: The mixing machine will be a continuous flow type. It will be capable of accurately delivering a predetermined proportion of pre-wetted aggregate, mineral filler, water and asphalt emulsion to the mixing chamber and discharging the thoroughly blended mixture on a continuous basis. The mixing machine will be equipped with a mineral filler feeder. The feeder will have an accurate metering device or method to introduce a predetermined proportion into the mixer. The filler will be introduced into the mixing chamber at the same time and location as the aggregate.

The mixing machine will be equipped with a water pressure system and fog-type spray bar, adequate for complete water fogging of the surface to be sealed.

The mixing machine will be mounted on a truck or other vehicle capable of producing evenly controlled low rates of speed throughout the operation to ensure the slurry is spread evenly and all cracks are filled.

332.3.3 Slurry Spreading Equipment: Attached to the mixer machine shall be a mechanical type squeegee spreader equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. It shall be maintained to prevent loss of slurry on varying grades and crown by adjustments to assure uniform spread. There shall be a steering device and a flexible strike-off. The spreader box shall have an adjustable width. The box shall be kept clean. Build-up of asphalt and aggregate on the box shall not be permitted. The use of burlap drags or other drags shall be approved by the Engineer.

332.3.4 Rollers: Rollers shall be approved by the Engineer.

332.3.5 Cleaning Equipment: Power brooms, pick-up brooms, air compressors, water flushing equipment, and hand brooms shall be suitable for cleaning the surface and cracks of the old surface.

332.3.6 Auxiliary Equipment: Hand squeegees, shovels, and other equipment shall be provided as necessary to perform the work.

332.4 PREPARATION OF THE SURFACE:

332.4.1 Immediately before applying the slurry, the area to be surfaced shall be cleaned of dirt, loose material, and other objectionable material. In urban areas, the surface shall be cleaned with a self-propelled pick-up sweeper. In rural areas, power brooms may be used. When necessary, cleaning shall be supplemented by hand brooms. Water flushing will not be permitted in areas where cracks are present in the pavement surface.

The slurry shall not be applied until an inspection of the surface has been made by the Engineer and he has determined that it is suitable.

SECTION 332

332.4.2 Tack Coat: When specified, a tack coat shall be applied in accordance with Section [329](#) using the same type and grade of asphalt emulsion as specified for the slurry seal.

332.4.3 Water Fogging: When required by local conditions, the surface, directly ahead of the slurry box, shall be pre-wetted by fogging. The fogging shall be accomplished in such a manner that the entire surface is damp with no apparent flowing water or puddles.

332.5 WEATHER LIMITATIONS:

The slurry seal shall not be applied unless the pavement temperature is at least 45°F. and rising. The mixture shall not be applied during unsuitable weather.

332.6 PROTECTION OF UNCURED SURFACE:

Adequate means shall be provided by the Contractor to protect the uncured product. Any damage done to the product shall be repaired at the Contractor's expense.

332.7 MIXING AND APPLICATION:

The mixing time shall not exceed four minutes. Excessive mixing will not be allowed. The resulting mixture shall have the desired consistency, when placed on the surface. If breaking, hardening, segregation, balling or lumping occurs during the mixing process, the batch will be discarded.

A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that a complete coverage is obtained.

No streaks caused by oversized aggregate shall be left in the finished surface. Build-up on longitudinal and transverse joints will be kept to a minimum. Approved squeegees shall be used to spread slurry in areas nonaccessible to the slurry mixer.

332.8 ROLLING:

As soon as the asphalt slurry has been set sufficiently to prevent any material from being picked up, it shall be rolled until all ridges have been ironed out and a uniform surface is obtained.

332.9 MEASUREMENT:

Quantities and materials for this work will be paid for at the contract price per unit of measurement for each of the following pay items as indicated in the proposal.

(A) Bituminous tack coat if specified	Ton (Diluted)
(B) Emulsified asphalt for slurry	Ton (Undiluted)
(C) Aggregate for slurry	Ton (Surface Dry)

- End of Section -

SECTION 333

FOG SEAL COATS

333.1 DESCRIPTION:

Fog seal coats on bituminous paved surfaces shall consist of the application of emulsified asphalt and a sand blotter when necessary.

333.2 TIME OF APPLICATION AND WEATHER CONDITIONS:

Fog seal coats on new pavements shall be applied within 24 hours. This time restriction may be extended by the Engineer.

Emulsified asphalt shall not be applied when the surface is wet or when there is a threat of rain. The ambient temperature shall be at least 50 degrees F. and rising and the application shall cease when the temperature is 55 degrees F. and falling.

333.3 MATERIALS:

333.3.1 Emulsified Asphalt: Unless otherwise specified in the special provisions, emulsified asphalt may be a grade SS-1h, CSS-1h, or CQSH, as specified in Section [713](#). The emulsified asphalt shall be diluted in proportions of 50% water and 50% emulsified asphalt.

333.3.2 Sand Blotter: The sand shall be as specified in Section [701.3](#) and shall be graded in accordance with Table [333-1](#).

TABLE 333-1	
SAND BLOTTER GRADATION	
Sieve Size	Percentage Passing (by weight)
3/8 inch	100%
No. 4	90-100%
No. 200	0-12%

333.4 TESTS, TEST REPORTS AND CERTIFICATIONS:

Asphalt emulsion shall meet requirements of Section [713](#).

Test reports and certifications shall be as specified in Section [711](#).

333.5 PREPARATION OF SURFACES:

Immediately before applying the emulsion, the area to be surfaced shall be cleaned of dirt and loose material by means of power brooms, or pick-up brooms supplemented by hand brooms if necessary. The fog seal shall not be applied until an inspection of the surfaces has been made by the Engineer and he has determined that the surfaces are suitable.

333.6 APPLICATION OF ASPHALT EMULSION:

The diluted material shall be well mixed before application. It shall be applied by a distributor truck equipped with fog nozzles at the approximate rate of 0.10 gallon per square yard. The exact rate shall be as directed by the Engineer. The distributor truck shall be as specified in Section [330](#).

333.7 SAND BLOTTER:

A sand blotter shall be applied as directed by the Engineer where there is an excess of asphalt emulsion. After the treated area has been opened to traffic, any excess asphalt emulsion that comes to the surface shall be immediately covered with additional sand.

SECTION 333

333.8 PROTECTION FOR ADJACENT PROPERTY:

Care shall be taken to prevent the spraying of asphalt emulsion on adjacent pavements, including that portion of the pavement being used for traffic, on structures, guard rails, guide posts, markers, trees, shrubs, and property of all kinds.

333.9 PROTECTION OF TREATED SURFACE:

The treated surface shall be protected by barricades until the asphalt emulsion will not be picked up by traffic.

333.10 PAYMENT:

Payment for asphalt emulsion in place will be by the ton, diluted.

Payment for furnishing and applying sand blotter in place will be paid for by the ton.

- End of Section -

SECTION 334

PRESERVATIVE SEAL FOR ASPHALT CONCRETE

334.1 DESCRIPTION:

The asphalt concrete preservative seal shall be composed of an emulsified asphalt or asphalt rejuvenate, or an asphalt sealant to preserve the asphalt concrete pavement.

Preservative seals are applicable for asphalt pavements as directed on the plans, special provisions, or the Engineer.

334.2 MATERIALS:

The preservative seal shall be one of the following materials as specified by the Engineer:

<u>Type</u>	<u>Description</u>	<u>Material Conformance</u>
A	Rejuvenating emulsion	Section 718
B	Petroleum hydrocarbon emulsion	Section 718
C	“Filled” asphalt sealer such as TRMSS or equal	Section 718
D	Acrylic polymer emulsion	Section 718
Other	Diluted asphalt emulsion, CSS-1 or SS-1h	Section 713

334.3 CONSTRUCTION METHOD:

The material shall be approved by the Engineer in accordance to this specification. The application rates, dilution and curing shall be directed by the Engineer in accordance with this specification.

The contractor shall be responsible to clean the pavement to be treated free of trash, debris, earth or other deleterious substances present in sufficient quality to not interfere with the work to be performed.

The application rate will be based upon a typical surface condition test site with application rate trials to determine the needed rate. All application rates specified in Section [712](#) shall be a diluted 50-50 emulsified asphalt and water, except as recommended by the manufacturer for Type B and C. Any over applied seal will be sanded as directed by the Engineer. Application equipment shall be in accordance with Section [330](#).

Before opening a treated area to traffic, the surface shall be checked for slipperiness and/or tackiness. If the treated portion of the roadway must be opened to traffic prior to the disappearance of slipperiness and/or tackiness, the surface shall be sanded with a minimum of 1 ½ pounds per square yard or as directed by the Engineer. Sand Blotter shall comply with Section [333](#).

334.4 MEASUREMENT:

Preservative seal for asphalt concrete will be measured by the gallon or ton applied.

334.5 PAYMENT:

Payment will be made on the basis of the unit price bid in the proposal. Payment shall be full compensation for preservative seal complete and in place.

- End of Section -

SECTION 335

PLACEMENT AND CONSTRUCTION OF HOT ASPHALT-RUBBER SEAL

335.1 DESCRIPTION:

This work shall consist of applying an application of asphalt-rubber binder, a combined mixture of hot paving grade asphalt and crumb rubber modifier. It shall be immediately covered with a cover material.

The work involves furnishing and placing all materials on existing pavement surfaces in accordance with this specification.

335.2 MATERIALS:

The asphalt-rubber binder shall comply with Section [717](#). Sand Blotter shall comply with Section [333](#). Cover material shall be precoated and comply with Section [716](#). Fog seal coats shall comply with Section [333](#).

335.2.1 Certification and Quality Assurance: Prior to application, the Contractor shall submit certification of compliance to the Engineer at least 7 days prior to application for all materials to be used in the work. For example: Asphalt-rubber binder designs (Section [717](#)), cover material test results (Section [716](#)), sand blotter material (Section [333](#)), fog seal coats (Section [333](#)), and any additional materials used on the project.

335.3 EQUIPMENT:

335.3.1 General: The method and equipment for combining the crumb rubber modifier and hot paving grade asphalt shall be so designed and accessible that the Engineer can readily determine the percentage by weight of each of two materials being incorporated into the mixture.

All equipment shall meet requirements of Section [330](#) with the following modifications:

(A) Pneumatic-tired rollers: At least three pneumatic-tired rollers shall be used. Each roller shall carry a minimum of 5,000 pounds on each wheel and a minimum of 90 psi in each tire. Rollers shall not travel in excess of 12 mph.

(B) Distributor: The distributor must be equipped with a mechanical mixing device.

335.3.2 Mechanical Pre-Blender: Crumb rubber modifier and the hot paving grade asphalt for the asphalt-rubber binder may be pre-blended prior to introduction of the blend into the distributor.

The mechanical pre-blender shall be equipped with an asphalt totalizing meter in gallons and a flow rate meter in gallons per minute.

335.4 MIXING:

Mixing shall be done in accordance with Section [717](#). Application shall proceed immediately upon the asphalt-rubber binder requirements being met.

335.5 CONSTRUCTION:

Prior to placing the hot asphalt-rubber binder, soil and other objectionable materials shall be removed from the pavement surface.

The application rate of the hot asphalt-rubber binder shall be 0.55 to 0.70 gallons per square yard or as directed by the Engineer based on field conditions. Material shall be applied at temperatures of 350 degrees F. to 400 degrees F. The application of the cover material shall follow as close as possible behind the distributor truck.

The cover material shall be preheated immediately prior to application and precoated as specified in Section [716](#) - PRECOATED. The temperature of the precoated chips shall be in accordance with Section [330](#).

SECTION 335

Hot asphalt-rubber binder with hot precoated cover aggregate shall be placed only when the ambient temperature is at least 60 degrees F. and rising, on a dry surface and there is no imminent threat of rain.

The rate of application of the cover material shall be from 18 to 25 pounds per square yard for the Low Volume Chip or 28 to 35 pounds per square yard for the High Volume Chip, or as directed by the Engineer.

The rolling of the cover material shall proceed immediately after application in order to insure maximum embedment of the aggregate. Sufficient rollers shall be used for the initial rolling to cover the width of the aggregate spread with one pass. The first pass shall be made immediately behind the aggregate spreader. If the spreading is stopped for an extended period, the spreader shall be moved ahead or off to the side so that all cover material may be immediately rolled. Three (3) complete passes with rollers shall be made with all rolling completed within one (1) hour after the application of the cover material.

The Contractor shall sweep all joint edges clean of overlapping cover material prior to the adjacent application of asphalt-rubber binder. Transverse joints shall be made by placing building paper over the ends of the previous applications. The joining application shall start on the building paper. Once the application process has progressed beyond the paper, the paper shall be removed and disposed of to the satisfaction of the Engineer. All reasonable precautions shall be taken to avoid skips and overlaps at joints and to protect the surfaces of adjacent structures, trees and shrubs, etc., from being spattered or marred. Correction of any such defects will be required at no additional cost to the Contracting Agency.

Traffic will not be permitted on the surface until after sweeping operations have finished and the cover aggregate has set. Traffic control shall be in accordance with Section [401](#) as supplemented by the Contracting Agency.

At signalized intersections, an application of 2 to 5 pounds of sand blotter per square yard shall be applied through the intersection and for a distance of 200 feet each way from the near curb returns after rolling and before opening a lane to traffic. Sand Blotter shall meet requirements of Section [333](#).

After sweeping and prior to striping, a fog seal coat shall be applied to the asphalt-rubber seal consisting of 0.05 to 0.10 gallons per square yard according to Section [333](#). The application of the fog seal coat may be delayed to facilitate curing or to avoid placement under unfavorable high temperature conditions.

Note: The fog seal coat shall not be applied to the area 200 feet either side of and through signalized intersections.

335.6 MEASUREMENT:

Certified weight slips of all materials shall be delivered to the Engineer before the materials are applied.

Certified weight slips of any bituminous material being weighed back in for credit shall be delivered to the Engineer for the next day.

Quantities of materials for this work will be paid for at the contract price per unit of measurement for each of the following pay items actually used on the project.

(A) Cover Material (Precoated)	Ton
(B) Asphalt Rubber Binder	Ton
(C) Emulsified Asphalt (Fog Seal)	Ton (diluted)
(D) Sand Blotter	Ton (surface dry)

335.7 PAYMENT:

Payment will be full compensation for furnishing and placing all materials specified and used, with no allowance for waste, and shall include labor, equipment, tools, and incidentals necessary to complete the work as prescribed in the specifications and as directed by the Engineer.

Revised 2012

SECTION 335

Asphalt cement for precoating chips will be included in the price per ton for hot precoated chips.

No payment will be made for materials rejected due to improper placing, improper proportions of materials, or materials found to be defective.

- *End of Section* -

SECTION 336

PAVEMENT MATCHING AND SURFACING REPLACEMENT

336.1 DESCRIPTION:

Street and alley pavement and surfacing within the Contracting Agency's rights-of-way, removed by construction activities or to be widened or matched in connection with the improvement of Public Works, shall be placed as shown on the plans and applicable standard details, in accordance with this specification and/or the special provisions.

Asphalt concrete roadway pavement replacement shall be constructed in accordance with Type A, B, or T-Top of Standard Detail 200-1 and as indicated on the plans or in the special provisions.

Portland cement concrete pavement replacement shall be in accordance with Type C of the Standard Detail 200-1 and as required by Section [324](#).

All other surface replacement in the right-of-way but not in paved roadways shall be constructed in accordance with Type D of Standard Detail 200-1 and as indicated on the plans.

Temporary pavement replacement shall be constructed as required herein.

Pavements to be matched by construction of new pavements adjacent to or at the ends of a project shall be milled or saw cut in accordance with these specifications and where shown on the plans.

Pavement and surfacing replacement within ADOT rights-of-way shall be constructed in accordance with their permits and/or specification requirements.

336.2 MATERIALS AND CONSTRUCTION METHODS:

Materials and construction methods used in the replacement of pavement and surfacing shall conform to the requirements of all applicable standard details and specifications, latest revisions.

336.2.1 Pavement Widening or Extensions: Existing pavements which are to be matched by pavement widening or pavement extension shall be trimmed to a neat true line with straight vertical edges free from irregularities with a device specifically designed for this purpose. The minimum depth of cut shall be 1 ½ inches or D/4, whichever is greater.

The existing pavement shall be cut and trimmed after placement of required ABC and just prior to placement of asphalt concrete for pavement widening or extension, and the trimmed edges shall be painted with a light coating of asphalt cement or emulsified asphalt immediately prior to constructing the new abutting asphalt concrete pavements. No extra payment shall be provided for these items and all costs incurred in performing this work shall be incidental to the widening or pavement extension.

The exact point of matching, termination, and overlay may be adjusted in the field, if necessary, by the Engineer or designated representative.

336.2.2 Pavement to be Removed: Existing asphalt pavement to be removed for trenches or for other underground construction or repairs shall be cut by a device capable of making a neat, straight and smooth cut without damaging adjacent pavement that is not to be removed. The Engineer's decision as to the acceptability of the cutting device and manner of operation shall be final.

In lieu of cutting trenches across driveways, curbs and gutters, sidewalks, alley entrances, and other types of pavements, the Contractor may, when approved by the Engineer, elect to tunnel or bore under such structures and pavements.

When installations are within the street pavement and essentially parallel to the center line of the street, the Contractor, with approval of the Engineer, may elect to bore or tunnel all or a portion of the installation. In such installations, the seal coat requirements, as discussed in Section [336.2.4](#), will be modified as follows:

SECTION 336

(A) If the pavement cuts (bore pits, recovery pits, etc.) are 300 feet or more apart, the bore or tunneled distance will not be considered as part of the open trench and the seal coat may not be required.

(B) If the pavement cuts (bore pits, recovery pits, etc.) are less than 300 feet apart, the distance between the cuts will be considered the same as a trench cut and the distance will be added to any trench cut distances.

336.2.3 Temporary Pavement Replacement: Temporary pavement replacement, as required in Section [601](#), may be with cold-mix asphalt concrete, with a minimum thickness of 2 inches, using aggregate grading in accordance with Marshall mix design of Section [710](#). Permanent pavement replacement shall replace temporary repairs within 5 working days after completion of temporary work.

Temporary pavement replacement shall be used in lieu of immediate placement of single course permanent replacement or the first course of two course pavement replacement only on transverse lines such as spur connections to inlets, driveways, road crossings, etc., when required by the Engineer, by utilities or others who subcontract their permanent pavement replacement, under special prior arrangement; or for emergency conditions where it may be required by the Engineer. Temporary pavement replacement shall be placed during the same shift in which the backfill to be covered is completed.

Rolling of the temporary pavement replacement shall conform to the following:

(A) Initial or breakdown rolling shall be followed by rolling with a pneumatic-tired roller. Final compaction and finish rolling shall be done by means of a tandem power roller.

(B) On small areas or where equipment specified above is not available or is impractical, the Engineer will approve the use of small vibrating rollers or vibrating plate type compactors provided comparable compaction is obtained.

The surface of the temporary pavement shall be finished off flush with the adjacent pavement.

336.2.4 Permanent Pavement Replacement and Adjustments:

336.2.4.1 Permanent Pavement Replacement: All pavement replacement shall match gradation and thickness of the existing pavement. Pavement replacement shall be compacted to the same density specified for asphalt concrete pavements in Section [321](#). The compacted thickness of all courses shall conform to the requirements of Table [710-1](#).

Unless otherwise noted, pavement replacement shall comply with the following:

(A) Single course pavement replacement shall consist of a 1/2" or 3/4" mix in accordance with Section [710](#).

(B) The base course(s) of a multi-course pavement replacement shall consist of a 3/4" mix in accordance with Section [710](#).

(C) The surface course of a multi-course pavement replacement shall consist of a 3/8" or 1/2" mix in accordance with Section [710](#) to match the existing surface.

(D) Where the base course is to be placed with non-compactive equipment, it shall be immediately rolled with a pneumatic-tired roller.

(E) Where the trench is 6 feet or more in width, all courses shall be placed with self-propelled spreading and compacting equipment. When the trench is from 6 to 8 feet in width, self-propelled spreading and compacting equipment shall not be wider than 8 feet.

(F) Placement of the surface course is to be by means which will result in a surface flush with the existing pavement.

The pavement replacement surface shall not vary more than 1/4 inch from the lower edge of a straightedge placed across the replacement pavement surface between edges of the existing matched surfaces. When the pavement replacement includes replacement of the roadway crown, the surface smoothness shall comply with requirements of Section [321](#).

SECTION 336

Laying a single course or the base course(s) of the asphalt concrete pavement replacement shall never be more than 600 feet behind the ABC placement for the pavement replacement.

The trench must be compacted to its required density, and required ABC must be in place and compacted prior to the placement of the asphalt concrete.

For cuts greater than 300 feet in length the entire area shall then be slurry seal coated in accordance with Section [332](#) or as otherwise specified. This seal coat shall extend from the edge of pavement or lip of gutter to the street centerline except that on residential streets less than 36 feet face to face of curb or where the pavement patch straddles the centerline, the entire width of street shall be seal coated.

In lieu of placing the seal coat as required previously, and with approval of the Contracting Agency, the Contractor may deposit with the Contracting Agency for credit to the Street Maintenance Department, a negotiated agreed upon amount. The Street Maintenance Department will incorporate this work into their street maintenance program.

336.2.4.2 Adjustments: When new or existing manholes, valves, survey monuments, clean outs, etc. fall within the limits of the permanent pavement replacement as discussed in this Section, the Contractor shall be responsible for adjusting the various items to the new pavement surface or as directed by the Engineer. This will include but not be limited to slurry and chip seals.

The Contractor will coordinate with the Engineer and with representatives of the various utilities regarding the adjustment and inspection of the work. The Contractor shall be responsible for obtaining and complying with all specifications, special requirements, details, etc. of the Utility Company regarding the adjustments. When adjusting the Agency's utilities, survey monuments, etc., the adjustment will comply with these Specifications and Details.

The work will be done in compliance with OSHA standards and regulations regarding confined space entry. The Contractor shall remove all material attached to the lids and/or covers including that of prior work. The method of removal shall be approved by the Engineer and/or the Utility Representative.

336.3 TYPES AND LOCATIONS OF PAVEMENT AND SURFACING REPLACEMENT:

Normally, the type of pavement replacement and backfill required will be noted on the plans or specified in other portions of the contract documents and construction will be in accordance with Detail 200-1 and 200-2. If a type is not noted on the plans or specified in the special provisions, the following criteria will govern:

Type A trench repair will be utilized on all streets where the excavation is essentially longitudinal or parallel to traffic.

T-Top trench repair will be utilized on all streets where the excavation is essentially transverse or not parallel to traffic, including trenches that go through an intersection. Type B trench repair may be used to repair transverse trenches if specified by the Agency.

Type C trench repair will be used to repair existing Portland cement concrete pavement.

Type D trench repair will be utilized to repair surfaces other than asphalt concrete or Portland cement concrete pavement. It may also be used when the condition of the existing pavement does not justify construction of Type A, Type B or T-Top trench repair. Prior written approval of the Engineer is required for this condition.

Where a longitudinal trench is partly in pavement, the pavement shall be replaced to the outside edge of the existing pavement, on a straight line, as indicated on the plans. Measurements for payment shall be from the inner limit of pay width allowed below, to the outside edge of the existing pavement as defined herein.

Where no part of a trench is in pavement, surfacing replacement will only be specified where existing surfacing materials have been removed.

When a trench cut is in aggregate surfaced area, the surfacing replacement shall be of a like type and depth as the existing material, compacted to the densities required in Section [601](#).

SECTION 336

336.4 MEASUREMENT:

Measurement for payment and surfacing replacement shall be by the square yard, based upon actual field measurement of the area covered except as noted below.

(A) In computing pay quantities for replacement Types B and E, pay widths will be based on the actual field measured width; however the boundaries of the measurement will not extend further than $\frac{1}{2}$ the distance, either side, from the centerline of the pipe as depicted on Table [601-1](#), Maximum Width At Top Of Pipe Greater Than O.D. Of Barrel.

(B) In computing pay quantities for replacement Types T-Top, A, C and D, pay widths will be based on the actual field measured width, however the boundaries of the measurement will not extend further than $\frac{1}{2}$ the distance plus 12 inches, either side, from the centerline of the pipe as depicted on Table [601-1](#), Maximum Width At Top Of Pipe Greater Than O.D. Of Barrel. In all cases, the minimum pay width for replacement Types T-Top, A and D shall be 48 inches.

(C) Where a longitudinal trench is partly in pavement, computations of pay quantities shall be based on the limitations specified above.

(D) The length of pavement and surfacing replacement shall be measured through any manhole, valve box, or other structure constructed in the pipe line, and any pavement or surface replacement and/or seal treatment in excess of the above pay widths shall be considered and included in the bid item for such structure.

(E) Any pavement replacement in excess of the specified pay widths necessitated by the installation of valves, tapping sleeves and valves, valve by-passes, and concrete thrust blocks shall be included in the bid price for these items.

(F) When special provisions allow deviations from the trench widths specified in Section [601](#), the above allowed pay widths for pavement replacement may be altered where so specified.

(G) Measurement of pavement and surfacing replacement shall be made along the finished surface of the ground to the nearest foot, and shall be computed to the nearest square yard.

336.5 PAYMENT:

Direct payment for pavement or surfacing replacement will be made for replacement over all pipe trench cuts except as otherwise allowed in the special provisions. Payment for replacements over other work shall be included in the cost of constructing that work, in accordance with the applicable standard details and specifications.

Payment for temporary pavement replacement shall be included in the cost of the pipe.

Payment for pavement replacement shall include the replacement cost of any existing pavement markings that have been obscured, obliterated or removed by underground trench construction or repairs.

When a Contractor has the option of jacking and/or boring or open cut construction, and elects to construct a pipeline by the jacking and/or boring method, he will be paid for the replacement of such items of work as pavement, curb and gutter, sidewalk, driveway, and alley entrances, as allowed for open cut construction.

End of Section -

SECTION 337

CRACK SEALING

337.1 DESCRIPTION:

This work consists of furnishing and placing sealant material in Contractor prepared cracks and joints of asphalt concrete or Portland cement concrete pavements. All cracks and joints, including the space between asphalt concrete pavement and the curb and gutter, which have a clear opening of one-quarter inch ($\frac{1}{4}$ ") or greater, shall be sealed for the length of the crack that equals or exceeds one-eighth inch ($\frac{1}{8}$ ") in width. The Contractor shall notify the Engineer when cracks are encountered that have an opening greater than one inch (>1 "). The Engineer shall specify the treatment requirements for cracks having an average clear opening greater than one inch (>1 ").

337.2 MATERIALS:

Sealant materials shall be a premixed, single component mixture of asphalt cement, aromatic extender oils, polymers, and granulated rubber in a closely controlled manufacturing process. Materials shall conform to the following specifications when heated in accordance with ASTM D5078 and the manufacturer's maximum safe heating temperature.

TEST	REQUIREMENT
Cone Penetration (ASTM D5329)	20-40
Resilience (ASTM D5329)	30% Minimum
Softening Point (ASTM D113)	210°F (99°C) Minimum
Ductility, 77°F (25°C) (ASTM D113)	30 cm Minimum
Flexibility (ASTM D3111 *Modified)	Pass at 30°F (-1°C)
Flow 140°F (60°C) (ASTM D5329)	3 mm Maximum
Brookfield Viscosity 400° (204°C) (ASTM D2669)	100 Poise Maximum
Asphalt Compatibility (ASTM D5329)	Pass
Bitumen Content (ASTM D4)	60% Minimum
Tensile Adhesion (ASTM D5329)	400% Minimum
Maximum Heating Temperature	400°F (204°C)
Minimum Heating Temperature	380°F (193°C)
Flash Point (ASTM D92)	450°F Minimum

*Specimen bent 90° over a 1-inch mandrel within 10 seconds.

337.2.1 Certification and Quality Assurance: Prior to application, the Contractor shall submit certification of compliance to the Engineer for all materials to be used in the work.

337.3 EQUIPMENT:

The melter applicator unit shall be a self-contained double boiler device with the transmittal of heat through heat transfer oil. It must be equipped with an on board automatic heat controlling device to permit the attainment of a predetermined temperature, and then maintain that temperature as long as required. The unit shall also have a means to vigorously and continuously agitate the sealant to meet the requirements of Appendix X1.1 of ATSM D6690. The sealant shall be applied to the pavement under pressure supplied by a gear pump with a hose and wand and direct connecting applicator tip. The pump shall have sufficient pressure to apply designated sealant at a rate of at least three (3) gallons (11.4 L) per minute. Melter applicators shall be approved for use by the sealant manufacturer.

337.4 CLEANING AND PREPARING CRACKS OR JOINTS:

Immediately prior to application of sealant, all cracks and joints shall be cleaned of debris and dust. Cracks and joints shall be vacuumed during final cleaning.

SECTION 337

337.4.1 Routing: Routing, when specified, shall create a sealant reservoir. Cutting should remove at least 1/8" from each side and produce vertical, intact surfaces with no loosely bonded aggregate. Routing of joints and cracks shall produce a reservoir having a nominal size of 3/4" wide x 3/4" deep. Variations from the nominal size are subject to acceptance or rejection at the engineer's discretion.

337.4.2 Vacuuming: Final cleaning shall thoroughly clean cracks and joints to a minimum depth of 1". The vacuum unit shall use high pressure 90 psi minimum, dry oil free compressed air to remove remaining dust. The high pressure tool shall be integral with a vacuum unit to collect the dust and residue. Both sides of the crack or joint shall be cleaned. Surfaces will be inspected to assure adequate cleanliness and dryness.

337.5 APPLICATION:

337.5.1 Weather: In no case shall sealant be placed during damp roadway conditions such as wet roadway surfaces or damp material inside the cracks. Operations stopped by the Engineer, due to weather, shall be at no additional cost to the contracting Agency. If installing at night, ensure that dew is not forming on the pavement surface.

Sealant material shall only be applied when pavement temperature exceeds 40°F (4°C). If pavement temperature is lower than 40°F (4°C), it may be warmed using a heat lance that puts no direct flame on the pavement.

337.5.2 Temperature: Sealant temperatures should be maintained at the maximum heating temperature recommended by the manufacture.

337.5.3 Placement of Sealant: The sealant shall be applied in cracks, joints, and sealant reservoirs uniformly from bottom to top and shall be filled without formation of entrapped air or voids.

Cracks and joints shall be slightly overfilled then leveled with a 3" sealing disk or v-shaped squeegee to create a neat band extending approximately 1" on each side of the crack or joint for surface waterproofing. The band shall be as thin as possible and shall not extend more than 1/8 inch above the pavement surface.

If the pavement is to be overlaid with Hot Mix Asphalt within six months of sealant application, cracks shall be routed, and sealant placement shall be recessed 1/4" in the crack or joint reservoir with no over band. If routing is not used, the sealant over band thickness and width should be kept as narrow and thin as possible.

During and after placement of the sealant, the Contractor shall protect against harm to persons or animals that may be exposed to the hot material.

337.5.4 Unacceptable Work: The Contractor, at no additional cost to the contracting Agency, shall correct unacceptable work. Unacceptable work shall include, but not be limited to, unsealed cracks, material wastage on the sides of the roadway, and excess quantities of material on the roadway that adversely affects driving.

Correction of unacceptable work shall be accomplished within five working days after notification from the Engineer of the unacceptable work. The Contractor shall not progress to a new area until the unacceptable work is corrected to the satisfaction of the Engineer.

337.5.5 Reporting Requirements: The Contractor shall meet with the Engineer or the Engineer's designated representative on a daily basis and supply a signed daily report indicating the amount of crack sealant material applied for the day in total pounds and total square yards of pavement sealed. In addition, the Contractor shall supply the Engineer with the dates of completion of each road segment.

337.6 OPENING TO TRAFFIC:

Sealant material shall not be exposed to traffic until fully cured. If the sealed area must be open to traffic, blotter material shall be applied to the surface of all uncured sealant material.

All sealed cracks that have an average clear opening of 1 1/2 inches or greater shall have blotter material applied prior to opening to traffic.

SECTION 337

337.6.1 Blotter: On two lane roads or where traffic may come in contact with the hot sealant before it cures, a blotter or specialized bond breaking material shall be used to prevent asphalt bleeding and/or pickup of sealant by vehicular traffic. Blotter material shall be compatible with the crack sealant and any surface treatment being used.

337.7 MEASUREMENT:

Accepted pavement crack sealing shall be measured as indicated in the fee proposal by one of the following methods: square yards of pavement surface area sealed, pounds of sealant placed, or linear feet of cracks sealed.

337.8 PAYMENT:

Payment for pavement crack sealing at the contract unit price shall be full compensation for all labor, materials, equipment, tools, and incidentals used for surface preparation, placement of crack sealant and blotter materials, and cleanup.

- End of Section -

SECTION 340

CONCRETE CURB, GUTTER, SIDEWALK, CURB RAMPS, DRIVEWAY AND ALLEY ENTRANCE

340.1 DESCRIPTION:

The various types of concrete curb, gutter, sidewalk, curb ramps, driveways and alley entrances shall be constructed to the dimensions indicated on the plans and standard detail drawings.

340.2 MATERIALS:

Concrete shall conform to the requirements of Section [725](#). Concrete class shall be as noted on the standard details.

Expansion joint filler shall be ½-inch thick preformed bituminous material in compliance with Section [729](#), unless otherwise noted.

340.2.1 Detectable Warnings: Truncated dome dimensions and spacing for detectable warnings are defined by the Americans with Disabilities Act Accessibilities Guidelines (ADAAG) for optimal detect-ability and public safety. Detectable warnings shall consist of raised truncated domes aligned in a square grid pattern in conformity to the ADAAG. Truncated domes shall have the following nominal dimensions: base diameter of 1.0 inches (0.9 inches minimum) top diameter of 50 percent of the base diameter minimum to 65 percent of the base diameter maximum, and height of 0.2 inches. Dome center-to-center spacing of 2.35 inches, measured between the most adjacent domes on the square grid. Dome center-to-center spacing for radial installations shall be 1.6 inches minimum and 2.4 inches maximum with a base-to-base spacing of 0.65 inches minimum. Detectable warning edges shall be sized and installed so that dome spacing is maintained across adjoining edges. Each dome shall have a minimum static friction of coefficient of 0.8 as tested per ASTM C1028.

340.2.1.1 Color and Contrast: Detectable warnings shall contrast visually with adjoining surfaces, either light-on-dark or dark-on-light. Specific colors to be used shall be approved by the local jurisdictional agency prior to installation. Detectable warnings shall have integral color throughout.

340.2.1.2 Materials: Detectable warning materials shall be durable with a non-slip surface not subject to spalling, chipping, delamination, or separation. All detectable warnings shall be approved by the local jurisdictional agency prior to installation.

340.2.1.3 Attachment System: Detectable warnings shall be either placed in freshly poured concrete (wet-set) or recessed into pre-formed concrete. Detectable warnings using wet-set placement shall have an anchoring method that assures constant contact of the detectable warning bottom surface with the concrete as it cures, thus rendering the ramp a single monolithic structure. The thicker and heavier detectable warnings lowered into pre-formed recesses in the concrete substrate must demonstrate a firm fitting into metal reinforced frames without gaps along the edges that can channel water, sand, or debris. They must also be able to resist movement (i.e. sliding, rocking, or lifting) once in service. All attachment systems shall be approved by the local jurisdictional agency.

340.3 CONSTRUCTION METHODS:

Existing concrete shall have a clean vertical edge where it is to be joined by new construction. Sawcutting is required when the existing matching edge is not a straight vertical edge.

340.3.1 Subgrade Preparation: The subgrade shall be constructed and compacted true to grades and lines shown on the plans and as specified in Section [301](#). All soft or unsuitable material shall be removed to a depth of not less than 6 inches below subgrade elevation and replaced with material satisfactory to the Engineer. Removal and replacement of soft or unsuitable materials will be paid for as extra work.

Subgrade classified as marginally expansive or expansive as defined in Table [340-1](#) shall be treated as follows unless the construction documents require alternative measures for mitigation of expansive soils. The upper 6 inches of marginally expansive soils shall be compacted per Section [301.3](#) at a moisture content between 0% to 3% above optimum moisture per ASTM D698. Expansive soils shall be considered unsuitable and shall be treated or removed and replaced with material as directed by the Engineer. Alternate corrective measures contained in an existing geotechnical report or new site analysis can be submitted to the Engineer for approval. The submittal of alternative corrective measures must be a recommendation of an

SECTION 340

Arizona registered engineer and have the professional seal affixed.

Table 340-1			
Description	Percent Fines (– #200 sieve) ⁽¹⁾	Plasticity Index ⁽²⁾	Additional Testing
Non-expansive	> 20%	≤ 15	None
Potentially expansive		> 15	Perform Swell Test ⁽³⁾
Description	% Swell ⁽³⁾		
Non-expansive	< 1		
Marginally expansive	1 – 3		
Expansive	> 3		

(1) Tested in accordance with ASTM C117

(2) Tested in accordance with AASHTO T-90 (wet prep per AASHTO T-146)

(3) Swell Test: Samples for swell tests shall be re-molded in accordance with ARIZ 249 (ADOT Materials Testing Manual) to 95% of maximum dry density at optimum moisture as determined by ASTM D698 and tested for one-dimensional expansion in accordance with the applicable portions of ASTM D4546 applying a surcharge of 144 psf.

Material removed for construction shall not be placed on the base and/or surfacing material already in place on the roadway nor shall the excavated material be placed in such a manner as to interfere with access to property or traffic flow in the street.

340.3.2 Formwork: Concrete curbs, gutters and sidewalks shall be constructed by the conventional use of forms, or may be constructed by means of an appropriate machine when approved by the Engineer.

If machines designed specifically for such work and approved by the Engineer are used, the results must be equal to or better than that produced by the use of forms. If the results are not satisfactory to the Engineer, the use of the machine shall be discontinued and the Contractor shall make necessary repairs at his own expense. All applicable requirements of construction by use of forms shall apply to the use of machines.

Forms conforming to the dimensions of the curb, gutter, sidewalk, curb ramps, driveway, and alley entrance shall be carefully set to line and grade, and securely staked in position. The forms and subgrade shall be watered immediately in advance of placing concrete.

Forms shall be thoroughly cleaned each time they are used, and shall be coated with a light oil, or other releasing agent of a type which will not discolor the concrete.

340.3.3 Concrete Placement: The concrete shall be thoroughly spaded away from the forms so that there will be no rock pockets next to the forms. The concrete may be compacted by mechanical vibrators approved by the Engineer. Tamping or vibrating shall continue until the mortar flushes to the surface, and the coarse aggregate is below the concrete surface. The surface shall then be struck off and worked to grade and cross section with a float.

If machine placement is used, the machine shall place, consolidate and finish the concrete in one complete pass, requiring a minimum of hand finishing producing a dense and homogeneous section. A form shall trail behind the machine for such a distance that no appreciable concrete slumping will occur. Final finishing shall be as specified in Section [340.3.7](#), Form Removal and Finishing.

340.3.4 Joints: Shall be constructed in a straight line, vertical plane and perpendicular to the longitudinal line of the sidewalk, curb and gutter, single curb, etc., except in cases of curved alignment, where they shall be constructed along the radial lines of the curve.

Curb and gutter joints shall match the location of concrete pavement joints when abutting concrete pavement.

The space between joints in curbs and gutters (space between contraction joints or between contraction and expansion joints) shall not exceed ten feet.

Sidewalk that abuts curb or gutter shall have joints that match the curb or gutter joints.

Revised 2015

SECTION 340

The space between sidewalk joints shall not exceed 125% of the sidewalk width (for example: maximum joint spacing for 5 foot wide sidewalk is 6.25 feet).

340.3.4.1 Expansion Joints: Expansion joints shall be constructed to the full depth and width of the concrete. The expansion joint material shall extend fully through the concrete and one inch into the subgrade with the top of the expansion joint material one-quarter inch below the top surface. Expansion joint material shall be secured in place prior to placement of concrete.

Expansion joints shall be installed along all abutting structures to provide complete separation from the structure.

Sidewalk, curb, and gutter expansion joints shall be installed at all radius points, at both sides of each driveway, at both sides of each alley entrance. The maximum distance between expansion joints shall be 50 feet.

340.3.4.2 Contraction Joints: Unless otherwise specified, the large aggregate in contraction joints shall be separated to either side of the joint for a minimum depth equal to 25% of the concrete thickness; the finished depth shall be a minimum of 3/4 inch.

340.3.5 Edges: All exposed edges shall be shaped with a suitable tool to form edges having the shape as indicated on the referenced detail.

340.3.6 Detectable Warnings: Detectable warnings shall be installed perpendicular to the direction of pedestrian/wheelchair travel and have a minimum width of 24 inches measured perpendicular to the edge of the roadway or rail crossing. The base surface of detectable warnings shall be installed flush with the adjacent walkway surface; the truncated domes shall extend above the walkway surface. The boundary between detectable warnings and the adjacent walkway shall provide a flush uniform surface that will not cause ponding of water nor present a tripping hazard. Partial domes at the edge of the detectable warning shall be made flush to match the base surface of the detectable warning. Detectable warnings installed on curb ramps shall extend the full width of the ramp depression.

Detectable warnings installed on curb ramps shall modify the sidewalk concrete thickness at the detectable warning to provide a minimum concrete thickness of four-inches (4"). When detectable warnings are modules inset into the curb ramp, the bottom surface of the sidewalk shall be lowered a distance equal to or greater than the module thickness to maintain the minimum sidewalk thickness. The sidewalk bottom surface shall have a minimum transition taper length of 12" between the thickened and normal depth sections of sidewalk. The detectable warning surface shall be located so that the edge nearest the curb line is 6 inches minimum and 8 inches maximum back from the face of curb.

Detectable warning surfaces for pedestrian at-grade rail crossings not located within a street or highway shall be installed on each side of the rail crossing, located as shown on plans. Detectable warnings shall extend the full width of the pedestrian walkway.

340.3.7 Form Removal and Finishing: The front face form shall not be removed before the concrete has taken initial set and has sufficient strength to carry its own weight. Gutter forms and rear forms shall not be removed until concrete has hardened sufficiently to prevent damage to the edges. Any portion of concrete damaged while stripping forms shall be repaired or replaced at no additional cost to the Contracting Agency.

After the forms are removed, the joints shall be tooled and the surface finished with a float to remove all imperfections. As needed, retool joints after finishing to prevent groove bonding. In all cases, the resulting surface shall be smooth and of uniform color with all rough spots, projections, and form stakes removed. No plastering of the concrete will be allowed. The concrete work shall have a true surface; shall be free from sags, twists, or warps; have a uniform appearance; and be true to the lines, grades, and configurations indicated on the drawings.

Surfaces shall be light broom finished; flow lines shall be troweled for a smooth finish.

If the evaporation rate on the concrete surface exceeds the rate of bleeding of the concrete due to weather conditions, materials used, or for any other reason, and there is any likelihood of the fresh concrete checking or cracking before the curing operation, measures shall be taken to prevent the rapid evaporation of water from the surface during finishing operations. When allowed by the Engineer, the addition of water to the surface may be permitted as an indirect fog spray with approved spray equipment immediately after screeding and/or between finishing operations. A commercial evaporation reducer that forms a monomolecular film may also be sprayed onto the concrete surface in accordance with the manufacturer's recommendations. At no time will free water/evaporation reducer be worked into the concrete surface. Approved measures shall continue until curing operations per Section [340.3.8](#), Curing, are started in the particular area affected.

SECTION 340

The Contractor shall stamp the company name and year on each end of the sidewalk or curb ramp constructed. The letters shall not be less than 3/4 inch in height and the depth of the stamped impression shall be between 1/8-inch and 1/4-inch.

340.3.8 Curing: As soon after the completion of the finishing operation as the condition of the concrete will permit, all exposed surfaces shall either be sprayed with a pigmented curing compound or sealed with a material conforming to Section [726](#). Curing compound shall be applied under pressure through a spray nozzle in such manner and quantity as to entirely seal all exposed concrete surfaces with a uniform film. The membrane shall be applied in two applications for a total coverage of 150 square feet per gallon. Concrete surfaces shall be kept damp until the curing compound is applied. Should the curing compound seal be broken or damaged before the expiration of 10 days after the placing of the concrete, the break shall be immediately repaired by the application of additional curing compound over the damaged area.

The need for adequate curing is greatest during the first few hours after placement of the concrete.

340.3.9 Tolerances: The face, top, back, and flow line of the curb and gutter shall not deviate in excess of 1/4-inch over 10 feet, as tested with a 10-foot straightedge or curve template, longitudinally along the surface.

The surface of concrete sidewalk or curb ramp shall not deviate in excess of 1/8-inch over 5 feet as tested with a 5-foot straightedge except for the 1/4-inch recess of the preformed material in expansion joints.

All finished concrete elevations shall not deviate from the elevations shown on the plans, or indicated by typical sections or standard details referenced within the construction documents, by more than 1/2 inch.

When required by the Engineer, gutters shall be water tested. The Contractor shall establish flow in the length of gutter to be tested by supplying and distributing water from a hydrant, tank truck or other source. After the supply of water is shut off and water has stopped flowing, the gutter shall be inspected for evidence of ponding or improper shape. The work shall be deemed deficient if water is found ponded in the gutter to a depth greater than 1/2 inch or ponding extends onto the adjacent asphalt pavement.

Areas between elevations shown on the plans shall be straight graded or smoothly transitioned through a vertical curve in a manner approved by the Engineer or as otherwise indicated on the construction documents.

340.3.10 Deficiencies: Any section of the work deficient in depth or not conforming to the plans or specifications shall be removed and replaced by the Contractor at no additional cost to the Contracting Agency. Replacement or reconstruction shall be from joint to joint.

Concrete work that does not comply with tolerance requirements of Section [340.3.9](#), Tolerances, shall be removed and replaced. Remove and replace gutters that exceed the ponding tolerance. Grinding shall only be allowed if approved by the Engineer.

340.4 BACKFILLING:

Unless otherwise specified the Contractor shall backfill behind the curbs, sidewalk or curb ramps with soil native to the area to the lines and grades shown on the plans.

340.5 MEASUREMENT:

Concrete curbs and gutters of the various types shown on the plans and in the proposal will be measured along gutter flow line through inlets, catch basins, driveways, curb ramps, etc., by the lineal foot to the nearest foot for each type, complete in place. Measurement for curb terminations and transitions shall be included with the linear measurement of the various types of curb or curb and gutter as shown on the plans and in the proposal.

Curb and gutter type shall be based on the configuration of the final exposed surfaces. The increased curb and gutter depth required at valley gutter aprons or driveways shall not be measured as a separate pay item; any additional Contractor cost shall be included in the unit cost associated with the valley gutter, driveway or other associated item.

Concrete sidewalks, driveways, alley intersections, valley gutters and aprons will be measured to the nearest square foot complete in place.

SECTION 340

Detectable warnings shall not be measured for payment. Detectable warnings are considered integral to the walking surface that they form a part of and the cost is included in the related pay item.

- Curb ramp installations shall be measured as complete installed units and shall include the ramp curb and the walking surfaces between the ramp curb and back of curb and gutter or single curb. Single curb or curb and gutter located at the edge of roadway
- shall be measured and paid for separately. The surface area of curb ramps shall not be included in the measured quantity for sidewalk.

340.6 PAYMENT:

Payment will be made in accordance with the unit prices or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, material, tools and equipment and accomplishing all work in conformance with the contract documents.

Over-excavation of soft, expansive or unsuitable materials and installation granular materials will be paid as a separate pay item, not included with the above measured pay items.

- End of Section -

SECTION 342

DECORATIVE PAVEMENT CONCRETE PAVING STONE

342.1 GENERAL:

The Contractor shall furnish all necessary labor, material, tools and equipment to complete the proper installation of decorative concrete pavers used in medians, crosswalks, intersections or as otherwise noted in the Contract Documents. This includes furnishing a 10-foot straightedge to accomplish the level test when required by this specification.

The decorative pavement shall be true in line and grade and installed to coincide and align with the adjacent work elevation. All edges shall be retained to secure the pavers and sand laying course.

The Contractor shall construct a sample panel 10-feet by 10-feet for inspection and approval by the Engineer, prior to the actual installation for the project. Once approved, the panel shall be used as a standard for the remainder of the work. The panel shall remain undisturbed throughout the construction of the pavers and final approval by the Engineer.

342.2 MATERIALS:

342.2.1 Aggregate Base Course: Aggregate Base Course shall be per Table [702-1](#).

342.2.2 Portland Cement Concrete: When the pavers are subject to vehicular traffic, Portland Cement Concrete shall be Class A per Section [725](#). All other locations, the Portland Cement Concrete shall be a minimum of Class B per Section [725](#).

342.2.3 Sand: Sand used for laying course shall conform to ASTM C33 except for the gradation. The gradation shall comply with Table [342-1](#).

TABLE 342-1								
SAND GRADATION								
Sieve Size	3/8 inch	No. 4	No. 8	No. 16	No.30	No. 50	No. 100	No. 200
Percent Passing	100	95-100	85-100	15-85	25-60	10-30	2-10	0-1

342.2.4 Concrete Pavers: Pavers shall have a minimum of thickness of 80 mm (3.15) when installed in traffic bearing areas and 60 mm (2.36 in.) When installed in non traffic bearings areas. Pavers shall be of an interlocking design conforming to ASTM C936-82. Pavers shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. The Contractor shall submit two samples of each type of pavers used on the project for review and approval by the Engineer prior to any work. The pavers and materials used in their manufacture shall conform to the following:

(A) Compressive Strength: Pavers shall have a minimum compressive strength of 8,000 psi in accordance with ASTM C140.

(B) Absorption: The average absorption shall not be greater than 5 percent, with no individual unit absorption greater than 7 percent.

(C) Portland Cement: Cement shall comply with Section [725.2](#), Type II.

(D) Aggregates: Aggregates shall conform to ASTM C33 (washed, graded sand and rock, no expanded shale or lightweight aggregates).

(E) Other Constituents: Coloring pigments shall be applied integrally to the concrete. Air entraining admixtures, coloring pigments, integral water repellents, and finely ground silica shall be previously established as suitable for use in concrete and either shall conform to ASTM standards where applicable, or shall be shown by test or experience not to be detrimental to the concrete.

(F) Physical Properties: The size, shape, design and color of the pavers shall be as noted in the Contract Documents.

SECTION 342

342.2.5 Expansion Joint: Expansion joint filler material shall be 1/2-inch premolded and comply with Section [729](#) and ASTM D1751.

342.3 CONSTRUCTION PROCEDURES:

342.3.1 Subgrade: The subgrade shall be constructed true to grades and lines shown on the plans and compacted to a minimum dry density of 95% as specified in MAG Section [301](#).

342.3.2 Aggregate Base Course: When aggregate base course is specified, the aggregate base course shall be constructed true to grades and lines shown on the plans and compacted to a minimum dry density of 100% per Section [301](#) with the surface of the aggregate base course not varying by more than +1/8-inch in 10-feet.

342.3.3 Concrete Header and Base Slab: Forms shall be thoroughly cleaned each time they are used, and shall be coated with a light oil, or other releasing agent of a type which will not discolor the Portland Cement concrete.

The Portland Cement concrete shall be thoroughly spaded away from the forms so that there will be no rock pockets next to the forms. Compacted by mechanical vibrators may be used when approved by the Engineer. Tamping or vibrating shall continue until the mortar flushes to the surface, and the coarse aggregate has been tamped below the surface.

All edges shall be shaped with a suitable tool to form a rounded edge of radius as directed in Detail 225.

The Portland Cement concrete header face form shall not be removed before the concrete has taken the initial set and has sufficient strength to carry its own weight. The concrete header outer form shall not be removed until the concrete has hardened sufficiently to prevent any damage to the concrete. Any porting of concrete damaged while stripping forms shall be repaired or if the damage is severe, replaced at no additional cost to the Contracting Agency. The face and top of the concrete header shall be tested with a 10-foot straightedge or curve template, longitudinally along the surface. Any deviation in excess of 1/4-inch in 10-feet shall be corrected at no additional cost to the Contracting Agency.

Any section of the work deficient in depth or not conforming to the plans or specifications shall be removed and replaced by the Contractor at no additional cost to the Contracting Agency.

Finishing and curing of the concrete shall be done in the manner specified in Section [340](#).

342.3.4 Expansion Joints: Expansion joints shall be constructed to the full depth and width of the concrete with the top of the material one-half inch below the top surface as depicted in Detail 225 unless otherwise specified. After the concrete is cured, the top one-half inch shall be filled to the surface of the concrete with a premium-grade, high-performance, moisture-cured, single-component, polyurethane-based, non-sag elastomeric sealant, ASTM C920, Type S, Grade NS, Class 25, Sikaflex-1A or equal.

Joints shall be constructed in a straight line and vertical plane perpendicular to the longitudinal line of the concrete header, except in cases of curved alignment when they will be constructed along the radial lines of the header. In the case of base slabs, pavers shall be placed continuously over the expansion joints.

342.3.5 Contraction Joints: Contraction joints shall be constructed in a straight line and vertical plane perpendicular to the longitudinal line of the concrete header, except in cases of curved alignment when they will be constructed along the radial lines of the header. They shall be constructed to a depth of one inch with rounded edges and placed at 10-foot intervals. Contraction Joints shall be filled to the surface of the surrounding concrete with elastomeric sealant specified in 342.3.3.

342.3.6 Sand Laying Course: The maximum thickness of the sand course shall be one-inch. Screeding boards shall be used to ensure a uniform thickness. The sand shall not be compacted, walked on or wet down.

342.3.7 Concrete Paving Stones: The concrete pavers shall be clean and free of foreign materials before installation. Paving work shall be plumb, level and true to line and grade and shall be installed to properly coincide and align with adjacent work and elevations. All edges must be retained to secure the perimeter pavers and the sand laying course. The pavers shall be laid in such a manner that the desired pattern is maintained and joints between the pavers are as tight as possible.

SECTION 342

The Contractor shall lay the pavers starting from the longest straight line and from a true 90-degree corner. The pavers shall be installed hand-tight and level on the undisturbed sand course in a manner that eliminates gaps between the stones and the edge retention header. String lines shall be used to hold all pattern lines true. The gaps at the edge of the paver surface shall be filled with pavers cut to fit. Cutting shall be accomplished to leave a clean edge to the traffic (vehicular or pedestrian) surface using a masonry saw cut.

After the pavers are in place, they shall be vibrated into the sand laying course using a vibrator capable of 3,000 to 5,000 pounds compaction force. This will require two passes at 90 degrees to each other. After vibration, approximately 1/4-inch of clean masonry sand containing at least 30 percent of 1/8-inch particles shall be placed over the paver surface, allowed to dry, and vibrated into the joints with additional vibrator passes and brushing so as to completely fill joints. Excess sand shall be swept from the surface.

The finished paver surface shall be tested longitudinally and transverse to the concrete header or curb with a 10-foot straightedge along the surface. Any deviation in excess of 1/8-inch shall be corrected at no additional cost to the Contracting Agency.

Any broken or damaged pavers shall be removed and replaced. Replacement pavers shall be tamped into place and the joints filled with masonry sand as specified herein. The completed installation shall be cleaned of all debris, surplus material and equipment.

342.4 MEASUREMENT AND PAYMENT:

Measurement will be the square foot. Payment will be made at the unit bid price per square foot. This payment shall be full compensation for all labor, materials, tools and equipment required to complete the work.

- End of Section -

SECTION 343

EXPOSED AGGREGATE PAVING

343.1 DESCRIPTION:

Exposed aggregate paving consists of placing a concrete slab with exposed aggregate in the surface of the finished concrete. This exposed aggregate paving is designed for decorative or pedestrian use only. It should not be used in areas subject to vehicular traffic.

343.2 MATERIAL:

343.2.1 Concrete: Concrete shall be Class A per Section [725](#) with a maximum slump of 3 inches.

343.2.2 Exposed Aggregate: The exposed aggregate shall be uncrushed river-run rocks. The Contractor shall provide at least a 10-pound sample for approval by the Engineer prior to any aggregate paving.

(A) When the paving is for decorative use only, no pedestrian traffic, the aggregate shall not be larger than 3 inches or smaller than 1 ½ inches.

(B) When the paving is to be used for pedestrian traffic, the aggregate shall be not larger than 2 inches or smaller than 1 inch.

343.3 CONSTRUCTION PROCEDURE:

The Contractor shall construct a sample panel 3 feet by 3 feet for inspection and approval by the Engineer, prior to actual construction. When approved, this panel shall be used as a standard for the remainder of the work.

After the slab has been placed, screeded and darbied, the aggregate shall be hand-scattered so that the entire surface is evenly covered. The surface shall be reworked so that the aggregate will be embedded just beneath the surface. The concrete shall completely surround and lightly cover the aggregate leaving no holes or voids.

A non-staining surface retarder will be applied to provide a surface penetration of at least 1/8-inch and the surface will be lightly screed to ensure penetration. The surface will be covered with a protective material for the period of time recommended by the retarder manufacturer. After this time has elapsed, the upper, retarded layer of concrete will be removed using a water jet stream and a brush. The protective cover will be replaced and the concrete allowed to cure. After curing, the surface shall be cleaned and a silicone seal applied.

343.4 MEASUREMENT AND PAYMENT:

Measurement will be by the square foot. Payment will be made at the unit bid price per square foot. This price shall be full compensation for all labor, material, tools, and equipment required to complete the work.

- End of Section -

SECTION 345

ADJUSTING FRAMES, COVERS, VALVE BOXES METER BOXES AND PULL BOXES

345.1 DESCRIPTION:

The Contractor shall furnish all labor, materials, and equipment necessary to adjust all frames, covers and valve boxes as indicated on the plans or as designated by the Engineer. The frames shall be set to grades established by the Engineer.

The Contractor may elect to remove old frames, covers, and valve boxes and then install new frames and/or boxes in accordance with standard detail drawings at no additional cost to the Contracting Agency.

The Contractor shall be responsible for maintaining an accurate description and location of all items to be adjusted. The locations shall be referenced with map documentation by the use of swing ties or GPS locations. This information shall be supplied to the Engineer and utility owner(s) prior to taking any action that would hide or restrict access to the items to be adjusted.

Any missing or defective frames, covers, valve boxes or related hardware shall be reported to the Engineer in writing during the initial location process to allow for timely replacement. The Engineer shall be responsible for providing replacement items to the contractor. The contractor is responsible for providing items required to accomplish the required adjustments such as additional adjusting rings, valve box extensions, meter box extensions, and pull box extensions.

345.2 LOWERING PROCEDURE:

If required, manholes, valve boxes, or survey monuments located within the paved areas to be milled or reconstructed shall be lowered to an elevation that will allow required work to be accomplished without damaging the facilities. Care shall be taken to prevent entrance of any material into the lowered facilities. Lowering shall be to a depth that will prevent damage to the utility during the construction activities.

All manhole frames, valves boxes, survey hand hole frames and related items removed by the contractor during the lowering process shall be maintained in a secure area, and the contractor shall bear full responsibility for the material. Any hardware items lost or damaged by the contractor shall be replaced in kind, at no additional cost to the Contracting Agency.

Preparation for Milling: Temporary asphalt concrete shall be placed over the steel plate filling the excavated area. The temporary pavement shall be maintained until removed during the adjustment to final grade. For manholes located on major streets that are to be kept opened to vehicular traffic, hot mix asphalt shall be used to backfill the excavated areas and compacted flush with the existing pavement prior to opening up to traffic. In residential or low volume streets with minimal traffic, cold mix or other approved product may be used for temporary pavement. No measurement or payment shall be made for temporary pavement placement or removal.

345.3 ADJUSTING FRAMES:

The Contractor shall loosen frames in such a manner that existing monuments, cleanouts, manholes, and valve boxes will not be disturbed or damaged. Debris shields shall be used to prevent debris from entering sanitary or storm sewers. All loose material and debris shall be removed from the excavation and the interiors of structures prior to resetting frames. If dirt or debris enters the sewer system the contractor shall be responsible for cleaning the sewer system for a minimum of one reach (the next downstream structure from the contamination point.)

Frames shall be set to match finished grade or the elevations and slopes established by the Engineer. Manhole frames shall be firmly blocked in place with masonry or metal supports. Spaces between the frame and the facility shall be sealed on the inside to prevent any concrete from entering the hand hole or manhole. A Class AA concrete collar shall be placed around and under the frames to provide a seal and properly seat the frame at the required elevation and slope. Concrete shall be struck off flush with the top of the existing pavement.

Adjustments of utilities, if located within the asphalt pavement, shall be made after placing the final surface course when there is only a single lift of pavement required. When there are multiple lifts of pavement required, adjustments may be made before the final surfacing or as directed by the Engineer.

SECTION 345

After removal of the temporary asphalt pavement in the area of adjustment, and prior to placement of the final concrete collar ring (as shown on Details 270 and 422) the asphalt pavement in proximity of the adjustment shall be rolled with a self-propelled steel wheel roller if requested by the Engineer.

345.4 ADJUSTING VALVE BOXES:

Valve boxes shall be adjusted to the new elevations indicated on the plans, or as established by the Engineer.

Adjustable valve boxes shall, if possible, be brought to grade by adjustment of the upper movable section. Any excavated area shall be filled with Class AA concrete to the level of the existing pavement, or as directed by the Engineer.

Concrete pipe valve boxes in areas not subject to vehicular traffic shall be adjusted to grades by installing a suitable length of metal or concrete pipe, of the same inside diameter as the present valve box, and reinforcing the outside with a concrete collar extending from at least 2 inches below the joint up to and flush with the top of the valve box extension. This collar shall be of Class AA concrete. The dimension from the outside of the box to the outside of the collar shall not be less than 2 inches. This adjustment will be known as Type B.

In areas subject to vehicular traffic and where the existing valve box is a Type B, the adjustment to the new elevation shall be made using the old cover and installing a new 8 inch frame in accordance with the standard detail for installation of valve boxes in vehicular traffic areas. This adjustment shall be known as Type BA.

Adjustment of existing Type A valve boxes to the new elevations shall be as described in Subsection 345.2. This adjustment shall be known as Type A.

345.5 ADJUSTING MANHOLE AND VALVE COVERS WITH ADJUSTMENT RINGS:

Adjusting rings may be used to raise manhole covers in asphalt pavements when deemed acceptable by the Engineer. The amount of adjustment, thickness of seal or overlay, and cross slope will be considered when using adjusting rings. Each location where an adjusting ring is used must have a sufficient depth of asphalt to assure the proper installation and operation of the ring. The rings shall be made of a concrete, non-metallic, polypropylene or fiberglass material and installed per the manufacturer's specifications. The rings shall be approved by the Engineer.

The concrete collar ring around the frame or valve box shall be circular, and shall be a minimum of eight (8) inches thick, placed flush with the adjacent new pavement surface. Concrete shall be a minimum of Class AA on all paved streets. All concrete shall be obtained from plants approved by the Engineer.

If required by the Contracting Agencies specifications or details, a single No. 4 rebar hoop will be placed in each adjustment collar. The hoop diameter shall be such that its placement is centered between the edge of the manhole frame or valve box, and the outer edge of the concrete collar, the depth of the hoop shall be centered in the thickness of the collar. Each concrete ring shall be scored radially at quarter-circle points. Score lines shall be ¼ -inch wide by ½ - inch deep. The concrete collar surface shall be rough broom finished. (See Details 270 and 422).

Traffic shall not be allowed on the concrete collars until the concrete had reached a minimum compressive strength of 2500 psi on residential and 3000 psi on collector and major streets. On major streets the contractor shall use "high-early" in the concrete mix, approved by the Engineer, to minimize delay in reopening the street(s) to traffic.

345.6 MEASUREMENT:

The quantities measured will be the actual number of frames, covers and valve boxes of each type, adjusted and accepted.

345.7 PAYMENT:

Accepted quantities, will be paid for at the contract unit price. Payment shall be compensation in full for all materials, labor, equipment and incidentals necessary to complete the work.

- End of Section -

SECTION 350

REMOVAL OF EXISTING IMPROVEMENTS

350.1 DESCRIPTION:

This work shall consist of removal and disposal of various existing improvements, such as pavements, structures, pipes, conduits, curbs and gutters, and other items necessary for the accomplishment of the improvement.

350.2 CONSTRUCTION METHODS:

350.2.1 Utilities

The removal of existing improvements shall be conducted in such a manner as not to injure active utilities or any portion of the improvement that is to remain in place.

A utility may be abandoned in place below a new major structure that is part of the work only if approved by the Agency and solidly filled with grout using methods approved by the Agency. All abandoned utilities to remain and the approved abandonment method shall be noted on the installation record drawings.

Utilities to be removed by the Contractor shall be disconnected and taken out in accordance with the requirements of the utility owner to the limits shown on the plans. Utility removal shall not be performed until a release has been obtained from the utility stating that their respective service connection and appurtenant equipment have been disconnected, removed or sealed and plugged in a safe manner.

The Engineer shall be notified when utilities are encountered that are not shown on the plans.

350.2.2 Others

Sidewalks shall be removed to a distance required to maintain a maximum slope for the replaced portion of sidewalk, for one inch per foot and all driveways shall be removed to a distance as required by standard details.

Portland cement concrete pavements, curbs and gutters and sidewalks designated on the plans for removal shall be saw-cut at match lines, in accordance with Section [601](#) and removed.

Portions of asphalt concrete pavements designated on the plans for removal shall be done in accordance with Section [336](#).

Removal of trees, stumps, roots, rubbish, and other objectionable materials in the right-of-way shall be done in accordance with Section [201](#).

350.2.3 Backfill and Disposal

Backfill of all excavated areas below structures shall be in accordance with Section 206.4. Backfill and compaction of all other excavated areas shall be compacted to the densities as prescribed in Section [601](#) (trenches) or Section 211 (holes, pits or other depressions).

All surplus materials shall be immediately hauled from the jobsite and disposed of in accordance with Section [205.6](#).

350.3 MISCELLANEOUS REMOVAL AND OTHER WORK:

This work shall include, but not be limited to the following, where called for on the plans:

- (A) Relocate existing fence and gate.
- (B) Remove and reset mail boxes.
- (C) Remove signs and bases in right-of-way.
- (D) Remove planter boxes, block walls, concrete walls, footings, headwalls, irrigation structures, and storm water inlets.

SECTION 350

(E) Install plugs for pipes and remove existing plugs as necessary for new construction.

(F) Remove wooden and concrete bridges.

(G) Remove median island slabs.

(H) Remove pavements and aggregate base where called for outside the roadway prism.

350.4 PAYMENT:

■ Payment for removals will be made at the unit proposal price which price shall be full compensation for the item complete, as described herein or on the plans.

- End of Section -

SECTION 355

UTILITY POTHOLES-KEYHOLE METHOD

355.1 DESCRIPTION:

This specification covers the requirements for coring, vacuum excavation, backfilling, and reinstatement of the asphalt core into asphalt pavement.

355.2 EXCAVATION:

Excavation requires coring a circular hole through asphalt pavement using drilling/coring equipment and removal of the intact asphalt pavement core. The vertical alignment of the coring operation shall be perpendicular to the horizon and cutting shall be extended the full depth of the existing pavement section.

Pavement cores shall not be greater than 24 inches in diameter, shall not be spaced closer than 3 feet between cores (edge to edge), shall not contain a joint or any pavement cracks greater than 1/8-inch wide, and shall only be obtained from pavements where the asphalt concrete section is at least 4 inches thick.

Contractor shall place a temporary mark (paint or chalk) on the pavement core and adjacent pavement prior to cutting to insure that the pavement core when replaced will have the same orientation as found in the original pavement.

Pavement cores shall be either removed from the work site or stored in a safe and secure on-site location. The cores shall be made readily available for reinstatement into the pavement.

Soil shall be removed by air/vacuum extraction methods to expose utilities. The zone of soil removal shall remain essentially within a vertical plane extending below the edges of the core hole.

The Contractor shall dispose of all excess materials.

355.3 BACKFILL AND COMPACTION:

355.3.1 Backfill Using Mechanical Compaction: Backfill shall be aggregate base per Section [702](#) or native backfill material per Section [601](#), placed in maximum 6 to 8-inch loose lifts.

Backfill compaction shall be determined by use of a compression wave amplitude monitoring device manufactured specifically for the purpose of measuring soil compaction. This device shall measure the compression wave amplitude as compaction progresses using below grade piezoelectric transducer wave sensors and an above-grade electronic monitor. The device shall signal the operator of successful compaction (the compaction wave amplitude becomes asymptotic for continued compaction effort) for each lift.

At time of compaction backfill material shall have sufficient available moisture to be compacted based on the physical appearance (soil ball) method as specified in USDA Soil Conservation Service Agricultural Information Bulletin 199, described as follows:

Firmly squeeze a palm-size sample of soil into a ball by hand. Granular soils with sufficient available moisture will tend to ball under pressure, but seldom holds together for long. Cohesive soils with sufficient available moisture will form a ball that can be rolled into approximate 1/4" wide ribbons between the palms of the hands without breaking apart, leaving no free water on the hand.

A compaction sensor shall be placed at the bottom of the first loose lift. A new sensor shall be placed for every 48 inches of compacted fill depth.

Pneumatic compaction equipment (pneumatic rammers or equivalent) shall be used for compaction of the backfill material. The size of the compactor shall not exceed one-half the diameter of the hole.

SECTION 355

Mechanical compaction on each lift shall be continued until the electronic monitor signals that compaction is complete. A new lift shall not be placed until a positive signal has been received. Remove backfill soil and sensor if the monitor does not give a positive compaction signal after repeated compaction efforts. Repeat backfilling and compaction with a new sensor.

Contractor shall provide compaction documentation to the Agency upon request.

355.3.2 Slurry Backfill: If mechanical compaction is not used, the Contractor shall use ½-sack CLSM as backfill in accordance with Section [728](#).

355.3.3 Leveling Course: A 1-1/2-inch to 2-inch thick leveling course of compacted crushed gravel meeting the requirements of ASTM C33, No. 8 coarse aggregate shall be placed above the backfill and directly below the asphalt concrete pavement section.

355.4 PAVEMENT RESTORATION

The pavement surface shall be restored to its original condition by setting the reinstated pavement core flush with and in its original orientation.

Bonding agent meeting the requirements of Section [708](#) shall be used for pavement core reinstatement. Excess bonding material shall be removed from the restored pavement surface. A "patched" appearance shall be avoided in surface restoration wherever possible.

The contractor shall reinstate the pavement core within 24 hours of cutting the pavement. Holes left open longer than 24 hours after cutting shall be covered with an approved steel road plate capable of supporting traffic loads. The steel plate must be rounded with a fitted collar that, when inserted into the hole, will prevent the steel plate from tipping, tilting, bouncing or spinning out of the hole under traffic conditions. An asphalt mix shall be used to ramp pavement up to the steel plate along all edges.

355.5 SURFACE TOLERANCES

The reinstated core shall be flush and level with the adjacent pavement. Gaps attributable to the positioning of the core shall be less than 1/16-inch between the bottom of a minimum 3-foot long straightedge and the surface of the pavement in any direction on the surface of the keyhole core, except across the pavement crown or drainage gutters.

355.6 DEFICIENCIES

Where the pavement core is found to be fractured or defective upon removal, or becomes damaged after removal and prior to reinstating, the defective or damaged core shall not be used to reinstate the pavement. Pavement repair shall be performed in accordance with Detail 212, Type A Pavement Repair.

A pavement core is considered unacceptable when one of the following conditions exist:

- (a) The core contains any vertical cracks wider than 1/8-inch extending full depth or partial depth through the core; or
- (b) Any deteriorated piece of the core is larger than 10 percent of the overall area of the core.
- (c) Two or more successive layers of asphalt concrete in the core become horizontally delaminated and cannot be rebounded to each other with the bonding compound.

All unacceptable pavement cores shall be removed from the job site.

355.7 MEASUREMENT

Each acceptable utility pothole repair shall be counted. No distinction shall be made based on size of the utility pothole or method of repair.

SECTION 355

355.8 PAYMENT

Payment at the contract price for utility pothole repair complete in place shall be full compensation for all labor, equipment and material required for a complete in place installation. Payment includes traffic control and disposal of all excess materials.

- *End of Section* -

SECTION 360

TELECOMMUNICATIONS INSTALLATION

360.1 DESCRIPTION:

This work shall consist of the installation of underground telecommunications facilities within the public right-of-way.

360.2 TRENCHING, BACKFILL AND RESTORATION:

All work shall be done in accordance with Section [601](#).

360.3 CABLE INSTALLATION:

(A) "Trunk Lines" Cable providing telecommunications service by connecting regions or states or by connecting central offices within a metropolitan area. Such cable shall be installed as described below:

(1) If the cable is to be installed within an open trench, the cable shall be placed within schedule 40 PVC conduit or equal with a minimum inside diameter of 4 inches. The conduit shall be buried at a minimum depth of 48 inches below finished grade measured to the top of the conduit. A color coded plastic warning tape with a minimum thickness of 5 mil and a minimum width of 3 inches shall be installed in the trench and centered over the PVC conduit at a depth of from 18 to 30 inches below finish grade.

(2) Cable crossings under existing paved streets shall be accomplished by jacking or boring unless open trenching is authorized by the Engineer or Agency. The cable shall be placed within a schedule 40 PVC conduit or better at a minimum depth of 48 inches.

(B) Telecommunications cables other than "trunk lines" shall be installed as described below.

(1) If a cable is to be installed within the right-of-way of an arterial or collector street, it shall be placed at a minimum depth of 36 inches below finished grade. A color coded plastic warning tape as described in "A" shall be placed 18 inches below the surface.

(2) If a cable is to be installed within the right-of-way of a local/residential street it shall be placed at a minimum depth of 24 inches below finished grade.

(3) Cable crossings under existing, paved streets shall be accomplished by jacking or boring unless open trenching is authorized by the Engineer or Agency.

360.4 CABLE LOCATING (FIBER OPTIC):

If a cable which is to be installed is fiber optic a tracing or locating wire shall be installed with the cable.

360.5 PAYMENT:

Payment will be made at the contract unit price bid per lineal foot.

- End of Section -

PART 400

RIGHT-OF-WAY AND TRAFFIC CONTROL

Section	Last Revised	Title	Page
401	1998	Traffic Control	401-1
405	2015	Survey Monuments	405-1
410	1998	Precast Safety Curbs	410-1
415	2014	Flexible Metal Guardrail	415-1
420	1998	Chain Link Fences	420-1
424	1998	Parkway Grading	424-1
425	1998	Topsoils	425-1
430	2014	Landscaping and Planting	430-1
440	1999	Sprinkler Irrigation System Installation	440-1

This Page Reserved for Future Use

SECTION 401

TRAFFIC CONTROL

401.1 DESCRIPTION:

Traffic control shall consist of traffic control devices and flagmen or pilot cars. All traffic control devices, the application of traffic control measures, and traffic regulation in these specifications are to supplement and are not intended to delete any of the provisions of the Contracting Agency's Traffic Barricade Manual, the Uniform Manual on Traffic Control Devices or any agency's Supplements to these Uniform Standard Specifications.

401.2 TRAFFIC CONTROL DEVICES:

Traffic control devices shall consist of providing, erecting, and maintaining necessary and adequate devices for the protection of the work, the workmen and the traveling public as approved by the Engineer.

(A) Temporary traffic control devices shall be used to guide traffic through construction areas. They include traffic cones to channelize traffic, portable barricades for warning, vertical panel channelizing devices to divert traffic, and lighting devices between the hours of sunset and sunrise.

(B) Advance warning devices shall be used to alert the motorist of an obstruction in the roadway. They include diamond-shaped signs, flags, and flasher type high level warning devices mounted 8 feet above the roadway.

401.3 FLAGMEN OR PILOT CARS:

Flagmen or pilot cars shall consist of providing sufficient flagmen, uniformed off-duty law enforcement officers or pilot cars to expedite the safe passage of traffic.

401.4 TRAFFIC CONTROL MEASURES:

The application of all traffic control measures shall be based primarily upon the conditions existing at the time that such measures are deemed necessary. Prior to the start of any work that would interrupt the normal flow of traffic; sufficient and adequate devices and measures shall be provided and erected as directed by the Engineer. These devices shall be immediately removed when no longer needed.

401.5 GENERAL TRAFFIC REGULATIONS:

A traffic lane shall be a minimum of 10 feet of clear street width with a safe motor vehicle operating speed of at least 25 miles per hour.

An intersection shall be all of the area within the right of way intersection streets plus 300 feet beyond the edge of the intersected right of way on all legs of the intersection.

A minimum of two traffic lanes, one for each direction, shall be maintained open to traffic at all times on all major streets.

(A) On Bond Issue and Budget Projects: All existing traffic lanes on major streets shall be maintained open to traffic at signalized intersections between the hours of 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. weekdays unless otherwise specified in the special provisions.

(B) On Improvement District Projects: All existing traffic lanes on major streets shall be maintained open to traffic between the hours of 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. weekdays. All work that enters or crosses a major street must be done at times other than 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. unless otherwise specified in the special provisions.

Local access shall be maintained to all properties on the project at all possible times. When local access cannot be maintained, the Contractor must notify the affected property owner at least 24 hours in advance and restore access as soon as possible.

SECTION 401

A traffic lane shall not be considered as satisfactorily open to traffic unless it is paved with hot mix or cold mix asphalt paving if surrounded by or adjacent to existing pavement. Where pavement did not previously exist or where all of the existing pavement has been removed, a traffic lane shall not be considered as satisfactorily open to traffic unless it is graded reasonably smooth and maintained dust free as directed by the Engineer.

Arrangements for partial or complete street closure permits shall be handled through the Engineer on local projects or the Arizona Highway Department, Resident Engineer on Federal Aid Projects, to the Contracting Agency's Traffic Engineering Department. An advance notice of 48 hours for major streets and 24 hours for local streets and alleys is required from the Contractor.

The Contractor shall provide and maintain all necessary traffic controls to protect and guide traffic for all work in the construction area.

The Contractor shall maintain all existing STOP, YIELD, and street name signs erect, clean, and in full view of the intended traffic at all times. If these signs interfere with construction, the Contractor shall temporarily relocate the signs away from construction but still in full view of the intended traffic.

The Traffic Engineering Department will reset all STOP, YIELD, and street name signs to permanent locations.

Existing traffic signs other than STOP, YIELD, and street name signs shall be maintained by the Contractor until such time as construction renders them obsolete. At that time the Contractor shall remove signs and posts without damage and deliver them as directed by the Engineer. The Traffic Engineering Department will reinstall all traffic signs.

Subject to the approval of the Traffic Engineer, the Contractor shall furnish and install the 25 MPH Construction Zone Speed Limit Signs. The Contractor shall maintain the signs erect, clean and in full view of the intended traffic at all times. Should the signs interfere with construction, the Contractor shall relocate the signs as necessary.

At any time project construction shall require the closure or disruption of traffic in any roadway, alley, or refuse collection easement such that normal refuse collection will be interfered with, the Contractor shall prior to causing such closure or disruption, make arrangements with the Contracting Agency's Sanitation Department in order that refuse collection service can be maintained.

Special traffic regulation will be listed in the special provisions.

401.6 MEASUREMENT:

No measurement will be made for traffic control devices.

Flagmen, uniformed off-duty law enforcement officers or pilot cars, with driver, will be measured by the hour for each individual, including vehicle and equipment, required to perform traffic control. When an officer is used less than 3 hours, a minimum of 3 hours will be charged. Anything over 3 hours will be measured by the hour.

401.7 PAYMENT:

Payment will be made at the contract bid price in the proposal for uniformed, off-duty law enforcement officer. If the officer is utilized in excess of 8 hours in any calendar day or in excess of 40 hours in any calendar work week, payment shall be at the rate of 1 1/2 times the contract bid price for all hours worked in excess in either of the above time periods.

- End of Section -

SECTION 405

SURVEY MONUMENTS

405.1 DESCRIPTION:

This work shall consist of furnishing and installing survey monuments at the locations shown on the plans or directed by the Engineer. The work also includes the preparation and recording of a corner record or results of survey in accordance with the Arizona State Board of Technical Registration requirements.

Monuments shall conform to the standard details or details shown on the plan.

405.2 MATERIALS:

The concrete portion of monuments shall be constructed in accordance with the provisions in Sections 725 and 505. Concrete shall be Class B.

Brass caps for survey monuments shall be furnished by the Contractor unless otherwise specified.

405.3 CONSTRUCTION:

Monuments may be cast in drilled holes without the use of forms.

Survey monuments shall be set vertically in the ground.

The brass cap assembly shall be firmly embedded in the concrete cylinder before the concrete has acquired its initial set. The concrete cylinder shall be so located that, the reference point will fall within a 1 inch circle in the center of the brass cap.

The tops of survey monument covers shall be set flush with the pavement surface.

405.4 MEASUREMENT:

Survey monuments will be measured by the number of units of each type of monument constructed and accepted.

405.5 PAYMENT:

Payment for monuments will be at the contract unit price and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in constructing the monuments, complete in place, as shown on the plans or as directed by the Engineer including preparing and recording a corner record or results of survey.

– End of Section –

SECTION 410

PRECAST SAFETY CURBS

410.1 DESCRIPTION:

This work shall consist of furnishing and installing precast safety curbs as shown on standard details or as detailed on the plans, or as directed by the Engineer.

410.2 MATERIALS:

Portland cement concrete shall be Class A, conforming to the applicable requirements of Section [725](#).

Steel reinforcing shall conform to the requirements of Section [727](#). The dimensions of the precast curb shall be as indicated on the plans and standard details.

Dowels shall conform to ASTM A615 plain, intermediate grade, 1/2 inch round by 24 inches.

Mastic may be either a fiberized mastic cement or an epoxy cement. The Contractor shall submit to the Engineer, the type of mastic and manufacturer's recommended procedures for use, within 10 days after the date of award of contract which will enable the Engineer to determine that the proposed material is acceptable.

410.3 CONSTRUCTION METHOD:

Back of safety curbs shall be set at the property line unless otherwise shown on the plans. Curbs shall be kept a minimum distance of 5 feet from driveways.

Precast safety curb installed on natural earth or gravel surfaces shall be secured in place with a minimum of 2 steel dowels through each curb. A minimum 12 inches diameter by 12 inches deep Class B concrete cylinder or approved equal shall be poured in place around each dowel.

Precast safety curb installed on Portland cement concrete or asphalt concrete surfaces shall be bedded in a continuous layer of mastic cement under its complete base area and secured with a minimum of 2 steel dowels driven through the safety curb.

Dowels shall extend into the sub-surface and/or concrete cylinder a minimum of 18 inches. When installed, the top of each dowel shall be flush with the top of the safety curb.

The Engineer will verify locations of all safety curbs in the field at time of construction.

410.4 MEASUREMENT:

Measurement will be the number of safety curbs furnished and installed, complete in place.

410.5 PAYMENT:

Payment will be made at the unit price bid each in the proposal for the following:

- (A) Safety curbs installed on natural earth or gravel.
- (B) Safety curbs installed on Portland cement concrete.
- (C) Safety curbs installed on asphalt concrete.

- End of Section -

SECTION 415

FLEXIBLE METAL GUARDRAIL

415.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials, constructing new guardrail, and delineating guardrail sections at the locations shown on the plans.

Guard rail end treatments shall be as specified on the plans or special provisions.

415.2 MATERIALS:

The rail elements, bolts, nuts and other fittings shall conform to the specifications of AASHTO M 180, except as modified in this section. The rail metal shall conform to AASHTO M 180, Type I, Class A and in addition to the requirements of AASHTO M 180, shall withstand a cold bend, without cracking of 180 degrees around a mandrel of a diameter equal to 2 1/2 times the thickness of the plate.

Three certified copies of mill test reports of each heat from which the rail element is formed shall be furnished to the Engineer.

All materials shall be new, except as otherwise noted on the plans or special provisions.

Railing Parts furnished under these specifications shall be interchangeable with similar parts regardless of source. All surfaces of guardrail elements that are exposed to traffic shall present a uniform, pleasing appearance and shall be free of scars, stains or corrosion.

Nails shall be 16 penny common galvanized.

Bolts shall have shoulders shaped to prevent the bolts from turning.

Unless otherwise specified the rail elements, terminal sections, bolts, nuts, and other fittings shall be galvanized in accordance with Section [771](#). Where galvanizing has been damaged, the coating shall be repaired in accordance with Section [771](#).

Guardrail reflector tabs shall be either 3003-H14 Aluminum strip 0.063 ± 0.004 inches thick, or steel strip 0.078 ± 0.008 inches thick galvanized in accordance with ASTM A 653 coating designation G 90. The reflector material shall be high-reflectivity sheeting, either silver-white or yellow and shall conform to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction. Adhesive for sheeting attachment to the metal tab shall be of the type and quality recommended by the sheeting manufacturer. Reflector tabs shall conform to the Reflector Tab Detail of Maricopa County Department of Transportation Standard Detail 3002.

Timber for posts and blocks shall be rough sawn (unplanned) or S4S with the nominal dimensions indicated. Any species or group of woods graded in accordance with the requirements for Timber and Posts of the Western Wood Products Association may be used. Timber shall be No. 1 or better, and the stress grade shall be as follows:

6" by 8" Post and Block	1200 psi
8" by 8" Post and Block	900 psi
10" by 10" Post and Block	900 psi

When the plans show guardrail systems using 8" by 8" timber posts and blocks, the Contractor may use 8 1/4" nominal size posts and blocks with a stress grade of 825 pounds per square inch.

At the time of installation, the dimensions of timber posts and blocks shall vary no more than plus or minus 1/2" from the nominal dimensions as specified on the project plans. The size tolerance of rough sawn block in the direction of the bolt holes shall vary no more than plus or minus 3/8".

All timber shall have a preservative treatment as per the requirements of AASHTO M 133.

Structural steel shapes shall conform to the requirements of ASTM A36 and be galvanized in conformance with the appropriate requirements of AASHTO M 111. Dimensions shall meet the dimensional requirements of the American Institute of Steel Construction.

SECTION 415

Steel tubes shall conform to the material requirements of ASTM A500 or A501 and be galvanized in conformance with the requirements of AASHTO M 180, Type 1.

415.3 CONSTRUCTION REQUIREMENTS:

415.3.1 General: The construction of the various types of guardrail shall include the assembly and erection of all component parts complete at the locations shown on the project plans or as directed by the Engineer.

Posts shall be as indicated by plans, standard details, or special provisions. Only one type and size of post and block shall be used for any one continuous length of guardrail.

Terminal sections shall be installed in accordance with the manufacturer's recommendations.

Workmanship shall be equivalent to good commercial practice and all edges, bolt holes and surfaces shall be free of torn metal, burrs, sharp edges and protrusions.

The various types of guardrail shall be constructed with wood posts and wood blocks, except as otherwise noted on the plans.

The bolted connection of the rail element to the post shall withstand a 5,000 pound pull at right angles to the line of the railing. All metal work shall be fabricated in the shop. No punching, cutting or welding shall be done in the field, except as provided for by the project plans. All metal cut in the field shall be cleaned and the galvanizing repaired in accordance with Section 771.

Where field cutting or boring of wood posts and blocks is permitted, the affected areas shall be thoroughly swabbed with at least two passes of the same type of wood preservative as initially used.

Where wood posts with rectangular sections are used, the posts shall be set so that the longest dimension is perpendicular to the rail.

All bolts shall extend beyond the nuts a minimum of two threads, except that all bolts adjacent to pedestrian traffic shall be cut off flush to the nut.

Bolts extending more than 2" beyond the nut shall be cut off to less than ½" beyond the nut.

Unless otherwise shown on the plans, bolts shall be torqued as follows:

Diameter of Bolt	Torque, Foot/Pounds
5/8"	45-50
3/4"	70-75
7/8" and larger	120-125

All bolts, other than those specified to be torqued, shall be securely tightened.

When guardrail is being constructed under traffic, the work shall be conducted so as to constitute the least hazard to the public. Guardrail work shall be performed in the direction of traffic flow when feasible.

Any section of guardrail that is removed for modification shall be replaced within five calendar days of the date the guardrail is removed, unless otherwise directed by the Engineer. At the end of each day, incomplete guardrail sections having an exposed end toward oncoming traffic shall have an appropriate temporary protective end treatment acceptable to the Engineer set securely in place together with approved overnight traffic control devices set in place.

415.3.2 Delineation: The maximum spacing between reflector tabs shall not exceed six posts. The slotted part of the tab shall be installed under the mounting bolt head so that the Reflectorized surface of the tab faces oncoming traffic. The exposed ends of the slotted part of the tab shall be bent up against and then over the top of the bolt head. The color of the reflective portion of the barrier markers shall conform to the color of the adjacent edge line. Silver-faced reflector tabs shall be installed on the right

SECTION 415

hand side of all roadways, and yellow-faced tabs shall be installed on the left-hand side of one-way, or median divided roadways.

415.3.3 Roadway Guardrail: Wood posts shall be used for new guard rail installations unless otherwise indicated by plans or special provisions. Wood posts shall either be driven or placed in manually or mechanically dug holes; however, driven posts will not be permitted at locations where damage to the curb, gutter, sidewalk, buried items, shoulders or pavement might occur. The Engineer will be the sole judge as to whether driving of posts will be allowed. Driving of posts shall be accomplished in a manner that will prevent battering, burring, or distortion of the post. Any post which is damaged to the extent it is unfit for use in the finished work, as determined by the Engineer, shall be removed and replaced at no additional cost to the Agency.

The posts shall be firmly placed in the ground. The space around posts shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted to the density of the surrounding material.

Where pavement is disturbed in the construction of guardrail, the damaged surfacing shall be repaired as approved by the Engineer.

Where a culvert or other obstacle is at an elevation which would interfere with full depth post placement, guardrail installation shall comply with requirements of Section [415.3.4](#) Bolted Guardrail Anchors or Section [415.3.5](#) Nested Guardrail.

Wood blocks shall be toe nailed to the wood post with one 16 penny galvanized nail on each side of the top of the block. Wood blocks shall be set so that the top of the block is no more than ½" above or below the top of the post, unless otherwise shown on the project plans.

Rail elements shall be spliced at 25 foot intervals or less. Rail elements shall be spliced at posts unless otherwise shown on the project plans and shall be spliced by lapping in the direction of traffic in the nearest adjacent lane. Rail elements at joints shall have full bearing. When the radius of curvature is 150 feet or less, the rail elements shall be shop curved.

The Contractor shall dispose of surplus excavated material remaining after the guard railing has been constructed.

415.3.4 Bolted Guardrail Anchors: Where the elevation of the top surface of a concrete box culvert or other similar installation prevents the placement of a post of the specified length, the posts shall be shortened and anchored in accordance with Maricopa County Department of Transportation Standard Detail 3010.

415.3.5 Nested Guardrail: This work shall consist of furnishing and constructing nested guardrail, Type 1, 2, or 3, as shown in Maricopa County Department of Transportation Standard Details 3008-1 through 3008-3.

415.3.6 Guardrail to Structure Transitions: Guardrail transitions shall be constructed in accordance with requirements shown on the plans and special provisions.

415.4 MEASUREMENT:

The limits of measurement for roadway guardrail shall be as detailed in Maricopa County Department of Transportation Standard Detail 3016, except as otherwise noted on the plans or special provisions. Guardrail, of the type shown on the project plans, will be measured by the linear foot along the face of the rail element from center to center of posts, exclusive of guardrail terminals, guardrail end terminal assemblies, nested guardrail (Types 1, 2 and 3) and guardrail transitions.

Delineation is considered a part of installation of guardrail and hence will not be measured as a separate item.

The accepted quantities of guardrail posts secured with bolted guardrail anchors will be measured by the unit each.

Nested guardrail, Types 1, 2, or 3, and guardrail transitions will be measured by the unit each, complete in place and accepted as shown on the plans.

SECTION 415

415.5 PAYMENT:

Payment for accepted quantities of each type of guardrail will be made at the contract unit price. Payment shall be full compensation for furnishing materials and installing guardrails, complete in place including excavation, backfill, and disposal of surplus material.

Payment for Bolted Guardrail Anchors will be at the contract unit price, and shall be full compensation for the work, complete in place, including steel brackets, hardware, excavation, backfill, removing and replacing surfacing, cutting and fitting steel beam posts or timber posts, drilling anchor bolt holes in steel posts, timber posts, and box culverts, and disposal of surplus materials.

Payment for guardrail transitions will be at the contract unit price. Payment shall be full compensation for furnishing materials and installing guardrail transitions, complete in place including excavation, backfill, and disposal of surplus material.

- End of Section -

SECTION 420

CHAIN LINK FENCES

420.1 DESCRIPTION:

This work shall consist of constructing chain link fences at the locations and in accordance with the details shown on the plans, and as provided in these specifications and the special provisions. When installation procedures are not covered within these specifications, standard details, special provisions, plans or other documents, installation will comply with ASTM F567.

420.2 MATERIALS:

Chain link fence material shall conform to the requirements of Section [772](#). Portland cement concrete shall conform to the requirements of Section [725](#).

420.3 CONSTRUCTION METHODS:

420.3.1 Fence Construction: Before any fence is installed, the Contractor shall submit to the Engineer for approval, shop drawings showing the details of all fittings and gates proposed to be furnished.

Posts shall be spaced at not more than 10 foot intervals, measured from center to center of posts, and shall be placed in a vertical position.

Changes in line or grade where the angle of deflection is 30 degrees or more shall be considered as corner and slope points, respectively, and corner or slope posts shall be installed at these points.

All posts shall be set in Class C concrete footings, which footings shall be crowned at the top to shed water. Footings for line posts for 72 inch fabric or less shall not be less than 30 inches deep and 8 inches in diameter, and footings for line posts for fabric more than 72 inches shall be shown on plans. All other footings, unless otherwise indicated on the plans or in the special provisions, shall be not less than 36 inches deep and 12 inches in diameter.

End, corner, slope and gate posts shall be braced to the midpoint of the nearest line post or posts with horizontal braces used as compression members and the said line posts trussed from the brace back to the bottom of the end, corner, slope or gate post with 3/8 inch steel truss rods with turnbuckles used as tension members.

Unless otherwise specified all fence shall be installed with a top rail and a bottom tension wire and the post tops shall be secured to the post by bolts or rivets. When top rail is omitted, a top and bottom tension wire shall be used.

The fabric shall be placed on the outward facing side of the posts and shall be installed so that the top edge projects above the top rail of the fence to form a knuckled or barbed projection. The fabric shall be stretched taut and securely fastened to the posts, the top rail, and the bottom tension wire. The tension wire shall be installed on a straight grade between posts by excavating the high points of ground and in no case will filling of depression be permitted. Unless otherwise specified the bottom of the fence shall be on a line approximately 2 inches above the ground surface.

The fabric shall be fastened to end, corner, slope and gate posts with 3/16 inch \times 3/8 inch high carbon steel tension bars and not less than 12 gage \times 1 inch steel tension bar bands spaced at 16 inch intervals; and to line posts, top rail and tension wire with 11 gage or heavier tie wires or metal bands. Tie wires or metal bands shall be placed on line posts at intervals of approximately 16 inches, and on top rail and tension wire at intervals of approximately 18 inches.

Barbed wire shall be installed on the fence only when specifically required by the plans or special provisions. When required, it shall be installed on extension arms of a type specified under Section [772](#).

420.3.2 Construction of Gates: The widths of any gates to be installed will be indicated on the plans or in the special provisions. Gates in which the width of the leaf is greater than 6 feet shall be constructed with an internal horizontal or vertical stiffener of the same diameter as the frame; the frame shall be trussed with a 3/8 inch adjustable tension rod. Gates in which the width of the leaf is 6 feet or less will not require a stiffener and will require only 1 truss rod.

SECTION 420

The corners of gate frames shall be fastened together and reinforced with a fitting designed for the purpose or by welding. All welds shall be ground smooth.

Chain link fence fabric shall be attached to the gate frame by the use of tension bars and tie wires as specified for fence construction, and suitable tension connectors spaced at approximately 16 inch intervals.

The swing gates shall be hung by at least 2 steel or malleable iron hinges, so designed as to securely clamp to the gate post and permit the gate to be swung back against the fence.

Semi-cantilever gates shall be provided with a combination steel or malleable iron catch and locking attachment of approved design, and shall be subject to approval of the Contracting Agency. Stops to hold gates open and a center rest with catch shall be provided on all double drive gates and on all other gates where required.

420.3.3 Repair of Damaged Coating: Welds made after galvanizing shall be ground smooth, then wire brushed to remove loose or burned zinc coating, after which the cleaned areas shall be repaired to the satisfaction of the Engineer in accordance with Section [771](#). Repairs to abraded or otherwise damaged zinc coating shall be made in a similar manner.

420.4 MEASUREMENT:

Chain link fence shall be measured on the fence line along the bottom strain wire from center to center of end posts, deducting the widths of gates and openings.

420.5 PAYMENTS:

The price bid and paid per linear foot for chain link fence shall include full compensation for furnishing all labor, materials, tools, and equipment, and doing all the work involved in constructing the fence complete in place as specified on the plans, and in the special provisions, except for furnishing and installing gates.

Gates will be paid for at the unit price bid for each size of gate required by the plans or special provisions, which price shall include full compensation for furnishing the gates, together with all necessary gate posts, fittings and hardware, and doing all the work involved in installing the gates complete in place as specified. If double gates are required, each double gate will be paid for at the unit price bid and such unit price shall include furnishing and installing both leaves.

Full compensation for clearing the line of the fence and disposing of the resulting material, excavating high points in the existing ground between posts, excavating and furnishing and placing concrete footings, connecting new fences to structures and existing fences, and any other related work shall be considered as included in the price bid per linear foot of fence and no additional allowance will be made therefore.

- End of Section -

SECTION 424

PARKWAY GRADING

424.1 DESCRIPTION:

This grading shall include all work necessary to bring the surface of the parkway, between the back of curbs and sidewalks and/or the parkway between sidewalks and the right-of-way line, to the grade and cross-section shown on the plans or as directed by the Engineer. It shall also include median islands between divided roadways.

424.2 ROUGH GRADING:

- (A) Fill material shall contain no rocks over 3 inches in diameter, broken concrete, or debris of any nature.
- (B) Backfill behind curbs and along the edges of the sidewalk shall be made immediately upon the completion of those items.

424.3 FINE GRADING:

- (A) The finished surface shall be free from stone and all debris and be true to grade and cross-sections after compaction to not less than 80% of maximum density, as determined by test methods specified in Section [301](#).
- (B) Where existing parkways are planted in grass, flowers, or shrubs and the level is somewhat above the top of the curb, or sidewalk, the parkway shall be graded back on a 4:1 slope from the edge of curb or sidewalk, with the least possible damage to the planted area.

424.4 PAYMENT:

Unless otherwise provided in the special provisions or proposal, no payment will be made for parkway grading as such; the cost thereof shall be included in the price bid for construction or installation of the items to which such grading is incidental or appurtenant.

- End of Section -

SECTION 425

TOPSOILS

425.1 DESCRIPTION:

This work shall consist of furnishing and hauling topsoil from an approved source and placing the topsoil as shown on the plans, in accordance with this specification and special provisions.

425.2 MATERIALS:

Topsoil shall conform to the requirements of Section [795](#).

425.3 CONSTRUCTION METHODS:

Prior to the excavation of topsoil, all grass, weeds, brush, stumps, loose rocks and other objectionable material shall be removed from the surface of the area from which the topsoil is to be removed.

The topsoil source shall be excavated in such a manner that all material excavated will be of the same composition and structure throughout.

Topsoil shall be spread over the areas and to the depths as specified, and shall be water settled.

After the topsoil has been spread, stumps, roots and other objectionable matter shall be removed from the surface of the area and disposed of in a manner satisfactory to the Engineer.

425.4 MEASUREMENT:

Unless otherwise specified, topsoil shall be measured by the cubic yard in place and loose after watering and settling.

425.5 PAYMENT:

The quantities measured as provided above, will be paid for at the contract price per cubic yard for furnishing and placing topsoil, which price shall be full compensation for the item complete, as described and specified.

- End of Section -

SECTION 430

LANDSCAPING AND PLANTING

430.1 DESCRIPTION:

This section shall govern the preparation and planting of landscape areas required in the Plans or Specifications. Materials will be in accordance with Section [795](#).

Existing utilities and improvements not designated for removal shall be protected in place. Any damages will be repaired by the Contractor at no additional cost to the Contracting Agency.

Unless otherwise provided, walls, curbs, planter boxes, irrigation systems, and other improvements shall be constructed after rough grading has been completed and prior to finish grading.

430.2 GENERAL:

Landscape or planting areas shall not be cultivated when they are so wet as to cause excessive compaction or so dry as to cause excessive dust or the formation of large clods.

Prior to any grading the areas shall be cleared and grubbed in accordance with Section [201](#), Clearing and Grubbing.

Finish grade for these areas shall not vary more than 1 inch from the specified grade and cross-section and shall be a smooth uniform surface, free of any abrupt grade changes or depressions. Unless otherwise specified, finish grade below adjacent paving, curbs, or headers shall be 1 inch for lawn and granite areas and 3 inches for planting areas.

Unless otherwise specified, in-place soil will be prepared and conditioned for utilization as topsoil. If imported topsoil is specified or has to be used, the existing soil, before subgrade, shall be scarified to a depth of 6 inches prior to placing the topsoil and the thickness of the topsoil layer shall be at least 6 inches.

All landscape and planting areas, except those intended for lawns, shall be treated with a pre-emergence control, such as "Surflan" or equal, applied in accordance with the manufacturer's recommendations.

430.3 LAWN AREAS:

430.3.1 Preparation of In-Place Soil: After clearing and grubbing has been completed, the existing surface shall be scarified and cultivated to a minimum depth of 8 inches; then brought to finish grade. During the operation, debris, including all stones over 1 inch in any dimensions, shall be removed and disposed of offsite.

After clearing and grubbing and initial cultivation has been completed, chemical fertilizer, 16-20-0 composition, shall be mechanically spread over the entire area at an average rate of 10 pounds per 1000 square feet. After spreading, the fertilizer shall be cultivated into the top six inches of soil using suitable equipment. The resulting soil shall be in a friable condition, suitable for planting.

The Engineer shall inspect and approve these areas prior to seeding.

430.3.2 Seeding: If a Bermuda summer lawn has not been established during its normal planting season, April through September, then rye grass (*Solium Multi-folium*) seed will be planted.

The rate of seeding shall be 3 1/2 pounds of Bermuda seed or 15 pounds of rye seed per 1000 square feet.

After seeding has been completed, the entire area shall be rolled with a lawn roller for leveling and seed retention. Immediately after rolling, the area shall be watered with a mist type spray until the soil is wet to a depth of 2 inches.

The Contractor shall provide the necessary safeguards to protect the planted areas from damage by erosion or trespass. Any damaged areas or any areas, greater than 6 inches in diameter, which fail to show a good stand shall be repaired and replanted until an acceptable stand of grass is obtained.

SECTION 430

430.3.3 Maintenance: The Contractor shall be responsible for maintenance of the lawn areas until they are accepted by the Contracting Agency. This shall include watering, mowing, weeding and removal of all debris.

430.4 DECOMPOSED GRANITE AREA:

Decomposed granite shall be in accordance with Section [795](#). The Contractor shall confirm that a sufficient quantity is available so that the entire area will be of the same composition and appearance, and shall furnish a sample to the Engineer for approval as to color.

After preliminary grading is completed and the area has been cleared and grubbed, a pre-emergence control, such as Surflan, or equal, shall be applied over the entire area, in accordance with the manufacturer's recommendations. The decomposed granite shall be evenly distributed over the area with a minimum depth of 2 inches. Finish grading will be accomplished and the granite will be lightly watered and then compacted to an extent satisfactory to the Engineer. After compaction, a second treatment with the pre-emergence control will be accomplished.

430.5 TREE, SHRUB, AND GROUND COVER PLANTING:

The species, sizes, the manner in which to be furnished, and the approximate number are as shown in the plant list. The quantities, as listed, are approximate and the Contractor shall furnish and install all plant material necessary to complete the plantings as shown on the landscape plan. Change order adjustment will be made for unit price proposals, but not for lump sum proposals.

430.5.1 Substitutions: All requests for substitutions must be submitted in writing to the Contracting Agency prior to commencement of work on the project. The Contractor shall not take any further action concerning his request until a written approval or denial is received from the Contracting Agency. Plants of kinds other than those indicated on the plant list will be considered by the Contracting Agency only upon submission of proof that the specified plant is not reasonably procurable in the local region. Substitutions will resemble the specified plant in regards to appearance, ultimate height, shape, habit of growth, and general soil requirement.

Substitution of a larger size of the same species may be made by the Contractor without written approval. However, the Contracting Agency will not be responsible for any additional costs incurred by the Contractor, either for the additional cost of the plants or for any additional planting costs.

430.5.2 Plant Inspection Prior to Delivery to the Project Site: Prior to delivery of any species to the project site, the Contractor shall make the necessary arrangement with the Engineer for an inspection of the plant material at the offsite location. Any plants found to be unsuitable in growth or condition or which are not true to name shall be removed and replaced with acceptable plants.

430.5.3 Plant Protection after Delivery to the Project Site: Plants transported to the site shall be planted as soon as possible. During any interim storage period, they shall not be exposed to excessive sun or drying winds. Any stock, that in the opinion of the Engineer has deteriorated due to exposure or has been damaged during transporting, will be removed and replaced at the Contractor's expense.

430.5.4 Plant Location: The Contractor shall stake out the location of planting areas and plantings pit prior to any excavation. Subject to the Engineer's approval, minor relocations may be accomplished at this time to avoid unsuitable conditions, such as utilities, rocky areas, poor soil, etc. If major relocations are necessary, the Engineer will provide revised plans.

430.5.5 Ground Cover Areas: The planting beds shall be brought to finish grade before spreading the fertilizer or conditioning material specified. Fertilizing and conditioning material shall be mechanically spread at a uniform rate over the entire bed area. After spreading, this material shall be uniformly cultivated into the upper 6 inches of soil using suitable equipment. The resulting soil shall be in a friable condition suitable for planting. A pre-emergence control application is required prior to planting.

SECTION 430

Ground cover shall be planted in moist soil with the spacing as indicated on the plans. Each plant shall be planted with its proportionate amount of soil so as to minimize root disturbance. After planting, the area shall be raked to restore a smooth finish grade and to provide drainage. Watering will begin immediately.

The Contractor is responsible for maintaining these areas until acceptance by the Contracting Agency. Maintenance will include protection from trespass or damage, weeding, watering, and removal of all debris. It may be necessary to install a protective fence or barrier around these areas until growth is assured.

430.5.6 Shrub and Tree Pits: Planting pits shall be approximately circular with a diameter and depth at least twice the size of the plant ball or container. It must be large enough to permit handling and planting without injury or breakage of the root ball or root system. Unless otherwise specified, the excavated soil will be conditioned and used as prepared soil mix for backfill. Plants will not be allowed to stand in these pits without watering.

Prepared soil mix shall consist of one part organic soil conditioner (Section [795](#)), two parts excavated soil and one pound of gypsum and four ounces of soil sulphur per tree or one-half pound of gypsum and two ounces of soil sulphur per shrub. The backfill shall be produced by thoroughly combining these components into a homogeneous mixture. The Contractor shall notify the Engineer prior to mixing prepared soil so that he may observe the mixing process. In addition, during backfilling, slow release fertilizer tablets, Agriform 21 gram tablets with a 20-10-5 analysis, shall be added in the following quantities:

For one-gallon container	1 tablet
For five-gallon container	2 tablets
For fifteen-gallon container	4 tablets
For twenty-four inches or larger box	6 tablets

All containers shall be opened and removed in such a manner that the roots of the plant are not damaged. Balled plants wrapping shall be loosened or cut back after the plant is positioned in the pit.

A layer of prepared soil mix shall be placed in the pit and the plant shall be set approximately in the center of the hole with the root crown at its natural growing depth with respect to finish grade. The plant shall be faced so as to present the best appearance and relationship to adjacent plants or structures. It shall be rigidly constrained until backfilling with prepared soil mix and slow release fertilizer tablets is completed. The backfill will be thoroughly settled by tamping and watering so that all voids are filled.

Trees shall be supported by two tree stakes (Section [795](#)) with a top tie placed for maximum support and a second tie placed midway between top tie and ground level.

After planting, the plants shall be pruned as directed by the Engineer.

430.6 HEADER INSTALLATION:

Headers shall be installed at the location and grades as shown on the plans prior to planting operations. Stakes shall be located at corners and at intervals not to exceed 5 feet and shall be driven to slightly below the top of the header. Headers shall be nailed to the stakes with two nails, clinched 1/2 inch. Splice plates shall be used at butt joint; centered on the joint and nailed with four nails.

430.7 CLEAN UP:

Any debris or other material dropped onto paved or graded area during excavation or hauling operation shall be promptly removed and these areas shall be kept neat and clean at all times. Upon completion of planting operation, all remaining soil, stones, and other debris shall be removed from the site and disposed of to the satisfaction of the Engineer.

430.8 PLANT GUARANTEE AND MAINTENANCE:

The Contractor shall insure that all plant materials are in a sound, healthy, vigorous condition free from insects, bark abrasions, or other objectionable disfigurements and shall immediately replace any plant which is unacceptable at any time up to and including final acceptance of the project or completion of the plant establishment period whichever occurs later. When the termination of the plant establishment period extends beyond the final acceptance date for the project, this additional period of

SECTION 430

time for plant establishment may be considered as a special warranty period within the standard 1-year guarantee period and the Engineer may authorize final payment in accordance with Section [109](#). Unless otherwise authorized by the Engineer, the Contractor shall maintain all landscaped areas on a continuous basis as they are completed during the course of work and until final project acceptance or the termination of the plant establishment period, whichever occurs later.

Maintenance shall include keeping the landscape areas free of debris and weeding and cultivating the planted areas at intervals acceptable to the Engineer. The Contractor shall provide adequate personnel to accomplish the required maintenance. Pruning and restaking of plants shall be as directed by the Engineer.

430.9 PLANT ESTABLISHMENT PERIOD:

The Contractor shall request an inspection by the Engineer whenever substantial completion of the planting and related work has been accomplished. After this initial inspection, and subject to his approval of the work, the Engineer will issue a written field notification to the Contractor setting the effective, beginning date for plant establishment. The plant establishment period shall be for a period of 60 calendar days, but is subject to extension by the Engineer if the landscape areas are improperly maintained, appreciable plant replacement is required, or other corrective work becomes necessary.

At final project acceptance or at the end of the plant establishment period, a final acceptance inspection of the planted areas will be made by the Engineer.

430.10 MEASUREMENT AND PAYMENT:

Measurement and payment shall be in accordance with Section [109](#).

The lump sum or unit prices established on the proposal sheet shall be full compensation for furnishing all labor, material, tools, and equipment and for performing all work necessary to complete the landscaping operation to include planting of trees, shrubs, and ground cover.

- End of Section -

SECTION 440

SPRINKLER IRRIGATION SYSTEM INSTALLATION

440.1 DESCRIPTION:

The Contractor shall furnish all the necessary labor, materials, and equipment required to complete the installation of the automatic sprinkler irrigation system providing full coverage to all plants and shrubs.

440.2 GENERAL:

Unless otherwise specified, the automatic sprinkler irrigation system layout as shown on the plans shall be considered schematic. The Contractor shall lay out the entire system using stakes to indicate the location of the various components. Preliminary adjustments to conform to actual site condition shall be accomplished at this time and the approval of the Engineer obtained prior to any actual work being performed. Utility connections, both water and electrical, shall be as shown on the plans or as designated by the utility concerned. Unless specifically exempted in the plans or specifications, the Contractor shall pay all costs concerned in providing these services.

Prior to the acceptance of the project, the Contractor shall furnish the Engineer 4 copies of the manufacturer's instruction and maintenance manual for each component or group of components to include parts listings and source of supply.

Prior to final inspection, the Contractor shall submit one set of corrected, as-built drawings showing the location of all pipe, valves, wiring, and utility services.

All permits for installation or construction of any of the work included under this section, which are required by legally constituted authorities having jurisdiction, shall be obtained and paid for by the Contractor, each at the proper time. He shall also arrange for and pay all costs in connection with any inspections and examinations required by these authorities.

440.3 MATERIALS:

Prior to the start of construction, the Contractor shall submit shop drawings per Section [105](#) on all material for approval of the Engineer. All materials shall conform to Section [757](#).

440.4 LANDSCAPE IRRIGATION SYSTEM REMOVAL AND RESTORATION

When construction encroaches into an existing landscaped irrigation system, the Contractor shall remove the conflicting portion of the system within the right-of-way and/or easements and any portion which may remain under the proposed improvements, whether shown or not shown on the plans. If the removals affect other areas of the system not in conflict with the construction, the Contractor shall permanently or temporarily restore or modify the existing system to provide water to the unaffected areas. The restoration or modifications shall be completed within 24 hours after the disruption occurs or notification by the Engineer.

The Contractor shall restore the affected landscape irrigation system to an operational condition equal to or better than the existing system. When necessary, bubbler and/or sprinkler heads shall be reinstalled at the edge of the new improvements. The reconstructed or modified system shall provide completed irrigation coverage without overspray onto walks, pavement, walls, buildings, etc.

The Contractor shall have the option to salvage and reuse existing materials. In the event that it is not feasible to reinstall the salvaged materials, new materials shall be installed.

To provide ample notification for owners who desire to remove and restore their own system, the Contractor shall notify the affected property owners at least fourteen (14) days prior to the scheduled removal of the irrigation system.

When determined by the Engineer that the existing sprinkler system cannot be practically restored, the existing system shall be plugged and removed as directed.

Unless specified by the agency and called out in the bid documents, this work shall be considered incidental to the contract and no separate payment shall be made to comply with these provisions.

SECTION 440

440.5 TRENCH EXCAVATION AND BACKFILL:

Trenches and other excavations shall be sized to accommodate the irrigation system components, conduit, and other required facilities. Additional space shall be provided to assure proper installation and access for inspection. Unless otherwise specified, the minimum depth of cover over pipelines and conduits shall be as follows:

- (A) Electrical conduit - 18 inches
- (B) Waterlines continuously pressurized - 18 inches
- (C) Lateral sprinkler lines - 12 inches
- (D) Plastic lines under pavement - 24 inches

The bottom of trenches shall be true to grade and free of protruding stones, roots or other matter which would prevent proper bedding of pipe or other facilities.

Trenches and excavations shall be backfilled so that the specified thickness of topsoil is restored to the upper part of the trench. Compaction shall be in accordance with Section [301](#).

Water settling of trench backfill will not be permitted unless approved by the Engineer.

440.6 PIPE INSTALLATION:

(A) General: Pipe fittings shall be installed in accordance with the manufacturer's recommendations and these specifications. When requested by the Engineer, the Contractor shall furnish the manufacturer's printed installation instructions before pipe installation.

Pipe shall be bedded in at least 2 inches of finely graded native soil or sand to provide a firm, uniform bearing. After laying, the pipe shall be surrounded with additional finely graded native soil or sand to at least 2 inches over the top of the pipe. Trench backfill, sufficient to anchor the pipes, may be deposited before the pipeline pressure testing, except that joints shall remain exposed until satisfactory completion of testing.

When two or more pipelines are installed in the same trench, they shall be separated by a minimum horizontal clear distance of 6 inches and they shall be installed so that each pipeline, valve, or other pipeline component may be serviced or replaced without disturbing the other.

Piping under concrete or asphalt shall normally be installed by jacking, boring, or hydraulic driving. When any cutting or removal of asphalt and/or concrete work is necessary, it shall be saw cut in accordance with Section [601](#). Permission to cut asphalt and/or concrete shall be obtained from the Engineer. Where piping on the drawings is shown under paved areas, but running parallel and adjacent to planted areas, the intent of the drawings is to install the piping in the planted area.

When plastic to steel pipe connectors are required, these connections shall be accomplished first. A non-hardening, non-oil base pipe compound or liquid teflon shall be used on the male threads only. The joint shall be hand-tightened with final tightening as necessary to prevent leaks accomplished with a strap wrench.

Threads shall be cut with clean sharp dies and shall conform to American Standards Association Specification B2.

Joints shall be made with a non-toxic non-hardening joint compound applied to the male threads only.

(B) When wrapped pipe is specified, joints and connectors shall not be wrapped until completion of the pressure test.

(C) Plastic Pipe: Plastic pipe shall be cut square, externally chamfered approximately 10-15 degrees, and all burrs and fins removed. It shall be joined utilizing threaded fittings or socket type, solvent welded fittings. Schedule 80 pipe only will be used for threaded joints. Field threading will be accomplished in the same manner as specified for steel pipe, except that a plug will be installed in the bore of the pipe prior to threading to prevent distortion. Threaded pipe joints shall be made using teflon tape on the male threads. Solvent will not be used for threaded joints. Threaded joints shall be hand tightened with final tightening as necessary to prevent leaks with a strap wrench. Solvent welded joints shall be made in accordance with ASTM D2855, and the

SECTION 440

type of solvent recommended by the pipe manufacturer shall be used. Solvent shall be applied to the pipe ends in such a manner that no material is deposited on the interior surface or forced into the interior of the pipe during insertion. Excess solvent on the exterior of the joint shall be wiped clean immediately after assembly.

The pipe shall be protected from damage during assembly. All vises shall have padded jaws and only strap wrenches shall be used. Any plastic pipe which has been nicked, scarred, or otherwise damaged shall be removed and replaced. Care shall be exercised so that stresses on the previously made joints are avoided. Movement of the pipe following assembly, such as lowering the pipe into the trench, shall not occur prior to the set time recommended by the manufacturer of the solvent cement used.

The plastic pipe will be snaked from side to side within the trench so as to provide approximately 1 foot of slack per each 100 feet of pipe.

The pipeline will not be exposed to water for at least 12 hours after the last solvent welded joint has been made.

440.7 VALVES, VALVE BOXES, AND SPECIAL EQUIPMENT INSTALLATION:

Valves, backflow preventers, pressure regulators and related accessories shall be furnished and installed as specified.

All valves and other equipment shall be installed in a normal upright position unless otherwise recommended by the manufacturer, and shall be readily accessible for operation, maintenance and replacement. Sectional control valves shall not be located within range of sprinklers they control.

Gate valves and sectional control valves shall be installed below ground. Gate valves shall be housed in a covered concrete or plastic box that will permit access for servicing. Sectional control valves shall be equipped with a sleeve and cap centered on the valve stem.

Quick-coupler valves and garden valves projecting above grade shall be installed a minimum of 3 feet from curbs, pavement and walks. In non-irrigated areas, quick-coupler valves shall be set flush with finish grade, and in irrigated areas at or just above water level. They shall be installed on a double swing joint riser assembly. Garden valves shall be set 12 inches above finish grade, and shall be installed on a galvanized riser. In non-irrigated areas all valve boxes, valve access sleeves, and caps shall be set to finish grade, and in irrigated areas set adjacent to curbs, sidewalks or pavement at or just above water level. Valves shall be set at sufficient depth to provide clearance between the cover and the cap, valve handle, or key when the valve is in the fully open position. Backflow preventers shall be provided with pipe supports and the accessories necessary to properly secure the assembly. All backflow preventers shall be assembled with pipe, fittings, and risers of an approved material by the contracting agency.

440.8 SPRINKLER HEAD INSTALLATION AND ADJUSTMENT:

In accordance with the requirements of Subsection [440.7](#) all mains and laterals, including risers, shall be flushed and pressure tested before installing sprinkler heads. A water coverage test shall be performed after the sprinkler heads are installed.

(A) Location, Elevation and Spacing: Sprinkler head spacing shall not exceed the maximum shown on the drawings or recommended by the manufacturer. They shall be installed with at least 4 inches clearance from adjacent vertical elements projecting above grade such as walls, planter boxes, curbs and fences. Bubbler heads shall be installed a minimum of 2 inches above finish grade. The Engineer will notify the Contractor in writing when the planted beds are sufficiently planted and settled to make the necessary adjustments to the bubbler heads. Any adjustments are to be made within sixty (60) calendar days after this notification is received and at no additional cost to the Contracting Agency.

(B) Riser Assembly: A top outlet riser assembly shall consist of a pipe riser threaded into a top outlet ell or tee installed in the lateral supply line. Double-swing joint and single-swing joint riser assemblies shall utilize a horizontal 6 inches pipe nipple threaded into a side outlet ell or tee installed in the lateral supply line. For a double-swing joint, 3 ells shall be used in the remaining assembly ahead of the vertical riser pipe. For a single-swing joint, one ell shall be used.

(C) Sprinkler Head Adjustment: After all sprinkler heads are installed and the irrigation system is operating, each section or unit shall be adjusted and balanced, with all section control valves fully open to obtain uniform and adequate coverage. Sprinkler heads having adjustable pin nozzles or orifices shall have the pins adjusted to provide adequate distribution of

SECTION 440

water over the coverage pattern. The Contractor shall substitute larger or smaller nozzle cores in non-adjustable sprinkler heads as necessary.

440.9 AUTOMATIC CONTROL SYSTEM INSTALLATION:

The Contractor shall install a complete automatic irrigation control system including the automatic controller, remote control valves and wiring, and all necessary accessories and utility service connection including the junction box and any work required from the stubout provided by the power company.

The automatic controller shall be installed outside of the coverage pattern of the irrigation system at the location designated in the contract documents. The foundation for the controller shall be Class C concrete of the size shown on the plan or recommended by the manufacturer. The control components in the controller shall be fused and the chassis shall be grounded. The controller shall be installed in a steel security cabinet with metal hasp and padlocks unless the controller is to be placed with a building or walled enclosure.

Remote control valves shall be compatible with the automatic controller. The valve is to be housed in a plastic box with locking cover, and it shall be installed with at least a 6 inches clearance below the plastic cover. The box shall be set to finish grade in non-irrigated areas and adjacent to curbs, sidewalks or pavement at or just above high water elevation in irrigated areas.

All service wiring shall be installed in rigid conduit from the service point to the controller at the minimum depth specified in Subsection [440.2](#). A separate disconnect switch or combination meter socket, as required, shall be installed between the source of power and the controller. The minimum service wire shall be No. 12 AWG copper 600 volt type, TWH or larger as required by the contract documents or controller manufacturer. Wire splices shall be located only in specified pull boxes and shall be made with a packaged kit approved for underground use. Pull boxes shall be plastic with locking covers set to proper elevations on a 12 inches layer of crushed rock or washed gravel.

All wiring issuing from the controller shall be direct burial installed in main or lateral waterline trenches wherever practicable. The wiring shall be bundled and secured to the lower quadrant of the irrigation pipeline at 10 foot intervals with plastic electrical tape. Sufficient slack shall be left in the wiring or tubing to provide for expansion and contraction. When the control wiring or tubing cannot be installed in a pipe trench, it shall be installed a minimum of 18 inches below finish grade. All pilot or "hot" wires are to be of one color and all common wires are to be of another color.

Unless otherwise required, all control wiring shall be direct burial Type UF, No. 14 AWG copper. Splices in control wire shall be made in accordance with the requirements for service wire. Sufficient slack shall be left at each splice and point of connection in pull boxes and valve boxes so that in case of repair the valve bonnet or splice may be brought to the surface without disconnecting the wire. No splices shall be permitted under pavement.

All wiring shall be tested for continuity, open circuits, and unintentional grounds prior to connecting the equipment.

Upon completion of the work the control system shall be in operating condition with an operational chart mounted within the controller cabinet.

440.10 FLUSHING AND TESTING:

After completion and prior to the installation of any terminal fittings, the entire pipeline system shall be thoroughly flushed to remove all foreign material. After flushing, the following tests shall be conducted in the sequence listed below. All equipment, materials, and labor necessary to perform the tests shall be furnished by the Contractor and all tests shall be conducted in the presence of the Engineer.

(A) Pipeline Pressure Test: A water pressure test shall be performed on all pressure mains and laterals before any couplings, fittings, valves, and the like are concealed. All open ends shall be capped after the water is turned into the lines in such a manner that all air will be expelled. Pressure mains shall be tested with all control valves to lateral lines closed. After the pressure main test, all valves shall be opened to test lateral lines. The constant test pressure and the duration of the test are as follows:

Mains	6 hours at 125 psi
Laterals	2 hours at 100 psi

SECTION 440

(B) Sprinkler Coverage Test: The coverage test shall be performed after sprinkler heads have been installed and shall demonstrate that each section or unit in the irrigation system is balanced to provide uniform and adequate coverage of the areas serviced. The Contractor shall correct any deficiencies in the system.

(C) Operational Test: The performance of all components of the automatic control system shall be elevated for manual and automatic operation.

During the maintenance period specified and at least 9 days prior to final acceptance, the Contractor shall set the controller on automatic operation and the system shall operate satisfactorily during this period. All necessary repairs, replacement and adjustment shall be made until all equipment, electrical work, controls and instrumentation are functioning in accordance with the contract documents.

440.11 MEASUREMENT AND PAYMENT:

Measurement and payment shall be in accordance with Section [109](#). The lump sum or unit prices established in the proposal sheets shall be full compensation for furnishing all labor, materials, tools and equipment, and performing all work necessary to complete the sprinkler irrigation system described or specified in the contract documents.

- End of Section -

This Page Reserved for Future Use

PART 500

STRUCTURES

Section	Last Revised	Title	Page
505	2014	Concrete Structures	505-1
506	2012	Precast Prestressed Concrete Members	506-1
510	1998	Concrete Block Masonry	510-1
511	1998	Brick Masonry	511-1
515	1998	Steel Structures	515-1
520	2012	Steel and Aluminum Handrails	520-1
525	1998	Pneumatically Placed Mortar	525-1
530	2000	Painting	530-1

This Page Reserved for Future Use

SECTION 505

CONCRETE STRUCTURES

505.1 DESCRIPTION:

Concrete bridges, culverts, catch basins, manholes, retaining walls, abutments, piers, footings, foundations and similar structures shall be constructed in conformity with the plans and specifications. Concrete for use in work constructed under this specification and testing thereof shall conform to the requirements of Section [725](#). Reinforcing shall conform to the requirements of Section [727](#).

Safe and suitable ladders shall be provided to permit access to all portions of the work.

505.1.1 Minor Structures: Concrete structures such as cattle guards, catch basins, median barriers, headwalls, and other miscellaneous structures as defined by the Engineer are hereby defined as Minor Structures. Such Minor Structures, at the option of the Contractor, may be either constructed of cast-in-place concrete, or furnished as precast units. Precast units shall be fabricated in accordance with shop drawings submitted by the Contractor and approved by the Engineer, in accordance with the requirements of Section [105.2](#). All structures not defined as Minor Structures shall be classified as Major Structures.

505.2 SUBGRADE FOR CONCRETE STRUCTURES:

Each subgrade upon which concrete is placed shall be firm and free from water. Ground water shall be kept several inches below subgrade until the concrete has set. When the subgrade is in dry earth, it shall be moistened with water from a spray nozzle immediately before concrete is placed.

When the design details for the project provide for the construction of filter or drain material consisting of gravel or combination of gravel and sand, which material becomes subgrade for concrete, the placing of steel reinforcement and placement of concrete shall follow the placing of the filter or drain material as closely as practical. The filter or drain material shall be kept dewatered to the extent necessary to prevent any portion of concrete materials being carried away before the concrete has attained its final set. No payment will be made for the work required to keep such materials dewatered, other than such costs as may be included in the prices bid for various items of work or amount bid for dewatering when the schedule provides an item for same.

When concrete is to rest on rock, the rock shall be fully uncovered. The surface of the rock shall be removed to a depth sufficient to expose sound rock. Bedrock shall be roughly leveled off or cut to approximately horizontal and vertical steps. Seams in the rock shall be grouted as directed by the Engineer and the base for structures shall be slush grouted or otherwise treated as the Engineer may direct.

Precast Concrete Minor Structures shall be founded in accordance with the requirements of Section [206.4.5](#).

505.3 FORMS:

Forming plans for cast-in-place bridge decks and cast-in-place bridge superstructures shall be prepared in accordance with the requirements of Section [105.2](#).

Forms shall be of suitable material and of type, size, shape, quality, and strength to enable construction as designed. The forms shall be true to line and grade, mortar tight, and sufficiently rigid to resist any appreciable amount of springing out of shape during placing of the concrete. The responsibility for their adequacy shall rest with the Contractor. All dirt, chips, sawdust, nails, and other foreign matter shall be completely removed from forms before any concrete is deposited. The surfaces of forms shall be smooth and free from irregularities, dents, sags and holes that would appreciably deface the finished surface. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being reused, and the reuse of forms shall be subject to the approval of the Engineer. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent that will leave no objectionable film on the surface of the forms that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete.

Forms for all surfaces that will not be completely enclosed or hidden below the permanent surface of the ground shall be made of surfaced lumber, or material which will provide a surface at least equally satisfactory. Any lumber or material which becomes badly checked or warped prior to placing concrete may be rejected.

SECTION 505

Forms for all exposed surfaces of bridges, viaducts, overcrossings and similar structures shall be constructed of plywood or an approved equal. Plywood for forms shall be exterior type, of the grade Concrete-Form Exterior, conforming to the specifications of the NBS, Commercial Standards latest edition. Plywood shall be furnished and placed in 48 inches widths and in uniform lengths of not less than 96 inches, except where the dimension of the member formed is less than the specified panel dimension. Plywood shall be placed with the grain of the outer plies in the direction of the span. Where plywood is attached directly to the studding or joints, the panels shall be not less than 5/8 inch thick, and the studdings or joints shall be spaced not more than 12 inches, center to center. Plywood less than 5/8 inch thick, otherwise conforming to the requirements specified, may be used with a continuous backing of 5/8 inch sheathing. All form panels shall be placed in a neat, symmetrical pattern with the horizontal joints level and continuous.

Wood forms for copings and curbs shall have a thickness of not less than 1 5/8 inches and a width of not less than the full depth of coping or curb.

Unless otherwise shown on the plans, all sharp edges shall be chamfered with 3/4 inch triangular fillets. Forms for curved surfaces shall be so constructed and placed that the finished surface will not deviate appreciably from the arc of the curve.

Forms shall be so constructed that portions, where finishing is required, may be removed without disturbing portion of forms to remain.

Forms for girders and slabs shall be cambered as may be required by the Engineer.

Forms shall, as far as practicable, be so constructed that the form marks will conform to the general lines of the structure.

Form clamps or bolts, approved by the Engineer, shall be used to fasten forms. The use of twisted wire loop ties to hold forms in position will not be permitted, nor shall wooden spreaders be used unless authorized by the Engineer. Clamps or bolts shall be of sufficient strength and number to prevent spreading of the forms. They shall be of such type that they can be entirely removed or cut back 1 inch below the finished surface of the concrete. Forms for outside surfaces shall be constructed with stiff wales at right angles to the studs and all form clamps shall extend through and fasten such wales, all based on the rate of concrete placement.

The Contractor may at his own option, place such portions of the concrete for the structure directly against the side of the excavation or sheathing without the use of outside forms, provided that the following conditions are met.

(A) If concrete is placed directly against the sides of the excavation, the faces of the excavation must be firm and compact, and be able to stand without sloughing off and be at all points outside the concrete lines shown on the plans.

(B) If concrete is placed against sheathing, such sheathing shall be closely fitted and shall be outside of the concrete lines shown on the plans. Those surfaces against which the concrete is to be placed shall be faced with building paper. Except as otherwise specified all sheathing shall be removed, but not until either at least 7 days after placing concrete or until the concrete has attained a strength in compression of not less than 2,000 psi. Care should be used in pulling sheathing so as to avoid damaging the concrete. Voids left by the removal of sheathing, piles and/or similar sheathing supports shall be backfilled with material having a sand equivalent of not less than 30 and consolidated by jetting as directed by the Engineer. When, in the opinion of the Engineer, field conditions or the type of sheathing or methods of construction used by the Contractor are such as to make the removal of sheathing impracticable, that portion of the sheathing against which concrete has been placed may be left in place.

Regardless of the method used in the placement of concrete without outside forms the following stipulations shall hold:

(A) The reinforcing steel shall be accurately set and held firmly in place, to the satisfaction of the Engineer.

(B) No direct payment will be made for building paper, sheeting, gunite or concrete placed outside of concrete lines shown on the plans. The cost thereof shall be absorbed in the prices bid for the various items of work.

(C) The Contractor shall assume all risks of damage to the work or to existing improvements due to any reason whatsoever that may be attributable to the method of construction outlined above.

SECTION 505

505.3.1 Removal of Forms: The falsework supporting any span of a continuous or rigid frame structure subject to bending stress shall not be released until after the last concrete placed in the span and in the adjoining spans, excluding concrete above the deck slab, has attained a compressive strength of not less than twice the design unit stress, or 21 days after the concrete is placed, whichever occurs first.

Stairway riser forms shall be removed and the finish of the steps completed on the day the concrete is placed. Metal stairway treads, if required by the plans, shall be installed immediately after the steps have been placed.

Side forms for beams, girders, columns, railings, or other members wherein the forms do not resist dead load bending shall be removed not more than 24 hours after placing concrete, where finishing is required, unless otherwise directed by the Engineer, provided that satisfactory arrangements are made to cure and protect the concrete thus exposed.

Side forms for arch rings, columns, and piers shall be removed before the members of the structure which they support are placed so that the quality of the concrete may be inspected. Such forms shall be so constructed that they may be removed without disturbing other forms which resist direct load or bending stress.

Forms and shoring for box and arch sections of sewers and storm drains may be removed as follows:

- (A) Forms for open channel walls — 16 hours.
- (B) Outside forms of box sections and inside wall forms of box sections which do not support the slab forms — 16 hours.
- (C) Arch sections in open cut — 12 hours.
- (D) Slab forms for box sections:
 - (1) Type II Cement — 48 hours or 6 hours per foot of span between supports, whichever is greater.
 - (2) Type III Cement — 24 hours or 3 hours per foot of span between supports, whichever is greater.
 - (3) Type V Cement — 56 hours or 7 hours per foot of span between supports, whichever is greater.

The periods of time at which the Contractor may remove forms, as set forth above, are permissive only and subject to the Contractor's assuming all risks that may be involved in such removals. At his option, except for surfaces to be finished, the Contractor may leave the forms in place for such longer periods as are, in his opinion, required.

505.4 FALSEWORK:

Falsework construction and erection shall not commence until the Contractor has received written approval of the sealed final falsework shop drawings.

All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure concrete were placed at one time.

All falsework, staging, walkways, forms, ladders, cofferdams, and similar accessories shall equal or exceed the minimum applicable safety requirements of Section [107](#). Compliance with such requirements shall not relieve the Contractor from full responsibility for the adequacy and safety of said items.

Falsework shall be founded upon a solid footing safe against undermining and protected from softening. When the falsework is supported on timber piles, the piles shall be driven to a bearing value as determined by the Contractor's Engineer.

Falsework and forms shall be so constructed as to produce in the finished structure the lines and grades indicated on the plans. Suitable jacks or wedges shall be used in connection with the falsework to set the forms to grade or camber shown on the plans, or to take up any settlement in the form work either before or during the placement of concrete. Single wedges for this purpose will not be permitted; it being required that all such wedges be in pairs to insure uniform bearing. Dead load deflection in stringers and joints will be compensated for by varying depths of the joists or by using varying depth nailing strips.

Arch centering shall be removed uniformly and gradually, beginning at the crown and working toward the springing, to permit the arch to take its load slowly and evenly. Centering for adjacent arch spans shall be struck simultaneously.

Falsework under any continuous unit or rigid frame shall be struck simultaneously; the supporting supports being released gradually and uniformly, starting at the center and working both ways towards the supports.

SECTION 505

505.4.1 Falsework Design: Falsework design shall be in accordance with the requirements of Section [105.2](#).

Falsework shall be designed by the Contractor to carry all loads and pressures which may be applied to it. The construction loads to be applied are as follows:

Tunnel centering – 100 percent of the concrete load where concrete is placed by pumping. Forms shall be so constructed to provide adequate relief for excessive pump pressure.

All other structures – a live load of 30 pounds per square foot of horizontal area.

Transverse and longitudinal bracing – a horizontal force equal to 2 percent of the vertical load.

The unit stresses for wood falsework shall be those recommended in the West Coast Lumbermen's Association's standard grading and dressing rules increased 25 percent for short time loading.

Falsework may be bolted or spiked at the option of the Contractor, but the use of bolts and spikes shall not be combined in the same connection. The allowable spacings and connection values of bolts and spikes shall be in accordance with the national design specifications for stress-grade lumber and its fastenings as recommended by National Lumber Manufacturers Association except that an additional allowance of 25 percent for temporary use shall be added to the connection values for bolts and spikes.

Ends of columns bearing on wedges shall be tied in both direction by girts.

Unit stresses for steel falsework shall be in accordance with the requirements of the specifications for design, fabrication and erection of structural steel for buildings of the AISC.

505.5 PLACING REINFORCEMENT:

Reinforcing bars shall be accurately placed as shown on the plans and shall be firmly and securely held in position by wiring at intersections with wire not smaller than No. 16 gage and by using concrete or metal chairs, spacers, metal hangers, supporting wires and other approved devices of sufficient strength to resist crushing under full load. Wooden supports shall not be used.

Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted. Before placing in the forms, all reinforcing steel shall be thoroughly cleaned of mortar, oil, dirt, loose mill scale, loose or thick rust and coatings of any character that would destroy or reduce the bond. No concrete shall be deposited until the placing of the reinforcing steel has been inspected and approved.

Bundle bars shall be tied together at not more than 6 foot centers.

The Contractor will be allowed the following tolerances when placing, tying and supporting reinforcing steel:

- (1) In slabs and beams, horizontal bars shall be within ¼ inch measured vertically, of the position indicated on the plans.
- (2) In vertical walls, columns, wings, and similar members, clearance from the forms shall be within ¼ inch of the clearance shown on the plans.
- (3) In slabs or walls, long runs of bars may vary up to 2 inches in spacing; however, the specified number of bars shall be placed.

505.5.1 Splicing: Splices of bars shall be made only where shown on the plans or as approved by the Engineer. Where bars are spliced they shall be lapped at least 30 diameters, unless otherwise shown on the plans.

Welding of reinforcing steel will not be permitted unless specifically authorized by the Engineer.

505.5.2 Bending Reinforcement: Bending of reinforcing steel shall conform to the requirements of the AASHTO LRFD Bridge Construction Specifications Section 9.4.

SECTION 505

Bars shall not be bent nor straightened in a manner that will injure the material. Bars with kinks or unspecified bends shall not be used.

505.5.3 Welded Wire Fabric: Welded wire fabric shall be held firmly in place and spliced not less than 2 meshes.

505.5.4 Dowels:

505.5.4.1 Dowel Placement: Dowel placement shall consist of drilling or coring dowel holes in concrete, furnishing and placing anchoring materials, and placing reinforcing steel dowels in accordance with the details shown on the Project Plans, and the requirements of the project Special provisions and these Specifications.

Dowel holes shall be cored where dowels are to be placed:

(A) in bridge decks and other thin concrete sections, and the depth of the dowel hole shown on the project plans projects to 3 inches or less from the opposite face of the concrete section, or

(B) within 4 inches from an existing concrete edge.

Cored holes shall be intentionally roughened after coring.

All holes shall be blown clean with compressed air, prior to applying the anchoring material.

The diameter of the holes for the dowels shall be 1/8" larger than the diameter of the dowels to be placed. The depth of the holes for the dowels shall be as shown on the Project Plans.

The anchoring materials for the dowels shall be an epoxy adhesive conforming to the requirements of Section [505.5.4.2](#), unless otherwise specified on the Project Plans and/or the project Special Provisions, or as approved by the Engineer.

505.5.4.2 Anchoring Materials: Epoxy materials shall be used for anchoring dowels. The Contractor shall submit Certificates of Compliance or Analysis, complete with supporting documentation, to the Engineer for all epoxy materials to be used for anchoring dowels on a specific project, in accordance with the requirements of Section [106.2](#). The epoxy materials shall be provided by the Contractor in general conformance with the requirements of Section 1015 – General Requirements of Section 1015 – EPOXY MATERIALS of the current Arizona Department of Transportation (ADOT) Standard Specifications for Road and Bridge Construction, amended to date.

Epoxy resin base anchoring adhesive shall be used for anchoring dowels in concrete. High viscosity, or non-sag epoxies in the form of a gel, shall be used for horizontal or near-horizontal applications, where flow out of the anchoring hole is a problem. Low and medium viscosity epoxies may be used in vertical anchoring holes that open upward. The anchoring product shall specifically be designed for the designated application, according to the manufacturer's product literature.

Epoxy resin base anchoring adhesive shall provide the specified minimum tensile pullout resistance, when tested in accordance with Arizona Test Method 725, as modified in accordance with Section [505.5.4.3](#) of these specifications. The pot life of the anchoring material shall be determined in accordance with AASHTO T-237, Part I. The determined pot life shall be within 25 percent or 10 minutes of the pot life specified by the manufacturer, whichever is greater.

505.5.4.3 Dowel Strength Requirements: The epoxy resin base anchoring adhesive shall provide the following minimum pullout resistances:

#4 dowels:	12.0 Kips
#5 dowels:	18.6 Kips
#6 dowels:	26.4 Kips
#7 dowels:	36.0 Kips

Arizona Test Method (ATM) 725 is a Tensile Proof Dowel Test, developed by ADOT to specifically test #6 reinforcing steel dowels anchored in Portland cement concrete with an epoxy adhesive. When testing reinforcing steel dowel sizes, the anchoring hole (ATM 725: PREPARATION – 4. (a)) shall be modified as follows; the rotary hammer drill bit size (ATM 725: APPARATUS – 2. (a)) shall be modified accordingly:

SECTION 505

#4 dowels:	5/8" diameter x 8" long
#5 dowels:	3/4" diameter x 10" long
#6 dowels	7/8" diameter x 12" long
#7 dowels	1" diameter x 14" long

The Contractor may opt to conduct pullout tests with hole lengths other than those required above, based on the adhesive manufacturer's product literature and recommendations; however, test results shall demonstrate that the tested system provides the required pullout resistances.

505.6 PLACING CONCRETE:

No concrete shall be placed in any forms supported by falsework until the Contractor's Professional Engineer has inspected the completed falsework, and has issued a properly sealed and signed certificate that the falsework has been constructed according to the approved falsework drawings.

Where a schedule for placing concrete is shown on the plans, no deviation will be permitted therefrom unless approved in writing by the Engineer.

The placing of concrete for a given pour shall start at the low point and shall proceed upgrade, unless otherwise permitted by the Engineer.

With the exception of concrete placed in slope paving and aprons, and concrete placed under water, all concrete shall be compacted by means of high frequency internal vibrators of a type, size and number approved by the Engineer. The number of vibrators employed shall be ample to consolidate the incoming concrete to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least 2 vibrators shall be available at the site of the structure in which more than 25 cubic yards of concrete is to be placed. The vibrators shall not be attached to or held against the forms or the reinforcing steel. The locations, manner and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without causing segregation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface. Fresh concrete shall be spread in horizontal layers insofar as practicable and the thickness of the layers shall not be greater than can be satisfactorily consolidated with the vibrators. If additional concrete is to be placed, care shall be taken to remove all laitance and to roughen the surfaces of the concrete to insure that fresh concrete is deposited upon sound concrete surfaces. Layers of concrete shall not be tapered off in wedge-shaped slopes, but shall be built with square ends and level tops.

Mixed concrete, after being deposited, shall be consolidated until all voids are filled and free mortar appears on the surface. The concrete shall be placed as nearly as possible in its final position and the use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted.

Fresh concrete shall not be permitted to fall from a height greater than 6 feet without the use of adjustable length pipes or elephant trunks.

The use of approved external vibrators for compacting concrete will be permitted when the concrete is inaccessible for adequate compaction provided the forms are constructed sufficiently rigid to resist displacement or damage from external vibration.

During the placing of concrete, care shall be taken that methods of compaction used will result in a surface of even texture free from voids, water or air pockets, and that the coarse aggregate is forced away from the forms in order to leave a mortar surface. Spades or broad-tined forks shall be provided and used to produce the desired results if required by the Engineer.

The use of chutes in conveying or depositing concrete will be allowed only at the discretion of the Engineer, and wherever they are used they shall be laid at such inclination as will permit the flow of concrete of such consistency as is required. The use of additional water in mixing the concrete to promote free flow in chutes of low inclination will not be allowed. Where necessary in order to prevent segregation, chutes shall be provided with baffle boards or a reversed Section at the outlet.

Concrete for columns shall be placed using pipes of adjustable length and not less than 6 inches in diameter.

Horizontal members or sections shall not be placed until the concrete in the supporting vertical members or sections has been consolidated and a minimum 2 hour period has elapsed to permit shrinkage to occur.

SECTION 505

Walkways shall be provided along each side and for the full length of bridge structures outside the deck area. These walkways shall be of sufficient width, and so constructed as to provide for the support of the bridges from which the longitudinal floats specified are to be operated. Inspection walkways and access thereto shall be provided under the deck forms between each pair of girders and outside of each outside girder for the full length of the bridge structure. The walkways shall be not more than 8 feet below the concrete to be inspected.

505.6.1 Construction Joints in Major Structures: The work shall be so prosecuted that construction joints will occur at designated places shown on plans unless specifically permitted otherwise by the Engineer. The Contractor shall complete, by continuous depositing of concrete, section for the work comprised between such joints. The joints shall be kept moist until adjacent concrete is placed.

All construction joints at the bottom of walls or arches, at the top of walls, and all longitudinal construction joints having a keyed, stepped or roughened surface shall be cleaned by sandblasting prior to placing the adjacent concrete. Any quality of sand may be used which will accomplish the desired results.

The sandblasting operations shall be continued until all unsatisfactory concrete, and all laitance, coatings, stains, debris, and other foreign materials are removed. The surface of the concrete shall be washed thoroughly to remove all loose material. The method used in disposing of waste water employed in washing the concrete surfaces shall be such that the waste water will not stain, discolor, or affect exposed surfaces of the structures. The method of disposal will be subject to the approval of the Engineer.

All horizontal construction joints or those on slight slopes, shall be covered with Class D mortar as specified in Section [776](#).

Expansion and contraction joints in the concrete structures shall be formed where shown on the plans and as directed. In general, such joints shall have smooth abutting surfaces, painted or separated and sealed as detailed on the plans. No reinforcement shall be extended through the joints, except where specifically noted or detailed on the plans. Concrete or mortar shall not be permitted to lap these joints in such a manner as to effect a tie or bond that would later promote spalling.

Asphalt paint or premolded asphalt filler used in joints shall be as specified in Section [729](#).

No direct payment will be made for furnishing and placing asphaltic paint, premolded asphaltic filler or other types of joint separators; their costs shall be included in the price bid for the item of work of which they are a part.

505.6.2 Adverse Weather Concreting:

(A) Hot Weather Concreting: Hot weather is defined as any combination of high ambient temperature, low relative humidity, and wind velocity which would tend to impair the quality of fresh concrete. These effects become more pronounced as wind velocity increases. Since last minute improvisations are rarely successful, preplanning and coordination of all phases of the work are required to minimize these adverse effects.

As an absolute minimum, the Contractor shall insure that the following measures are taken:

- (1) An ample supply of water, hoses, and fog nozzles are available at the site.
- (2) Spare vibrators are on hand in the ratio of one spare vibrator for each three in use.
- (3) Preplanning has been accomplished to insure prompt placement, consolidation, finishing, and curing of the concrete.
- (4) Concrete temperature on arrival should be approximately 60°F. and in any event shall not exceed 90°F. The use of cold water and ice is recommended.
- (5) The subgrade is moist, but free of standing water.
- (6) Fog spray is utilized to cool the forms and steel. Under extreme conditions of high ambient temperature, exposure to the direct rays of the sun, low relative humidity, and wind, even strict adherence to these measures may not produce the quality desired and it may be necessary to restrict concrete placement to early morning only. If this decision is made, then particular attention must be directed to the curing process since the concrete will be exposed to severe thermal stresses due to temperature variation; heat of hydration plus midday sun radiation versus nighttime cooling.

(B) Cold Weather Concreting: Concrete shall not be placed on frozen ground, nor shall it be placed when the ambient temperature is below 40°F. unless adequate means are used to heat the aggregate and/or water and satisfactory means have been taken for protecting and heating the concrete during the curing period.

SECTION 505

(C) Wet Weather Concreting: Placing of concrete shall be discontinued when the quantity of rainfall is such as to cause a flow or wash to the surface. Any concrete already placed and partially cured shall be covered to prevent dimpling. A construction joint will be installed prior to shut down.

(D) Replacement of Damaged or Defective Concrete: Upon written notice from the Engineer, all concrete which has been damaged or is defective, shall be replaced by the Contractor at no cost to the Contracting Agency.

(E) Recommended Reference:

- (1) ACI-305 Hot Weather Concreting
- (2) ACI-306 Cold Weather Concreting
- (3) ACI-308 Recommended Practices for Curing Concrete

505.6.3 Bridge Deck Joint Assemblies:

505.6.3.1 Description: This work shall consist of furnishing and installing expansion devices including the seals, anchorage system, and hardware in accordance with the project plans and these specifications.

505.6.3.2 Materials: Elastomer Seals shall be of the Compression Seal or Strip Seal type, and shall conform to the requirements of the Arizona Department of Transportation Standard Specifications for Road and Bridge Construction Section 1011-5.

Steel shapes and plates shall conform to the requirements of ASTM A36, or ASTM A588.

505.6.3.3 Construction Requirements:

(1) General: Deck joint assemblies shall consist of elastomer and steel assemblies which are anchored to the concrete at the deck joint. The seal armor shall be cast in the concrete. The completed assembly shall be properly installed in the planned position, shall satisfactorily resist the intrusion of foreign material and water, and shall provide bump-free passage of traffic. For each size of seal on a project, one piece of the seal material supplied shall be at least 18 inches longer than required by the project Plans. The additional length will be removed in the presence of the Engineer and used for materials testing. Certificates of Compliance conforming to the requirements of Section [106.2](#) shall also be submitted by the Contractor.

(2) Shop Drawings: Prior to fabrication, the Contractor shall submit shop drawings to the Engineer for approval, in accordance with the requirements of Section [105.2](#). The shop drawings shall show complete details of the method of installation to be followed, including a temperature correction chart for adjusting the dimensions of the joint according to the ambient temperature, and any additions or rearrangements of the reinforcing steel from that shown on the project plans.

(3) Elastomer Seals: Seals shall conform to the requirements specified.

(4) Armor: All steel for cast-in-place deck joint assemblies shall conform to the requirements specified.

(5) Galvanizing: All steel parts of strip seal assemblies shall be galvanized after fabrication, in accordance with the requirements of ASTM A123 and A153, unless ASTM A588 steel is used. Bolts shall be high strength, conforming to the requirements of ASTM A325M, with a protective coating of zinc, followed by a chromate and baked organic coating conforming to the requirements of ASTM F1135, Grade 3, 5, 6, 7, or 8 and Color Code A.

Steel parts of compression seal assemblies do not require galvanizing, plating, or painting.

(6) Joint Preparation and Installation: At all joint locations, the Contractor shall cast the bridge decks and abutment backwalls with a formed blockout, sized to accommodate the pre-assembled joint assembly. The joint assembly will be anchored in the concrete to be placed with the secondary pour in the blockout. Prior to the secondary pour, the surface of the existing concrete in the blockout shall be coated with an approved adhesive specifically formulated for bonding new concrete to old concrete.

(7) Welding: All welding and inspection of welding for structural steel shall be performed in accordance with the requirements of the latest revision of the AASHTO/AWS D1.5M/D1.5 Bridge Welding Code. The use of electro-slag welding process on structural steel will not be permitted.

SECTION 505

Installed armor assemblies shall be covered or otherwise protected at all times prior to installing the elastomer portion of the joint assembly. The elastomer shall be installed at such time and in such manner that it will not be damaged by construction operations.

Immediately prior to the installation of the seal element, the steel contact surfaces of the joint armor shall be clean, dry, and free of oil, rust, paint, or foreign material. Any perforation or tearing of the seal element due to installation procedures or construction activities will be cause for rejection of the installed seal element.

During the installation of all proprietary deck joint assemblies, the manufacturer's representative shall be present. As a minimum, the representative shall be present during the placement of the joint assembly in the deck blockout, prior to the secondary concrete pour, and shall also be present during the installation of the seal element.

505.6.4 Water Stops: Water stops of rubber or plastic, shall be placed in accordance with the details shown on the project plans. Where movement at the joint is provided for, the water stops shall be of the type permitting such movement without damage. Water stops shall be mechanically spliced, vulcanized, or heat-sealed to form continuous watertight joints, in accordance with the manufacturer's recommendations, and as approved by the Engineer.

505.6.5 Longitudinal Joints between Precast Bridge Deck Units: After erection of the units and at the time requested by the Engineer, the longitudinal shear key joints between units shall be thoroughly packed with a pre-packaged non-shrink grout or a sand-cement grout with an expansion agent approved by the Engineer. The Contractor shall then transversely connect the deck units with the connection rods, stressing and anchoring them as shown on the project plans.

505.7 CONCRETE DEPOSITED UNDER WATER:

When conditions render it impossible or inadvisable in the opinion of the Engineer to dewater excavation before placing concrete, the Contractor shall deposit under water, by means of a tremie or underwater bottom dump bucket, a layer of concrete of sufficient thickness to thoroughly seal the cofferdam. To prevent segregation the concrete shall be carefully placed in a compact mass and shall not be disturbed after being deposited. Water shall be maintained in a still condition at the point of deposit.

A tremie shall consist of a water tight tube having a diameter of not less than 10 inches with a hopper at the top. The tube shall be equipped with a device that will close the discharge end and prevent water from entering the tube while charging the tube with concrete. The tremie shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering, when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of the work to prevent water entering the tube and shall be entirely sealed at all times, except when concrete is being placed. The tremie tube shall be kept full of concrete. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed and the resulting concrete seal shall be monolithic and homogeneous.

The underwater bucket shall have an open top and the bottom doors shall open freely and outward when tripped. The bucket shall be completely filled and slowly lowered to avoid back wash and shall not be dumped until it rests on the surface upon which the concrete is to be deposited. After discharge, the bucket shall be raised slowly until well above the concrete.

Concrete deposited in water shall have 10 percent extra cement added.

505.8 CURING:

As soon after the completion of the specified finishing operations as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surface shall either be sprinkled with water, covered with earth, sand or burlap; sprayed with a curing compound or sealed with a material conforming with Section [726](#). All concrete for bridge structures shall be water cured unless otherwise permitted by the Engineer. The Contractor shall use the wet burlap method for the water cure of all concrete in bridge decks and approach slabs, unless otherwise authorized by the Engineer.

Concrete that is water cured must be kept continuously wet for at least 10 days after being placed; preferably being covered, if possible, with at least 2 layers of not lighter than 7 ounce burlap, except that handrail, baserail, railing posts, tops of walls, and similar parts of the structure, if water cured, must be covered with burlap as above prescribed, immediately following the

SECTION 505

finishing treatment specified therefore, and such covering shall not be removed in less than 4 days. Roadway areas, floors, slabs, curbs, walks, and the like, that are water cured may be covered with sand to a depth of at least 2 inches, in lieu of the burlap as specified above, as soon as the condition of the concrete will properly permit, and such covering must remain wet and in place until the concrete so covered is at least 10 days old unless otherwise directed by the Engineer or provided by special provisions.

When a sprayed impervious membrane is used, it shall be applied under pressure through a spray nozzle in such manner and quantity as to entirely cover and seal all exposed surfaces of the concrete with a uniform film. To insure complete coverage, membrane shall be applied in two applications for a total coverage of 150 square feet per gallon. The membrane, however, shall not be applied to any surface until all of the finishing operations have been completed; such surfaces being kept damp, until the membrane is applied. All surfaces on which a bond is required, such as construction joints, shear planes, reinforcing steel, and the like, shall be adequately covered and protected before starting the application of the sealing medium in order to prevent any of the membrane from being deposited thereon; and any such surface with which the seal may have come in contact shall immediately thereafter be cleaned. Care shall be exercised to avoid and prevent any damage to the membrane seal during the curing period. Should the seal be broken or damaged before the expiration of 10 days after the placing of the concrete, the break shall be immediately repaired by the application of additional impervious membrane over the damaged area.

Should any forms be removed sooner than 10 days after the placing of the concrete, the surface so exposed shall either be immediately sprayed with a coating of the membrane seal, or kept continuously wet by the use of burlap or other suitable means until such concrete has cured for at least 10 days.

When tops of walls are cured by the membrane sealing method the side forms, except metal forms, must be kept continuously wet for the 10 days following the placing of the concrete.

If due to weather conditions, materials used, or for any other reason, there is any likelihood of the fresh concrete checking or cracking prior to the commencement of the curing operations, it shall be kept damp, but not wet, by means of an indirect fine spray of water until all danger of such checking or cracking is past, or until the curing operations are started in the particular area affected.

Since hot weather leads to more rapid drying of concrete, protection and curing are far more critical than in cool weather. Water curing shall be used wherever it is practical and shall be continuous to avoid volume changes due to alternation of wetting and drying. The need for adequate continuous curing is greatest during the first few hours after placement of concrete in hot weather.

505.9 FINISHING CONCRETE:

Immediately after the removal of forms as provided above, all concrete surfaces shall be finished in accordance with the requirements specified below.

All surfaces scheduled to be covered with backfill shall be finished so as to be free of open and rough spaces.

All surfaces that will remain exposed in the completed work shall be finished so as to be free of open and rough spaces, depressions or projections. All angles and fillets shall be sharp and true and the finished surface shall present a pleasing appearance of uniform color.

All top surfaces of walls, abutments, piers, etc., shall be finished to a smooth surface and shall be cured by an approved method.

If rock pockets or honeycomb are of such an extent and character as to affect materially the strength of the structure and to endanger the steel reinforcement the Engineer may declare the concrete defective and require the removal and replacement of that portion of the structure affected by the Contractor at no additional cost to the Contracting Agency.

If finishing operations are not carried out as set forth below, all placing of concrete shall stop until satisfactory arrangements are made by the Contractor to promptly correct defective finishing work and to carry out finishing operations as specified.

One of the classes of finish as specified shall be applied to the various surfaces as set forth under applicability of finishes.

SECTION 505

No finishing or patching shall be permitted until the surface has been inspected by the Engineer.

505.9.1 Finishing Fresh Concrete in Bridge Decks: Upon placing the deck to a uniform and true surface, screed supports shall promptly be removed from the surface and any necessary hand finishing shall be promptly accomplished in the areas where the screed supports have been removed.

After final floating of the plastic concrete, bridge decks subject to vehicular traffic shall be textured transversely. Apparatus producing textured grooves shall be mechanically operated from an independent self-propelled bridge. Grooves shall be 1/16 to 1/8 inch in width and 3/32 to 6/32 in depth. Center to center spacing of the grooves shall be as follows: 7/8 inch, 3/4 inch, 1 inch, 3/4 inch, 1-1/8 inch and then repeated or other measurements as approved by the Engineer. Texturing shall be completed before surface of concrete is torn or unduly roughened by texturing operation. Grooves that close following texturing will not be permitted and will have to be retextured. Hand tine brooms shall be available on the job site, at all times during texturing operation, to repair faulty texturing grooves.

The finished surface will be tested with a 10 foot straightedge furnished by the Contractor. The testing will be accomplished by holding the straightedge in contact with the deck surface and parallel to the centerline. The surface shall not vary more than 1/8 inch from the lower edge of the straightedge. Areas showing high spots of more than 1/8 inch shall be corrected by cutting or planning. The cutting or planning machine shall be a rotary type, equipped with an adjustable cutter and having a minimum wheel base of 10 feet. Areas showing low spots of more than 1/8 inch shall be filled with an approved mixture of sand, cement and epoxy. The mixture shall firmly adhere to the surface and shall match the surrounding concrete. All areas corrected shall not show deviations in excess of 1/8 inch when tested with a 10 foot straightedge.

505.9.2 Finishing Fresh Concrete in Sidewalks and Bridge Sidewalks: After the concrete has been placed and spread between the forms, it shall be thoroughly worked until all the coarse aggregate is below the surface and the mortar comes to the top. Concrete may be consolidated by means of mechanical vibrators approved by the Engineer.

The surface shall then be struck off and worked to grade and cross-section with a wood float.

A mechanical finishing machine that will consolidate the concrete and strike off and finish the surface may be used if permitted by the Engineer, provided that the machine produces a sidewalk equal to or better in all respects than that produced by the methods specified herein.

The surface shall be sweat finished by means of a steel trowel followed by a light broom finish.

The sidewalks shall be marked and edged with the proper tools to form the joints, marking and edges shown on the plans.

505.9.3 Finishing Green Concrete: Class I Finish — All bolts, wires and rods shall be clipped and recessed. All holes, honeycomb, rock pockets and other surface imperfections shall be cleaned out, thoroughly moistened and carefully patched with mortar. Mortar shall be composed of 1 part of cement and 2 parts of fine sand. A portion of the required cement for mortar shall be white as required to match the color of the surrounding concrete.

Class II Finish — The surface shall be patched and pointed as specified above for Class I Finish and then promptly covered with polyethylene film, wet burlap or wet cotton mats. If polyethylene film is used, the film shall be held securely to the surface by means of weights, adhesive or other suitable means. Only white polyethylene film for covering will be acceptable.

When the mortar used in patching and pointing has set sufficiently, the surface shall be uncovered and thoroughly rubbed with either a float or a carborundum stone until the surface is covered with a lather. Cork, wood or rubber floats shall be used only on surfaces sufficiently green to work up such lather, otherwise a carborundum stone shall be used. During the rubbing process, a thin grout composed of 1 part cement and 1 part of fine sand may be used to facilitate producing a satisfactory lather; however, this grout shall not be used in quantities sufficient to cause a plaster coating to be left on the finished surface. A portion of the required cement for grout shall be white as required to match the color of the surrounding concrete. Rubbing shall continue until irregularities are removed and there is no excess material. At the time a light dust appears, the surface shall be brushed or sacked. Brushing or sacking shall be carried in one direction so as to produce a uniform texture.

Class III Finish — The surface shall be treated as specified above under Class II Finish except that after brushing, the surface shall again be securely covered with polyethylene film, wet burlap or wet cotton mats. In not less than 1 day nor more than 4 days, the surface shall be uncovered and rubbed with a carborundum stone. This rubbing shall continue until the entire surface

SECTION 505

is of a smooth texture and uniform color. During the process, the use of a thin mixture of equal parts of sand and cement with water will be permitted. At the time a light dust appears, the surface shall be brushed or sacked, care being taken to carry this brushing in one direction so as to produce a uniform texture.

505.9.4 Finish Hardened Concrete: If for reasons either beyond the control of the Contractor or with the approval of the Engineer, more than 6 days have elapsed between the time of placing concrete and the time of the removal of forms, the concrete shall be considered as hardened. Prior to finishing hardened concrete, the surface shall be covered with burlap or cotton mats and kept thoroughly wet for a period of at least 1 hour. Finishing shall be identical to the respective requirements for Class I, Class II and Class III Finish for green concrete, except that the use of a mechanically operated carborundum stone will be required for Class II and Class III Finishes.

505.9.5 Applicability of Finishes: Surfaces requiring Class I Finish — All formed structures that are to be covered by backfill and those surfaces that are normally not in view of either vehicular or pedestrian traffic such as the surfaces on the inside of barrels of culverts, the under surfaces of decks, surfaces of concrete girders, piers and abutment walls.

Surfaces requiring Class II Finish — All exposed surfaces of headwalls, wingwalls, deck edges on culverts, end of piers on bridges and culverts, retaining walls and those vertical surfaces under highway grade separation structures that are exposed to view of the traveling public, including piers and pier caps, the outside face of outside girders, and other similar surfaces.

When surfaces of uniform texture and pleasing appearance are obtained through the use of first class metal forms, paper tubing or the use of special form coatings and the use of special care, such surfaces may, upon approval of the Engineer, be excluded from the surfaces requiring Class II Finish.

Surfaces requiring Class III Finish for bridge structures — All formed or finished surfaces above the surface of the deck on the roadway side of the handrail and the outside vertical surfaces from the top of handrail and dado to the lower edge of the chamfer at the bottom of the deck.

505.10 DIMENSIONAL TOLERANCES:

The maximum allowable tolerances or deviations from dimensions shown on the project plans or the approved shop drawings shall be as follows:

505.10.1 Cast-in-Place Concrete:

- (A) Variation from plumb in the lines and surfaces of columns, piers, abutment and girder walls:
 - In any 10 foot or less length: 0.4 inches
 - Maximum for the entire length: 1 inch
- (B) Variation in cross-sectional dimensions of columns, piers, girders, and in the thickness of slabs and walls:
 - + 1/4 inch
 - 1/8 inch
- (C) Girders alignment (deviation from straight line parallel to center line of girder measured between diaphragms):
 - 1/8 inch per every 10 feet in length
- (D) Variation in footing cross-sectional dimensions in project plans:
 - + 2 inches
 - 1/2 inch
- (E) Variation in footing thickness:
 - Greater than specified - No Limit
 - Less than specified - 5 percent of specified thickness up to a maximum of 1 inch
- (F) Subgrade Tolerances:
 - Slab poured on subgrade excepting footing thickness:
 - + 1/4 inch
 - 3/4 inch

SECTION 505

(G) Girder Bearing Seats:

Deviation from plane surface (flatness): $\pm 1/8$ inch in 10 feet.

Deviation from required elevation:

+ $1/4$ inch

- $1/8$ inch

(H) Cast-in-Place concrete box girder superstructures:

Deviation in overall depth:

+ $1/4$ inch

- $1/8$ inch

Deviation in slab and wall thickness:

+ $1/4$ inch

- $1/8$ inch

Deviation of post-tensioning ducts:

$\pm 1/4$ inch

505.10.2 Minor Precast Concrete Structures: Precast units that do not comply with the dimensional tolerances specified herein will be rejected. Precast units that show evidence of cracks, pop outs, voids or other evidence of structural inadequacy, or imperfections that will reduce the aesthetics of the unit after final placement will be rejected. The maximum allowable tolerances or deviations from the dimensions shown on the drawings shall be as follows:

(A) Over-all dimensions of member: $\pm 1/4$ inch per 10 feet, maximum of $\pm 3/4$ inch.

(B) Cross-sectional dimensions: sections 6 inches or less $\pm 1/8$ inch

Sections 18 inches or less and over 6 inches $\pm 1/4$ inch

Sections 39 inches or less and over 18 inches $\pm 1/4$ inch

(C) Deviations from straight line:

Not more than $1/4$ inch per 10 feet

All exposed, sharp corners of the concrete shall be filleted $3/4$ inches with a maximum allowable deviation of $\pm 1/8$ inch.

505.11 MEASUREMENT:

505.11.1 Reinforcing Steel: When reinforcing steel is scheduled for payment as a specific item, it will be measured in pounds, based on the total computed weight for the size and length of bars, or for the area of welded wire fabric, as shown on the Project Plans or as approved by the Engineer.

Unit bar weights for deformed and plain billet-steel bars will be the nominal unit weights specified in AASHTO M-31 (ASTM A615).

Area unit weights for steel welded wire fabric will be calculated based on specified wire spacing's and unit weights for specified wire types and sizes. Unit weights for plain wire shall be based on the nominal areas specified for Wire Size Numbers in AASHTO M-32 (ASTM A82). Unit weights for deformed wire shall be the nominal unit weights specified for Deformed Wire Size Numbers in AASHTO M-225 (ASTM A496).

If the area unit weights for steel welded wire fabric are specified on the Project Plans or in the Special Provisions, both the Contractor and the Engineer shall independently calculate the area unit weight, using specified wire spacing's, types and sizes, and the criteria in the preceding paragraph. Any apparent discrepancy between the specified and calculated area unit weights shall be resolved by the Engineer prior to the Contractor placing the order for the steel welded wire fabric.

Lap splices made for the convenience of the Contractor will not be included in the measurement for payment.

Reinforcing steel for Minor Structures, as defined in Section [505.1.1](#), will not be measured, but will be included in the items unit price or specified method of payment, unless otherwise called out on the Project Plans or in the Special Provisions.

Dowel Placement will be measured by the unit each.

SECTION 505

505.11.2 Concrete: When concrete is scheduled for payment on the basis of cubic yards, the calculation of the quantity of concrete for payment will be made only to the neat lines of the structures as shown on the plans. The quantity will be based on the concrete having the specified plan lengths, widths/depths, and thicknesses. However, all concrete shall be placed to line and grade within the tolerances specified in Section [505.10](#), or as approved by the Engineer as being reasonable and acceptable for the type of work involved. No volumetric deductions will be made for rounded or beveled edges, space occupied by reinforcing steel, metal inserts, or openings 0.5 square yard or less in area.

The quantity of concrete will be calculated considering any mortar used to cover construction joints as being concrete. The cost of cement used in any mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be absorbed in the cost of the item of work of which said mortar is a part.

505.11.3 Deck Joint Assemblies: Deck joint assemblies will be measured to the nearest tenth of a foot. Measurement will be made along the centerline of the joint, at the surface of the roadway, from face-to-face of curb or barrier. No measurement will be made for that portion of the deck joint assembly required by plan details to extend through the barrier face or curb; that portion of the joint assembly will be considered incidental to the sealing of the joint.

505.11.4 Bridge Railing, Curbs, Barriers, and Approach Slabs:

Bridge Pedestrian Fence and Curb, Bridge Pedestrian Fence and Parapet, and Bridge Fence and Parapet will be measured to the nearest tenth of a foot, from end post to end post.

Bridge Traffic and Pedestrian Rail will be measured to the nearest foot, determined from the outside dimensions of the rail.

Bridge Concrete Barrier will be measured to the nearest tenth of a foot.

Barrier Concrete Barrier Transition will be measured as a unit for each constructed.

Reinforced Concrete Approach Slab will be measured to the nearest square yard.

505.12 PAYMENT:

Payment for Portland cement concrete structures will be made in conformity with the terms of the contract and will be based on unit prices and/or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, preparation of subgrade for placing of concrete and doing all work required to construct the structures in conformity with the plans and specifications.

505.12.1 Reinforcing Steel: The accepted quantities of reinforcing steel, of the type indicated on the Project Plans or specified in the Special Provisions, and measured in conformance with Section [505.11.1](#) will be paid for at the contract unit price per pound, complete in place.

The accepted quantity of dowels placed will be paid for at the contract unit price for Dowel Placement, which shall be full compensation for the work, complete in place. Steel reinforcement furnished for the dowels will be measured and paid for under the pay item Reinforcing Steel.

No measurement or direct payment will be made for dowels which are required to replace existing reinforcing steel that is damaged as a result of the Contractor's operations; the Contractor shall furnish and place such dowels at his own expense.

505.12.2 Concrete: Payment for Portland cement concrete structures will be made in conformity with the terms of the contract and will be based on unit prices and/or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, preparation of subgrade for placing of concrete, and doing all work required to construct the structures in conformity with the plans and specifications.

Where concrete is scheduled for payment on the basis of cubic yards, the calculation of the quantity of concrete for payment will be made only to the neat lines of the structures as shown on the plans and on the basis of the concrete having the specified lengths, breadths, and thicknesses. The quantity of such concrete will be calculated considering the mortar used to cover construction joints as being concrete and no deductions will be made for rounded or beveled edges, space occupied by

SECTION 505

reinforcing steel, metal inserts, or openings 5 square feet or less in area. The cost of cement used in mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be absorbed in the item of work of which said mortar is a part.

An adjustment in the contract unit price, to the nearest cent, will be made for the quantity of concrete represented by the results of cylinder strength tests that are less than the specified 28-day compressive strength. Strength tests will be conducted in accordance with Section [725.8](#). The adjustment in contract unit price, if the concrete is accepted, will be based on Table [725-2](#) in Section [725.9](#).

The contract unit price for structural concrete shall include full compensation for all items incidental to providing a concrete structure complete in place, including waterstops, roadway drains, scuppers, metal inserts, and bearing pads.

505.12.3 Minor Concrete Structures and Accessories:

The accepted quantities of:

Minor Structures	Each
Deck Joint Assemblies	0.1 Foot
Bridge Pedestrian Fence and Curb	0.1 Foot
Bridge Pedestrian Fence and Parapet	0.1 Foot
Bridge Fence and Parapet	0.1 Foot
Bridge Traffic and Pedestrian Rail	Foot
Bridge Concrete Barrier	0.1 Foot
Bridge Concrete Barrier Transition	Each
Reinforced Concrete Approach Slab	Square Yard

will be paid for at the unit price and/or lump sums as set forth in the proposal. The contract unit price shall include full compensation for all labor, materials, tools and equipment necessary to provide the concrete structure or accessory complete in place, including all concrete, reinforcing steel, and items embedded in the concrete, such as anchor bolts, grates and frames, metal inserts, etc.

- *End of Section* -

SECTION 506

PRECAST PRESTRESSED CONCRETE MEMBERS

506.1 DESCRIPTION:

This work shall consist of furnishing and placing precast prestressed concrete members in accordance with the details shown on the plans, and as provided in these specifications and special provisions.

This work shall include the manufacture, transportation and storage of girders, slabs, and other structural members of precast prestressed concrete and shall also include the placing of all precast prestressed concrete members.

The members shall be furnished complete including all concrete, prestressing steel, bar reinforcing steel, and incidental materials in connection therewith.

Prestressing may be performed by either pretensioning or posttensioning methods. The method of prestressing to be used shall be optional with the Contractor, subject to the requirements provided in these specifications.

Prior to casting any members to be prestressed, the Contractor shall submit to the Engineer for review complete details of the method, materials and equipment he proposes to use in the prestressing operations, including any additions or rearrangement of reinforcing steel from that shown on the plans. Such details shall outline the method and sequence of stressing and shall include complete specifications and details of the prestressing steel and anchoring devices, anchoring stresses, type of enclosures, and all other data of the prestressing steel in the members, pressure grouting materials and equipment. For any rearrangement of prestressing tendons the stress calculations shall be submitted for approval by the Engineer.

506.2 CONCRETE:

Concrete construction shall conform to the provisions in Section [505](#).

The Contractor shall be responsible for furnishing concrete for prestressed members which contains not less than 611 nor more than 752 lbs., of cement per cubic yard of concrete, which is workable and which conforms to the strength requirements specified. Batch proportions shall be determined by the Contractor.

The compressive strength of the concrete will be determined from concrete test cylinders cured under conditions similar to those affecting the member.

The use of admixtures for the purpose of producing high strength at an early date shall be subject to the approval of the Engineer. In no case shall calcium chloride or any additive containing calcium chloride be used in concrete for prestressed construction.

Concrete shall not be deposited in the forms until the Engineer has inspected the placing of the reinforcement, enclosures, anchorages, and prestressing steel.

The concrete shall be vibrated internally or externally, or both, as required to consolidate the concrete. The vibrating shall be done with care and in such a manner that displacement of reinforcement, enclosures, and prestressing steel will be avoided.

Holes for anchor bars, and for diaphragm dowels which pass through the member, openings for connection rods, recesses for grout and holes for railing bolts shall be provided in the members in accordance with the details shown on the plans. Where diaphragm dowels do not pass through the member, the dowels may be anchored in the member by embedment in the concrete or by means of an approved threaded insert.

Forms for interior cells or voids in the members shall be constructed of a material that will resist breakage or deformation during the placing of concrete and will not materially increase the weight of the member.

Forms may be removed when permitted by the Engineer provided that the concrete is not damaged in so doing and that adequate curing is provided. The members shall be properly supported to prevent dead load bending at all times prior to initial tensioning. After prestressing, the members shall be handled or supported at or near the final bearing points for storage.

SECTION 506

The members shall be supported in transporting in a manner that will allow reasonable conformity to the proper bearing points with consideration for limitations of adequate hauling equipment. At all times members shall be handled or supported securely in an upright position, avoiding tipping or racking.

Lifting devices shall not project above the surface of the member after erection unless they will be imbedded in a subsequent concrete pour, have a minimum concrete cover of 2 inches and do not interfere with the placement of reinforcing steel or concrete.

The steam curing method or other approved methods may be used for curing precast prestressed concrete members in lieu of water curing. Steam curing, if elected by the Contractor, shall conform to the following provisions:

(A) After placement of the concrete, members shall be held for a minimum 2-hour presteaming period. The initial application of the steam shall be from 2 to 4 hours after the final placement of concrete to allow the initial set of the concrete to take place.

(B) All exposed surfaces of the members shall be kept wet continuously during the holding and curing period.

(C) The steam shall be saturated below pressure and shall be distributed uniformly over all exposed surfaces of the member and shall not impinge on the exposed concrete surfaces.

(D) The steam hood shall be equipped with temperature recording devices that will furnish an accurate continuous permanent record of the temperatures under the hood during the curing period. The position of the temperature devices shall be approved by the Engineer.

(E) During application of the steam the ambient air temperature shall increase at a rate not to exceed 40°F. per hour until a maximum temperature of from 140°F. to 160°F. is reached. The maximum temperature shall be held until the concrete has reached the desired strength.

506.3 PRESTRESSING STEEL:

Prestressing steel shall be high-tensile wire conforming to ASTM A421, high-tensile wire strand conforming to ASTM A416, or high-tensile strength alloy bars conforming to the following requirements:

High-tensile strength alloy bars shall be thermal stress relieved to produce suitable metallurgical structure and shall be individually proof-tested during the process of manufacturing to a minimum of 90 percent of the manufacturer's minimum guaranteed ultimate strength. The mechanical properties of the completed bars shall be as follows:

	Regular Grade	Special Grade
Ultimate tensile strength psi. min.	145,000	160,000
Yield strength, measured by the 0.7 percent extension under load method, psi. min.	130,000	140,000
Elongation in 20 bar diameters after rupture, percent, minimum.....	4.0	4.0
Reduction of area, percent, min.	25.0	20.0
Modulus of elasticity at 70 percent of the manufacturer's minimum guaranteed ultimate strength psi.min.....	25×10 ⁶	25×10 ⁶

Diameter tolerances shall conform to ASTM A29

Bars of different ultimate strength shall not be used interchangeably in the same member, unless otherwise permitted by the Engineer.

In handling and shipping bars, every care shall be taken to avoid bending, injury from deflection, scraping or overstressing of the bars. All damaged bars will be rejected.

All wire and strand to be post-tensioned shall be:

SECTION 506

(A) Protected from corrosion during shipping by a factory treatment or processing.

(B) Protected against abrasion during shipment and handling.

Wires shall be arranged to produce equal stress in all wire of wire groups or parallel lay cables that are to be stressed simultaneously or when necessary to insure proper positioning in the enclosures.

Where wires are to be button-headed, the buttons shall be cold formed symmetrically about the axes of the wires, and shall develop the full strength of the wire. No cold forming process shall be used that causes indentations in the wire.

When the button-headed wire assembly is tested as a unit in tension at least 90 percent of the failures at or above the minimum guaranteed ultimate strength of the wire shall occur in the wire and not in the buttons.

All prestressing steel shall be protected against rust and other corrosion and damage and shall be free of all dirt, scale and pits due to rust, oil, grease and other deleterious substances when finally encased in concrete or grouted in the member.

506.4 ANCHORAGES AND DISTRIBUTION:

All post tensioned prestressing steel shall be secured at the ends by means of approved anchoring devices. The anchors shall be of such nature that they will not kink, neckdown or otherwise damage the prestressing steel.

The load from the anchoring device shall be distributed to the concrete by means of approved devices that will effectively distribute the load to the concrete.

Anchoring devices for all post-tensioned prestressing steel shall be of the permanent type.

Where the end of a post-tensioned assembly will not be covered by concrete, the anchoring devices shall be recessed so that the ends of the prestressing steel and all parts except tendons of the anchoring devices will be at least 2 inches inside of the end surface of the members, unless a greater embedment is shown on the plans. Following post-tensioning, the recesses shall be filled with grout, and finished flush.

When headed wires are used, the outside edge of any hold for prestressing wire through a stressing washer or through an unthreaded bearing ring or plate shall not be less than 1/4 inch from the root of the thread of the washer or from the edge of the ring or plate.

Distribution plates or assemblies shall conform to the following requirements:

(A) The final unit compressive stress on the concrete directly underneath the plate or assembly shall not exceed 3,000 psi, and a suitable grillage of reinforcing steel shall be used in the stressed area.

(B) Bending stresses in the plates or assemblies induced by the pull of the prestressing steel shall not exceed design working stress, as determined by the Engineer, in the anchorage plate when 100 percent of the ultimate load is applied.

(C) Materials and workmanship shall conform to the requirements in Section [515](#).

Should the Contractor elect to furnish anchoring devices of a type which are sufficiently large and which are used in conjunction with a steel grillage imbedded in the concrete that effectively distributes the compressive stresses to the concrete and steel distribution plates or assemblies may be omitted.

506.5 ENCLOSURES:

Enclosures for prestressing steel shall be metallic and mortar-tight and shall be accurately placed at the locations shown on the plans or approved by the Engineer.

In lieu of metallic enclosures, openings for prestressing steel may be formed by means of cores or ducts composed of rubber or other suitable materials that can be removed prior to installing prestressing steel.

SECTION 506

All enclosures or openings or anchorage assemblies shall be provided with pipes or other suitable connections for the injection of grout after prestressing.

506.6 PRESTRESSING:

All prestressing tendons shall be tensioned by the use of equipment allowing actual elongation to be measured directly and using a hydraulic ram equipped with an accurate method of determining the tensioning force applied using one of the following methods; a gauge measuring the internal hydraulic pressure of the ram, or force exerted by the ram; a spring-type dynamometer used with the tensioning force applied directly; an electronic load cell used with the tensioning force applied directly. Readings taken from any one of these gauges shall be converted to actual tensioning forces through the use of calibrated values taken from a certified chart from a recent calibration. All gauges shall be of sufficient size and adequately made to allow accurate readings to be made of load increments of one percent of the total capacity of the ram used, not to exceed two percent of the tensioning force used.

The force in each tendon as obtained from the calibrated value shall be compared with the tensioning force obtained from calculation using the modulus of elasticity, cross-sectional area and length of tendon for the actual net elongation measured directly. When there is a difference between the values in excess of 5 percent final anchorage of the tendon shall be delayed until the reason for the discrepancy is found and appropriate correction is made to reduce the difference to five percent or less. Within the allowable difference, final anchorage shall be made when the required tensioning force is obtained according to the elongation used in pretensioning and according to the corrected gauge reading in post-tensioning.

The tensioning of prestressing steel in any post-tensioned member and the cutting or releasing of prestressing steel in any pretensioned member shall not be performed until tests on concrete cylinders indicate that the concrete in the member has attained a compressive strength of not less than the value shown on the plans for transfer strength.

Subject to prior approval by the Engineer, a portion of the total prestressing force may be applied to a member when the strength of the concrete in the member is less than the value shown on the plans and the member may then be moved. Approval by the Engineer of such partial prestressing and moving shall in no way relieve the Contractor of full responsibility for successfully constructing the members.

The cutting and releasing of prestressed steel in pretensioned members shall be performed in such an order that lateral eccentricity of prestress will be a minimum. The prestressing steel shall be cut off flush with the end of the member and the exposed ends of the prestressing steel shall be heavily coated with roofing asphalt or coal tar.

Post-tensioning will not be permitted until it is demonstrated to the satisfaction of the Engineer that the prestressing steel is free and unbonded in the enclosure.

The tensioning process as applied to post-tensioned members shall be so conducted that tension being applied and the elongation of the prestressing steel may be measured at all times. A record shall be kept of gauge pressures and elongations at all times and shall be submitted to the Engineer for approval.

Draped prestressing steel in post-tensioned members shall be tensioned by simultaneous jacking at each end of the assembly, except where low frictional forces permit tensioning from one and as determined by the Engineer.

Determination of the jacking stresses shall be supported by calculations, or both calculations and field tests when specified, prepared by the Contractor. The Contractor shall submit his calculations to the Engineer for approval, and prior to making field tests shall submit details of his proposed gauges and load devices for determining the jacking load at each end of the test prestressing unit to the Engineer for approval. The stress at the center will be calculated from the average of the end test loads, when tests are required. Jacking stresses within 2 percent of the specified values will be considered satisfactory.

The following friction coefficients shall be used in calculating friction losses. K represents the wobble of the ducts, and U represents the curvature in draped cables:

SECTION 506

Type of Steel	Type of Duct	K	U
Bright metal wire or strand	Bright metal	0.002	0.30
	Galvanized	0.0015	0.25
Bright metal bars	Bright metal	0.0003	0.20
	Galvanized	0.0002	0.15

The maximum temporary tensile stress (jacking stress) in prestressing steel shall not exceed 75 percent of the ultimate tensile strength of the prestressing steel. The prestressing steel shall be anchored at stresses (initial stress) that will result in the ultimate retention of working forces of not less than those shown on the plans but in no case shall the initial stress exceed 70 percent of the ultimate tensile strength of the prestressing steel.

506.7 BONDING AND GROUTING:

Post-tensioned prestressing steel shall be bonded to the concrete by pressure grouting the enclosures or openings.

All prestressing steel to be bonded to the concrete shall be free of scale and pits due to rust, dirt, oil, grease and other deleterious substances.

Grouting equipment shall be capable of grouting to a pressure of at least 100 psi. The grouting shall consist of neat cement and water conforming to the provisions in Section [725](#). The grout shall completely fill the enclosure or opening.

All enclosures or openings shall be clean and free of all foreign materials that would impair bonding of the grout. Each enclosure or opening shall be thoroughly flushed out with water and blown out with air or cleaned by other approved methods immediately prior to grouting.

After post-tensioned prestressing steel has been pressure grouted, the member shall not be moved or otherwise disturbed until at least 24 hours have elapsed.

506.8 SAMPLES FOR TESTING:

Sampling and testing shall conform to the specifications or ASTM A416 and A421 as provided in this specification.

Samples from each size and each lot of prestressing steel wires and bars, from each manufactured reel of prestressing steel strand, and from each lot of anchorage assemblies and bar couplers to be used shall be furnished for testing.

All wire or bars of each size from each mill lot and all strands from each manufactured reel to be shipped to the site shall be assigned an individual lot number and shall be tagged in such a manner that each such lot can be accurately identified at the job site. Each lot of anchorage assemblies and bar couplers to be installed at the site shall be likewise identified. All unidentified prestressing steel, anchorage assemblies or bar couplers received at the site will be rejected.

The following samples of material and tendons, selected by the Engineer from the prestressing steel at the plant or job site, shall be furnished by the Contractor to the Engineer well in advance of anticipated use:

(A) For wire or strand one 7 foot long sample shall be furnished for each heat or reel and for bars one 6 foot long sample shall be furnished for each heat.

(B) If the prestressing tendon is to be prefabricated, one completely fabricated prestressing tendon 5 feet in length for each size of tendon shall be furnished, including anchorage assemblies. If the prestressing tendon is to be assembled at the job site, sufficient wire or strand and end fittings to make up one complete prestressing tendon 5 feet in length for each size of tendon shall be furnished, including anchorage assemblies.

SECTION 506

(C) If the prestressing tendon is a bar, one 6 foot length complete with one end anchorage shall be furnished and in addition if couplers are to be used with the bars two 3 foot lengths of bar equipped with one coupler and fabricated to fit the coupler shall be furnished. Prestressing systems previously tested and approved need not be furnished as complete tendon samples, provided there is no change whatsoever in the material, design or details previously approved. Shop drawings shall contain an identification of the project on which approval was obtained, otherwise sampling will be necessary.

For prefabricated tendons, the Contractor shall give the Engineer at least 10 days' notice before commencing the installation of end fittings or the heading of wires. The Engineer will inspect all end fitting installations and wire headings while such fabrication is in progress at the plant and will arrange for all required testing of the material to be shipped to the site.

No prefabrication tendon shall be shipped to the site without first having been released by the Engineer, and each tendon shall be tagged before shipment for identification purposes at the site. All unidentified tendons received at the site will be rejected.

Job site or site as referred to herein shall be considered to mean the location where the members are to be manufactured whether at the project site or a removed casting yard.

The release of any material by the engineer shall not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective.

506.9 HANDLING:

Extreme care shall be exercised in handling, storing, moving and erecting precast prestressed concrete members to avoid twisting, racking or other distortion that would result in cracking or damage to the members. Precast prestressed members shall be handled, transported and erected in an upright position and the points of support and directions of the reactions with respect to the members shall be approximately the same during transportation and storage as when the member is in its final position.

Precast prestressed concrete members shall be placed in the structure in the conformity with the plans and special provisions for the structure to be constructed.

506.10 PAYMENT:

Precast prestressed concrete members, will be paid for at the contract price or prices for furnishing and erecting precast prestressed concrete members of the various types and lengths set forth in the proposal.

The contract price paid for furnishing the member shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in constructing and furnishing the member at the site of the work complete in place as shown on the plans, and as specified.

Partial payment will be allowed for members which are in the stockpile at the manufacturer's plant.

- End of Section -

SECTION 510

CONCRETE BLOCK MASONRY

510.1 DESCRIPTION:

All materials for concrete block masonry shall conform to the requirements of Sections [775](#) and [776](#).

510.2 CONSTRUCTION:

Proper masonry units shall be used to provide for all windows, doors, bond beams, lintels, pilasters, etc. with a minimum of unit cutting. Where masonry unit cutting is necessary, all cuts shall be neat and regular and edges exposed in the finished work shall be cut with a power driven abrasive saw.

Where no bond pattern is shown, the wall shall be laid up in straight uniform course with regular running bond with alternate header joints in vertical alignment.

Intersecting masonry walls and partitions shall be bonded by staggering the joints to form a masonry bond and the use of 1/4 inch minimum diameter ties at 24 inches o.c. maximum.

Where stack bond is indicated on the plans, approved metal ties shall be provided horizontally at 24 inches o.c. maximum.

Where masonry facing is a part of wall construction metal, ties shall be furnished and installed as directed by the Engineer.

Mortar joints shall be straight, clean and uniform in thickness. Unless otherwise specified or detailed on the plans, horizontal and vertical joints shall be approximately 3/8 inch thick with full mortar coverage on the face shells; shall have vertical joints buttered well for a thickness equal to the face shell of the block and these joints shall be shoved tightly, so that the mortar bonds to both blocks. No slushing or grouting of a joint will be permitted, nor shall a joint be made by working in mortar after the units have been laid.

Exposed walls shall have joints tooled with a round bar or V-shaped bar to produce a dense, slightly concave surface well bonded to the block at the edges. Tooling shall be done when the mortar is partially set but still sufficiently plastic to bond. All tooling shall be done with a tool which compacts the mortar, pressing the excess mortar out of the joint rather than dragging it out.

If it is necessary to move a block so as to open a joint the block shall be removed from the wall, cleaned and set in fresh mortar.

510.3 PLACING REINFORCING STEEL:

Reinforcing steel shall be placed as indicated on the plans. Splices shall be lapped a minimum of 40 diameters, except that dowels other than column dowels need to be lapped only 30 diameters. Column dowels shall lap 50 diameters.

Outside horizontal steel shall lap around corners 40 diameters, and be carried through columns unless otherwise shown on the plans. Inside horizontal steel shall extend as far as possible and bend into corner core. A dowel shall be provided in the foundation for each vertical bar. Bending of dowels to fit openings will not be permitted and, where required, new dowels shall be installed by drilling and grouting. All lap joints shall be wired.

Vertical cores containing steel shall be filled solid with grout, and thoroughly rodded.

Where knockout blocks are used, steel shall be erected and wired in place before 3 courses have been laid. Vertical cores at steel locations shall be filled as construction progresses.

Where knockout blocks are not used, vertical cores at steel locations shall be filled in lifts of not more than 4 feet. The maximum height of pour shall be 8 feet. Cores shall be cleaned of debris and mortar and shall have reinforcing steel held straight in place. If ordered by the Engineer, inspection and cleanout holes shall be provided at the bottom of each core to be filled.

Reinforcing steel shall be inspected prior to placing grout.

SECTION 510

510.4 CURING:

Newly constructed masonry shall be kept damp for at least 5 days with a nozzle regulated fog spray sufficient only to moisten faces of the masonry but not of such quantity as to cause water to flow down over the masonry.

510.5 MORTAR AND GROUT:

Mortar and grout used for concrete block masonry shall conform to Section [776](#).

510.6 PAYMENT:

Payment for concrete block masonry will be included in the lump sum price for the structure of which the masonry is a part, unless another basis for payment is included in the proposal.

- End of Section -

SECTION 511

BRICK MASONRY

511.1 MATERIALS:

Unless otherwise specified, brick masonry shall be constructed of brick conforming to Section [775](#) and cement mortar as described in Section [776](#).

511.2 BRICKLAYING:

The amount of wetting will depend on the rate of absorption of the brick at the time of laying. When being laid, the brick shall have suction sufficient to hold the mortar and to delete the excess water from grout, and shall be sufficiently damp so that the mortar will remain plastic enough to permit the brick to be leveled and plumbed after being laid without breaking the mortar bond.

Brick work shall be plumb, level, straight and true to dimensions shown on the plans. Such work shall start, where feasible, at a least important corner of wall and the masonry contractor shall request an early inspection of the work by the Engineer. All pattern work, bonds or special details indicated on the plans shall be accurately and uniformly executed. Face bonding shall be as shown on the plans, but if not shown, shall be running bond for standard size brick and approximately $\frac{1}{3}$ bond for oversize brick and approximately $\frac{1}{4}$ bond for modular brick unless otherwise designated by the Engineer. All bed and head joints shall be solidly filled with mortar at the time of laying.

Unless otherwise shown or detailed on the plans the thickness of mortar joints shall be uniformly $\frac{1}{2}$ inch.

Face bricks shown to be laid in stack bond shall have the center lines of vertical joints plumb and the brick laid equidistant from the center line with not more than $\frac{1}{8}$ inch variation in the width of these joints. The brick in each separate stack shall not vary more than $\frac{1}{8}$ inch in length, but the separate stacks may vary in width of stacks.

When mortar has slightly stiffened, solidly fill with mortar all interstices between bricks and between bricks and other materials and also fill all line pin holes. Jointing and tooling shall be done before mortar has stiffened.

Masonry to be plastered shall have all mortar joints trowel cut flush.

Masonry to be painted and not shown to be tooled or raked, shall have all joints carefully and evenly struck with a trowel.

Masonry to be left exposed without paint or plaster, shall have all mortar joints carefully and evenly tooled with a metal jointing tool of a type as approved by the Engineer. Masonry shown or indicated to have raked joints shall have the joints raked out $\frac{3}{8}$ inch deep, then tooled with a flat jointing tool, then brushed with a stiff non-metallic brush. Sack-rubbing or wiping finished masonry with rags will not be permitted.

511.3 PROTECTION:

Protect all sills, ledges, offsets, other materials, etc., from droppings of mortar during construction. Protect the tops of all unfinished masonry from rain by using water-repellant covering such as roofing felt or tar paper.

Protect the surfaces of wall, piers, etc., from mortar droppings, or splashes at scaffold heights.

511.4 CURING:

Finished masonry shall not be wetted, except when exposed to extreme hot weather or hot wind, and then only by using a nozzle regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.

511.5 REINFORCED GROUTED BRICK MASONRY:

Mortar in all bed joints shall be held back $\frac{1}{4}$ inch from edges of brick adjacent to grout space, or shall be beveled back and upward from grout space. The thickness of head and bed joints shall be as hereinbefore specified or shown. Head joints specified or shown to be less than $\frac{5}{8}$ inch thick shall be solidly filled with mortar as brick are laid. Head joints $\frac{5}{8}$ inch or more

SECTION 511

in thickness may have mortar sufficient only to form dams to retain the grout. Bed joints shall not be deeply furrowed with the trowel. All brick shall be shoved at least $\frac{1}{2}$ inch into place. One outer tier shall be not more than 12 inches before grouting, but the other tier shall be not more than 4 inches high before placing the grout. Grout shall be thoroughly agitated and mixed to eliminate segregation before being placed. All interior grout spaces shall be filled with grout and immediately puddled or swished with a stick or rod (not a trowel) sufficiently to cause the grout to flow into all interstices between the bricks and to fully encase the reinforcing steel. Wherever possible, grouting shall be done from the inside face of exterior masonry. If any grout contacts the finished masonry, it shall be immediately removed, and the surface cleaned.

In masonry which is more than 2 tiers in thickness, including pilasters and columns, the interior shall be of whole or half bricks placed into grout with not less than $\frac{3}{4}$ inch of grout surrounding each brick or half brick. Except at the finish course, all grout shall be stopped 1 $\frac{1}{2}$ inches below the top of both outer tiers. Where necessary to stop off a longitudinal run of masonry, it shall be done only by racking back $\frac{1}{2}$ brick length in each course and stopping grout 2 inches back of the rack. Tothing will not be permitted unless special approval is given by the Engineer.

Reinforcing steel shall be accurately placed in strict accordance with the plans and notes thereon. Vertical steel shall be held firmly in proper position. Where necessary this shall be done by means of frames or other suitable devices. Horizontal steel may be placed as the work progresses.

511.6 PAYMENT:

Payment for brick masonry will be included in the lump sum price for the structure of which the masonry is a part unless another basis for payment is included in the proposal.

- End of Section -

SECTION 515

STEEL STRUCTURES

515.1 DESCRIPTION:

515.1.1 Shop Drawings: The Contractor shall prepare and submit to the Engineer for approval, complete shop drawings which shall show details, dimensions, sizes of materials, and all information and data necessary for the metal work, including full details of the match markings. Any materials fabricated by the Contractor prior to the approval of the drawings will be at his risk. The Contractor shall be responsible for the correctness of the drawings and for shop fits and field corrections, even though the drawings may have been approved by the Engineer.

515.1.2 False work: The Contractor shall be fully responsible for designing and providing false work capable of supporting all loads which are applied.

515.1.3 As Built Plans: When required by the special provisions, the Contractor shall furnish to the Engineer before formal acceptance of the work detailed plans of the structure as built. Inasmuch as the plans will be retained by the Contracting Agency as permanent records, they must be in the form of printable transparencies of quality satisfactory to the Engineer.

515.1.4 Methods and Equipment: When requested by the Engineer, before starting erection of any structural members, the Contractor shall inform the Engineer fully as to the methods he proposes to follow and the amount and character of equipment he proposes to use. The use of such methods and equipment shall be subject to the approval of the Engineer. Approval by the Engineer shall not be considered as relieving the Contractor of the responsibility for the safety of his methods or equipment or for carrying out the work in full accordance with the plans and specifications.

An inspector or other authorized representative of the Engineer may examine the metals and metal items to be fabricated before they are worked in the shop and may exercise constant surveillance over the work during its progress, with full power to reject materials or workmanship not conforming to the plans and specifications.

The Contractor shall give the Engineer sufficient advance notice to permit ample time for the inspection of materials before commencement of the fabricating operations.

The Engineer shall be furnished complete copies in triplicate of all mill reports. The Contractor shall furnish ample means and assistance for sampling all materials. Arrangements shall be made for the Engineer to have free access at all times to any portion of the shops where work is being done.

No fabricating, machining, cutting, welding, assembling, or painting shall be done except with the knowledge of the Engineer. Any work done otherwise will be subject to rejection.

The acceptance of any material or finished member by the Engineer shall not be a bar to subsequent rejection if it is later found to be defective. Rejected material and workmanship shall be promptly replaced.

Samples of materials, except castings, shall be cut from stock designated by the Engineer or will be selected from items furnished. Gray iron, steel, and bronze castings shall be cast with test coupons.

515.2 STEEL BUILDING AND MISCELLANEOUS STEEL STRUCTURES:

Details of design, fabrication and erection of such buildings and structures shall conform to the specifications for the design, fabrication and erection of structural steel for buildings of the AISC except as modified by the special provisions for any conflicts with the applicable building code which may exist.

The design, fabrication and erection of structural steel and all similar work incidental or appurtenant to steel construction for highway bridges shall be performed in accordance with the latest standard specifications for highway bridges adopted by AASHTO. The plans or special provisions will designate the members to be galvanized.

515.2.1 Miscellaneous Metal Fabrication: The provisions of this subsection shall apply to items not intended primarily for structural purposes and which are fabricated from metals.

SECTION 515

If straightening of any materials is necessary, the straightening shall be done by methods which will restore the material to its original shape or surface without residual blemish. Sharp kinks or bends will be considered a cause for rejection of the materials.

The finish of miscellaneous metal items shall not be less in quality and workmanship than that standard considered to be the commercial standard for the kind of member being furnished. Punched and drilled holes shall be burred and, unless otherwise specified, sheared and machined edges shall be finished by grinding to an appropriate radius. Riser, sprue, or vent marks on castings shall be ground flush with the adjacent surface. Blow holes in castings shall not be repaired by any method except as authorized in advance by the Engineer. Exposed edges of sheet metal shall be dressed with a stone or file to remove the sharp edges or corners. Drilled or punched holes which are improperly located or misaligned shall be cause for rejection and may not be corrected without the prior approval of the Engineer. All parts of assemblies shall be fabricated so that they may be assembled without forcing or drifting.

Welders proposed to be used on miscellaneous metal fabrication will be subject to qualifications.

515.3 WORKMANSHIP:

Workmanship and finish shall be equal to the best general practice in modern bridge shops.

Rolled material before being laid off or worked shall be straight. If straightening is necessary, it shall be done by methods approved by the Engineer. Kinks and bends may be cause for rejection of the material.

If straightening is necessary in the field only methods approved by the Engineer shall be used.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture.

Portions of the work exposed to view shall be finished neatly. Shearing, flame cutting and chipping shall be done carefully and accurately. Undercut gusset plates will not be accepted. All sharp corners and edges, and edges that are marred, cut or roughened in handling or erection, shall be slightly rounded by grinding or other suitable means.

515.4 COMPUTED WEIGHT:

The computed weight shall be obtained by the use of the following rules and assumptions:

(A) The weight of structural and cast steel shall be assumed at 0.2833 pound per cubic inch. The weight of cast iron shall be assumed at 0.2604 pound per cubic inch. The weight of wrought iron shall be assumed at 0.2776 pound per cubic inch.

(B) The weights of rolled shapes and of structural plates, shall be computed on the basis of their nominal weights and dimensions, as shown on the shop drawings, deducting for copes, cuts, and open holes, exclusive of rivet or bolt holes.

(C) Rivets, bolts, and welds shall be considered as incidentals and their price shall be included in the price of steel shapes and plates.

(D) The weight of castings and fillets shall be computed from the dimensions shown on the shop drawings, deducting for all openings or cuts in the finished casting.

(E) The weight of pins and rollers shall be computed from the dimensions shown on the shop drawings, deducting for all holes, openings, pockets, and metal removed by machine finishing.

Pilot nuts and driving nuts for each size of pin shall be furnished for erection work and the weights of such nuts will not be included in the weight of structural steel to be paid for.

(F) If computed weights are used to determine the pay quantities of galvanized metal, the weight to be added to the calculated weight of base metal for the galvanizing shall be determined from the table of weights of zinc coatings specified by the ASTM A153.

SECTION 515

515.5 PAINTING:

With the exception of items which are to be galvanized, structural steel members and miscellaneous metal items shall have a shop prime coat of approved rust-inhibitive paint. Application shall be as specified in Section [530](#). The thickness of the prime coat shall be not less than one mill.

After erection of structural steel uncoated surfaces at connections, surfaces where the shop coat has been abraded or otherwise damaged shall be touched up. Match marks and identification marks shall be properly cleaned off and painted over. The paint shall be identical to that used for the shop prime coat.

515.6 MEASUREMENT:

Steel structures will be paid for at a lump sum price or at a price per pound for structural steel, and at prices per pound for cast steel and cast iron. The pay quantities will be determined by computed weights or, by scale weights obtained as provided in this specification. Only material actually used in the completed structure will be paid for.

The pay quantities will be determined by computed weights for rolled sections and scaled weights for castings except as otherwise specified.

Computed weights will be used to determine pay quantities of alloy and carbon steel when members contain both alloy and carbon steel.

The weight of erection bolts, paint, boxes, crates, and other containers used for packing and the materials used for supporting members during transportation will not be included in the weights of material to be paid for.

The weight of structural steel to be paid for will not exceed the computed weight by more than 1 ½ percent. The weight of cast steel or cast iron to be paid for will not exceed the computed weights by more than 7 ½ percent. If the scale weight of any member is less than 99 ½ percent of the computed weight of that member, the member will be rejected and will not be paid for.

If computed weights are used, the weight to be paid for will be the calculated weight as established by the Engineer and no allowance will be made for weight in excess thereof.

515.7 PAYMENT:

Unless otherwise provided in the proposal, the basis of payment for steel structures shall be as follows:

The price paid per pound for structural steel including full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing, fabricating, delivering, erecting and prime coating the steel work, complete in place, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

The prices paid per pound for cast steel, cast bronze and cast iron shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and placing the materials, complete in place, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

Full compensation for furnishing and placing sheet piling, performed fabric pads, elastomeric or elastic bearing pads, and red lead paste, and for grouting masonry or bearing plates as shown on the plans shall be considered as included in the price paid for structural steel and no separate payment will be made therefore. Where the specifications or plans require metal to be galvanized, the price paid per pound for the metal, including the weight of zinc coating, shall be considered as full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing the galvanized metal complete in place, as shown on the plans, and as specified in the specifications and the special provisions, and as directed by the Engineer.

- End of Section -

SECTION 520

STEEL AND ALUMINUM HANDRAILS

520.1 DESCRIPTION:

Metal handrail shall consist of furnishing all materials and constructing handrail of steel or aluminum, including railing, posts, fittings and anchorages. Metal handrail shall be fabricated, installed and painted, when required, in accordance with the details shown on the plans and these specifications.

520.2 FABRICATION:

Prior to beginning any work on the fabrication of the railing, the Contractor shall submit shop drawings for approval, showing complete railing details.

Materials furnished for metal handrail shall conform to the requirements specified on the plans.

The Engineer shall be furnished complete, copies in triplicate of all mill reports on steel and aluminum materials furnished.

Railings shall be fabricated from welded or seamless members of the size and thickness shown on the plans. Steel members shall conform to the requirements of ASTM A53, Grade B structural steel conforming to ASTM A36, or tubular sections of hot rolled mild steel, as shown. Aluminum handrails shall conform to the requirements of either ASTM B429 for round extruded tube or ASTM B221 for semi-hollow extruded tube with rounded corners.

Welding shall be performed by the electric arc process and shall be done in conformance with AASHTO/AWS D1.5, Bridge Welding Code. All butt welds on exposed surfaces shall be ground flush with adjacent surfaces.

Railing panels shall be straight and true to dimensions.

For structures on curves, either horizontal or vertical, the railing shall conform closely to the curvature of the structure.

The completed steel railing units shall be galvanized in accordance with the requirements of Section [771](#) unless otherwise specified.

Provide Series 300 stainless steel fasteners for aluminum alloy handrails.

520.3 ERECTION:

The railing shall be carefully erected, true to line and grade. Posts and balusters shall be vertical and parallel with the deviation from the vertical for the full height of the panel not exceeding 5/8 inch. After erecting the railing, any abrasions or exposed steel shall be repaired in accordance with Section [771](#) or Section [530](#).

520.4 MEASUREMENT:

The various types of railing will be measured by the linear foot from end to end along the face of the railing including terminal sections.

520.5 PAYMENT:

The price paid per linear foot for handrailing shall include full compensation for furnishing all labor, materials, tools, and equipment and doing all work involved in constructing the railing complete in place as shown on the plans and specified herein.

- *End of Section* -

SECTION 525

PNEUMATICALLY PLACED MORTAR

525.1 DESCRIPTION:

The work under this section shall consist of furnishing all material and pneumatically placing, by means of suitable equipment and competent operators, either premixed Portland cement and fine aggregate (dry mix process) or premixed concrete (wet mix process).

525.2 DRY MIX PROCESS:

The dry mix process shall consist of thoroughly mixing a proportional combination of fine aggregate and Portland cement and conveying this mixture through a delivery hose to a special nozzle where water is added and combined with the dry ingredients prior to discharge. The nozzle water ring shall be cleaned daily.

The fine aggregate shall be material sand, conforming to ASTM C33, with Gradation No. 1 as shown in Table [525-1](#) and with not less than 3 percent or more than 7 percent moisture by weight.

Portland cement and mixing water shall conform to the requirements of Section [725](#).

The dry mix shall consist of 1 part Portland cement and 4.5 parts of fine aggregate by weight. Machine mixing will be required. This operation of proportioning and mixing shall be subject to the approval of the Engineer.

525.3 WET PROCESS:

The wet process shall consist of premixing by mechanical methods a proportional combination of Portland cement, aggregate and water required to produce mortar or concrete and conveying this mortar or concrete through the delivery hose to the special nozzle where additional compressed air is added prior to discharge. The air ports in the nozzle shall be cleaned daily.

The Portland cement concrete used for the Wet Mix Process shall conform to Section [725](#) and shall be Class A (3000 psi) unless otherwise specified. In no event shall a slump greater than 4 inches be used. As the work approaches the vertical, the maximum slump shall not exceed 1 inch.

The fine and coarse aggregate shall conform to ASTM C33 using one of the three graduations shown in Table [525-1](#). Unless otherwise specified, Gradation No. 1 will be used.

TABLE 525-1			
PNEUMATICALLY PLACED MORTAR GRADATION (A.C.I. TABLE 2.2.1)			
Sieve size	Percent by weight passing individual sieves		
	Gradation No. 1	Gradation No. 2	Gradation No. 3*
3/4 in.	—	—	100
1/2 in.	—	100	80-95
3/8 in.	100	90-100	70-90
No. 4	95-100	70-85	50-70
No. 8	80-100	50-70	35-55
No. 16	50-85	35-55	20-40
No. 30	25-60	20-35	10-30
No. 50	10-30	8-20	5-17
No. 100	2-10	2-10	2-10

*Batch fine and coarse aggregates separately to avoid segregation.

525.4 REINFORCING STEEL:

Reinforcing steel bars or welded-wire fabric shall conform to Section [727](#) and shall be 6 x 6 - W 1.4 x 1.4 welded wire fabric unless otherwise specified. Reinforcement shall be placed as closely as possible to the center of the mortar.

SECTION 525

525.5 EQUIPMENT:

Prior to the start of construction, the Contractor shall demonstrate that his equipment, materials and operators are capable of providing a finished structure in accordance with the specifications. For this demonstration, the Contractor shall provide test panels, 30 inches by 30 inches, with a depth the same as the structure, but not less than 4 inches. A separate panel shall be provided for each shooting position to be used (overhead, slope and/or slab) and one half of each panel shall contain reinforcement as used in the structure. Cores will be taken for visual inspection and compressive strength tests. The Engineer has the authority to accept or reject equipment, materials and/or operators based on his evaluation and his decision will be final.

If the Contractor can present valid, factual documentation to the satisfaction of the Engineer that his equipment, materials and operators have produced satisfactory results on similar work within the past six months, the Engineer may eliminate the test panel procedure.

525.6 SURFACE PREPARATION:

The surface on which the mortar is to be placed shall be compacted and true to line and grade as required by the plans and specifications. The surface shall be uniformly moistened so that water will not be drawn from the freshly-placed mortar. Placement of the mix shall not start until the temperature is 35° F and rising and shall stop when the temperature is 40°F and falling.

525.7 FORMS AND GROUND WIRES:

Forms shall be plywood or some other suitable material, true to line and grade, sufficiently rigid to resist deflection during mortar placement.

Ground or gauging wires shall be installed where necessary to establish the thickness and finish lines of the structure.

525.8 JOINTS:

Construction joints shall be tapered to a shallow edge from not more than one inch thick over a width of approximately one foot except where the joint will be subjected to compressive stress. In this case, square joints shall be constructed. Joints shall be thoroughly cleaned and wetted prior to any additional application.

Install control joints in accordance with the plans. Reinforcement will not extend across control joints.

525.9 FINISHING:

Unless otherwise specified, the natural gun finish will be provided.

525.10 CURING:

Curing shall be accomplished using Type 2 compound as specified in Section [726](#). Application rate shall be not less than one tenth of a gallon per square yard. Subsection [505.6.2](#) Adverse Weather Concreting is applicable.

525.11 TESTING:

Tests to determine the quality of the mortar will be performed by the Engineer periodically during the course of work. Test panels shall be prepared by the Contractor.

Test panels shall be at least 12 inches square and as deep as the structure, but not less than 4 inches. Cores shall be taken from the panel for visual and compressive strength tests. The minimum compressive strength at the end of 28 days shall be 3000 psi.

The Engineer may allow the use of 6 inches by 12 inches hardware cloth cylinders for testing in lieu of the test panels. These cylinders will be furnished by the Contractor.

All rebound pockets and any mortar, defective in the compressive strength test, shall be cut out and replaced.

SECTION 525

525.12 PAYMENT:

Payment for pneumatically-placed mortar will be made at the unit price per square yard or the lump sum as set forth in the proposal. Such payment shall be full compensation for furnishing all labor, tools, equipment and accomplishing all work in conformity with the plans and specifications.

- End of Section -

SECTION 530

PAINTING

530.1 DESCRIPTION:

This work shall consist of furnishing paint and other necessary materials and painting metal, wood or other surfaces in accordance with the details shown on the plans and these specifications.

530.2 MATERIALS:

Materials used in paint for painting shall conform to the requirements of Section [790](#).

530.3 WEATHER CONDITIONS:

Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather. Except as provided below, painting will not be permitted when weather conditions during application are such that the atmospheric temperature will drop below 35°F. during the drying period. If fresh paint is damaged by the elements, it shall be replaced by the Contractor at no additional cost to the Contracting Agency.

Subject to the approval of the Engineer, the Contractor may provide suitable enclosures to permit painting during inclement weather. Provisions must be made to control atmospheric conditions artificially inside the enclosures within limits suitable for painting throughout the painting operation. The cost of providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work and no additional payment will be made therefore.

530.4 APPLICATION:

Painting shall be done in a neat and workmanlike manner. Unless otherwise specified paint shall be applied either by brush, roller, or spray methods.

If brushes are used, they shall have sufficient body and length of bristle to spread the paint in a uniform coat. In general, the primary movement of the brush shall be such as to fill thoroughly all irregularities in the surface, after which the coating shall be smoothed by a series of parallel strokes. Paint shall be evenly spread and thoroughly brushed out. If a considerable amount of brush marks appear, it will be considered that the paint has been improperly applied. If rollers are used, they shall be of a type that does not leave a stippled texture in the paint file.

On all surfaces which are inaccessible for brushing, the paint shall be applied by spray or by sheepskin daubers especially constructed for the purpose, or by other means approved by the Engineer.

If spray methods are used, the operator shall be thoroughly experienced. Runs, sags, thin areas in the paint coat, or skips and holidays shall be considered as evidence the work is unsatisfactory and the Contractor may be required to apply the remainder of the paint by brush.

A water trap acceptable to the Engineer shall be furnished and installed on all equipment used in spray painting.

Mechanical mixers shall be used to mix the paint. The paint shall be mixed a sufficient length of time, prior to use, to thoroughly mix the pigment and vehicle together. Paint shall be kept thoroughly mixed while being applied.

530.5 THINNING PAINT:

Paints specified are formulated ready for application and no thinning will be allowed. If the paint becomes thick in cool weather, it shall be heated in the container immersed in hot water.

530.6 PROTECTION OF WORK:

The Contractor shall protect all parts of the structure against disfigurement by spatters, splashes, and smirches of paint or of paint materials. The Contractor shall be responsible for any damage caused by his operations to vehicles, persons, or property, and shall provide protective means to guard against such damage at his expense.

SECTION 530

Paint stains which might result in an unsightly appearance shall be removed or obliterated by the Contractor.

When ordered by the Engineer, if traffic causes an objectionable amount of dust, the Contractor shall sprinkle the adjacent roadbed and shoulders with water for a distance on each side of the location where painting is being done sufficient to abate the dust nuisance. The Contractor shall furnish and post at his own expense DRIVE SLOWLY signs and take other necessary precautions to prevent dust and dirt from accumulating on freshly painting surfaces.

530.7 SAFETY PRECAUTIONS:

The following safety precautions shall be observed in addition to those prescribed by law in Section [107](#).

The applicable sections of NACE, A Manual for Painter Safety.

530.8 SURFACE PREPARATION FOR PAINTING:

530.8.1 Steel: Surface preparation for painting of the steel shall conform to the surface preparation specifications of the Steel Structures Painting Council.

Unless otherwise specified, the commercial blast method shall be used.

After erection and riveting or welding, all surfaces of structural steel which will be exposed to air in the completed structure and the repainting of existing steel structures where partial painting is required, the method of cleaning will be as directed by the Engineer or as specified in the special provisions.

530.8.2 Galvanized Surfaces:

(A) Hand Cleaning: Concrete spatter, heavy grease, and other foreign matter shall be removed from galvanized surfaces by hand scraping or wire brushing.

(B) Solvent Cleaning: After hand cleaning, all galvanized surfaces shall be cleaned by the solvent cleaning procedures prescribed in Section [530.8.1](#) above to remove oil, grease and other detrimental foreign matter.

(C) Pretreatment: After hand and solvent cleaning, the cleaned areas shall then be painted by brushing on at least 1 full coat of paint No. 1. Unless otherwise directed by the Engineer, the second coat shall be applied within 24 hours after the primer is applied.

530.8.3 Wood Surface: Wood surfaces shall be prepared for painting by removing all cracked or peeled paint, loose chalky paint, dirt, and other foreign matter by wire brushing, scraping, sanding, or other approved means immediately prior to painting. All surfaces shall be wiped or dry brushed to remove any dust or chalky residue that may result from cleaning operations. All wood designated to be painted shall be thoroughly dry before paint is applied.

530.9 PAINTING:

530.9.1 Structural Steel:

(A) Paint: Unless otherwise required on the plans or in the special provisions, the paints to be applied to structural steel surfaces shall consist of a shop prime coat, as specified in Section [515](#), a second coat, and a finish coat. The total dry film thickness of the prime and second coat shall be not less than 3 mills. The dry thickness of the paint will be measured in place with a calibrated magnetic film thickness gauge.

Excessively thick coats of paint will not be permitted. The thickness of each coat shall be limited to that which will result in uniform drying throughout the paint film.

Unless specified otherwise on the plans or in the special provisions, the paint coats shall be as specified for general use on structural steel in Section [790](#). Succeeding coats of paint, not otherwise materially different in color, shall have carbon black mixed into the paint in accordance with Section [790](#) to produce a perceptible color difference between the paint coat being applied and the preceding coat.

SECTION 530

Any damage to sound paint on areas not designated for treatment, resulting from the Contractor's operations, shall be repaired as directed by the Engineer.

Application of Paint: Painting of structural steel, except for shop applied prime coats and sections which will be inaccessible after erection as described below, shall be done after erection unless otherwise specified in the special provisions. Requests to do any additional painting prior to erection shall be submitted by the Contractor and approved by the Engineer in writing before such work is started. Painting prior to erection will be limited to a prime coat of paint, except that surfaces exposed to the atmosphere which would be inaccessible for painting after erection shall be painted the full number of coats prior to erection. Any deficiencies in the prime coat of paint, or any second coat shall be corrected to the satisfaction of the Engineer prior to the application of the finish coat of paint.

The surface of the paint coat being covered shall be free from moisture, dust, grease, or any other deleterious material which would prevent the bond of the succeeding coat. In spot painting, any old paint which lifts after application of the touch-up coat, shall be removed by scraping and the area repainted before application of the next coat.

The finish coat shall not be applied until the required total film thickness of the undercoats of paint, as described above is obtained.

Open seams at contact surfaces of built-up members which would retain moisture shall be caulked with red lead paste before applying the second coat of paint.

Except for anchor bolt assemblies, steel embedded in concrete need not be painted. Anchor bolt assemblies shall be painted or dipped with 1 coat of paint prior to installation.

With the exception of abutting chord and column splices and column and truss shoe bases, machine finished surfaces shall be coated with a rust inhibitor which can be easily removed. Surfaces of iron and steel castings which have been machine finished shall be painted with a coat of shop paint.

530.9.2 Machinery: Prior to installation, all surfaces of machinery exposed to the atmosphere which are subject to corrosion and are normally painted, shall be painted with 2 coats of paint. Unless otherwise specified, after installation of the machinery, such surfaces shall be painted with a finish coat. All coats shall be as specified for structural steel.

530.9.3 Galvanized Surfaces: Unless otherwise provided on the plans or in the special provisions, galvanized surfaces shall be left unpainted. Areas of galvanized coating damaged due to welding after fabrication or handling shall be prepared as specified above and then painted with 1 full coat of paint No. 15.

530.9.4 Metal Guard Rails: Metal guard rails when required to be painted shall be painted with 2 coats of paint No. 11.

530.9.5 Wood Surfaces:

(A) **Paint:** The surface shall be prepared as specified above and painted with paint No. 6 or 7. The number of coats of paint will be specified in the special provisions.

(B) **Application of Paint:** When permitted in writing by the Engineer, the prime coat of paint may be applied prior to erection. After the prime coat has dried and the timber is in place, all cracks, checks, nail holes, etc., shall be puttied flush with the surface and allowed to dry before the second coat is applied.

Skips, holidays, and thin areas or other deficiencies in any 1 coat of paint shall be corrected to the satisfaction of the Engineer before the succeeding coat is applied.

The surface of the paint coat being covered shall be free of any deleterious material before any additional paint is applied.

530.10 TESTING::

Paint and paint materials shall be sampled and tested prior to use. Tests shall be conducted in accordance with methods specified by ASTM or by methods set forth in Federal Standard 141. In the absence of any such methods, other suitable methods may be designed and utilized by the Engineer. Lots or batches of paint of proprietary brand, as defined in Section [790](#), which have been previously sampled and tested by the Contracting Agency, and approved, may be used without further testing, if permitted by the Engineer.

SECTION 530

530.11 PAYMENT:

Payment for the preparation of surfaces, shop prime coat and field touch-up coats on structural steel and miscellaneous metal items shall be considered as included in the prices for the structural steel and miscellaneous metal items. Payment for second and finish coats on structural steel or miscellaneous metal items shall be considered as included in payments for the structures, except that payment for cleaning all painting on miscellaneous metal items shall be considered as included in the price for the item when a separate price therefore is included in the proposal.

Full compensation for preparing surfaces and for painting machinery, galvanized metal, guard rails and wood shall be considered as included in the various prices paid for the contract items or work and no separate payment for such work will be made.

- End of Section -

PART 600

WATER, SEWER, STORM DRAIN AND IRRIGATION

Section	Last Revised	Title	Page
601	2015	Trench Excavation, Backfilling and Compaction	601-1
602	2014	Trenchless Installation of Steel Casing	602-1
603	2012	Installation for High Density Polyethylene Pipe	603-1
604	2012	Placement of Controlled Low Strength Material	604-1
605	2014	Subdrainage	605-1
607	2015	Trenchless Installation of Smooth Wall Jacking Pipe	607-1
610	2015	Water Line Construction	610-1
611	2015	Water, Sewer and Storm Drain Testing	611-1
615	2015	Sanitary Sewer Line Construction	615-1
616	2015	Reclaimed Water Line Construction	616-1
618	2015	Storm Drain Construction	618-1
620	2012	Cast-In-Place Concrete Pipe	620-1
621	1998	Corrugated Metal Pipe and Arches	621-1
625	2015	Manhole Construction and Drop Sewer Connections	625-1
630	2012	Tapping Sleeves, Valves and Valve Boxes on Water Lines	630-1
631	2012	Water Taps and Meter Service Connections	631-1

This Page Reserved for Future Use

SECTION 601

TRENCH EXCAVATION, BACKFILLING AND COMPACTION

601.1 DESCRIPTION:

The work covered by this specification consists of furnishing all labor, equipment, appliances, materials, and performing all operations in connection with the excavation, backfilling and compaction of trenches for pipe installations.

Excavation for appurtenance structures, such as manholes, inlets, transition structures, junction structures, vaults, valve boxes, catch basins, etc., shall be deemed to be in the category of trench excavation.

The Trench Cross-Section Detail shown on Detail 200-2 illustrates the terminology used in this specification.

See Section 620 for cast-in-place concrete pipe.

Pipe materials that are considered to be rigid include reinforced concrete pipe, non-reinforced concrete pipe, reinforced concrete cylinder pipe, vitrified clay pipe, steel casings, cast iron, and ductile iron pipe.

Pipe materials that are considered to be flexible include thermoplastic pipes (HDPE, SRPE, PP, PVC) and corrugated metal pipe.

601.2 EXCAVATION:

601.2.1 General: The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the plans, and including excavation ordered by the Engineer of compacted backfill for the purpose of making density tests on any portion of the backfill.

601.2.2 Trench Widths: Trenches for a single pipe shall conform to the dimensions in Table [601-1](#). Multiple pipe installations in a single trench shall be installed in accordance with details on the plans or in the special provisions.

Table 601-1 TRENCH WIDTHS		
Size of Pipe (Nom. Dia.)	Maximum Width At Top Of Pipe Greater Than O.D. Of Bell	Minimum Width At Springline Each Side of Pipe Barrel
Rigid Pipes:		
Less than 18 inches	16 inches	6 inches
18 inches to 24 inches inclusive	19 inches	7.5 inches
27 inches to 39 inches inclusive	22 inches	9 inches
42 inches to 60 inches inclusive	30 inches	12 inches
66 inches to 78 inches inclusive	42 inches	15 inches
84 inches to 96 inches inclusive	50 inches	19 inches
102 inches to 120 inches inclusive	60 inches	24 inches
Flexible Pipes:		
Less than 18 inches	20 inches	8 inches
18 inches to 24 inches inclusive	23 inches	9.5 inches
27 inches to 39 inches inclusive	28 inches	12 inches
42 inches to 60 inches inclusive	34 inches	14 inches
66 inches to 78 inches inclusive	44 inches	16 inches
84 inches to 96 inches inclusive	48 inches	18 inches
102 inches to 120 inches inclusive	54 inches	21 inches

SECTION 601

The width of the trench shall not be greater than the maximum indicated in Table [601-1](#), at and below the level of the top of the pipe. The width of the trench above that level may be made as wide as necessary for shoring, bracing, and for proper installation of the work.

If the maximum trench width as specified in Table [601-1](#) is exceeded at the top of the pipe, additional load bearing capacity to compensate for the increased pipe loading may be required by the Engineer. The Contractor shall provide, at no additional cost to the Contracting Agency, the additional load bearing capacity. This may require changing the material requirements of initial backfill, a higher strength pipe, a concrete cradle, cap or encasement, or other means approved in writing by the Engineer. Where safety or undermining situations occur, a controlled low strength material (CLSM) backfill as specified in Sections 604 and 728 may be used as needed.

601.2.3 Trench Grade: Alignment and elevation stakes shall be furnished by the Contractor at set intervals and agreed upon offsets. On water main projects, elevation stakes will be furnished only when deemed necessary by the Engineer. In all cases where elevation stakes are furnished, the Contractor will also furnish the Engineer with cut sheets.

For all pipe 12 inches or greater in diameter, the Contractor shall excavate for and provide a bedding at least 4 inches thick or 1/12 the O.D. of the pipe barrel whichever is greater. This bedding material shall be placed at a uniform density with minimum compaction and fine graded as specified herein.

601.2.4 Fine Grading: The bedding or the bottom of the trench when bedding is not required shall be accurately graded to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for portions of the pipe where it is necessary to excavate for bells or other joint types and for proper sealing of the pipe joints.

601.2.5 Over-excavation: Except at locations where excavation of rock from the bottom of the trench is required, care shall be taken not to excavate below the depth needed to accommodate the required bedding depth.

Unauthorized excavation below the specified trench grade line shall be refilled at the Contractor's expense with ABC material compacted to a uniform density of not less than 95 percent of the maximum density as determined by AASHTO T-99 and T-191 or ASTM D6938. When AASHTO T-99, method A or B, and T-191 are used for density determination, ARIZ 227c will be used for rock correction.

Whenever rock is encountered in the trench bottom, it shall be over-excavated to a minimum depth of six inches below the bottom of the pipe barrel. This over-excavation shall be filled with bedding material placed with the minimum possible compaction.

Whenever unsuitable soil incapable of supporting the pipe is encountered, the Contractor will notify the Engineer and a field determination will be made as to the depth of over-excavation and the granular fill required.

601.2.6 Excavation for Manholes, Valves, Inlets, Catch Basins and Other Accessories: The Contractor may place concrete directly against excavated surfaces for cast-in-place items, provided that the faces of the excavation are firm, unyielding, and are at all points outside the structure lines shown on the plans. If the native material is such that it will not stand without sloughing or if precast structures are used, the Contractor shall excavate as needed to place bracing, shoring, and forms or to place the precast structure. The excavation shall be backfilled with the same material required for the adjoining pipe line trench and compacted per Table [601-2](#).

Any unnecessary excavation below the elevation indicated for the foundation of any structure shall be replaced with the same class of concrete specified for the structure or with 1½ sack controlled low strength material as specified in Section [728](#). When the replacement material is structural concrete, the material shall be placed at the same time as the structure. However, when using 1½ sack controlled low strength material, placement of the material shall be per Section [604](#) which requires a time lag between placement of the controlled low strength material and the structural concrete. The placement of the additional material shall be at no cost to the Agency.

601.2.7 Pavement and Concrete Cutting and Removal: Where trenches lie within the portland cement concrete section of streets, alleys, driveways, or sidewalks, etc., such concrete shall be sawcut to neat, vertical, true lines in such a manner that the adjoining surface will not be damaged. The minimum depth of cut shall be 1½ inches or 1/4 of the thickness, whichever is greater.

SECTION 601

Asphalt pavement shall be clean-cut, with approved equipment and by approved methods in accordance with the requirements of Section [336](#).

No ripping or rooting will be permitted outside limits of cuts. Surfacing materials removed shall be hauled from the job site immediately, and will not be permitted in the backfill.

601.2.8 Grading and Stockpiling: All grading in the vicinity of trench excavation shall be controlled to prevent surface water from flowing into the trenches. Any water accumulated in the trenches shall be removed by pumping or by other approved methods.

During excavation, material suitable for backfilling shall be placed in an orderly manner, a sufficient distance back from the edges of trenches, to avoid overloading and to prevent slides or cave-ins. Material unsuitable for backfilling, or excess material, shall be hauled from the job site and disposed of by the Contractor.

The Contractor shall, prior to commencement of the work, submit a letter to the Contracting Agency stating the location of each disposal site for all excess or unsuitable material and certify that he has obtained the property owner's permission for the disposal of all such materials.

Where the plans and/or special provisions provide for segregation of topsoil from underlying material for purposes of backfill, the material shall not be mixed.

601.2.9 Shoring and Sheathing: The Contractor shall do such trench bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. The bracing, sheathing, or shoring shall not be removed in one operation but shall be done in successive stages to prevent overloading of the pipe during backfill operations. The cost of the bracing, sheathing, or shoring, and the removal of same, shall be included in the unit price for the pipe or other item which necessitated the work.

All shoring and sheathing deemed necessary to protect the excavation and to safeguard employees, shall be installed. See Section [107](#).

601.2.10 Open Trench: Except where otherwise noted in the special provisions, or approved in writing by the Engineer, the maximum length of open trench, where the construction is in any stage of completion (excavation, pipe laying or backfilling), shall not exceed 1320 feet in the aggregate at any one location.

Any excavated area shall be considered open trench until all ABC for pavement replacement has been placed and compacted. With the approval of the Engineer, pipe laying may be carried on at more than one location, the restrictions on open trench applying to each location. Trenches across streets shall be completely backfilled as soon as possible after pipe laying.

Substantial steel plates with adequate trench bracing shall be used to bridge across trenches at street crossings where trench backfill and temporary patches have not been completed during regular work hours. Steel plates shall be installed in accordance with Detail 211. Safe and convenient passage for pedestrians shall be provided. The Engineer may designate a passage to be provided at any point he deems necessary. Access to hospitals, fire stations and fire hydrants must be maintained at all times.

601.3 PROTECTION OF EXISTING UTILITIES:

601.3.1 Utilities: Unless otherwise shown on the plans or stated in the specifications, all utilities, either underground or overhead, shall be maintained in continuous service throughout the entire contract period. The Contractor shall be responsible and liable for any damages to or interruption of service caused by the construction.

If the Contractor desires to simplify his operation by temporarily or permanently relocating or shutting down any utility or appurtenance, he shall make the necessary arrangements and agreements with the owner and shall be completely responsible for all costs concerned with the relocation or shutdown and reconstruction. All property shall be reconstructed in its original or new location as soon as possible and to a condition at least as good as its previous condition. This cycle of relocation or shutdown and reconstruction shall be subject to inspection and approval by both the Engineer and the owner of the utility.

SECTION 601

The Contractor shall be entirely responsible for safeguarding and maintaining all conflicting utilities that are shown on the plans (Sections [107](#) and [105](#) apply). This includes overhead wires and cables and their supporting poles whether they are inside or outside of the open trench. If, in the course of work, a conflicting utility line that was not shown on the plans is discovered, the Contracting Agency will either negotiate with the owner for relocation, relocate the utility, change the alignment and grade of the trench or as a last resort, declare the conflict as “extra work” to be accomplished by the Contractor in accordance with Section [104](#).

Backfill, around utilities that are exposed during trench excavation, shall be placed in accordance with the utility’s haunching and initial backfill requirements.

601.3.2 Irrigation Ditches, Pipes and Structures: The Contractor shall contact the owners of all irrigation facilities, and make arrangements for necessary construction clearances and/or dry-up periods.

All irrigation ditches, dikes, headgates, pipe, valves, checks, etc., damaged or removed by the Contractor, shall be restored to their original condition or better, by the Contractor at no additional cost to the Contracting Agency.

601.3.3 Building Foundations and Structures: Where trenches are located adjacent to building foundations and structures, the Contractor shall take all necessary precaution against damage to them. The Contractor shall be liable for any damage caused by the construction.

Except where authorized in the special provisions or in writing by the Engineer, water settling of backfill material in trenches adjacent to structures will not be permitted.

601.3.4 Permanent Pipe Supports: Permanent pipe supports for the various types and sizes of sewer, water and utility lines shall conform to the Standard Details or the details shown on the plans. Such pipe supports shall be erected at the locations shown on the plans and/or at any other location as necessary as determined by the Engineer.

601.4 FOUNDATION, BEDDING, HAUNCHING, BACKFILLING AND COMPACTION:

601.4.1 Foundation: The bottom of an excavation upon which a structure is to be placed or the bottom of a trench where the elevation is set below the pipe elevation shown on the plans or as directed by the Engineer. The elevation of the trench foundation is determined from the desired pipe elevation by taking into account the bedding and pipe wall thicknesses. The foundation surface will consist of native material or replacement material required due to over-excavation.

601.4.2 Bedding: Bedding is the material upon which a pipe is to be placed.

The bedding material type shall be ABC per Section 702 unless otherwise specified.

601.4.3 Haunching: Haunching is the material placed between the bedding and springline. If placed in lifts, the lift thickness shall not exceed 2 feet (1 foot for flexible pipe) and shall be deposited and compacted to the specified density uniformly on each side of the pipe to prevent lateral displacement of the pipe.

The haunching material shall be ABC per Section 702. With Agency approval an alternative granular material or CLSM may be used.

601.4.4 Initial Backfill: The material placed between the springline to 12 inches above top of pipe. Initial backfill shall be placed in lifts that shall not exceed 2 feet (1 foot for flexible pipe) and which can be effectively compacted depending on the type of material, type of equipment, and methods used.

Initial backfill material shall be ABC per Section 702. With Agency approval an alternative granular material or CLSM may be used, and with agency approval native backfill with no piece larger than 1½ inches may be used for concrete pipe.

601.4.5 Final Backfill: Material placed above the initial backfill to the top of the trench or to the bottom of the road base material. Final backfill shall be placed in lifts that shall not exceed 2 feet and the lift height shall not be more than can be compacted to the required density with the equipment and methods being used.

SECTION 601

Final backfill shall be ABC per Section 702 or sound earthen material with no piece larger than 4 inches and be free from broken concrete, broken pavement, wood or other deleterious material.

Backfill under street pavement shall be constructed per Detail 200-1 with the type of replacement noted on the plans or in the special provisions. Unless otherwise noted, backfill under single curb, curb and gutter, sidewalk, driveways, valley gutters, etc. shall be the same as the adjacent street pavement.

601.4.6 Compaction Densities: Trench backfill shall be thoroughly compacted to not less than the densities shown in Table 601-2 when tested and determined by AASHTO T-99 and T-191 or ASTM D6938. When AASHTO T-99, method A or B, and T-191 are used for density determination, ARIZ-227c shall be used for rock correction.

Backfill material shall be within 2 percentage points of its optimum moisture content while being compacted.

When backfill material is CLSM and it is placed in accordance with Section 604, no compaction testing is required, the compaction density shall be deemed acceptable.

TABLE 601-2				
MINIMUM TRENCH COMPACTION DENSITIES				
Backfill Type	Location	From Surface To 2 feet Below Surface	From 2 feet Below Surface To 1 foot Above Top of Pipe	From 1 foot Above Top of Pipe to Bottom of Pipe
I	Under any existing or proposed pavement, curb, gutter, attached sidewalk, roadway shoulders, and other areas within right-of-way subject to vehicular traffic, or when any part of the trench excavation is within 2-feet of the existing pavement, curb, or gutter.	100% for granular 95% for non-granular	95%	95%
II	On any utility easement or right-of-way outside limits of Type I backfill.	85%	85%	90%
III	Around any structures (manholes, etc.) or exposed utilities outside limits of Type I backfill.	95% in all cases		

601.4.7 Water Consolidation: Jetting is the only acceptable water consolidation method and its use is restricted. Jetting may only be used in Type I Backfill for the haunching and initial backfill zones and in Type II Backfill locations as defined in Table 601-2.

Water consolidation by jetting shall use a 1 ½ inch pipe of sufficient length to reach the bottom of the lift being settled and shall have a water pressure of not less than 30 psi. All jetting shall be accomplished transversely across the trench at intervals of not more than 6 feet with the jetting locations on one side of the trench offset to the jetting locations on the other side of the trench. The entire lift shall be leveled and completely saturated working from the top to the bottom.

When jetting is used within the haunching and initial backfill zones, the Contractor shall be responsible for establishing each lift depth so as to avoid floating the pipe being placed and shall make any needed repair or replacement at no cost to the Contracting Agency. For pipes larger than 24 inches I.D. the first lift shall not exceed the springline of the pipe and subsequent lifts shall not exceed 3 feet.

Where jetting is used and the surrounding material does not permit proper drainage, the Contractor shall provide, at his expense a sump and a pump at the downstream end to remove the accumulated water.

The use of water consolidation does not relieve the Contractor from the responsibility to make his own determination that such methods will not result in damage to existing improvements. The Contractor shall be responsible for any damage incurred.

If jetting does not obtain the required compaction density, mechanical compaction methods shall be used to meet the compaction requirements. Water consolidated backfill material may need to be removed and replaced.

SECTION 601

Jetting within Type I backfill locations shall not be used unless the material in which the trench is located and the backfill are both granular material. No exception shall be made for construction within new developments.

601.4.8 Granular Material and Native Backfill Material: For purposes of this specification, granular material is material for which the sum of the plasticity index and the percent of the material passing a No. 200 sieve does not exceed 23. The plasticity index shall be tested in accordance with AASHTO T-146 Method A (Wet Preparation), T-89 and T-90.

Native material used for backfill shall be sound earthen material free from broken concrete, broken pavement, wood or other deleterious material with no piece larger than 4 inches.

601.4.9 Rights-Of-Way Belonging to Others: Backfill and compaction for irrigation lines of the Salt River Valley Water Users' Association and Roosevelt Irrigation Districts and for trenches in State of Arizona or another entity's right-of-way outside the limits of the Contracting Agency shall be accomplished in accordance with their permit and/or specifications.

601.4.10 Test Holes: Boring logs shown on the plans do not constitute a part of the contract and are included for the Contractor's convenience only. It is not intended to imply that the character of the material is the same as that shown on the logs at any point other than that where the boring was made. The Contractor shall satisfy himself regarding the character and amount of rock, gravel, sand, silt, clay and water to be encountered in the work to be performed.

601.4.11 Bedding and Backfilling for Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines: The bedding and backfill for these underground facilities shall be native material or sand which conforms to the grading requirement of ASTM C33 for fine aggregate. When backfill material consists of aggregate base course, crushed stone, or other material containing stones, only sand will be used within the bedding, haunching, and initial backfill zones. The bedding depth shall be six inches. Compaction shall be in accordance with Table 601-2.

601.5 CONTRACTOR CERTIFICATION OF INSTALLATION PROCEDURES:

When requested in the Special Provisions or by the Engineer prior to installation, the Contractor shall furnish to the Contracting Agency an affidavit (certification) from the pipe manufacturer (or his designee) stating that the Contractor is familiar with the manufacturer's suggested installation methods and procedures and the manufacturer's suggested installation methods and procedures are consistent with MAG requirements.

When required by the Special Provisions, the pipe manufacturer or his designee will review the Contractor's methods and procedures for pipe installation in the field. The Contractor will make any adjustments in the installation as recommended by the manufacturer or his representative. If necessary, the Contractor may be required to reinstall or provide corrections to pipe installed prior to the field review at no cost to the Agency. Once the manufacturer or his representative has reviewed the Contractor's installation methods and the Contractor has adjusted his installation methods as recommended by the same, the manufacturer or his representative shall furnish to the Contracting Agency an affidavit (certification) that the Contractor's installation methods and procedures, at the time of the review, complied with the manufacturer's installation practices. The affidavit must provide the name of the manufacturer's representative witnessing the pipe installation.

601.6 PAVEMENT REPLACEMENT AND SURFACE RESTORATION:

601.6.1 Grading: The Contractor shall do such grading in the area adjacent to backfilled trenches and structures as may be necessary to leave the area in a neat and satisfactory condition approved by the Engineer.

601.6.2 Restoring Surface: All streets, alleys, driveways, sidewalks, curbs, or other surfaces, in which the surface is broken into or damaged by the installation of the new work, shall be resurfaced in kind or as specified to the satisfaction of the Engineer in accordance with Section [336](#).

601.6.3 Cleanup: The job site shall be left in a neat and acceptable condition. Excess soil, concrete, etc., shall be removed from the premises.

SECTION 601

601.6.4 Temporary Pavement: The Contractor shall install temporary asphalt pavement or the first course of permanent pavement replacement in accordance with Section [336](#) immediately following backfilling and compaction of trenches that have been cut through existing pavement. Except as otherwise provided in Section [336](#), this preliminary pavement shall be maintained in a safe and reasonably smooth condition until required backfill compaction is obtained and final pavement replacement is ordered by the Engineer. Temporary paving removed shall be hauled from the job site and disposed of by the Contractor at no additional cost to the Contracting Agency.

601.7 PAYMENT:

No pay item will be included in the proposal or direct payment made for trench excavation, backfilling, compaction, or placement of temporary pavement. The cost of these features of the work shall be included in the unit price per linear foot for furnishing and laying pipe.

- End of Section -

SECTION 602

TRENCHLESS INSTALLATION OF STEEL CASING

602.1 DESCRIPTION:

The Contractor shall furnish all labor, material and equipment as required for the trenchless operation to install steel casing using horizontal earth auger boring, hand tunneling or pipe ramming.

602.2 MATERIALS:

The steel casing shall consist of steel plates rolled and welded into a cylinder. Plate material shall meet the minimum requirements of ASTM A283. Shop and field joints shall be butt welded in accordance with the minimum requirements of American Welding Society (AWS) D1.1/D1.1M. Welding shall be performed by AWS D1.1 certified personnel.

The steel casing for pressurized carrier pipes shall be a minimum of 12-inches larger than the largest OD of the carrier line including pipe bells and flanges or the size indicated on the plans, whichever is greater.

The steel casing for gravity carrier pipes shall be a minimum of 18-inches larger than the largest OD of the carrier line including pipe bells and flanges or the size indicated on the plans, whichever is greater.

602.3 TRENCHLESS OPERATION:

Before starting operations, the Contractor shall submit in accordance with Section [105.2](#), detailed shop drawings of the bore pit and receiving pit shoring, the casing, bulkheads, carrier pipe installation method, and welder certifications.

The bore and reception pits for the trenchless operation shall be shored to safeguard existing sub-structures and surface improvements and to protect against ground movement.

On steel casing 37-inches (ID) or larger, grout connections shall be provided at a maximum spacing of every 20-feet located at 12 o'clock in the steel casing. Upon completion of the boring operation, the contractor shall inspect each grout hole to determine if grouting is required. Any void greater than 2 inches outside the casing will require the boring contractor to grout fill the void. After grouting, the grout holes shall be closed with a threaded plug.

Steel casing smaller than 36-inches (OD) installed by horizontal earth auger boring, hand tunneling or pipe ramming will not require outside grouting unless caving or earth movement occurs.

602.4 DEWATERING:

All water encountered during the trenchless operation shall be disposed of by the Contractor in a manner that will not damage public or private property or create a nuisance or health problem. The cost of furnishing pumps, pipes and equipment for dewatering shall be considered incidental to the work and no additional payment shall be made.

602.5 CARRIER PIPE PLACEMENT:

The tolerances allowed for the alignment and grade of carrier pipe shall comply with requirements of Section [610](#), [615](#) or [618](#) as applicable. The Contractor shall be responsible to obtain the required line and grade for the carrier pipe. The carrier pipe shall not contact or rest on the casing.

Pressurized carrier pipes, (i.e. water, gas, force main) shall be placed using casing spacers, wood skids or steel pipes for rails. Casing spacers shall be installed 3 per joint minimum with 8-foot maximum spacing. The annular space between the casing and carrier line shall be left empty unless otherwise directed. When the annular space is to be filled, 3/8-inch pea gravel shall be used.

Gravity carrier pipes, (i.e. sewer, storm drain, irrigation) shall be placed using wood skids or steel pipes for rails. The annular space between the casing and carrier line shall be left empty unless otherwise directed. When the annular space is to be filled, 3/8-inch pea gravel shall be used.

SECTION 602

Bulkheads consisting of brick and mortar or concrete shall be constructed on the ends of the casing; bulkheads shall be a minimum of 8-inches thick. Alternative casing end closures may be substituted for brick and mortar or concrete bulkheads if approved by the engineer.

PVC conduits for dry utilities, (i.e. communications, fiber, electric) shall be placed using non-metallic PVC casing spacers. The annular space between the casing and carrier line shall be filled as indicated in the contract documents.

After completing the carrier pipe installation, the Contractor shall remove all loose and disturbed material in the bore pits and backfill the pits in accordance with Sections [601](#) and [336](#).

602.6 MEASUREMENT AND PAYMENT:

Measurement for steel casing shall be the number of horizontal linear feet from the end of casing in the bore pit to the end of casing in the reception pit. Payment for steel casing shall be full compensation for furnishing all labor, material, tools, and equipment required for the trenchless installation of steel casing, complete in place including but not limited to carrier pipe and bulkhead placement and the excavation and backfilling of pits.

- End of Section -

SECTION 603

INSTALLATION FOR HIGH DENSITY POLYETHYLENE PIPE

603.1 DESCRIPTION:

The work covered by this specification consists of furnishing all plant, labor, equipment, appliances and materials and performing all operations in connection with a large-diameter High Density Polyethylene (HDPE) pipe installation in accordance with the plans, specifications and special provisions.

For installation procedures of HDPE for sewer line construction, see Section [615](#).

For installation procedures of HDPE for storm drain construction, see Section [618](#).

HDPE pipe and fittings shall conform to Section [738](#).

This section covers large-diameter HDPE pipeline installations of gravity and low-pressure storm drain and sanitary sewer construction.

For the purpose of this specification, low-pressure is defined as the test pressures of 3.5 psi of air or 4 feet of water as specified in Section [615.11](#).

For the purpose of this specification, large-diameter HDPE pipe shall include 8 inches through 120 inches nominal diameter.

603.2 EXCAVATION:

Excavation shall comply with Subsection 601.2. Trench widths shall comply with Subsection [601.2.2](#), Table [601-1](#) and Note (1) for HDPE pipe, meeting AASHTO M-252, and AASHTO M-294. Trench widths for profile HDPE pipe, meeting ASTM F894, will be designed by the Engineer and included on the plans or in the special provisions.

603.3 PROTECTION OF EXISTING UTILITIES:

Protection of existing utilities shall comply with Subsection [601.3](#).

603.4 FOUNDATION, BEDDING, BACKFILLING AND COMPACTION:

603.4.1 Foundation: Foundation shall comply with Subsection [601.4.1](#).

603.4.2 Bedding: Coarse aggregate shall be used for bedding of large-diameter profile HDPE pipe. Coarse aggregate shall be in accordance with Subsection [603.4.6](#), for size, type, and gradation. For corrugated HDPE pipe as defined under Section [738](#), bedding shall meet the requirements of subsection [601.4.2](#) and Table [601-2](#) with the compaction requirements stipulated below.

Bedding material shall be carefully deposited in 8 inches or less loose lifts, thoroughly and carefully compacted around the pipe, equally around both sides of the pipe, with approved vibratory compactors or other tools or equipment when applicable, or by shovel slicing as approved by the Engineer. This shall be repeated until enough material is placed and compacted to provide a minimum of one (1) foot cover over the top of profile HDPE pipe, or to the top of corrugated HDPE pipe. Compaction densities, as well as further compaction requirements shall be as stipulated in Table [601-2](#), unless shown otherwise on the plans.

603.4.3 Backfilling: Backfilling shall comply with Subsection [601.4.3](#).

603.4.4 Compaction Densities: Compaction densities shall comply with Subsection [601.4.4](#).

603.4.5 Compaction Methods: For large-diameter HDPE pipe installations where the backfill and bedding material is coarse aggregate, mechanical compaction shall be the only method for consolidating backfill and bedding. Water consolidation shall not be used as a method of compaction for coarse aggregate whether used as a foundation, bedding or backfill material.

SECTION 603

For large-diameter pipe installations where the backfill material is other than coarse aggregate, consolidation shall be by mechanical means. Water consolidation may be used as a compaction method for the backfill material only when prior written approval to do so is provided by the Engineer.

603.4.6 Specifications for Material: Coarse aggregate shall consist of crushed rock as defined in Section [701.2](#) with 100 percent of the specified size of aggregate having one fractured face tested in accordance with ARIZ-212, and having the gradation complying with ASTM D448, Table 1, Size Numbers 6, 67, 68, 7, 78, or 8 as recommended by the Engineer. The gradation size number to be furnished shall be shown on the plans or in the project specifications.

603.4.7 Rights-of-Way Belonging to Others: Rights-of-way belonging to others shall comply with Subsection [601.4.7](#).

603.4.8 Test Holes: Test holes shall comply with Subsection [601.4.8](#).

603.4.9 Foundation and Bedding for Electronic, Telephonic, Telegraphic, Electric, Oil and Gas Lines: Foundation and bedding for electronic, telephonic, telegraphic, electric, oil and gas lines shall comply with Subsection [601.4.9](#).

603.5 PREPARING AND INSTALLING HDPE PIPE:

603.5.1 Storage and Handling: Pipe shall be stored and handled in such a way to minimize out-of-roundness. Pipe shall be stored in shaded areas to minimize adverse effects of thermal, and ultraviolet exposure.

Pipe that is out-of-round in excess of 3% of the nominal pipe diameter as specified in Section [738](#), shall not be installed and shall be removed if installed.

603.5.2 Strutting: Strutting of Profile HDPE pipe per Section [738](#) will be required when the diameter is 42 inches or larger. For Profile HDPE pipe with diameters smaller than 42 inches, strutting may be required at the discretion of the Engineer. Strutting of Corrugated HDPE pipe per Section [738](#) is not required.

Strutting consists of placing wood struts, whose length is typically 3% longer than the nominal pipe diameter, inside the pipe. A minimum of three (3) sets of struts are placed in each pipe length, oriented vertically, spaced equally throughout the length of pipe and set so as not to interfere with the jointing of the pipe. The struts shall be kept in place until the bedding material is placed and compacted around the pipe. The struts must be removed before any backfill or bedding is placed above the pipe. The procedure of strutting the pipe shall not damage the pipe in any way. If the pipe is out of round, the struts will be placed in the long direction of the out-of-round. If the strut cannot be held in place by the pipe, the pipe will be removed from the job site per Subsection [738.9](#).

603.5.3 Orienting: If the pipe is out-of-round, the pipe should be oriented so that the long axis is placed vertically when installed in the trench. When struts are used, the struts shall be oriented vertically when pipe is installed in the trench.

603.5.4 Installing Pipe: HDPE pipe and fittings shall be installed in accordance with ASTM D2321 or manufacturer's recommendation. HDPE pipe shall be handled so as not to damage the pipe. Hoisting shall be accomplished with cloth belt slings or ropes. The pipe shall be protected by wood blocking when jointing is accomplished by pipe jacking, back hoe bucket, come-along, or cable pipe puller.

603.6 PAVEMENT REPLACEMENT AND SURFACE RESTORATION:

Pavement replacement and surface restoration shall comply with Subsection [601.5](#).

603.7 PAYMENT:

No pay item will be included in the proposal, nor direct payment made for trench excavation, backfilling, compaction, or placement of temporary pavement. The cost of these features of work shall be included in the unit price per bid per linear foot for furnishing and laying pipe.

- End of Section -

SECTION 604

PLACEMENT OF CONTROLLED LOW STRENGTH MATERIAL

604.1 DESCRIPTION:

The work covered by this specification consists of furnishing all materials, labor and equipment for the placement of controlled low strength material (CLSM).

The type of backfill to be used shall be as specified in the special provisions, plans or by the Engineer.

The following is a brief description of the types of CLSM and their intended uses:

1/2 SACK: General trench backfill in areas where future excavation into the backfill with conventional hand tools is anticipated or in areas of low loading such as streets, parking areas, behind retaining walls, etc.

1 SACK: General trench backfill and backfill behind retaining walls where additional strength is required above that of 1/2 sack CLSM.

1-1/2 SACK: Structural backfill under foundations and as thermal fill and/or mechanical protection of duct banks and conduits.

604.2 MATERIALS:

CLSM shall conform to the requirements of Section [728](#). Ready-mixed concrete shall not be used in lieu of CLSM without prior approval from the Engineer and shall be subject to rejection.

604.3 PLACEMENT:

The controlled low strength material shall be placed directly into the excavation. The CLSM shall be placed in a uniform manner that will prevent voids in or segregation of the material. Foreign material which falls into the trench prior to and during placing of the CLSM shall be immediately removed. The CLSM shall have consistency, workability, plasticity, flow characteristics and pumpability (when required) such that the material when placed is self-compacting. Mechanical compaction or vibration may be used to consolidate around structures, pipes, multiple conduits, etc., otherwise no mechanical compaction or vibration shall be required. The total elapsed time between the initial addition of water to the CLSM and the completed placement shall not exceed 90 minutes.

When CLSM is used for backfill around pipes or conduits, the CLSM shall be placed equally on both sides of pipe or conduit to prevent lateral displacement. Also, the CLSM shall be placed in lifts. The height of each lift shall not exceed the depth that will cause floating of the pipe or conduit. When placing the CLSM in greater lift depths, sufficient anchorage shall be provided so the pipe or conduit will not float.

Where CLSM is used for backfill around pipes or conduits with a depth less than 20 feet, the width of the excavation shown on the plans or in Section [601](#) may be reduced so that the minimum clear distance between the outside of the pipe or conduit and the side of the excavation (each side) shall be 12 inches for pipes or conduits 42 inches and larger, 6 inches for pipes or conduits between 4 inches and 42 inches and 3 inches for pipes or conduits 4 inches and smaller.

When CLSM is used behind retaining walls, the depth of each lift shall be limited so it will not induce hydraulic loads greater than the design loads.

For long trenches or installations which require a large amount of CLSM, bulkheads of wood, dirt, sand bags, etc. can be used to control the material's flowability. The bulkhead shall be removed prior to the continuation of the backfilling.

CLSM shall NOT be permitted to come in contact with any aluminum, copper or brass materials, e.g., aluminum pipes or culverts, copper water pipe, saddles, fittings, etc. Protection shall be any combination of the following: place a layer of noncorrosive material around the pipe e.g., native material, import material, etc. or provide a protective covering or wrapping such as polyethylene wrap per Section [610.6](#). Pipes smaller than 4 inches can be completely wrapped with tape as per Section [610.6](#) or approved equal.

SECTION 604

Generally, CLSM does not resist freezing and thawing and in some cases may propagate the condition. CLSM mixes must be modified where long term freeze-thaw durability is indicated as a concern. The mix design shall have an air content of no less than six percent by volume, when tested in accordance with ASTM C6023.

604.4 PERFORMANCE TESTING:

CLSM placed within the traveled way or otherwise to be covered by paving or embankment materials, shall not be covered until one of the following performance criteria have been met:

- (A) When a person of average weight and shoe size can walk on the surface of the CLSM without creating greater than 1/8-inch indents in the material, or
- (B) When the in-place CLSM has reached a strength of 30 psi, when tested in accordance with ASTM D4832, or
- (C) When a ball drop indentation of 3-inches or less is obtained, when tested in accordance with ASTM D6024, or
- (D) When a penetration resistance reading of 650 is achieved, when tested in accordance with ASTM C403.

Additionally, CLSM shall not be covered if proof rolling by pneumatic-tired or steel wheel vibratory roller results in the bringing of free water to the surface or results in surface undulation (pumping).

When CLSM is placed in foundation excavations, the material shall be protected from foundation loading and placement of foundation concrete prior to having reached initial set per ASTM C403, or allowed to set in place for 24 hours, whichever occurs first.

604.5 ACCEPTANCE:

CLSM shall be considered deficient and may be rejected at the discretion of the Engineer if:

- (A) The CLSM is outside of the limits specified in Table [728-1](#) and/or
- (B) The aggregate gradation is outside the limits specified in Section [728.2](#).

Rejected material not placed shall be immediately removed from the job site. Rejected material placed shall be removed and replaced with acceptable material. Removing and disposing of the rejected material shall be at no additional cost to the Contracting Agency.

604.6 PAYMENT:

No pay item will be included in the proposal nor direct payment made for CLSM unless specifically included in the Project Specifications and Fee Proposal. The cost for placing the material shall be included in the unit price for the specific work function (laying pipe, placing structure foundation, construction retaining wall, etc.).

- End of Section -

SECTION 605

SUBDRAINAGE

605.1 DESCRIPTION:

The subdrainage system shall be constructed in accordance with the notes and details shown on the plans and the applicable provisions of these specifications except as modified in the special provisions.

605.2 CONCRETE:

All concrete placed in drainage structures, subdrain outlets, pipe collars, and similar features of the subdrainage system shall conform to the applicable provisions of Section [725](#).

605.3 SUBDRAINAGE PIPE:

Subdrainage pipe, both perforated and non-perforated, shall be either bell and spigot concrete, bell and spigot vitrified clay, or corrugated metal pipe, as shown on the plans or specified in the special provisions. However, if the particular kind of pipe is not shown on the plans nor specified in the special provisions, subdrainage pipe shall be concrete pipe of at least standard strength quality and shall conform to the requirements of Section [736](#). Vitrified clay pipe shall conform to the requirements of Section [743](#). Corrugated metal pipe shall conform to the requirements of Section [760](#).

605.3.1 Pipe Joints: Unless the pipe joints are of a self-aligning type, have the bottom half of the bell joint filled with mortar to securely hold the pipe in alignment and to bring the inner surface of abutting pipes flush and even. Where a tight joint for non-perforated pipe is required, the bell joint shall be completely filled with mortar.

605.4 SUBDRAINAGE MANHOLES:

Subdrainage manholes, including inlets, outlets, flap gates, gate boxes, and drop steps, shall comply with the requirements of the plans and the special provisions.

605.5 FILTER MATERIALS:

The filter materials shall be placed within the limits shown on the plans. The compositions of the filter materials shall each conform to one of the grading requirements in Table [605-1](#); the particular requirement to be used will be specified in the special provision.

The materials used shall conform to requirements for concrete aggregates in Section [725.3](#); however, the requirements for grading, and reactivity, as stated therein, shall not apply. The minimum bulk specific gravity shall be 2.50, by ASTM C127.

TABLE 605-1			
FILTER MATERIAL GRADING - % PASSING			
Screen or Sieve Size	TYPE		
	F1	F2	F3
3/4"		100	100
3/8"	100	80 - 100	70 - 100
No. 4	90 - 100	60 - 85	45 - 75
No. 8	75 - 90	45 - 70	30 - 60
No. 16	55 - 80	30 - 55	20 - 45
No. 30	30 - 60	15 - 40	10 - 30
No. 50	10 - 40	5 - 20	0 - 15
No. 100	0 - 15	0 - 10	0 - 5
No. 200	0 - 5	0 - 5	

SECTION 605

605.6 PLACEMENT:

605.6.1 General: The excavated subgrade shall be kept free of surface water. Mudholes, ruts, or soft spots due to the Contractor's operations shall be repaired at no additional cost to the Contracting Agency, as ordered by the Engineer.

Filter and drain material shall be placed around drainage pipe so as to provide even support throughout the entire length of the pipe and to permit the installed pipe to lie upon true alignment and grade. The minimum thickness of filter material surrounding the pipe shall be 6 inches.

Filter material shall be spread to such depth as to obtain the required thickness after compaction and shall be uniform and true to the line and grades indicated on the plans.

The surface under sloped bank lining or invert shall not show any variation or departure greater than ½ inch from the testing edge of a 10 foot straightedge. Ridges and humps shall be regarded depressions filled and compacted, and tested for straightness until grading is accomplished within the tolerance specified. No relative density will be required.

Pipe damage during placement or compaction shall be replaced by the Contractor at no additional cost to the Contracting Agency. The Contractor shall exercise due care to prevent water from surface drainage or other sources, mud, muck, or debris, from running into the filter material both during and after its placement, until the lining, backfill, or structure placed thereon is completed or set. The Contractor shall provide and operate drainage sumps and pumps, or equivalent means satisfactory to the Engineer, to prevent any such saturations of the filter materials.

605.6.2 Under Sloped Bank Lining: Those portions of filter materials which become subgrade for sloped bank lining shall be compacted by 4 passes of a small roller weighing not less than 600 pounds, and 20 pounds per inch of roller width, or by other means approved by the Engineer.

605.6.3 Under Invert: Those portions of filter materials which become subgrade for channel invert linings shall be compacted by 2 passes of a smooth-wheeled roller lapping 1 foot each pass, or by use of manually-operated hand tampers, or by other means as approved by the Engineer. The weight of the roller or the size of the tamper shall be approved by the Engineer.

605.6.4 In Trenches and Along Heels or Walls of Sides of Structures: The filter materials shall be placed in 1 foot lifts and compacted by hand-held tamping or vibrating equipment to the satisfaction of the Engineer.

605.7 TESTS OF THE SUBDRAINAGE SYSTEM:

Two separate tests shall be made on each subdrain line by the Contractor to assure the proper functioning of the subdrainage system.

Each test shall be conducted in the presence of the Engineer and shall consist of the flushing of the subdrain line with sufficient water to develop a flow of 5 cubic feet per minute out of the end of the line being tested, as measured by approved measuring equipment furnished by the Contractor.

When a channel invert slab is required, the first test of each completed section of the subdrain system shall be performed immediately prior to the placement of reinforcing steel for the channel invert slab and the second test shall be performed after completion of the channel invert work. Manholes shall be cleared of all debris prior to beginning the second test.

Final acceptance of the subdrainage system will be made only if the discharge is of uniform flow and of adequate quantity. Any necessary clearing of drain lines to meet the above requirements shall be performed by the Contractor at no additional cost to the Contracting Agency.

All costs involved in the performance of the tests, including the furnishing of all labor, equipment, and material required therefore, shall be included in the prices bid for the items under which the subdrainage system is to be constructed.

SECTION 605

605.8 PAYMENT:

Payment for the work included in this specification will be made on the basis of the lump sum or unit prices stipulated in the proposal, unless the payment for subdrainage work is included in the cost for other improvements. Such payment shall include full compensation for furnishing all labor, tools, and equipment and incidentals for doing the work involved.

- End of Section -

SECTION 607

TRENCHLESS INSTALLATION OF SMOOTH WALL JACKING PIPE

607.1 DESCRIPTION:

The Contractor shall furnish all labor, material and equipment as required for the trenchless operation for the installation of thirty-inch inside diameter (30" ID) and larger, tongue and groove smooth wall jacking pipe installed by horizontal earth pipe jacking or hand tunneling.

607.2 MATERIALS:

The jacking pipe shall be tongue and groove smooth wall reinforced concrete pipe per ASTM C76 class V, unless vitrified clay pipe per ASTM C1208, or centrifugally cast fiberglass reinforced polymer mortar pipe per ASTM D3262, is approved by engineer.

607.3 TRENCHLESS OPERATION:

Before starting operations, the Contractor shall submit in accordance with Section [105.2](#), detailed shop drawing of the bore pit and receiving pit shoring, the jacking pipe, bulkheads, installation method, and the annular grouting mix design and grouting method. The proposed installation method and equipment shall be at the Contractor's option, no field construction shall commence until the proposed installation method is approved in writing by the Engineer. The Engineer's approval shall in no way relieve the Contractor of the responsibility for damages of any nature which might occur as a result of the methods used.

The bore and reception pits for the trenchless operation shall be shored to safeguard existing sub-structures and surface improvements against ground movement.

The leading section of jacking pipe shall be equipped with a tunnel shield. Excavation shall be carried out entirely within the tunnel shield and no excavation in advance thereof will be permitted. Every effort shall be made to avoid any loss of earth outside of the tunnel shield. Excavated material shall be removed from the jacking pipe as excavation progresses.

Upon completion of the jacking operation and if the grade of the jacking pipe is acceptable, all voids around the outside of the pipe shall be filled with grout.

607.4 DEWATERING:

All water encountered during the trenchless operation shall be disposed of by the Contractor in a manner that will not damage public or private property or create a nuisance or health problem. The cost of furnishing pumps, pipes and equipment for dewatering shall be considered incidental to the work and no additional payment shall be made.

607.5 MEASUREMENT AND PAYMENT:

Measurement for jacking pipe shall be the number of horizontal linear feet from the end of jacking pipe in the bore pit to the end of jacking pipe in the reception pit.

Payment for jacking pipe shall be full compensation for furnishing all labor, material, tools, and equipment required for the trenchless installation of the jacking pipe, complete in place including but not limited to shop drawings, dewatering, jacking pipe, bulkhead placement, grouting, and the excavation and backfilling of pits.

When a Contractor has the option of jacking and/or boring or open cut construction, and elects to construct a pipeline by the jacking and/or boring method, he will be paid for the replacement of such items of work as pavements, curb and gutter, sidewalk, driveway and alley entrances, as allowed for by open cut construction.

- End of Section -

SECTION 610

WATER LINE CONSTRUCTION

610.1 DESCRIPTION:

The construction of all water lines shall conform to applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

610.2 GENERAL:

All pipes shall be delivered, handled and installed in accordance with the manufacturer's recommendations and/or applicable provisions of AWWA standards for installation of the various types of water mains specified, insofar as such recommendations and provisions are not in variance with the standard specifications and details.

Where water lines are to be constructed in new subdivisions or in conjunction with street repaving projects, the streets shall be pre-graded to within 6 inches of the new street subgrade prior to trenching or cut stakes shall be set for trenching.

610.3 MATERIALS:

All pipes for water lines shall be of the classes shown on the plans or as specified below.

(A) The 4-inch through 16-inch diameter pipe sizes may be PVC C900 or ductile iron, except where a particular material is specified by the agency or the contract documents. All pipes shall be minimum 150 psi design unless otherwise specified.

(B) Pipe 16 inches and larger may be either ductile iron, or concrete pressure pipe-steel cylinder type.

Ductile iron and cast iron water pipe and fittings per: Section [750](#). Concrete pressure pipe-steel cylinder type per: Section [758](#). C900 PVC per: AWWA C900-07.

Service material containing brass or bronze must comply with the current NSF 61-8 standards at the time the project begins.

All brass or bronze service material must meet the current AWWA C-800 standards.

Any product used in water line construction containing brass or bronze that comes in contact with potable water shall meet the current NSF standards and federal law.

Only such packing materials as are included in the list of acceptable materials in AWWA C-600 for installation of cast iron water main shall be used. The packing materials shall be handled in such a manner as to avoid contamination, and shall be dry when placed in the joints. All such materials shall be free of oil, tar, or greasy substances, except that treated paper packing material, jute, cement, or sulfur compound caulking will not be permitted.

610.4 CONSTRUCTION METHODS:

610.4.1 Trenching/Cover: All water mains in major streets shall have a minimum cover of 48 inches over the top of the pipe. Water mains in other locations shall have a minimum cover over the top of the pipe as follows:

(A) 36 inches for mains smaller than 12 inches.

(B) 48 inches for mains 12 inches and larger.

Cover for water mains will be measured from existing or proposed finished grade of pavement or from natural ground, whichever is deeper.

Except as otherwise required in this specification, the special provisions, or by the Engineer, trench excavation, backfilling and compaction shall be in accordance with the requirements of Section [601](#). Backfilling may be accomplished as soon as the pipe line has been installed to the satisfaction of the Engineer, subject to the requirements for testing per Section 611.

SECTION 610

610.4.2 Laying Pipe: No water main shall be deflected, either vertically or horizontally, in excess of that recommended by the manufacturer of the pipe or coupling.

If adjustment of the position of a length of pipe is required after it has been laid, it shall be removed and rejoined as for a new pipe.

Curb stops with flushing pipes or fire hydrants shall be installed at the ends of dead-end mains according to standard details.

Thrust blocks shall be installed in accordance with this specification.

Valve boxes and covers shall be according to standard details.

Ductile iron pipe shall be installed in accordance with this specification and pipe and fittings shall be in accordance with Section [750](#).

PVC C-900 pipe shall be installed in accordance with AWWA C900 and Section [601](#).

610.4.3 Blocking and Restraints: All pipe lines, valves and fittings 16 inches and smaller in diameter shall be blocked with concrete thrust blocks in accordance with standard details. Thrust block areas for pipe, valves and fittings larger than 16 inches in diameter shall be installed per details shown on the plans. The areas stipulated in the standard details are minimums and shall not be decreased.

If irregular soil or pressure conditions are encountered, a thrust block design revision or an alternate joint restraint system may be required by the Engineer.

When restrained/welded joints are specified to resist thrust forces, blocking is not required.

With the Engineers approval, restrained/welded joints may be used in lieu of thrust blocks.

Where restrained joints are specified on mains sixteen (16) inches in diameter and smaller, ductile iron pipe shall be used with an approved joint restraint method.

On mains sixteen (16) inches in diameter and larger where plans specify welding joints and where ductile iron pipe is furnished, joints shall be restrained by an approved joint restraint method for the distance specified.

610.4.4 Maintain Pipe Cleanliness / Pipe Cleaning: The interior of all pipe and fittings shall be kept as free as possible of all dirt and foreign material at all times, until the pipe is placed in the new line.

Every precaution shall be taken to prevent foreign material from entering the pipe. When on the project site, the ends of the pipe section shall be plugged, wrapped or tarped at all times when pipe laying is not in progress, which includes storage and staging at the site. The pipe shall be stored on a pallet, blocking or other means to prevent foreign materials from entering the pipe. The pipe line shall be protected by a water-tight plug or other means approved by the Engineer when the pipe is in the trench if pipe laying is not in progress.

If in the opinion of the Engineer, the pipe contains dirt that will not be removed during the flushing operation; the interior of the pipe shall be cleaned and swabbed, as necessary, with a .005 to .010 percent chlorine solution.

If the Contractor or pipe-laying crew cannot install the pipe in the trench without getting earth into it, the Engineer may require that, before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size be placed over each end of the pipe and left there until the connection is to be made to the adjacent pipe.

At the close of each day's work, and at times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer. Joints of all pipe in the trench shall be completed before the work is stopped. If water is in the trench, the seal shall remain in place until the trench is pumped dry.

SECTION 610

610.4.5 Testing: Hydrostatic testing shall be in accordance with [Section 611](#). After pressure testing and before placing in service, all water lines shall be disinfected. Disinfection shall be accomplished in accordance with [Section 611](#). All corporation stops used for testing and chlorination shall be left in the pipe line with the stop closed and all connecting pipe removed.

610.5 SEPARATION:

610.5.1 General: Water lines and sewer lines shall be separated to protect water lines from contamination by sewer lines.

The angle of a water line and sewer line crossing shall be limited to between (45) forty-five degrees and (90) ninety degrees. Intersection angles of less than (45) forty-five degrees shall not be allowed.

Separation distances are measured from the outside diameter of the water or sewer line, or the centerline of a manhole.

When water and sewer lines cannot meet separation requirements, extra protection is required as described in Subsection [610.5.5](#) and shown in Standard Details 404-1, 404-2 and 404-3.

Extra protection requirements for line crossings are measured from the closest outside surfaces of the sewer and water line.

Water line service connections to individual building supply and distribution plumbing shall not be placed below sewer lines, and shall otherwise comply with the separation requirements of the applicable plumbing code as applied by the Agency (Administrative Authority). Methods described for extra protection do not apply to these service lines.

Water and sewer lines shall not be constructed parallel within a common trench.

610.5.2 Water Line Separation from Gravity Sewer Lines: Water lines shall not be placed within two (2) feet horizontal and one (1) foot vertical above and two (2) feet vertical below gravity sewer lines.

Extra protection is required where a water line is placed within six (6) feet horizontal and two (2) feet vertical above a gravity sewer line.

Extra protection is required where a water line is placed within six (6) feet horizontal and any distance below a gravity sewer line.

610.5.3 Water Line Separation from Pressurized Sewer Lines: Water lines shall not be placed within six (6) feet horizontal and within two (2) feet vertical below or within two (2) feet vertical above a pressurized sewer line.

Extra protection is required where a water line is placed within six (6) feet horizontal and within six (6) feet vertical above a pressurized sewer line.

Extra protection is required where a water line is placed within (6) feet horizontal and any distance below a pressurized sewer line.

610.5.4 Water Line Separation from Manholes: Water lines shall not pass through or come into contact with any part of a sewer manhole and shall be separated six (6) feet horizontal from the center of a sewer manhole.

610.5.5 Extra Protection: New water lines that require extra protection from new sewer lines, shall have extra protection provided by using ductile iron pipe for both lines. Lines of standard pipe length shall be centered at the point of crossing so that no joints exist within six (feet) horizontal and only restrained or mechanical joints exist within ten (10) feet horizontal.

New water lines that require extra protection from sewer lines, shall have identification wrap and/or tape installed on the water and sewer lines for the length that requires extra protection for each line.

New water lines that require extra protection from existing sewer lines shall be constructed using the extra protection specified for new water lines, and the existing sewer line:

SECTION 610

- (1) shall be reconstructed using a standard length of ductile iron pipe centered at the point of crossing so that no joints exist within six (6) feet horizontal and only restrained or mechanical joints exist within ten (10) feet horizontal, or
- (2) shall be encased in 6 inches of concrete for the horizontal distance of the line that requires extra protection but for a distance no less than ten (10) feet horizontal.

Existing water lines that require extra protection from new sewer lines shall provide for extra protection by:

- (1) constructing the new sewer line and reconstructing the existing water line using ductile iron pipe for both lines with standard pipe lengths centered at the point of crossing so that no joints exist within six (feet) horizontal and restrained or mechanical joints exist within ten (10) feet horizontal, or
- (2) encasement of both the existing water line and the new sewer line in six (6) inches of concrete for the horizontal distance of the lines that require extra protection but for a distance no less than ten (10) feet horizontal.
- (3) Extra protection for existing ductile iron water lines can be met by the installation of restrained or mechanical joints on the existing water line within ten (10) feet horizontal of the crossing and either
 - (a) construction of new sewer line using a standard pipe length of ductile iron pipe centered at the point of crossing so that no joints exist within six (6) feet horizontal and restrained or mechanical joints exist within ten (10) feet horizontal, or
 - (b) encasement of the new sewer line in 6 inches of concrete for the horizontal distance of the line that requires extra protection but for a distance no less than ten (10) feet horizontal.

610.6 POLYETHYLENE CORROSION PROTECTION:

610.6.1 General: Where called for in the plans and specifications or directed by the Engineer, pipe, valves and fittings shall be protected from corrosion by encasement in a polyethylene protective wrapping referred to hereafter as polywrap. Although not intended to be a completely air and water tight enclosure the polywrap shall provide a continuous barrier between the pipe and surrounding bedding and backfill.

610.6.2 Materials: The polywrap shall be of virgin polyethylene, not less than 8 *mils* in thickness, formed into tubes or sheets as may be required. Naturally pigmented material may be used where exposure to ultraviolet light will be less than 48 hours.

Otherwise the material shall be pigmented with 2 to 2 1/2 percent of well dispersed carbon black with stabilizers.

The polywrap shall be secured as specified below with 2-inch wide pressure sensitive tape not less than 10 mils thick. This flexible tape shall consist of a polyethylene or polyvinyl chloride backing with a synthetic elastomeric adhesive film comprised of butyl rubber. Tape shall remain flexible over a wide range of temperatures, with tensile strength and elongation properties in conformance with ASTM D1000.

The minimum tube size for each pipe diameter shall be per Table [610-1](#).

SECTION 610

TABLE 610-1 (from AWWA C105-05)
POLYWRAP FLAT TUBE WIDTHS

Nominal Pipe Diameter (Inches)	Cast Iron Or Ductile Iron With Push-On Joints (inches)	Cast Iron or Ductile Iron With Mechanical Joints (inches)
4	14	16
6	16	20
8	20	24
10	24	27
12	27	30
14	30	34
16	34	37
18	37	41
20	41	45
24	54	53
30	67	.
36	81	.
42	81	.
48	95	.
54	108	.
60	108	.
64	121	.

610.6.3 Installation: The polyethylene tubing shall be cut into lengths approximately 2 feet longer than the pipe sections. With the pipe suspended from the center the tube shall be slipped over the spigot end and bunched up between the point of support and the spigot end. After the pipe is installed into the bell of the adjacent pipe the pipe shall be lowered to the trench bottom and the supporting sling removed from the center of the pipe. The pipe shall then be raised at the bell end enough to allow the tube to be slipped along the full length of the barrel with enough left at each end to overlap the adjoining pipe about 1 foot. A shallow bell hole must be made at each joint to facilitate installation of the polywrap.

Pull the bunched-up polywrap from the preceding length of pipe, slip it over the end of the new length of pipe, and secure in place with one circumferential turn of tape plus enough overlap to assure firm adhesion. Then slip the end of the polywrap from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Tape it in place.

The loose wrapping on the barrel of the pipe shall be pulled snugly around the barrel of the pipe, and excess material folded over the top of the pipe and the folds held in place by means of short strips of adhesive tape, at about 3 foot intervals along the pipe.

Repair any rips, punctures or other damage to the tube with the adhesive tape or pieces of tube material secured with tape.

Bends and reducers in the line shall be covered with polyethylene in the same manner as pipe.

Valves, tees, crosses and outlets shall be wrapped with flat sheets of the same material. The sheets shall be passed under valves and brought up around the body to the stem. Edges shall be brought together, folded twice and secured with the adhesive tape.

610.6.4 Payment for Polywrap: Payment for this item shall be per the provisions of Subsections [109.4](#) and [109.5](#) of the specifications unless this item is specifically called for on the plans or in the supplemental specifications or special provisions as a specific component and pay item for a given project.

610.7 VALVES:

Valves shall be installed in accordance with AWWA C-600 or AWWA C-603 modified as follows:

All tapping sleeves, gate valves, butterfly valves, air release and vacuum valves and corporation stops shall be in accordance with Section [630](#).

Just before installation in the trench, valves shall be fully opened and closed to check the action, and a record made of the

SECTION 610

number of turns required to fully open or close the valve. For valves 16 inches and larger, a member of the water utility shall be present to check the action and record the number of turns. The inside of all valves shall then be thoroughly cleaned and the valve installed.

Valves 12 inches and smaller in size shall be supported by concrete blocks, in accordance with the standard details.

Valves 16 inches and larger in size along with their bypass valves, shall be supported on concrete slabs, and/or concrete piers, as indicated on the plans.

Concrete supports shall be provided under valves in vaults and manholes, and shall be constructed an inch low, then grouted with non-shrink grout. Adjustable pipe supports shall be as indicated on the plans. Buried valves shall be supported on concrete blocks as detailed on the plans.

Valve boxes shall be installed over all buried valves in accordance with standard details.

Standard couplings or matching joints shall be used when more than one length of pipe is required, or when two or more pieces are joined, to form the valve box riser. Install extension stems on all valves where the operating nut is 5 feet or more below grade.

610.8 MANHOLES AND VAULTS:

Construction shall consist of furnishing all materials and constructing manholes or vaults complete in place, as detailed, including foundation walls, cast iron steps, frames, covers, and any incidentals thereto, at location shown on the plans.

Manholes shall be constructed to conform with the requirements of Section [625](#) and standard details, except the inside diameter shall be 60 inches.

Vaults shall be constructed of reinforced concrete conforming to Section [725](#) and of concrete pipe conforming to ASTM C76 Wall A or B. Vaults shall be kept moist for 7 days before backfilling.

610.9 FIRE HYDRANTS:

The Contractor shall furnish all labor, materials, and equipment necessary to install fire hydrants complete in place at locations shown on the plans in accordance with the standard details and special provisions. Fire hydrants furnished by the Contractor shall conform to the requirements of Section [756](#).

If paint is chipped, scuffed, or otherwise damaged during handling and installation, the Contractor shall touch up such spots as may be designated by the Engineer.

All hydrants must be flushed and left in good working condition with the control valve open.

610.10 COUPLINGS, JOINTS, GASKETS AND FLANGES:

(A) **Couplings:** The couplings used to join the pipe to flanged valve adapters shall have a minimum working pressure of 150 psi, and shall have a fusion-bonded epoxy finish. The coupling sleeves shall be carbon steel with a minimum yield of 30,000 psi. The flanges shall have a minimum yield of 30,000 psi and be ductile iron or carbon steel for sizes up to 12", or high-strength, low-alloy steel for sizes 14" and larger.

(B) **Joints:** The joints and fitting shall conform to Sections [750](#) and [752](#).

Bolts and Nuts:

- (1) Bolts, studs, and nuts used in underground field flanged connections or for connecting fittings shall be carbon steel compliant with ASTM A307, Grade A unless Grade B is specified. Bolts, studs, and nuts shall be in accordance with AWWA C111. Bolts and studs shall have Class 2A thread tolerance with the corresponding nuts having Class 2B

SECTION 610

tolerance. Bolts, studs and nuts shall have a hot-dipped zinc coating in accordance with ASTM F2329. All bolt diameters shall normally be 1/8 inch smaller than the bolt hole diameter. If specified, allowable exceptions to zinc coating shall be bolts, studs, and nuts made from 316 stainless steel per ASTM F593 or cadmium plated per ASTM B766. All bolts shall be hexagonal heads.

- (2) The minimum requirement for underground mechanical joint connections using T-head bolts shall meet the requirements of AWWA C111 using a high strength low alloy steel manufactured for atmospheric corrosion resistance per ASTM A242.

These bolted joints shall be protected as follows: Following installation and before backfilling, all couplings, steel flanges, bolts, nuts, anchor bolts and rods, bolting of all flanged valves, and all exposed steel shall be protected from corrosion by either of the two methods outlined below at the Contractor's option.

(A) Below ground installations shall be coated with NO-OX-ID "A" with a film of not less than 1/32 inch thick and then coated with cement mortar not less than 1 inch thickness before backfilling. Cement mortar shall be composed of 1 part cement, ASTM C150, Type II, low alkali, to 3 parts sand. Before application of the cement mortar coating the area to be protected shall be covered with a layer of 2 x 2 inch No. 14 gage welded wire fabric, firmly wired in place.

(B) Below ground installations shall be protected by the application of hot coal-tar enamel. The coal-tar enamel shall be in accordance with AWWA C-203 and shall be applied to the top part of the pipe or fittings by daubers for at least 2 coats for a total minimum thickness of 1/16 inch. The coal-tar for under side of the pipe flanges or fittings shall be applied by the pan or cocoon method as described below and in AWWA Manual M-11, Steel Pipe.

Pan Method: The coating pan is securely anchored in place on the underside of the pipe and straddling the connection to be coated. The pan shall be wide enough so that the entire connection will be coated.

Hot coal-tar enamel is poured into the pan, from one side only, until the pan is completely filled. The drain plug or valve, is then opened and the excess coal-tar drained out. The pan can then be removed. Details of the coating pan and corresponding dimensions are given in AWWA Manual M-11.

The upper portion of the connection, and all remaining exposed steel pipe, will then be coated by the use of a dauber. The coal-tar coating shall be applied in at least 2 coats for a minimum thickness of 1/16 inch. The daubers and method of application shall conform to AWWA C-203. No thinning will be allowed.

(C) **Cocoon Method:** The cocoon is formed by placing glass fiber cloth or roofing paper, of the proper width, around the underside of the connection and adjacent exposed steel pipe. The edges of the cocoon shall be securely fastened to the pipe. Backfill is lightly placed to the spring line, and the top of the cocoon is opened and layed back on the filled area and hot coal-tar enamel poured, from one side only, until the cocoon is completely filled. The loose backfill prevents rupture of the cocoon. The upper portion of the connection and remaining exposed steel pipe shall be coated as above.

(D) **Gaskets:** Except as otherwise provided, all gaskets for pipe lines shall be one piece full faced gaskets from one-ply cloth inserted SBR rubber material. Gaskets for flanges 20 inches and smaller shall be from 1/16 inch thick material. Gaskets for flanges 24 inches and larger shall be from 1/8 inch thick material. Gasket material shall be J-M 109 as manufactured by Johns-Manville Corporation or an approved equal. Physical characteristics of the rubber compound shall meet ASTM D2000, Class 4AA805A13.

(E) **Flanges:** Cast iron flanges shall conform to AWWA C-110 as to material, diameter, thickness, drilling, etc. Steel flanges shall be ring or hub type, and shall conform to AWWA C-207, Class D. All flanges shall be drilled and have flange diameters and bolt circles conforming to AWWA C-110, except bolt holes will be 1/8 inch larger than the bolts given for the various sizes. All bolts shall be as specified above and all flanges shall have a flat facing.

610.11 CONNECTION TO EXISTING MAINS:

Existing pipe to which connections are to be made shall be exposed by the Contractor as directed by the Engineer, to permit field changes in line, grade or fittings, if necessary.

SECTION 610

All connections to existing mains shall be constructed according to the plans.

Valves connecting new work to the existing system shall be kept closed at all times.

Only Agency personnel shall operate existing valves. The Contractor shall not operate valves in the existing system.

After disinfected samples have been taken and the new work passes the bacteriological tests, the new line shall then be turned over to the Contracting Agency with all branch lines and tie-in valves closed.

When shutdown of an existing water main is necessary in order to connect to the new lines, the Contractor shall make application and pay the required charges to the Contracting Agency. A conference between the Contractor's representative, Engineering Inspection, and Water Distribution personnel shall establish the time and procedures to insure that the shutdown will be for the shortest possible time. If necessary to minimize inconvenience to customers, shutdowns may be scheduled during other than normal working hours. The water supply to some customers, such as hospitals, cannot be shut off at any time. Provisions to furnish a continuous supply of water to such establishments will be required. After the procedures and time for a shutdown are agreed upon, it shall be the Contractor's responsibility to notify all customers in advance that the water will be turned off. When possible, customers shall be notified 24 hours in advance and in no case, except in emergency, shall notification be less than 30 minutes. Notification shall be in writing, giving the reason for the shutdown and the time and duration the water service will be shut off.

The Contracting Agency will close existing valves, but will not guarantee a 100% complete shutdown.

610.12 FIRE LINE SERVICE CONNECTIONS:

Fire line service connections shall be installed in accordance with standard details.

The fire line from the control valves at the main to the detector check valve shall be constructed of ductile iron pipe per Section [750](#).

610.13 METER SERVICE CONNECTIONS:

All new meters must be installed by the Contracting Agency after the proper application as required by Code with fees paid at prevailing rates.

When plans call for connections from a new water main to an existing water meter, the work shall include new copper pipe and fittings except as follows:

(A) Wrapped galvanized pipe shall be used to connect or extend existing galvanized service pipe. Type K soft copper pipe or tubing shall be used to connect or extend existing copper service pipe except when otherwise called for in the plans.

(B) When the existing main is not abandoned, and the existing meter is to be connected to the new line, the corporation stop at the old main shall be closed and the abandoned service line cut 6 inches from the old main.

(C) Taps and service connections to the new main shall be made prior to testing and disinfection of the new line.

(D) Meter service piping may be installed by drilling in place of open cut construction when approved by the Engineer.

When called for on the plans, the meter and box shall be relocated by the Contractor as directed by the Engineer. Existing meters which are shown on the plans to be relocated shall be located and installed in accordance with standard details.

Water meter boxes which are broken during construction shall be replaced by the Contractor at no additional cost to the Contracting Agency. Existing meter boxes which are already broken prior to start of construction shall be replaced by the Contractor with boxes furnished by the Contracting Agency. Boxes may be picked up by the Contractor after written authorization is received from the Engineer. The written authorization shall include the street address of each broken meter box and the size of meter box required. All water meter boxes shall conform to the standard details.

SECTION 610

610.14 CLEANUP:

When testing, chlorination, compaction, and cleanup do not follow pipe laying in an orderly manner, the Engineer reserves the right to close down trenching and pipe laying until these operations are adequately advanced.

610.15 PAVEMENT AND SURFACING REPLACEMENT:

Pavement and surfacing replacement shall be in accordance with the requirements of Section [336](#).

610.16 MEASUREMENT AND PAYMENT:

(A) Pipe:

- (1) Measurement of all pipe shall be of the linear feet of pipe installed, measured along the centerline of the pipe, through all valves and fittings, from the centerline of the fittings or centerline of valves on ends of pipe to the centerline of fittings, centerline of valves on ends of pipe or to the end of pipe, as the case may be, for all through runs of pipe. Measurement of lateral line pipes shall start at the centerline of valve at connection to the main. Measurement of service lines shall be from the centerline of the new main to the connection at the meter. Measurement shall be to the nearest foot.
- (2) Payment will be made at the contract unit price per linear foot of each type and size of pipe. Such payment shall be compensation in full for furnishing and installing the pipe and fittings, specials, adapters, etc., complete in place, as called for on the plans and/or on the standard details, and shall include all costs of excavation, removal of obstructions, shoring and bracing, bedding, backfilling, compaction, maintenance of traffic, testing, disinfecting, connections to existing lines or works, and all work not specifically covered in other pay items.

(B) **Service Line Connections:** Measurement shall be of the number of unit connections made for water services, if called for in the bid. Each bid item unit shall consist of the connection to the water main and to the meter, as may be required in the plan details. Payment will be made at the contract unit price for each water service connection and shall be compensation in full for labor materials (other than pipe) equipment, tapping, and all necessary incidentals. Payment for new service pipe required to make the connection will be made separately, as stipulated above. If no contract bid item exists for connections, then the cost for connections to meters and main lines shall be included in the corresponding pipe bid item unit price.

(C) **Relocation of Existing Meters and Boxes:** Measurement shall be of the number of meters and boxes moved and reinstalled. Payment will be made at the contract unit price for each meter and box relocated and installed.

(D) **Permanent Pipe Supports and Encasement of Existing Pipes:** Measurement shall be of each unit included in the bid, and payment shall be compensation in full for supporting or encasing existing pipe, as required on the plans, including excavation, form work, reinforcing, concrete, handling and controlling flows in the existing pipe, removing and replacing existing pipe where necessary, supporting, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section [336](#).

(E) **Concrete Thrust Blocks:** Concrete thrust blocks and anchors for all pipe 16 inches and larger shall be measured by the cubic yard(s) of concrete placed, as required on the plans and/or as directed by the Engineer. Payment will be made at the contract unit price per cubic yard, and shall be compensation in full for excavation, formwork, placing and finishing concrete, reinforcing, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section [336](#). All thrust blocks and anchors for 12 inches and smaller pipe shall be included in the linear foot cost of the pipe.

(F) **Valves:** Measurement of and payment for valves, tapping sleeves and valves, and valve boxes shall be for each item furnished and installed, as designated in Section [630](#).

(G) **Fire Hydrants:** Measurement shall be the number of fire hydrants installed. Payment will be at the contract unit price for the installation of each fire hydrant complete in place and in operating condition. The 6 inch ductile iron pipe and fittings, required for making the connection from the main to the hydrant, shall be a separate pay item in the proposal as described above.

SECTION 610

(H) **Pavement and/or Surfacing Replacement:** Payment for pavement and/or surfacing replacement will be made as stipulated in Section [336](#), except as otherwise established in this specification. The cost of pavement and/or surface replacement required for service line installations shall be included in the contract unit price for service line pipe.

- *End of Section* -

SECTION 611

WATER, SEWER AND STORM DRAIN TESTING

611.1 HYDROSTATIC TESTING:

Water lines, including all fittings and connections to the water mains shall be tested for water-tightness by subjecting each section to hydrostatic testing in accordance with applicable provisions of AWWA C-600, except as modified below, and shall consist of pressure testing and allowance testing.

The test section shall be slowly filled with potable water and all air shall be vented from the line. The rate of filling shall be as determined by the Superintendent of Water Distribution, with at least 24 hour notice required before tests are scheduled.

The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pumps, and measuring devices and all other equipment necessary for making the tests, including pressure gages, and shall pay the Contracting Agency for water used in the tests.

Hydrostatic Testing: Pressure testing may be made before or after backfilling, but backfilling must be completed before allowance testing. If the pipe is center-loaded, a visual inspection for leaks may be made along the pipe line while the test section is under test pressure, and all visible leaks repaired. However, if mechanical compaction is to be used in the backfilling operations as spelled out in AWWA C-600, the tests shall not be made until the backfilling is completed and compacted. Backfill and compaction for the full distance encompassed by restrained/welded joints shall be completed prior to testing. All connections, blowoffs, hydrants and valves shall be tested with the main as far as is practicable. Hydrostatic testing shall not begin until the pipe has been filled with water for at least 24 hours to allow for air venting.

- (A) **Pressure Testing:** Unless otherwise noted in the contract documents, the minimum prescribed test pressure shall be at least 200 psi for lines smaller than 16 inches and 150 psi for lines 16 inches or larger, not to exceed 5 psi over the minimum prescribed test pressure, as measured at the lowest end of the section under test. The duration of each pressure test shall be at least 2 hours, during which time the test section shall not drop below the minimum prescribed test pressure. If the pressure in the pipe test section has not stabilized by the end of the testing period, a hydrostatic retest will be required.

Each section of a new line between sectionalizing valves or between the last sectionalizing valve and the end of the project shall be tested separately as required in AWWA C-600, and/or as modified in these specifications, except that any such section less than 500 feet in length may be tested with the adjacent section, if both sections of line have the same pipe class rating. No section greater than 1/2 mile in total pipe length shall be tested without special written permission of the Engineer.

- (B) **Testing Allowance/Makeup Water:** Makeup water volume shall be determined after the pressure test has been satisfactorily completed and all backfilling and compaction has been completed to top of trench. Testing allowance shall be defined as the maximum quantity of makeup water necessary to be supplied into the pipe line section under test to restore the ending test pressure to the beginning test pressure, after the pipe line has been filled with water and all air expelled. The Contractor shall furnish the necessary apparatus and assistance to conduct the test.

The duration of each makeup water test shall be at least 2 hours. To pass the allowance testing, the quantity of makeup water from the pipe line shall not exceed the makeup water quantity allowed by the following formula, from AWWA C-600:

$$M = \frac{SD \sqrt{P}}{148,000}$$

in which

M = testing Allowance (makeup water), in gallons per hour.

S = length of pipe tested, in feet

D = nominal diameter of pipe, in inches.

P = test pressure of the pipe being tested, per 610.15 (A)

SECTION 611

Should the test on any section of the pipe line require more makeup water than allowed by the above formula, the Contractor shall locate and repair the defective pipe, fittings, or joint until the makeup water volume is within the specified allowance. All repairs and retests, if required, shall be made at the Contractor's expense.

Connections to the existing pipelines or existing valves shall not be made until after that section of new construction has satisfactorily passed the hydrostatic tests.

Ductile iron pipe used in conjunction with ACP will be tested to the ACP standards, unless otherwise directed by the Engineer. High pressure systems of all ductile iron pipe will be tested in accordance with AWWA C-600, Section 4.1.

611.2 DISINFECTING WATER MAINS

611.2.1 Flushing Completed Pipe Lines:

- (A) **Preliminary Flushing:** All mains 12 inches and smaller shall be flushed, prior to chlorination, as thoroughly as possible with the water pressure and outlets available. Flushing shall be done after the pressure test has been made. It must be understood that flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying. It is difficult to flush mains over 12 inches in diameter, so in such instances the requirements above, must be rigidly adhered to.

Heavy duty, factory bushed, tapped couplings, with corporation stops shall be located at all high points in the lines to allow the air to be removed prior to testing the water lines and at disinfection points as may be required. Field taps will not be permitted.

The couplings, at high points and disinfection points, shall be left exposed during backfilling until the testing is complete. Couplings and corporation stops shall be left on the mains upon completion of water mains.

- (B) **Valve Damage by Foreign Material:** Unless proper care and thorough inspection are practiced during the laying of water mains, small stones, pieces of concrete, particles of metal, or other foreign material may gain access to mains newly laid or repaired. If it is believed that such foreign material(s) may be in the main, all hydrants on the line shall be thoroughly flushed and carefully inspected after flushing to see that the entire valve operating mechanism of each hydrant is in good condition.

611.2.2 Chlorine Residual: Before being placed in service, all new mains and repaired portions of, or extensions to existing mains shall be chlorinated so that a chlorine residual of not less than 10 ppm remains in the water after 24 hours standing in the pipe.

611.2.3 Methods of Applying Chlorine: Any of the following methods of application of chlorine (arranged in order of preference) may be used, subject to the approval of the Engineer.

- Liquid chlorine gas-water mixture.
- Direct chlorine feed.
- Calcium or sodium hypochlorite and water mixture.

611.2.4 Application of Liquid Chlorine: A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device or, if approved by the Engineer, the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas or of the gas itself must provide means for preventing the backflow of water into the cylinder.

611.2.5 Chlorine-Bearing Compounds in Water: On approval of the Engineer, a mixture of water and a chlorine-bearing compound of known chlorine content may be substituted for liquid chlorine.

SECTION 611

(A) Compounds to be used: The chlorine-bearing compounds that may be used are: calcium hypochlorite*, and sodium hypochlorite**.

(B) Preparation of mixture: High-test calcium hypochlorite must be prepared as a water mixture for introduction into the water mains. The powder should first be made into a paste and then thinned to approximately a 1 percent chlorine solution (10,000 ppm). The preparation of a 1 percent chlorine solution requires the following proportions of powder to water:

Product	Amount of Compound	Quantity of Water (Gallons)
High-test calcium hypochlorite (65—70% Cl)	1 lb.	7.50
Liquid laundry bleach (5.25% Cl)	1—2 pts.	12.6

- **611.2.6 Point of Application:** The preferred point of application of the chlorinating agent is at the beginning of the pipe line extension or any valved section of it and through a corporation stop inserted in the top of the newly laid pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipe line extension.

- **611.2.7 Rate of Application:** Water from the existing distribution system or other source of supply shall be controlled so the rate of flow shall not exceed 500 gpm, unless approved by the Superintendent of Water Distribution, through a suitable measuring device into the newly laid pipe line during the application of chlorine. The rate of chlorine solution flow shall be in such proportion to the rate of water entering the pipe that the chlorine dose applied to the water entering the newly laid pipe shall produce at least 10 ppm of residual chlorine after 24 hours standing in the pipe. This may be expected with an application of 50 ppm, although some conditions may require more

On lines 12 inches in diameter or less, determination of the rate of flow of water into the line to be treated may be made by starting with the line full of water and measuring the rate of discharge at a hydrant located at the end of the pipe farthest away from the point of chlorine application.

For lines larger than 12 inches in diameter, the disinfection operation is generally started with the line empty.

Measurement of the flow of water into and out of all lines shall be made by means of a pitot gage, current type meter, or other approved device.

- **611.2.8 Preventing Reverse Flow:** Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Check valves shall be used to accomplish this.
- **611.2.9 Retention Period:** Treated water shall be retained in the pipe long enough to destroy all nonspore-forming bacteria. This period should be at least 24 hours and should produce no less than 10 ppm residual chlorine at the extreme end of the line at the end of the retention period.

NOTE: If the circumstances are such that less than a 24 hour retention period must be used, the chlorine concentration shall be increased to 100 ppm. Under these conditions, special care should be taken to avoid attack on pipes, valves, hydrants and other appurtenances.

- **611.2.10 Chlorinating Valves and Hydrants:** In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent. All valves in lines being disinfected shall be opened and closed several times during the 24 hour period of disinfection.
- **611.2.11 Final Flushing, Sampling and Testing:** Following chlorination, all treated water in the newly laid pipeline shall be thoroughly flushed until the replacement water throughout the new pipeline can be proved, by laboratory testing, comparable in quality to the water served to the public from the existing water system. Prior to sampling for laboratory testing, the residual chlorine throughout the length of the pipeline shall be reduced to 1.0 ppm or less. Once the required residual chlorine level in the pipeline is achieved, samples shall be taken as outlined below.

*Comparable to commercial products known as HTH, Perchloron, and Pittchlor.

** Known commercially as liquid laundry bleach.

SECTION 611

The Contracting Agency or its authorized representative will collect all samples for testing of the new water mains. To initiate the sampling and testing, the Contractor will present to the Contracting Agency a written request for such work no later than 24 hours prior to the time when samples are to be taken.

Samples shall be taken from a tap and riser located and installed in such a way as to prevent outside contamination. Samples shall never be taken from an unsterilized hose or fire hydrant, because such samples will seldom meet bacteriological standards. The number of sampling locations shall be as follows: Waterlines up to but less than 150 feet in length require one sampling riser installed as near the end as possible; lines 150 feet to 300 feet in length, two sampling risers, one near each end of the line; lines 300 to 3,000 feet in length, a minimum of three sampling risers. In addition, dead ends on main lines should be represented with a sampling riser.

The number of samples taken at each sampling location shall be determined by the Contracting Agency based on one of the following methods.

- (A) One sample from each sampling location which is examined and analyzed in the laboratory over a three day (72 hour) period.
- (B) Two samples taken on separate days from each sampling location. Satisfactory water quality of the new main shall continue for a period of at least two days (48 hours) as demonstrated by laboratory examination of these samples.

Upon completion of laboratory testing, results of all tests shall be sent by the laboratory to the Contracting Agency. Results of laboratory analysis will be interpreted by the Contracting Agency, and reported to the Contractor. Under no circumstance shall the Contractor contact the laboratory. If there is need for test results before written reports are submitted, such information shall be obtained only from the Contracting Agency or its authorized representative.

611.2.12 Repetition of Chlorination Procedure: Should the initial treatment fail to result in the conditions specified above, the original chlorination procedure shall be repeated until satisfactory results are obtained.

611.3 SEWER LINE TESTING:

Pressure testing of force mains shall be done in accordance with Section 611.1

Sewers and pipe lines shall be subject to acceptance testing after backfilling has been completed but prior to the placement of the finished surface material.

The Contracting Agency reserves the right to require testing of the entire installation. Cost of repairs or corrections necessary to conform to the following testing requirements will be borne by the Contractor at no additional cost to the Contracting Agency.

(A) Low Pressure Air Test:

Testing will be accomplished by the means of "Low Pressure Air Testing." Tests may be conducted by the Contractor or an independent testing firm. However, acceptance tests shall be made only in the presence of the Engineer.

Test Procedure:

- (1) Before testing, the pipe shall be thoroughly cleaned.
- (2) The Contractor shall seal off the section of pipe to be tested at each manhole connection. Test plugs must be securely braced within the manholes.
- (3) A minimum of two connecting hoses to link the air inlet test plug with an above ground test monitoring panel must be provided.
 - (a) One hose is to induce air through the test plug and into the test chamber.
 - (b) The second hose is for the purpose of monitoring the test pressure from within the enclosed pipe.
- (4) UNDER NO CIRCUMSTANCES ARE WORKERS TO BE ALLOWED IN THE CONNECTING MANHOLES WHILE A PRESSURE TEST IS BEING CONDUCTED.

SECTION 611

- (5) Add air slowly into the test section. After an internal pressure of 4.0 psi is obtained, allow internal air temperature to stabilize.
- (6) After stabilization period, adjust the internal air pressure to 3.5 psi, disconnect the air supply and begin timing the test.
- (7) Refer to Table [611-1](#) to determine the length of time (minutes) the section under test must sustain while not losing in excess of 1 psi as monitored by the test gauge. If the section of line to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.
- (8) Sections so determined to have lost 1 psi or less during the test period will have passed the leakage test. Those sections losing in excess of 1 psi during the test period will have failed the leakage test.
- (9) Appropriate repairs must then be completed and the line retested for acceptance.

TABLE 611-1			
SANITARY SEWER AIR TEST			
Minimum Test Time for Various Pipe Sizes*			
Nominal Pipe Size, in.	T (time), min/100 ft	Nominal Pipe Size, in.	T (time), min/100 ft.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

* The time has been established using the formulas contained in ASTM C828, Appendix.

(B) Hydrostatic Test:

Exfiltration Testing (water):

Sanitary sewer testing by means of exfiltration should only be considered when low pressure air testing cannot be used and only with the approval of the Engineer.

Testing Procedure:

- (1) The Contractor shall furnish all equipment for testing.
- (2) Seal off the downstream end of the line and fill with water to a minimum head of 4 feet in a stand pipe at the high end.
- (3) A period of at least one hour will be allowed for absorption time before making the test.
- (4) A suitable meter or method of measuring the quantity of water used is necessary.
- (5) The allowable water loss for sanitary sewers shall not exceed 0.158 gallons per hour per 100 feet of pipe per inch of diameter of pipe under a minimum test head of 4 feet above the top of the pipe at the upper end.

(C) Deflection Test for HDPE and PVC Pipe:

In addition to the tests prescribed above, the Contractor shall perform a deflection test on the system as directed by the Engineer. Any part of the installation which shows deflection in excess of 5% of the nominal inside diameter per Section [738](#) for HDPE pipe or in excess of 5% of the average inside diameter per ASTM D3034 for PVC pipe, shall be evaluated and appropriate remedy, if any, shall be performed.

After acceptance but prior to the termination of the warranty period, the Contracting Agency may test the long term deflection of the sewer. If the Contracting Agency determines that the deflection has exceeded 7 ½% of the average inside diameter, that portion of the installation shall be corrected by the Contractor at no cost to the Contracting Agency.

SECTION 611

(D) Closed Circuit T.V. Inspection:

The Contracting Agency reserves the right to visually inspect the interior of the sewer line using a television camera. Any defects in the pipe or construction methods revealed shall be corrected by the Contractor at no additional cost to the Contracting Agency.

611.4 POST INSTALLATION INSPECTION OF NEW MAINLINE STORM DRAINS:

(A) Video Inspection:

The Contractor shall provide the Engineer with an annotated video inspection record (either VHS or DVD format) of the new mainline storm drain pipeline. The video shall clearly show all joints, seals, connecting pipes, and manholes. This video shall be provided to the Engineer, and reviewed and approved by the Engineer prior to the Contractor being allowed to place the final pavement over the storm drain line.

(B) Deflection Test for HDPE and PVC Pipe:

In addition to the tests prescribed above, the Contractor shall perform a deflection test on the system as directed by the Engineer. Any part of the installation which shows deflection in excess of 5% of the nominal inside diameter per Section 738 for HDPE pipe or in excess of 5% of the average inside diameter per ASTM D3034 for PVC pipe, shall be evaluated and appropriate remedy, if any, shall be performed.

After acceptance but prior to the termination of the warranty period, the Contracting Agency may test the long term deflection of the storm drain. If the Contracting Agency determines that the deflection has exceeded 7 ½% of the average inside diameter, that portion of the installation shall be corrected by the Contractor at no cost to the Contracting Agency.

611.5 PAYMENT:

No separate pay item shall be contained in the proposal for disinfecting water mains. This operation shall be included in the price bid for the water mains, installed complete in place, as specified in the proposal

The Contracting Agency will pay for the initial Sewer C.C.T.V. inspection. Any additional inspection(s) required, due to the failure of the initial inspection, shall be paid for by the Contractor.

No separate payment will be made for this Storm Drain Video or Deflection Testing; the cost of the video and deflection testing shall be included in the cost of the pipe.

- End of Section -

SECTION 615

SANITARY SEWER LINE CONSTRUCTION

615.1 DESCRIPTION:

The construction or extension of sanitary sewer lines shall conform to the applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

615.2 MATERIALS:

Pipe used for sewer line construction, including specials, joints, and gaskets, shall be according to the following Sections, or as modified by the special provisions.

- Reinforced Concrete Pipe (RCP), see Section [735](#)
- High Density Polyethylene (HDPE) Pipe, see Section [738](#)
- Steel Reinforced Polyethylene (SRPE) Pipe, see Section [739](#)
- Polypropylene Pipe (PP), see Section [740](#)
- Vitrified Clay Pipe (VCP), see Section [743](#)
- Polyvinylchloride Pipe (PVC), see Section [745](#)
- Ductile Iron Pipe (DIP), see Section [750](#)

615.3 TRENCHING:

Trench excavation shall be accomplished in accordance with Section [601](#), except as specified below, or as modified by special provisions.

The Engineer shall furnish the Contractor alignment and elevation stakes at agreed-upon intervals and offset together with cut sheets showing the difference in elevation from the top of the stakes to the flow line of the pipe.

The trench shall be dry when the fine grading of the trench bedding is accomplished. Before placement of pipe the fine grade shall be carefully checked by use of a string line, laser beam, or other means so that when in final position the pipe will be true to line and grade, ± 0.05 feet for 12 inch and smaller diameter pipe and ± 0.10 feet for 15 inch and larger diameter pipe.

615.4 SEPARATION:

To protect water lines from contamination by sewer lines, separation and extra protection shall be in accordance with Section [610](#).

Sewer lines that are constructed of ductile iron pipe for extra protection shall be internally lined for sewer service.

615.5 PIPE INSTALLATION:

Pipe shall be of the type, class, and size called for on the plans. All pipe shall be protected during handling against impact shocks and free falls. No damaged or defective pipe shall be installed in the work. Pipe shall be kept clean at all times, and as the work progresses, the interior of the pipe shall be cleared of all dirt and superfluous materials of every description.

The laying of the pipe shall be in trenches free from water or debris, and shall commence at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a closed concentric joint with the adjoining pipe and to prevent sudden offsets of the flowline. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

The alignment and grade of each length of pipe shall be checked after setting by measurement from the string line, laser beam target or other means approved by the Engineer.

SECTION 615

At all times when work is not in progress, open ends of the pipe and fittings shall be securely closed to the satisfaction of the Engineer, so that no water, earth or other substance will enter the pipe or fittings.

615.6 FITTINGS:

All fittings shall conform to the requirements of the pipe specifications and shall be located as shown on the plans, or as directed by the Engineer, in accordance with the standard details.

615.7 JOINTING:

615.7.1 Gasket Joints: Prior to joining pipes, all surfaces of the portions of the pipes to be joined shall be cleaned, dried, and prepared in accordance with the manufacturer's recommendations. The joints shall then be carefully centered and completed.

Trenches shall be kept water-free during the installation of joints and couplings.

The joint and coupling materials shall be as specified in the appropriate pipe sections and shall be installed in accordance with the manufacturer's recommendations. Cement mortar joints will NOT be permitted in sanitary sewer construction.

615.7.2 Water Stops: Water stops will be required when connecting pipes other than VCP or RCP to concrete structures, manholes, etc. The water stop shall comply with Section [738](#) and shall be installed per manufacturer recommendations.

615.8 SANITARY SEWER SERVICE TAPS:

Sanitary sewer service taps shall be constructed in accordance with standard details.

To maintain structural integrity of the pipe, service tap connections into an existing flexible pipe shall be made in accordance with the pipe manufacturer's recommendations.

When any damage occurs to the pipe, the Contractor shall perform repairs, as recommended by the manufacturer at no cost to the Contracting Agency. Damage to the pipe will include but not be limited to gouging, marring, and scratching forming a clear depression in the pipe.

The locations of the service tap for each property shall be in the downstream $\frac{1}{3}$ of the lot, or as requested by the property owner. Sewer service taps shall not be covered until they have been plugged and marked in accordance with standard details and their location has been recorded by the Engineer. Electronic markers shall be placed at no greater depth than electronic locating devices can locate them (typically 2'-4').

615.9 SANITARY SEWER CLEANOUTS:

Cleanouts shall be constructed at locations shown on the plans, in accordance with the standard details.

615.10 MANHOLES:

Manholes shall be constructed to conform with the requirements of Section [625](#) and standard details.

615.11 BACKFILLING:

Backfilling and compaction shall be accomplished in accordance with Section [601](#) except as modified by special provisions.

615.12 TRENCHLESS INSTALLATIONS:

Trenchless installation of pipe shall be in accordance with [Section 602](#) or [Section 607](#).

SECTION 615

615.13 INSPECTION AND TESTING

Testing and inspection shall be in accordance with [Section 611](#).

615.14 PAVEMENT AND SURFACING REPLACEMENT:

Pavement and surfacing replacement shall be in accordance with [Section 336](#).

615.15 CLEANUP:

The Engineer has the right to close down forward trenching and pipe laying where testing, backfill, compaction and cleanup does not follow in an orderly manner.

615.16 MEASUREMENT AND PAYMENT:

(A) Sanitary Sewer Pipe and Fittings:

Measurement will be made horizontally through manholes and fittings and from centerline to centerline of structures, for the various types and sizes of pipe called for on the plans and in the proposal.

Payment for the various sizes and types of pipe will be made at the contract unit price per linear foot, and shall be compensation in full for furnishing and installing the pipe and fittings complete in place, as specified, including excavation, removal of obstructions, backfilling, compaction, sheeting and bracing, testing, and all incidental work not specifically covered in other pay items.

(B) Sanitary Sewer Service Lines and Taps:

Measurement of the number of taps installed will only be made when pay items for sanitary sewer taps are contained in the contract.

When pay items for sanitary sewer taps are contained in the contract, payment for sanitary sewer service taps will be made at the contract unit price and shall be compensation in full for furnishing and installing pipe and fittings needed to connect to the main, complete in place, as specified and called for on the plans and standard details, including all cost for furnishing and installing electronic markers, and all cost of excavation, removal of obstructions, shoring and bracing, backfilling, compaction, pavement replacement, maintenance of traffic, and all work incidental thereto.

The length of pipe required for the service lines shall be measured and payment made as Sanitary Sewer Pipe and Fittings. If no pay item is provided for the sanitary sewer taps, the connection cost including all costs for furnishing and installing electronic markers shall be included in the unit cost of the sanitary sewer pipe.

(C) Sanitary Sewer Cleanouts:

Measurement will be the number and type of cleanout installed.

Payment will be made at the contract unit price and shall be compensation in full for furnishing and installing pipe, fittings, and frame and cover as called for on the plans and in accordance with the standard details.

- End of Section -

SECTION 616

RECLAIMED WATER LINE CONSTRUCTION

616.1 GENERAL:

This specification prescribes standards for utility water mains for the purpose of conveying, under pressure, reclaimed water for permitted reuse. Installation of reclaimed water mains shall be constructed in accordance with these specifications for materials, installation, and identification.

616.2 MATERIALS:

Pipe materials shall be in accordance with Section [610](#).

Valves shall be in accordance with Sections [610](#) and [630](#).

Valve boxes shall be in accordance with Section [345](#), this Section and Detail 391-1 and 391-2. Manholes shall be in accordance with Section [625](#), [787](#) and this Section, and applicable Details.

616.3 INSTALLATION:

Pipe shall be installed in accordance with Sections [601](#), [610](#), and this Section.

Valves and risers shall be installed in accordance with this section.

Valve box debris caps shall be installed in accordance with this Section and Detail 392.

When a reclaimed water main is adjacent to or crosses a potable water main, the reclaimed water main shall be considered a pressure or force sanitary sewer and comply with Details 404-1, 404-2 and 404-3 for separation and/or protection. When reclaimed water main is adjacent to or crosses a gravity, pressure or force sanitary sewer, the reclaimed water main shall be considered a potable water main and comply to Detail 404-1, 404-2 and 404-3 for separation and/or protection.

616.4 IDENTIFICATION:

The color purple shall be used for identifying all pipes, valves, and other equipment used for conveying reclaimed water.

Reclaimed water identification tape shall be an inert polyethylene plastic impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The tape shall be a minimum of 4.0 mils thick and no less than 3 inches wide. The tape shall be purple and shall have the words, "CAUTION: RECLAIMED WATER LINE" or similar wording printed in black lettering continuously along the entire length. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water identification sleeving (pipe socks) shall be an inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The sleeving shall be a minimum of 4.0 mils thick. The sleeving shall be purple and shall have the words, "CAUTION: RECLAIMED WATER LINE" or similar wording printed in black lettering continuously along the entire length. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water identification decals shall be made of inert material resistant to cracking, peeling, and fading due to sunlight and heat. Decals shall have an aggressive adhesive to ensure permanent bonding to the surface that is being identified. The decals shall have the words, "CAUTION: RECLAIMED WATER - DO NOT DRINK" or similar wording printed in black lettering on a purple background. Lettering shall be a minimum 1 inch high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water pipe identified by stenciling shall use paint or ink resistive to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. Stenciled pipe shall have the words, "CAUTION: RECLAIMED WATER - DO NOT DRINK" or similar wording printed in black or white lettering on a purple background continuously along the entire length.

SECTION 616

Lettering shall be a minimum of 1 ½ inches high lettering shall be placed on a painted purple band a minimum of 3 inches wide that runs the entire length of the pipe.

Reclaimed water locating tape shall be an inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The tape shall be a minimum of 4.0 mils thick, 3 inch wide and contain a minimum thickness of 1/3 mil metallic foil or two embedded copper wires. The tape shall be purple and printed with the words, "CAUTION: RECLAIMED WATER LINE BELOW" or similar wordings printed in black lettering continuously along the entire length. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Integral colored reclaimed water pipe shall be purple in color and shall have the words, "CAUTION: RECLAIMED WATER-DO NOT DRINK" or similar wording printed in black lettering at intervals no greater than 3 feet. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water valve tags shall be inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The tags shall be purple and shall have the words, "CAUTION: RECLAIMED WATER-DO NOT DRINK" or similar wording printed in black lettering. The lettering shall be a minimum of ½ inch high.

616.4.1 Below- Ground Pipe:

(A) All below-ground reclaimed water pipelines shall be marked by identification tape, or sleeving, or integral coloring, or stenciling in conformance with this section.

Identification tape shall be installed parallel to the centerline and on top of the pipe. The identification tape shall be installed continuously for the entire length of the pipe and shall be securely fastened with plastic adhesive tape banded around both the pipe and identification tape at no more than 4-foot intervals.

Identification sleeving shall be installed so the wording runs along the top of the pipe. Care shall be exercised to avoid displacement of sock and to ensure its integrity.

Stenciled pipe shall be installed so the wording is parallel to the centerline and on top of the pipe.

(B) The Agency will need to maintain adequate records, install locating devices, conduct surveys, etc. to be capable of locating all below-ground reclaimed water mains as required by Arizona Revised Statutes 40-360. The means for locating the mains shall be at the discretion of the Agency. When locating tape is used, the tape shall be installed with the printed side up, directly above the pipe, parallel to the centerline, and buried 24 inches below the finished surface grade. The backfill shall be sufficiently leveled so that the tape is installed on a flat surface. Care shall be exercised to avoid displacement of the tape and to ensure its integrity.

In lieu of locating tape, a locating wire can be fastened by plastic adhesive tape to the top center of the pipe. The adhesive tape shall be banded around both the pipe and wire at no more than 4 foot intervals. The wire shall be continuous for the entire length of the pipe, without gaps, breaks, etc. The wire shall terminate above ground in a valve riser housing.

616.4.2 Above-Ground Pipe: All above ground pipe shall be identified by stenciling or decals in conformance to this section.

Stenciled pipe shall be installed so that the wording runs along both sides of the pipe.

Identification decals shall be placed on both sides of the pipe at intervals no greater than 3 feet. Surfaces shall be prepared to ensure proper adhesion of the decals.

616.4.3 Valves and Risers: Valve handles shall be affixed with tags in accordance with this section. Tags shall be securely fastened in a manner that ensures their visibility.

SECTION 616

Riser pipes shall be painted purple both inside and out from the top of the pipe to at least one foot below the finished grade.

Debris caps shall be required in all valve housings per Detail 392 and shall be colored purple and affixed with tags in accordance with this section. Tags shall be securely fastened in a manner that ensures their visibility.

616.4.4 Valve and Manhole Covers: Valve and manhole covers shall be stamped with the words or shall have raised lettering with the words "RECLAIMED WATER". Reclaimed water valve covers shall be of a shape that is not interchangeable with potable water valve covers.

-End of Section -

SECTION 618

STORM DRAIN CONSTRUCTION

618.1 DESCRIPTION:

This section covers pipe line construction used for the conveyance of irrigation water and storm drainage in streets, easements, and alley right of ways, under low hydrostatic heads.

Installation of pipe in laterals of Salt River Valley Water Users' Association or other irrigation districts shall conform to the specifications and permit of the respective irrigation district.

Installation of pipe in State Highways shall conform to the specifications and permit of the Arizona Department of Transportation.

Installation of pipe under railways shall conform to the specifications and permit of the respective railway agency.

618.2 MATERIALS:

Pipe used for storm drain construction, including specials, joints, and gaskets, shall be according to the following Sections, or as modified by special provisions.

- Cast-in-Place Concrete Pipe (CIPP), see Section [620](#).
- Reinforced Concrete Pipe (RCP), see Section [735](#). For permitted construction reinforced concrete pipe strength shall be equal to or higher than Class III, A-III, HE-III, or VE-III.
- Non-Reinforced Concrete Pipe, see Section [736](#).
- High Density Polyethylene (HDPE), see Section [738](#).
- Steel Reinforced Polyethylene (SRPE) Pipe, see Section [739](#).
- Polypropylene Pipe, see Section [740](#).
- Corrugated Metal Pipe, see Section [760](#).

The size, type, and minimum strength of pipe shall be as shown on the plans, or as specified. Pipe stronger than that specified may be furnished at the Contractor's option and at no additional cost to the Contracting Agency.

When specified in the special provisions pipe line layout drawings shall be furnished to the Engineer prior to the manufacture of the concrete pipe. Catch basin connector pipe need not be included in the pipe line layout; however, special prefabricated pipe connections to the main line shall be included. In lieu of including catch basin connector pipe in the pipe layout, a list of catch basin connector pipes shall accompany the layout. The connector pipe list shall contain the following information.

(A) Size and Class of pipe.

(B) Station at which pipe joins main line.

(C) Number of section of pipe, length of section, type of sections (straight, horizontal bevel, vertical bevel, etc.).

The pipe layouts will be used by the Contracting Agency for reference only, but their use shall in no way relieve the Contractor of the responsibility for the correctness of the layout.

618.3 CONSTRUCTION METHODS:

Trench excavation, backfilling, and compaction shall be accomplished in accordance with Section [601](#), except as specified below, or as modified by special provisions.

The laying of the pipe shall be in finished trenches free from water or debris, and shall be commenced at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden off-sets of the flow line. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

SECTION 618

Trenchless installation of pipe shall be in accordance with Section 602 or Section 607.

Variation from prescribed alignment and grade shall not exceed 0.10 foot and the rate of departure from or return to established grade or alignment shall be no more than 1 inch in 10 feet of pipe line unless otherwise approved by the Engineer. For closures and deflection angles greater than 10 degrees, joints shall be made by use of a bend, specially manufactured fitting, or by a concrete collar, per standard details.

618.4 POST INSTALLATION INSPECTION AND TESTING:

Post installation inspection and testing shall be in accordance with Section 611.4.

618.5 MEASUREMENT:

(A) Main Line Pipe: Shall be the number of linear feet of pipe laid as measured along the pipe axis.

Unless hereinafter modified, measurement shall extend through manholes when no change in pipe size occurs. When a change in pipe size occurs within a manhole, unless hereinafter modified, measurement for each size will be taken to the centerline of the manhole.

(B) Connecting Pipe: Shall be the number of linear feet of pipe installed, as measured along the pipe axis from a main line pipe, or a manhole, or a catch basin to a catch basin, or a plugged end, and shall include the portions of the connecting pipe embedded in the above structures.

618.6 PAYMENT:

(A) Main Line Pipe: Will be paid at the contract unit price per linear foot, to the nearest foot, for each size and type of pipe and shall be compensation in full for furnishing and installing the type of pipe as specified and as shown on the plans including removal of obstructions, excavation, bedding, backfilling, compacting, testing, joint materials, joining, collars, and field closures.

(B) Connecting Pipe: Will be paid at the contract unit price per linear foot, to the nearest foot for each type and size of pipe and shall be compensation in full for furnishing and installing complete in place as shown on the plans and as specified, the connecting pipe and specials including spur connections, removal of obstructions, excavation, bedding, backfilling, compacting, joint materials, joining, collars, field closures, and testing.

End of Section

SECTION 620

CAST-IN-PLACE CONCRETE PIPE

620.1 GENERAL:

This specification covers cast-in-place non-reinforced concrete pipe intended for use as storm sewers or irrigation lines. The abbreviated title is CIPP. CIPP is conduit made of Portland cement concrete cast monolithically in a properly prepared trench, using equipment specifically designed for this purpose. The type of equipment to be used by the Contractor must be approved by the Engineer and the Contractor may be required to furnish evidence of the successful use of this equipment on prior work. CIPP will be placed only:

- (A) By experienced operators. The Engineer will be the sole judge as to experience level.
- (B) In the presence of the Engineer.
- (C) In ground capable of standing unsupported from the bottom of the trench to the top of the pipe without sloughing.
- (D) In fill when it can be demonstrated to the satisfaction of the Engineer that the fill will adequately support the pipe.

620.2 MATERIALS:

620.2.1 Cement shall be ASTM C150, Type II, and low alkali as per Section [725](#).

620.2.2 Sand aggregate used for concrete and mortar shall conform to Section [725.3](#). Maximum size of the aggregate shall not be greater than $\frac{1}{3}$ of the minimum wall thickness up to and including a wall thickness of 4 $\frac{1}{2}$ inches. The maximum aggregate size is 1 $\frac{1}{2}$ inches.

620.2.3 Water used for concrete and for curing the pipe shall be as per Section [725](#).

620.2.4 Concrete shall be Class A in accordance with Section [725](#). Slump shall be the minimum required for satisfactory placement of the concrete by the equipment used by the Contractor. The slump shall not exceed 3 inches.

620.2.5 Bonding mortar shall consist of two (2) or more parts of cement to three (3) parts of sand by volume.

620.3 CONSTRUCTION METHODS:

620.3.1 Excavation: The trench will be neatly excavated with vertical sides and semi-circular bottom. The trench shall be shaped to form the bottom outside of the pipe on the alignment and to the grades specified in the plans. Departure from and return to established grade shall not exceed 1 inch per 10 linear feet with a maximum allowable departure of 1 $\frac{1}{2}$ inches. Departure from and return to specified alignment shall not exceed 2 inches per 10 linear feet with a maximum allowable alignment departure of 4 inches. The bottom of the trench, hereinafter known as the trench form, will be shaped to provide full, firm, and uniform support by undisturbed earth or compacted fill for at least the bottom 210 degrees of the pipe. Density of the fill shall be at least five percent (5%) greater than the natural in-place soil, but in no case less than 85 percent (85%) when tested in accordance with AASHTO T-99, Method A and T-191 or ASTM D6938.

When it is necessary to install the pipe in rocky areas, the rock will be removed and replaced with suitable fill material compacted to proper density. The rock will be over-excavated to leave 6 inches minimum compacted soil cushion between the rock and the pipe. For construction accuracy, areas left void by rock removal will be completely filled with compacted material, then trenched for the pipe as though natural ground. If the rock below the pipe subgrade is fractured or fragmented or if it consists of large cobblestones or boulders, the replacement fill material will be carefully selected to insure that it is of such gradation that it will not be removed downward by fluctuation of the water table. In no case will expansive soils be used for fill. A similar procedure of over-excavation, backfill, compaction, and retrenching will be used where sloughing sand or where soft or spongy soil conditions are encountered. When expansive clays are encountered, they will be thoroughly moistened by ponding, to completely expand the soil, and the moisture maintained until the concrete is placed.

Where the pipe is to be constructed through fill materials, such fill shall have stability in the zone of the trench form equal to firm undisturbed earth, in the area adjacent to the fill.

Upon direction of the Engineer, the Contractor shall substitute RCP or an acceptable alternate at locations where the conditions are unsuitable for CIPP. All cost for this substitution shall be borne by the Contractor.

SECTION 620

620.3.2 Placement: At the time of concrete placement, all soil in the trench will be adequately moistened so that water is not drawn from the freshly placed concrete. However, the trench form will be completely free of water, mud, and debris. All forming devices, including the slipforms and hopper of the placement device, shall be thoroughly moistened.

Concrete shall not be placed when temperature of the concrete exceeds 90 degrees Fahrenheit or is less than 50 degrees Fahrenheit. The soil adjacent to the trench shall be at a temperature above freezing.

The pipe shall be constructed in one placement, the entire cross-section being placed monolithically. Inside forms shall be sufficiently rigid to withstand consolidation of the fresh concrete. Placement shall be such as to produce a thoroughly consolidated homogeneous concrete mixture conforming to the test requirements of this specification. Effective consolidation means shall be applied to the fresh concrete over the entire circumference and from within the pipe shell. Consolidation means shall be capable of effectively placing and consolidating fresh concrete at production speeds. Methods of consolidating shall be capable of building up sufficient pressure to effectively bond the concrete to the surrounding earth and to keep loose sand, mud, and water out of the pipe shell.

(A) Construction Joints:

When work is stopped at the end of a placement or for any period that would permit initial set to take place, a construction joint shall be formed. The ends of the pipe that are to be in butt contact shall be left in rough condition with a slope of approximately 45 degrees. Before resuming, if the pipe diameter is 60 inches or less, an excavation shall be made along the sides and bottom of the joint to permit casting of a concrete collar around the outside of the joint. This collar shall have a minimum thickness of $1\frac{1}{4}$ times the wall thickness of the pipe and shall lap the entire joint by at least two (2) times the wall thickness. Immediately before resuming concrete placement the surfaces to be bonded shall be cleaned of all laitance, coatings, foreign materials, and loose or defective concrete, thoroughly wetted and coated with a layer of bonding mortar (Subsection [620.2.5](#)) approximately $\frac{1}{4}$ inch thick. In lieu of the bonding mortar, neat cement paste may be thoroughly scrubbed onto the wet surface of the previously placed concrete.

For a joint that may be used for connections to another pipe or structure, a joint shall be made by squaring off the end of the pipe. An excavation shall be made along the sides and bottom of the cast-in-place pipe, for any diameter, to permit casting of a concrete collar as described above.

The outside top of all joints shall be capped for the entire width of the pipe that is exposed, that is, between the earth walls of the excavated trench. This cap shall have a minimum thickness equal to the wall thickness of the pipe and shall lap the joint, both upstream and downstream from the joint by at least twice the wall thickness of the pipe. A cap as described is required regardless of pipe size.

(B) Pipe Dimensions and Tolerances:

- (1) The internal diameter of the pipe at any point shall not be less than 95 percent of the nominal diameter, and the average of any four (4) measurements of the internal diameter made at 45 degree intervals shall not be less than the nominal diameter.
- (2) For pipe less than 15 inches inside diameter, the minimum wall thickness shall be 2 inches. For pipe with an inside diameter of 15 inches to 24 inches the minimum wall thickness shall be $2\frac{1}{2}$ inches. For pipe exceeding 24 inches inside diameter, the minimum wall thickness shall be $\frac{1}{12}$ of the inside diameter, plus $\frac{1}{2}$ inch.
- (3) Offsets at form laps and horizontal edges shall not exceed $\frac{1}{2}$ inch for pipe having inside diameter not greater than 42 inches; $\frac{3}{4}$ inch for pipe having inside diameter greater than 42 inches, but not greater than 72 inches; and 1 inch for pipe having inside diameter greater than 72 inches.

620.3.3 Curing and Backfilling: The Contractor shall be responsible for proper curing of the concrete and backfilling the trench to an even grade. Final backfill and compaction shall not be started until concrete has developed a compressive strength of at least 2,000 psi. Curing shall be performed in such a manner as to prevent the premature drying of the concrete. The Contractor shall use one of the four methods described below.

(A) A 3 inch layer of moist loose soil or sand shall be carefully placed over the top of the pipe immediately after the pipe is cast. The backfill shall be material free of clods and rocks having a diameter greater than 2 inches and any other deleterious foreign materials. The backfill shall be carefully placed over the top of the pipe to prevent damage to the wet concrete. The thickness of

SECTION 620

the backfill shall be increased by 9 inches after initial set of the concrete has occurred. The backfill shall be kept moist at all times until the pipe has been covered to a depth of 12 inches or more

(B) The exposed top portion of the pipe may be covered with wet burlap or other material of high moisture retentive properties immediately after the pipe is cast. The covering material shall be kept continuously moist until the placement of final backfill as described above. Moisture retentive material may be removed or left in place at the option of the Contractor.

(C) A pigmented membrane-curing compound conforming to ASTM C309 may be applied to the exposed surface immediately after the pipe is cast. The compound shall be applied at the rate of not less than one (1) gallon for each 150 square of exposed concrete. The pipe shall then be covered with a minimum of 3 inches of moist loose soil when the curing compound is sufficiently hard to resist damage from the fill. Final backfill shall be placed when the pipe attains suitable strength.

(D) Polyethylene film complying with ASTM C171, nominal thickness 0.0015 inches may be placed on the exposed top surface of the pipe immediately after the pipe is cast. The film shall be anchored in place with loose soil to assure continuous, adequate curing. The trench shall be completely backfilled as soon as the pipe attains suitable strength.

A humid atmosphere within the pipe, as evidenced by condensation on the interior surface, shall be maintained for at least seven (7) days following placement, except for a maximum period of 48-hours allowed for removing forms and making repairs. To prevent air drafts which may dry the pipe and to maintain a humid atmosphere inside the pipe, all openings into the pipe line shall be kept closed or covered, except when and where work is actually in progress on the inside of the pipe. If necessary to promote high humidity, the pipe line will be partially filled with ponded water during the curing period.

620.3.4 Repair: Care shall be taken when removing the forms that the pipe is not damaged. Immediately after the removal of the forms, the inside of the pipe shall be inspected and all required repairs made before final backfilling begins. All spalls, cracks or indentations not satisfying Subsection [620.3.2](#)(A) shall be filled with mortar per Subsection [620.2.5](#). Cracks may be repaired with epoxy materials.

Longitudinal cracks exceeding 0.01 inches in width and 12 inches in length shall be cause for rejection of the pipe. The pipe section or reach in question shall either be removed or replaced or shall be repaired in a manner approved by the Engineer.

620.3.5 Finish: Except for the form offsets the interior surface of the pipe shall be equivalent to or better than a wood float finish. All extraneous concrete shall be removed from the interior surface.

620.4 METHODS OF TESTS:

Wall thickness shall be checked at the top, sides and bottom, every 100 feet. Where thickness is not determined by probes through the fresh concrete, small holes shall be drilled a day or so after placement. The holes shall be properly and permanently closed and sealed, flush with the inside surface of the pipe, after measurements are made.

Test cylinders shall be prepared and tested as per Section [725](#). If the cylinder tests indicate that the concrete does not meet the specified strength requirements, cores shall be taken from the same section of concrete represented by the faulty test cylinder under the supervision of the Engineer. The concrete should be at least 14 days old before the core specimens are taken. The diameter of the core specimens for the determination of compressive strength should be at least three (3) times the maximum nominal size of the coarse aggregate used and must be at least twice the maximum nominal size of coarse aggregate.

The length of the specimen, when capped, should be twice the core diameter. A core having a maximum height of less than 95 percent of its diameter before capping or a height less than its diameter after capping shall not be tested.

If cores are taken, the Contractor shall patch all core holes in such a manner that the patch will be permanent, will not leak, and will have a smooth interior finish flush with the interior surface of the pipe.

Procedures and payment for coring shall be in accordance with applicable portions of Section [725](#).

The Engineer will evaluate the test results and his decision as to required corrective action will be final.

SECTION 620

620.5 MEASUREMENT:

Measurement of cast-in-place concrete pipe will be the number of linear feet of pipe measured horizontally along the pipe axis from end to end of the pipe. At changes in diameter, the measurement shall be to center of manhole or transition.

620.6 PAYMENT:

Payment will be made at the contract unit price bid per linear foot to the nearest foot for each size of pipe and shall be compensation in full for furnishing and installing the cast-in-place concrete pipe as specified, including removal of obstructions, excavation, backfilling, compacting, testing, and all incidental costs not specifically covered in other items in the proposal.

- End of Section -

SECTION 621

CORRUGATED METAL PIPE AND ARCHES

621.1 DESCRIPTION:

These specifications cover plain galvanized, bituminous coated, and bituminous coated and paved galvanized corrugated metal pipe for use in storm sewers. The pipe shall be of the types, constructed as specified, and shall be manufactured in accordance with the requirements of the stated specifications. Except as otherwise required, corrugated metal pipe shall conform to AASHTO M-36 for Type I, Type IA, II and Type IIA. The external coating and internal lining shall be in accordance with AASHTO M-190 and Section [760](#).

621.2 MATERIALS:

The types of pipe and fabrication shall be in accordance with Section [760](#).

All helically-wound corrugated metal pipe shall have a marking system which shall provide a quick external visual check of diameter variations during and after the manufacturing process.

621.3 INSTALLATION:

Excavation, bedding and backfill shall be in accordance with Section [601](#), except as modified by standard details.

No pipe shall be laid except in the presence of an inspector. Each pipe shall be carefully inspected immediately before it is laid and defective pipe will be rejected. Pipe lines shall be laid to the grades and alignment indicated on the drawings. Variation from prescribed grade and alignment shall not exceed 0.10 foot, and the rate of departure from, or return to established grade or alignment shall be no more than 1 inch in 10 feet, unless otherwise approved by the Engineer. Proper facilities shall be provided for lowering sections of pipe into trenches. All pipes, elliptical or round, as well as pipe arches requiring external coating or internal lining shall be equipped with lifting lugs as required and shall have connecting bands designed to provide positive connection without damaging the coating on the pipe or pipe arch.

All field repairs to the bituminous coating or paving shall be made with approved fiber reinforced bituminous mastic.

Corrugated metal pipe and/or pipe arches shall be laid with separate section joined together in such a manner that the joint space shall not exceed ½ inch, with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the side. Elliptical pipe shall be installed so that the major or minor axis, whichever the case may be, and which should be indicated by suitable markings on the top of each end of the pipe sections, coincides with the survey alignment of the trench excavation. Any metal in the joints which is not thoroughly protected shall be coated with bituminous mastic. During the installation, the pipe shall be handled with care so as not to damage the external coating or internal lining. Coupling band bolts and damaged areas of the coupling bands and pipe shall be given a coating of bituminous mastic as specified above prior to placing the backfill. As determined by the Engineer, pipe that is damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced at no additional cost to the Contracting Agency.

621.3.1 Joints: Before the connecting band is placed around the pipe, the ends of the pipe that will be beneath the band, shall be coated with bituminous mastic or, if of suitable design, fitted with circular rubber gaskets to provide a watertight joint. The band shall be tightened evenly, keeping equal tension on the bolts. If mastic is used, tension shall be maintained over an interval of time until the flow of mastic terminates. The joint shall remain uncovered over a period designated by the Engineer, and before covering the joint the nuts shall be tested for tightness. If the nut has a tendency to loosen its grip on the bolt, it shall be tightened again and remain uncovered until a tight, permanent joint can be obtained. Prior to backfilling around the joint, the bolts, lugs, and nuts shall be given a coating of bituminous mastic. The annular space between abutting pipe sections shall be filled with bituminous mastic after jointing.

621.3.2 Pipe Elongation: Except as otherwise specified, the standard details shall control as to conditions under which pipe must be elongated. Pipe shall be elongated $5 \pm \frac{1}{2}$ percent of the nominal diameter to take advantage of the buildup of side support as it settles back toward a full round shape under the backfill load. The method or technique for obtaining and releasing the elongation shall be optional to the Contractor. Under no circumstances shall the vertical diameter of the pipe at any point along the pipe section, after backfill and compaction is completed, be less than the nominal diameter of the pipe, or more than 5 percent greater than the nominal diameter of the pipe as shown on the plans or specified elsewhere in this specification. Any

SECTION 621

damage done as a result of strutting shall be repaired as directed by the Engineer at no additional cost to the Contracting Agency. Strutting of pipe shall be approved by the Engineer.

621.3.3 Cutting: The Contractor will be prohibited from using conventional welding torches in cutting full lined CMP due to fire hazard. Pipe will either be sawcut or cut with special cutting tools which will not expose the pipe to the fire hazard of a normal acetylene torch. Whenever possible, connections shall be shop fabricated to prevent any exposure to fire hazard.

621.3.4 Repair of Damage to Coatings: Corrugated metal pipe shall be carefully handled at all times to prevent damage to the external coating, spelter coating, or internal lining. Each length of pipe shall be carefully inspected immediately prior to placing in the trench to ascertain that no damage has been done to the exterior coating that will be concealed when the pipe is placed. Any damage to the spelter coating shall be repaired to the satisfaction of the Engineer in accordance with Section [771](#). Any damage to the external coating or internal lining shall be repaired to the satisfaction of the Engineer with bituminous mastic as specified above.

621.4 TEST SPECIMENS:

All tests on the bituminous coating shall be made on samples secured from pipe delivered to or about to be delivered to the Contractor, or from the coating and lining facility of the pipe fabricator at the time the pipe is being coated.

Compliance with these specifications as set forth, shall be the responsibility of the Contractor. Three certified copies of test results indicating compliance shall be furnished for each lot or shipment prior to delivery of the material to the Contractor.

621.5 MEASUREMENT:

Measurement of corrugated metal pipe will be the number of linear feet of pipe, measured horizontally, from end to end of the pipe through manholes and specials. At changes in diameter the measurement will be to center of manhole or special.

621.6 PAYMENT:

Payment will be made at the contract unit price bid per linear foot, to the nearest foot, for each size and type of pipe and shall be compensation in full for furnishing and installing the corrugated metal pipe as specified, including removal of obstructions, excavation, backfilling, compacting, testing, and all incidental costs not specifically covered in other items in the proposal.

- End of Section -

SECTION 625

MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS

625.1 DESCRIPTION:

625.1.1 Manholes: Construction shall consist of furnishing all materials and constructing manholes complete in place, as detailed, including foundation walls, manhole frames, covers, and any incidentals thereto, at locations shown on the plans.

625.1.2 Sanitary Drop Sewer Connections: Construction shall consist of furnishing all materials and constructing drop sewer connections complete in place as detailed, including foundation materials, pipe, and any incidentals thereto, at locations shown on the plans.

625.2 MATERIALS:

Unless otherwise shown on the plans or specified in the special provisions, materials to be used shall conform with the following:

If allowed by the contracting agency, brick may be used for maintenance and adjustment of the existing sanitary sewer manhole or ring and cover. For the use of bricks in manholes see Section [775](#).

Cement mortar for manholes Class D, per Section [776](#).

Concrete for cast in place sanitary sewer manhole bases shall be Class A, for drop sewer connection shall be Class C, per Section [725](#).

Pipe used in sanitary sewer manholes or drop sewer connections shall comply with pipe requirements of Section [615](#).

Manhole frame and cover per Section [787](#) and cast in accordance with standard details.

Manhole steps shall not be used.

625.3 CONSTRUCTION METHODS:

625.3.1 Manholes: Manholes shall be constructed of precast concrete sections, or cast in place concrete. The invert channels shall be smooth and semi-circular in shape, conforming to the inside of the adjacent sewer sections. Changes in direction of flow shall be made with a smooth curve, having a consistent radius as large as the manhole will permit with no angle points. Changes in size and grade of the channels shall be made gradually, evenly, and uniformly throughout the manhole base.

Invert channels may be formed of concrete, half tile laid in concrete, or be constructed by laying full section of sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. The bench of the manhole outside the channels shall be smoothed and shall slope towards the channels.

The excavation shall be in such a manor, access is maintained around the manhole base before, during, and after placement of the manhole.

For cast-in-place manhole bases, a foundation of Class A concrete shall be constructed in accordance with the standard details and Section [505](#).

No brickwork shall be laid in water, nor, except as prescribed for curing, shall water be allowed to stand or run on any brickwork until the mortar has thoroughly set. Where new work is joined to existing unfinished work, the contact surfaces of the latter shall be thoroughly cleaned and moistened.

SECTION 625

Bricks shall be thoroughly moistened prior to placing, and shall be laid in full cement mortar beds. Every course may be a header course, but at least every fourth course shall be a header course. The horizontal cross-section of the manhole shall be circular unless otherwise called for on the plans or standard details. An oval or egg-shaped section will not be permitted. The brick manholes shall be mortared outside with ½ inch of cement mortar as shown. Inside of the brick wall shall be neatly pointed. The mortar coat shall be cured with a liquid membrane-forming compound conforming with Section [726](#) immediately after mortar has been placed and finished.

All machined surfaces on the frame and cover shall be such that the cover will lie flat in any position in the frame and have a uniform bearing through its entire circumference. Any frame and cover which creates any noise when passed over by automobiles shall be replaced. Frames shall be set firmly in a bed of mortar true to line and grade, all as shown on the plans and as called for in these specifications.

Backfilling shall be done in accordance with the requirements for trench backfilling as stated in Section [601](#).

625.3.2 Sanitary Sewer Drop Connections: Drop sewer connections shall be constructed in conformance with standard details.

Backfilling shall be done in accordance with the requirements for trench backfilling as stated in Section [601](#).

625.4 MEASUREMENT:

Each type of manhole installed, shall be measured as a complete unit, no distinction shall be made based on manhole depth.

625.5 PAYMENT:

Payment will be made at the contract unit price for each accepted manhole, and shall be compensation in full for furnishing and installing the manhole, complete in place, with formed or pre-cast inverts, concrete foundation, sanitary sewer drop connections sheeting and bracing, removal of obstructions cast iron frame and cover, excavation and backfill, paving cut replacement in excess of the applicable pay widths authorized in Section [336](#), and any incidentals thereto, in conformance with the plans and specifications.

- End of Section -

SECTION 630

TAPPING SLEEVES, VALVES AND VALVE BOXES ON WATER LINES

630.1 DESCRIPTION:

The installation of all tapping sleeves, valves and valve boxes shall conform to this specification and standard details, except as otherwise required on the plans or as modified in the special provisions.

630.2 GENERAL:

For valves 12 inches and smaller, the Contractor shall furnish the manufacturer's standard data and catalogues for gate valves, tapping valves, tapping sleeves, curb stop valves, butterfly valves and any castings.

For valves larger than 12 inches, the Contractor shall furnish shop drawings and technical data required for evaluating and approval of each type of valve, tapping sleeve and valve and butterfly valve. This information shall include complete details, dimensions, weights, diameter of stems, alloy for all valve parts, and any information that may be required to assemble, install, operate and maintain the valve.

The name of the manufacturer, the year of manufacture, the size of the valve, model number and rated working pressure, shall be cast on the body of each valve.

The Contracting Agency may test 10 percent of each type and size of valve furnished. Failure of any of the valves tested to meet these specifications shall be deemed sufficient cause to reject the entire lot delivered.

The internal working parts of valves of the same make, type, and size, shall be interchangeable.

630.3 GATE VALVES:

630.3.1 General: All valves shall conform to the latest revisions of AWWA standards supplemented as follows:

Valves shall be of the non-rising stem type and shall be counter-clockwise opening (left-hand).

The valve may be furnished with valve stems made from 300 or 400 series stainless steel.

Unless otherwise noted, valves shall have a 2 inch square operating nut.

All valves shall be class 150 or higher as necessary to withstand the requirements of the pressure and leakage test.

Bronze for all interior parts of valves shall contain no more than 6 percent zinc if made from cast bronze, or must conform to Copper Development Association #67600 if made from bar stock material.

All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with two coats of asphaltic varnish conforming to Federal Specifications TT-V-51c, or shall be epoxy coated as required above for interior surfaces.

By-pass valves, valves attached to side outlets and valves in blow-off lines shall be flanged.

Valves in air release and vacuum relief lines shall be flanged or screwed as shown on the plans.

Valves in fire hydrant lines shall have a flanged joint end on the side towards the main and a restraint or mechanical joint end on the side towards the hydrant.

SECTION 630

Valves larger than 20 inches shall have flanged ends, unless otherwise noted.

Valves 20 inches and smaller may be furnished with flanged ends, mechanical joint ends, or push-on joint ends compatible with the type of pipe used, unless otherwise noted.

630.3.2 Supplements Specifically Relating to Valve Sizes:

(A) Valves smaller than 3 inches:

Valves shall be threaded, all bronze, standard double disc, non-rising stem with wheel handles or brass ball style.

Service Material containing Brass or Bronze must comply with the current NSF 61-8 Standards at the time the Project begins.

All Brass or Bronze service material must meet the current AWWA C-800 Standards.

(B) Valves 3 inches through 12 inches:

Valves shall be iron body resilient-seated gate valves in accordance with the latest revision of AWWA C-509 or AWWA C-515.

The valve shall be designed to work equally well with pressure on either side of the gate.

The valve shall be equipped with o-ring packing.

(C) Valves. 14 inches through 20 inches:

Valves shall be iron body resilient-seated gate valves in accordance with the latest revision of AWWA C-509 or AWWA C-515, or shall be double-disc gate in accordance with AWWA C-500.

Valves designed in accordance with AWWA C-509 shall be designed to work equally well with pressure on either side of the gate

Valves designed in accordance with AWWA C-500 shall be equipped with bronze tracks, rollers and scrapers. The bolts, nuts, studs, etc., used with the gear case shall conform the requirements for Bonnet Bolting in AWWA C-500.

Valves shall be for operation in a horizontal position. The valve shall have bevel gears. The gears and stuffing box shall be enclosed in a watertight iron case, for operation in a buried location. The case shall be filled with grease at the factory.

By-pass valves shall be furnished and installed on each valve unless otherwise indicated on the approved plans. See Table [630-1](#) for by-pass valve sizes.

(D) Valves 24 inches and larger:

Valves shall be double-disc gate in accordance with AWWA C-500.

Valves shall be for operation in the horizontal position and equipped with bronze tracks, rollers and scrapers. Valves shall have bevel gears. The gears and stuffing box shall be enclosed in a watertight iron case, for operation in a buried location. Bolts, nuts, studs, etc., used with the gear case shall conform to the requirements for Bonnet Bolting in AWWA C-500. The case shall be filled with grease to the factory.

By-pass valves shall be furnished and installed on each valve unless otherwise indicated on the approved plans. See Table [630-1](#) for by-pass valve sizes.

630.4 TAPPING SLEEVES AND VALVES:

630.4.1 Tapping Valves: Tapping valves shall be identical in construction with the above specifications for gate valves. Tapping sleeves are considered an integral part of a tapping sleeve and valve assembly, with openings the same as the valve. Tapping valves shall have ends and seat rings of sufficient size to permit the use of full size cutters of either the Mueller or

SECTION 630

Smith type tapping machines. Tapping sleeve valves shall be flanged on one end to fit the tapping sleeve and a flange hub-end or mechanical joint on the other.

The tapping valve shall have the discs and seat ring so constructed that the inside diameter of the rings shall be at least 3/16 inch larger than the nominal size of the valve. The seat rings shall be bronze and shall have a minimum seating surface area equal to that of a standard gate valve, and the discs shall be proportionately larger to match.

Once the tap has been completed, the Contractor shall not operate the valve unless under direct supervision of the inspector.

TABLE 630-1	
BY-PASS VALVE SIZES	
Gate Valve Diameter in Inches	By-Pass Valve Diameter in Inches
16 to 20	3
24 to 30	4
36 to 42	6
48	8

630.4.2 Tapping Sleeves: Tapping sleeves shall be of extra heavy construction to provide resistance to line pressures. They shall be built in two halves for assembly around the main to be tapped.

The branch outlet shall have a flanged face for bolting to the tapping valve.

The inside diameter of the outlet branch shall be sufficiently larger than the nominal size to provide clearance for the full size cutters of the tapping machine.

Tapping sleeves shall be of the following types:

(A) Tapping sleeves for pipelines constructed of cast iron, ductile iron or asbestos cement:

Unless otherwise noted, the tapping sleeve assembly shall be pressure tested to 200 psi for a minimum of 30 minutes. The pressure test shall occur prior to tapping the main.

(1) Tapping sleeves in which the water is allowed to circulate between the sleeve and the outside surface shall comply to the following:

Gaskets of approved material shall be provided to form watertight joints along the entire length of the sleeve. The circumferential joints at the ends of the run of these sleeves shall be sealed by mechanical joints. Mechanical joints shall conform to the requirements set forth in AWWA C-111 as to dimensions, clearance, materials, etc. except the gaskets and glands for mechanical joints shall be in two pieces.

The longitudinal gaskets shall be totally confined or compressed between ridges and/or grooves extending continuously for the full length of both halves of the sleeve casting. Bolts shall be located close to the outside of the gaskets and closely spaced so as to exert sufficient pressure to form a watertight joint and to amply take care of any design stresses.

(2) Tapping sleeves in which the water is confined to the immediate area of the tap opening may be either of the following:

(a) Cast Iron - The outlet half of each sleeve shall be fitted with a continuous gasket of approximately circular cross-section permanently cemented into a groove surrounding the outlet opening. The back half of each sleeve shall be fitted with elastomeric pads, a metal shoe, or other device for developing adequate pressure on the gasket to prevent leakage at any pressure within the design capacity of the pipe. The sleeve shall be similar in construction to the Kennedy Square Seal or Rich-Corey improved sleeve.

(b) Stainless Steel, Type 304 - All integral metal parts of the sleeve shall be stainless steel, type 304. All welds shall be chemically treated and the residue removed so as to return the welded stainless steel to its original corrosion resistant state. The sleeve shall be capable of withstanding 125 ft.-lbs. of bolting torque without deformation of any

SECTION 630

sleeve components. Actual bolting torque during installation shall be as specified by the manufacturer.

All gaskets shall be of virgin styrene butadiene rubber (SBR), or equal, compound for water services. The complete circle gasket shall be 0.25 inch ± 0.03 thick and permanently attached to the sleeve. A dielectric insulating flange insulation kit shall be installed between the stainless steel flange and the cast iron valve. The kit shall contain full faced gaskets, full length sleeves, and single insulating washers. Insulation gasket material shall be neoprene-faced phenolic, insulation sleeves shall be mylar or minlon and full length, insulation washers shall be phenolic, or approved equal. All insulation material shall be of a type designated by the manufacturer as suitable for service at the operation temperatures and pressure specified.

(B) Tapping sleeves for concrete pressure pipes shall be fabricated tapping sleeves and comply to the following:

The sleeves shall be installed in accordance with AWWA Manual M-9. They shall also meet AWWA C-301, and AWWA C-303 standards pertaining to design, manufacturing, testing and welder qualifications. When tapping AWWA C-301 pipe, additional considerations pertaining to installation, testing and tapping shall be noted in the special provision and/or the plans.

The tapping sleeve assembly shall be designed to meet or exceed the pressure rating of the pipe using the same safety factors.

The tapping sleeve assembly shall be pressure tested to at least 5 percent over the actual working pressure in the pipeline. The main shall be pressurized to full working pressure during the test of the sleeve. The test shall occur prior to tapping of the main.

The sleeve shall be a three part design, back half, front half with draw flange and a gland as shown in Detail 342. The sleeve shall be designed to permit the cutting of the rods or prestressing wires of the pipe after installation of the two sleeve halves. The gland shall have a sealing gasket set in a retaining groove on the pressure plate. The sealing portion of the gasket shall be square or rectangular in shape and have minimum dimensions of 1/2 inch x 1/2 inch. The pressure plate on the gland shall be stabilized to eliminate flexing. The gland shall be equipped with load bearing set screws to protect the pipe cylinder from any excess loading caused by the valve, tapping machine, etc. The annular space between the sleeve and the gland shall be grouted through an opening in the sleeve.

Both halves of the sleeve shall be the same thickness and width. With approval from the Engineer, stainless steel strapped back sleeves will be permitted when the outside pipe diameter is irregular and cannot accommodate a full back sleeve.

The sleeves shall be furnished with grout horns/openings through which the annular space between the outside pipe surface and the sleeve shall be grouted.

All interior and exterior ferrous surfaces shall be epoxy coated to a minimum dry film thickness of 12 mils. Epoxy coating shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550 for use in a potable water system.

All bolts shall be 304 stainless steel.

No weld-on sleeves or nozzles will be permitted.

Tapping sleeves shall be JCM #415 Type 2 ESS or approved equal.

All external surfaces of the tapping sleeve shall be covered with a minimum of two inches of mortar. The mortar shall be Type "M" per Section [776](#) using Type II low alkali cement. The mortar shall be held in place by use of wire mesh.

The Contractor shall obtain the necessary dimensions for ordering the sleeve from direct field measurements. Excavation may be required to obtain the measurements. If an excavation is required, the Engineer may require the Contractor to return the land to its original use until the materials are delivered.

The contractor shall provide, for approval of the Engineer, the manufacture, shop drawings, calculations, and any other technical data as required by the Engineer for the tapping sleeve. Also, the contractor shall submit the manufacture history of

SECTION 630

6 successful production of the sleeves over the last year. The submittal shall include but not limited to the number, size, location, agency and contact person, etc.

The Contractor shall also provide, for approval by the Engineer, the name of the company/contractor/subcontractor to install the sleeve and perform the tap. The submittal shall include a history of 5 successful sleeve installations and taps per year over the last 3 years. The submittal shall include but not limited to the sizes and locations of the taps, the agencies and contact persons, the addresses and telephone numbers, etc.

630.4.3 Tapping and Associated Fees: Except for meter service connections, taps shall be made by the Agency at prevailing rates or by approved Contractors when allowed or requested by the Contracting Agency. After installation of the tapping sleeve and valve, the Contractor shall provide an excavation sufficient in size to accommodate the tapping operation.

The Contractor shall pay the established shutdown charge to the Contracting Agency every time it is necessary to shut off valves and take a section of a water main out of services.

The above charges, as well as charges for tap connections to steel cylinder and reinforced concrete pipe, are subject to change, as established by the Contracting Agency.

630.5 BUTTERFLY VALVES:

(A) 16 inches and larger:

Valves shall be in accordance with AWWA C-504 latest revision as modified herein:

- (1) Valve body shall be of cast iron or ductile iron with connecting ends one of or a combination of Flanged (Short Body), mechanical joint or ACP Hub End.
- (2) Valves shall be Class 150-B unless otherwise specified.
- (3) When requested the manufacturer shall furnish records of tests specified in AWWA C-504.
- (4) Shaft seal may be O-ring seal, V-type packing or pull down packing.
- (5) The valve disc may be either cast iron or ductile iron.
- (6) Valves and operators shall be for direct burial installation.
- (7) Valves to be furnished with manual operators and 2 inch square operating nut. Operator torque rating shall be calculated in accordance with AWWA C-504.
- (8) Valves shall open when turning the operating nut counter-clockwise.
- (9) Valves shall be installed with valve shaft in a horizontal position and the operating shaft vertical.
- (10) All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.
- (11) All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with two coats of asphaltic varnish conforming to Federal Specification TT-V-51c, or shall be epoxy coated as required above for interior surfaces.
- (12) A manufacturer's affidavit of compliance shall be furnished.
- (13) Shop drawings shall be furnished.

SECTION 630

(B) 3 inches through 12 inches:

This specification generally describes valves and operator assemblies designed for underground service, as manufactured by Dresser Industries, B-I-F Industries Incorporated, Henry Pratt Company, Allis Chalmers Manufacturing Company, or approved equal.

Where material or equipment is designated on the plans or in this specification by a trade or manufacturer's name, it is so designated primarily to establish standards of quality, finish, appearance and performance.

All specific requirements of this specification must be adhered to, and all necessary modifications shall be made in the article specified by the trade name, type or model or manufacturer's equipment to make it conform to all specific requirements of this specification.

The valves shall be in accordance with AWWA C-504, Class 150-B, except as modified herein:

- (1) Valve ends may be the thin type or wafer type to be installed between flanges drilled in conformance with ASA B 16.1-125 or may be flanged both ends or the valves may have bell ends with rubber gaskets, forecast iron pipe or asbestos cement pipe conforming to the kind of pipe being used.
- (2) Valves shall be designed for buried service with the valve shaft in a horizontal position and the operating shaft vertical.
- (3) Valves shall be left-hand opening, counter-clockwise unless shown otherwise on the plans.
- (4) Discs shall be Ni-Resist, ASTM A436, Type 1, or cast iron, ASTM A48, Class 40, in accordance with the following variations:
 - (a) Cast iron disc may be used providing the rubber seat ring is contained on the disc with the rubber ring closing against a Type 304 stainless steel ring or a bronze ring contained in the body of the valve.
 - (b) Ni-Resist disc may be used where rubber seat is contained in the valve body.
 - (c) Valves with rubber seats in the valve body may have cast iron discs with a Type 304 stainless steel or bronze edge seating surface retained on the edge of the disc.

Shafts and disc shaft fasteners shall be constructed of Type 304, stainless steel, unless the shaft is completely sealed from the line fluid. Valve shafts completely sealed from the line fluid may be of high strength steel with all other metal parts in contact with the line fluid to be Type 304 stainless steel.

Valves with rubber seat mounted in the body shall have the rubber either bonded or mechanically retained in its final position. Rubber seats which are on the disc edge shall be retained by a clamping ring and screws. Clamping ring and screws shall be made of 18-8 stainless steel, Type 304, or bronze conforming to ASTM B61 or ASTM B584.

Manual operators shall have AWWA 2 inch square operating nuts and shall require at least 2 turns per inch diameter to rotate the disc 90 degrees. Operators must accept a minimum of 300 ft. lbs. input torque on stops at ends of travel without damage to valve or operator. The operator torque rating shall equal, or exceed, the valves shown in Table I of AWWA C-504 for valve class specified above.

All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils.

Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions.

The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements AWWA C550-81, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with 2 coats of asphaltic varnish conforming to Federal Specification TT-V-51c, or shall be epoxy coated as required above for interior surfaces.

SECTION 630

630.6 AIR RELEASE AND VACUUM VALVES

Valve assemblies shall be furnished and installed where shown and as detailed on the drawings.

(A) Air release on water mains shall be controlled by the use of an air release valve assembly, of size and type as shown on the plans. Air release valves shall be of the flanged or screwed type as designated on the Agency's approved products list or in the special provisions.

(B) Vacuum and Air Relief when called for on the plans shall be controlled by a vacuum relief valve on the air release valve noted above. The valves shall be of the same manufacture or may be a combination air and vacuum valve assembly designated on the Agency's approved products list or in the special provisions.

630.7 CONSTRUCTION METHODS:

All valves, their supports, manholes, vaults, and valve boxes shall be installed in accordance with Section [610](#).

Valves 16 inches and larger, before being shipped from the factory, shall have the flanged ends completely covered with plywood. Plywood shall be left on the valve until just before installation in the line.

630.8 MEASUREMENT:

Measurement will be by the unit each of the various kinds and sizes of valves, manholes, vaults, or tapping sleeves and valves, including valve boxes and covers.

630.9 PAYMENT:

Payment will be made at the contract unit price and shall be compensation in full for the complete installation in place including all labor, materials, equipment, and all incidentals necessary to complete the installation. The compensation will also include the cost of necessary pavement replacement in excess of the pay widths allowed in Section [336](#) for pavement replacement over pipe trenches.

- End of Section -

SECTION 631

WATER TAPS AND METER SERVICE CONNECTIONS

631.1 DESCRIPTION:

This specification covers work by Contractors installing water services in new subdivisions by Permit and in projects under Contract. All the materials used shall comply with applicable standard specifications and the work performed in accordance with these specifications and standard details. The service connections shall be complete and all material shall be furnished by the Contractor except for the water meter.

All water service connections shall be constructed of Type K copper tubing or ultra high molecular weight polyethylene pipe of nominal iron pipe outside diameter.

All new subdivision water lines shall be staked for line and grade at 100 foot intervals by the Developer's Engineer prior to construction. All meter locations shall be staked by setting two stakes for line and marking one of the stakes for grade.

631.2 MATERIALS:

Copper pipe, tubing and fittings shall conform with Section [754](#). Polyethylene pipe shall conform with Section [755](#).

All fittings, pipe and tubing for polyethylene and copper pipe shall be as noted on standard details and as indicated in Section [610.3](#) Materials.

631.3 INSTALLATIONS:

631.3.1 General: Installation of copper tubing for meter service connections shall be in accordance with Section [754](#).

Meter service connection with copper tubing shall be in accordance with standard details.

The water service connection shall include the tap on the main, the corporation stop, the saddle if applicable, service pipe, appurtenant fittings, the curb stop, meter box and meter box cover, in accordance with standard details. Water meter boxes shall be installed in accordance with standard details to line and grade set by the Developer's Engineer. Upon acceptance, the Developer shall be responsible for damage to water meter boxes and covers until such time as the meters are installed by the Contracting Agency.

After the installation and acceptance of the water main and meter service pipe connections the water meter will be installed by the Contracting Agency upon proper application and payment of prevailing fees.

631.3.2 Standards: Except as otherwise specified all work shall be done in accordance with Sections [601](#) and [610](#).

631.3.3 Excavation and Backfill: The backfilling and compaction may be done as soon as the service line is installed, except backfilling and compaction shall not be completed around the corporation stop at the main water line until after inspection and recording of all tap locations. Trench bottom must be smooth and free of sharp objects. The minimum width of trench for water service pipe shall be 3 inches. The minimum depth of service pipe shall be 30 inches below the finished paving grade.

631.3.4 Polyethylene Pipe: Polyethylene pipe shall not be kinked, gouged or damaged during installation and backfilling operations. The pipe shall be placed in the trench allowing at least 12 inches per 100 feet for thermal contraction and expansion. Polyethylene pipe has a high thermal expansion and should never be confined under tension. The pipe should not be stored in the sun or left in the trench under abnormal high temperature. The pipe shall be carefully snaked in the trench bottom and covered up with uniform slack throughout its length. In trenches less than 8 inches in width, the expansion shall be obtained by making the tap on the opposite side of the main from the water meter and providing a loop of slack service pipe back over the top of the water main. Before installing, inspect pipe to detect any damage that may be caused by shipping, storage or handling. Damage spots can be cut out and pipe recoupled with Ford C-66-33, C-66-44, or approved equal brass compression fitting to form a continuous length. Damaged pipe shall not be used. Polyethylene pipe shall be cut only with a tubing cutter with rollers properly designated for the size of pipe being cut. When polyethylene pipe is used, the meter box setting must be placed parallel to the back of the sidewalk in accordance with standard details. Polyethylene pipe shall be installed with large sweeping bends

SECTION 631

with radius of not less than 18 inches. Polyethylene pipe has a cold flow characteristic and must not be installed under a stressed condition. Compression fittings only may be used with the plastic being held securely between metal to metal. Stainless steel or brass inserts shall be placed in the proper position in each compression fitting with care taken to assure that the insert remains in place when the fitting is tightened. All meter service lines shall extend at right angles from the main to the curb lines.

631.3.5 Service Taps: One inch and 3/4 inch service taps to new meter mains may be made with a saddle, tapped coupling or direct tap in accordance with the following provisions:

The Developer may use heavy tapped couplings for meter service connections on all sizes of pipe including the 3 inch pipe in cul-de-sac streets. Bronze corporation stops must be installed in the tapped couplings prior to pressure testing or disinfection of the water main. Normally in subdivisions no saddles are required for 6 inch pipe and larger. At the Contractor's option, saddles may be used on all 6 inch pipe and larger. All service connections on major and collector streets shall be made with saddles or heavy duty tapped couplings regardless of the water main size or service pipe size. All taps on pipe smaller than 6 inches must be made by either a saddle or heavy tapped coupling with bronze insert. Direct taps must be made by the use of a corporation stop with tapered AWWA machine thread. All wet taps must be made by the Mueller Type B-100 tapping machine or approved equal. A sharp tapping bit must be used in order to obtain clean sharp threads. In general, each tapping tool should be resharpened or discarded after making 6 taps. The minimum distance between taps, saddles, and tapped couplings shall be 3 feet.

631.4 TESTING:

All services, service taps and fittings shall be tested along with the water main in accordance with Subsection [610.14](#).

631.5 CLEANUP AND COMPLETION:

Upon completion and acceptance of all phases of the water main and meter service lines the Developer shall release the new subdivision water system to the Contracting Agency for final operation and maintenance with all interior valves and corporation stops in open position and with all meter curb stops and valves at the connections to existing mains closed.

631.6 INSPECTION:

The Developer's Engineer shall make an as-built plan and make a record of the locations of all water service connections prior to the connections being covered up. This as-built plan shall give the stationing of each service tap. The stationing to be continuous for each street, and shall begin at the street intersection or property line at the end of the block.

631.7 SERVICE OVER 2 INCHES:

All service taps larger than 2 inches shall be made by the Agency after an application and payment of prevailing fees, unless otherwise required by the Agency.

631.8 SERVICE ON EXISTING MAINS:

Where all or part of a new subdivision is served by existing water mains, only authorized personnel of the Contracting Agency shall install the service connections upon proper application and payment of prevailing fees.

- End of Section -

PART 700
MATERIALS

Section	Last Revised	Title	Page
701	2013	Aggregate	701-1
702	2013	Base Materials	702-1
703	2012	Riprap	703-1
705	2012	Portland Cement Treated Base	705-1
708	2011	Asphalt Pavement Core Bonding Materials	708-1
710	2015	Asphalt Concrete	710-1
711	2014	Paving Asphalt	711-1
712	1999	Liquid Asphalt	712-1
713	2012	Emulsified Asphalts Materials	713-1
714	2012	Microsurfacing Materials	714-1
715	2012	Slurry Seal Materials	715-1
716	2012	Cover Material	716-1
717	2015	Asphalt-Rubber Asphalt Concrete	717-1
718	2012	Preservative Seal for Asphalt Concrete	718-1
725	2014	Portland Cement Concrete	725-1
726	2015	Concrete Curing Materials	726-1
727	2008	Steel Reinforcement	727-1
728	2013	Controlled Low Strength Material	728-1
729	2014	Expansion Joint Filler	729-1
735	2015	Reinforced Concrete Pipe	735-1
736	2012	Non-reinforced Concrete Pipe	736-1
738	2012	High Density Polyethylene Pipe and Fittings for Storm Drain and Sanitary Sewer	738-1
739	2015	Steel Reinforced Polyethylene Pipe & Fittings for Storm Drain, Irrigation & Sanitary Sewer	739-1
740	2014	Polypropylene Pipe & Fittings for Storm Drain, Irrigation & Sanitary Sewer	740-1
741	2011	Lining for Reinforced Concrete Sanitary Sewer Pipe	741-1
742	2015	Precast Manhole	742-1
743	1998	Vitrified Clay Pipe	743-1
744	1998	ABS Truss Pipe and Fittings	744-1
745	1998	PVC Sewer Pipe and Fittings	745-1
750	2015	Iron Water Pipe and Fittings	750-1
752	1998	Asbestos-Cement Water Pipe and Fittings	752-1
753	2000	Galvanized Pipe and Fittings	753-1
754	2012	Copper Pipe, Tubing and Fittings	754-1

Section	Last Revised	Title	Page
755	2012	Polyethylene Pipe for Water Distribution	755-1
756	2008	Dry Barrel/Fire Hydrants	756-1
757	1998	Sprinkler Irrigation System	757-1
758	2005	Concrete Pressure Pipe - Steel Cylinder Type	758-1
759	2002	Steel Pipe	759-1
760	1998	Coating Corrugated Metal Pipe and Arches	760-1
761	1998	Structural Plate Pipe, Arches, and Pipe Arches	761-1
770	2013	Structural and Rivet Steel, Rivets, Bolts, Pins, and Anchor Bolts	770-1
771	2005	Galvanizing	771-1
772	2012	Chain Link Fence	772-1
775	2015	Brick and Concrete Masonry Units (Blocks)	775-1
776	2012	Masonry Mortar and Grout	776-1
778	1998	Lumber	778-1
779	1998	Wood Preservatives	779-1
787	1999	Gray Iron Castings	787-1
790	1999	Paint	790-1
792	2010	Dust Palliative	792-1
795	2014	Landscape Material	795-1
796	2010	Geosynthetics	796-1

SECTION 701

AGGREGATE

701.1 GENERAL:

Coarse and fine aggregates are defined in accordance with ASTM D2487. Material property requirements for specific uses are provided in applicable MAG sections.

Apparent specific gravity shall be at least 2.50, when tested in accordance with ASTM C-127.

701.2 COARSE AGGREGATE:

Rock and gravel shall be clean, hard, sound, durable, uniform in quality, and free of any detrimental quantity of soft, friable, thin elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance. Aggregate sources shall include, but not be limited to alluvial deposits, terrace aggregates, quarry stone, or other suitable sources including recycled products that meet all material test requirements as approved by the Engineer. Aggregate classification shall be made by size as noted herein.

701.2.1 Boulders: Particles of rock that will not pass a 12-inch square opening.

701.2.2 Cobbles: Particles of rock that will pass a 12-inch square opening, but are retained on a 3-inch square opening.

701.2.3 Coarse Gravel: Particles of rock that will pass a 3-inch U.S. standard sieve, but are retained on a 3/4-inch U.S. standard sieve.

701.2.4 Fine Gravel: Particles of rock that will pass a 3/4-inch U.S. standard sieve, but are retained on a No. 4 U.S. standard sieve

701.3 FINE AGGREGATE (SAND):

Fine aggregate (sand) shall be fine granular material produced by the crushing of rock or gravel or naturally produced by disintegration of rock and shall be sufficiently free of organic material, mica, loam, clay, and other deleterious substances to be thoroughly suitable for the purpose for which it is intended. Fine aggregates particles shall pass a No. 4 U.S. standard sieve, but are retained on a No. 200 U.S. standard sieve.

701.4 RECLAIMED CONCRETE MATERIAL (RCM)

Reclaimed concrete material (RCM) is defined as an aggregate material that is derived from the crushing, processing and classification of Portland cement concrete construction materials recovered, salvaged, or recycled from roadways, sidewalks, buildings, bridges, and other sources.

In accordance with Section 7 of AASHTO M319, RCM shall not contain more than five percent by mass of brick or concrete block and shall be substantially free of wood, metal, plaster, and gypsum board. RCM shall be free of all materials that fall under the category of solid waste or hazardous materials as defined by the state or local jurisdiction. With the approval of the Engineer, these respective quantities may be adjusted if the performance of the RCM is not adversely impacted. RCM may be used alone or uniformly blended with other approved aggregate materials to obtain the applicable performance criteria. RCM shall not be used in Portland Cement Concrete without the prior approval of the Engineer.

701.5 RECLAIMED ASPHALT PAVEMENT (RAP):

Reclaimed asphalt pavement (RAP) is defined as all recovered, salvaged or recycled asphalt road waste, large particles or milled material that has been size-reduced, crushed and or screened appropriately, making it reusable. This material shall be of a consistent and relatively clean manner as to not adversely affect the final material usage. RAP may be used alone or uniformly blended with other approved aggregate materials to obtain the applicable performance criteria. RAP shall not be used in Portland Cement Concrete without the prior approval of the Engineer.

SECTION 701

701.6 SAMPLING:

Sampling of aggregates shall be performed in accordance with ASTM D-75.

- End of Section -

SECTION 702

BASE MATERIALS

702.1 GENERAL:

Base materials shall be as defined in Section [701](#), consisting of appropriately sized coarse and fine aggregates, Reclaimed Concrete Material (RCM) or Reclaimed Asphalt Pavement (RAP), other inert materials, and/or aggregates that have been treated for plasticity index mitigation, as approved by the Engineer. These materials, whether virgin or reclaimed or a uniform blend of both, shall conform to the end result quality requirements of this section.

When base material without further qualification is specified, the Contractor shall supply materials that meet the gradation and other quality requirements for Aggregate Base Course as defined in Table [702-1](#). When a particular classification of base material is specified, the Contractor may substitute materials meeting the gradation and other quality requirements for Aggregate Base Course for Select material, when approved by the Engineer.

The Contractor shall provide the Engineer laboratory testing documentation on the source of the base material showing compliance to Table [702-1](#) at least 10 business days prior to placement except where the base materials are being obtained from a currently approved source from a list maintained by the appropriate Agency or as determined by the Engineer. Included in the documentation shall be the percentage of RCM or RAP, if applicable.

RCM meeting the requirements of Section [701.4](#) can be utilized in base material at a maximum quantity of 50% and may be used in roadway applications or where otherwise specified by project plans or special provisions.

RAP meeting the requirements of Section [701.5](#) can be utilized in base material up to 100% and may be used in roadway applications or where otherwise specified by Project plans or special provisions.

702.1.1 Aggregate Base Course is primarily used in roadway applications or where otherwise specified by project plans or special provisions.

702.1.2 Select Material is primarily used, as a sub base in roadways, fill and embankment applications or where otherwise specified by project special provisions.

702.2 PHYSICAL PROPERTIES:

702.2.1 Base material shall meet the physical properties listed in Table [702-1](#).

SECTION 702

Table 702-1			
Sieve Analysis			
Test Methods AASHTO T-27, T-11			
Sieve Size	Accumulative Percentage Passing Sieve, by Weight		
	Select Material		Aggregate Base Course
	Type A	Type B	
3 in.	100	--	--
1-1/2 in.	--	100	100
1 in.	--	--	90 – 100
No. 4	30 - 75	30 - 70	38 - 65
No. 8	20 - 60	20 - 60	25 – 60
No. 30	10 - 40	10 - 40	10 – 40
No. 200	0 - 12	0 - 12	3 – 12
Plasticity Index			
Test Methods AASHTO T-89 Method A, T-90, T146 Method A			
Maximum allowable value	5	5	5
Fractured Face, One Face			
Test Method ARIZ 212, Percent by Weight of the Material Retained on a #4 Sieve			
Minimum required value	50	50	50
Resistance to Degradation and Abrasion by the Los Angeles Abrasion Machine			
Test Method AASHTO T-96, Percent Loss by Weight			
Maximum allowable value at 100 revolutions	10	10	10
Maximum allowable value at 500 revolutions	40	40	40

702.2.2: When tested for acceptance, Base material that does not meet Table [702-1](#) properties for gradation or PI may be approved at the Engineer's discretion if the R-Value is at least 70, when determined by test method AASHTO T-190 (see Table [310-1](#)).

- End of Section -

SECTION 703

RIPRAP

703.1 GENERAL:

Aggregate for grouted and ungrouted riprap shall meet the requirements of Sections [701.2](#) and [703.2](#) unless otherwise stated in the project specifications.

Aggregate shall be color-matched with adjacent landscape aggregate if specified on the plans or in the special provisions.

The Contractor shall provide the Engineer, in writing, material information and the source location at least 10 days prior to use of the material unless the material is currently acceptable for use as determined by the Engineer.

703.2 PHYSICAL PROPERTIES:

Riprap shall have the following physical properties:

(A) The maximum aggregate size shall be 150% of the indicated D_{50} size and the minimum aggregate size shall be 50% of the indicated D_{50} size.

(B) Aggregate shall be angular and shall not exceed 3:1 ratio for flat and/or elongated pieces when determined by ASTM D4791. Rounded aggregate shall only be allowed when specified or approved by the Engineer.

(C) The loss by abrasion in the Los Angeles Abrasion Machine, determined as prescribed in ASTM C535, shall not exceed 40 percent (by weight) after 1000 revolutions.

- End of Section -

SECTION 705

PORTLAND CEMENT TREATED BASE:

705.1 GENERAL:

The cement treated base shall consist of aggregate, cement, and water. Use of other types of materials must be approved by the Engineer. The compressive strength requirement shall be determined by the project specifications. The amount of cement used in the mix design shall be determined by the project specifications.

705.2 AGGREGATE FOR CEMENT TREATED BASE:

The aggregate for cement treated base shall conform to the requirements of Section [702.2](#) Aggregate Base Course.

705.3 PORTLAND CEMENT AND WATER:

Portland cement and water shall conform to the requirements of Section [725](#).

705.4 CEMENT TREATED BASE MIX DESIGN:

A cement-treated base mix design incorporating the proposed materials shall be completed prior to the start of work. The mix design shall be performed in accordance with Arizona Department of Transportation test methods ARIZ-220, ARIZ-221, and ARIZ-222. Compressive strength specimens shall be tested in accordance with ARIZ-241.

The final report shall include the following elements:

- (1) The source and supplier of the aggregate including gradation and plasticity index testing.
- (2) The source, supplier, and type of cement.
- (3) The cement content required to meet the project specifications. Cement content shall be calculated by the dry weight of the combined aggregate-cement mixture.
- (4) The optimum moisture and maximum dry density of the proposed blend at the target cement content as determined by ARIZ-221.
- (5) The rock corrected optimum moisture and maximum dry density of the proposed blend at the target cement content as determined by ARIZ-222.
- (6) A summary of design compressive strength testing including a graph plotting cement content as the x-axis and compressive strength as the y-axis.

- End of Section -

SECTION 708

ASPHALT PAVEMENT CORE BONDING MATERIALS

708.1 GENERAL:

This specification covers the materials required to bond asphalt pavement cores to the asphalt concrete pavement from which it was originally removed.

708.2 MATERIALS:

Bonding material shall be a single component cementitious, rapid hardening, high strength, waterproof bonding agent conforming to the physical properties shown in Table [708-1](#).

TABLE 708-1		
Bond Material Properties		
Property	ASTM Test Method	Requirements
Bond Strength, psi	C882	20 min.
Compressive Strength, psi, (70 degrees F., 30 minute cure)	C109	200 min.

Bonding material shall be impervious to water penetration at the joint after curing.

Bonding material shall, within 30 minutes at minimum ambient temperature of 70 degrees F., allow an 18" diameter core to support a traffic load equivalent to at least three (3) times the AASHTO H-25 standard wheel load.

The bonding material is required to securely bond the asphalt concrete core to asphalt concrete pavement and to fill all voids between the core and pavement and within the core.

708.3 TEST REPORT:

Specifications and test results for the bonding material shall be submitted to the Agency for review and approval before use.

- End of Section -

SECTION 710

ASPHALT CONCRETE

710.1 GENERAL:

Asphalt concrete shall be a mixture of asphalt cement and mineral aggregates. Mineral admixture shall be included in the mixture when required by the mix design or by the Engineer. Asphalt concrete shall be produced in accordance with Section [321](#).

The designation for asphalt concrete mixes shall be based on the nominal maximum aggregate size of the mix. The applicable mix designations are 3/8 inch, 1/2 inch, 3/4 inch and Base (1") mix.

Each mix shall be designed using Marshall or Gyratory compaction methods. Either Gyratory or Marshall Mixes may be used for low or high traffic conditions, as determined by the agency. Low traffic conditions are conditions where the asphalt mix will be subject to low volume and low weight vehicle usage. Examples of this condition are residential streets, most parking lots and residential minor collector streets. High traffic conditions are conditions where the asphalt mix will be subject to high volume and/or heavy weight vehicle usage as found on major collector, arterial and commercial streets. Street classifications (i.e. minor collector and major collector) shall be determined by the specifying agency.

The following table (Table [710-1](#)) displays the recommended lift thickness for various asphalt concrete mix designations found within Section [710](#). Please note that these recommended lift thicknesses are minimums based on each mix designation's "Nominal Aggregate Size" and the relative coarseness of its gradation. The compacted thickness of layers placed shall not exceed 150% of the Minimum Lift Thickness of Table [710-1](#) except as otherwise provided in the plans and specifications, or if approved in writing by the Engineer.

TABLE 710-1		
RECOMMENDED MINIMUM LIFT THICKNESS FOR ASPHALT CONCRETE MIXES		
Asphalt Concrete Mix Designation (inches)	Minimum Lift Thickness Marshall Mixes	Minimum Lift Thickness Gyratory Mixes
3/8"	1.0 inches	1.5 inches
1/2"	1.5 inches	2.0 inches
3/4"	2.5 inches	3.0 inches
Base	3.0 inches	n/a

710.2 MATERIAL:

710.2.1 Asphalt Binder: The asphalt binder specified in this section has been developed for use in desert climate conditions. When used in other climates, consideration should be given to adjustments in the asphalt binder selection. The asphalt binder shall be Performance Grade Asphalt conforming to the requirements of Section [711](#) for PG 70-10, unless otherwise approved by the Engineer or specified differently in the plans or special provisions.

710.2.2 Aggregate: Coarse and Fine aggregates shall conform to the applicable requirements of this section. Coarse mineral aggregate shall consist of crushed gravel, crushed rock, or other approved inert material with similar characteristics, or a combination thereof, conforming to the requirements of these specifications.

Coarse aggregate for hot mix asphalt is material retained on or above the No. 4 sieve and Fine aggregate is material passing the No. 4 sieve. Aggregates shall be relatively free of deleterious materials, clay balls, and adhering films or other material that prevent coating with the asphalt binder. Coarse and Fine aggregates shall conform to the following requirements when tested in accordance with the applicable test methods.

SECTION 710

TABLE 710-2			
COARSE/FINE AGGREGATE REQUIREMENTS			
Characteristics	Test Method	Low Traffic	High Traffic
Fractured Faces, % (Coarse Aggregate Only)	Arizona 212	75, 1 or more	85, 1 or more 80, 2 or more
Uncompacted Voids, % Min.	AASHTO T-304, Method A	42	45
Flat & Elongated Pieces, % 5:1 Ratio	ASTM D4791	10.0 Max.	10.0 Max.
Sand Equivalent, %	AASHTO T-176	50 Min.	50 Min.
Plasticity Index	AASHTO T-90	Non-plastic	Non-plastic
L.A. Abrasion, % Loss	AASHTO T-96	9 max. @ 100 Rev. 40 max. @ 500 Rev.	9 max. @ 100 Rev. 40 max. @ 500 Rev.
Combined Bulk Specific Gravity	AI MS-2/SP-2	2.35 – 2.85	2.35 – 2.85
Combined Water Absorption	AI MS-2/SP-2	0 – 2.5%	0 – 2.5%

Tests on aggregates used in asphalt concrete outlined above, shall be performed on materials furnished for mix design purposes and composited to the mix design gradation.

Blend sand (naturally occurring or crushed fines) shall be clean, hard and sound material which will readily accept asphalt binder coating. The blend sand grading shall be such that, when it is mixed with the other mineral aggregates, the combined product shall meet the requirements of Table [710-2](#).

The natural sand shall not exceed 20 percent for the Marshall mixes and 15 percent for the Gyratory mixes by weight of the total aggregate for a mix.

710.2.3 Reclaimed Asphalt Pavement (RAP): When allowed by the Engineer, Reclaimed Asphalt Pavement (RAP), as defined in Section [701.5](#), may be used in asphalt concrete provided all requirements of Section [710](#) are met. References to use of RAP in Section [710](#) apply only if RAP is used as part of the mixture.

When RAP is used in asphalt concrete, it shall be of a consistent gradation, asphalt content, and properties. When RAP is fed into the plant, the maximum RAP particle size shall not exceed 1 1/2 in. The percentage of asphalt in the RAP shall be established in the mix design. The percentage of RAP binder shall be established in the mix design.

When RAP is used in base and intermediate courses, the amount of RAP aggregate and RAP binder should not exceed 30% contribution; Surface courses should be limited to 20% RAP aggregate and RAP binder contribution.

In addition to the requirements of Section [710.3.1](#), the job mix formula shall indicate the percent of asphalt RAP and the percent and performance grade of virgin (added) asphalt binder.

When less than or equal to 15% RAP binder is used by weight of total binder in the mix, the added virgin binder shall meet the requirements for PG 70-10 as shown in Section [711](#). When greater than 15% RAP is used by weight of the total binder in the mix, the added virgin binder will be dropped one grade for low and high temperature properties to a PG 64-16, unless testing indicates that the blend of the recovered RAP binder and virgin binder meets the requirements for PG 70-10 as shown in Section [711](#). The virgin asphalt binder shall not be more than one standard asphalt material grades different than the specified mix design binder grade.

710.2.4 Mineral Admixture: Mineral admixture when used as an anti-stripping agent in asphalt concrete shall conform to the requirements of AASHTO M-17. Mineral admixture used in asphalt concrete shall be dry hydrated lime, conforming to the requirements of ASTM C1097 or Portland cement conforming to ASTM C150 Type II or ASTM C595 Type IP. The amount of hydrated lime or Portland cement used shall be determined by the mix design. The minimum Mineral admixture content within a mix will be 1.00 percent, by weight of total aggregate.

SECTION 710

710.3 MIX DESIGN REQUIREMENTS:

710.3.1 General: The mix design for asphalt concrete shall be prepared by a laboratory that is accredited through the AASHTO Accreditation Program (AAP) in Hot Mix Asphalt Aggregates and Hot Mix Asphalt. The laboratory shall be under the direct supervision of a Civil Engineer, registered by the State of Arizona, and who is listed by ADOT as a “Qualified Asphaltic Concrete Mix Design Engineer” within ADOT’s latest list of approved laboratories. The latest list of approved laboratories is available on ADOT’s web page www.azdot.gov. The date of the design shall not be older than one year from the date of submittal, unless supportive documentation is provided and approved by the Engineer.

The mix design report shall include the following elements as a minimum.

- (1) The name and address of the testing organization and the person responsible for the mix design report.
- (2) The mix plant identification and/or location, as well as the supplier or producer name.
- (3) A description of all products that are incorporated in the asphalt concrete along with the sources of all products, including admixtures and asphalt binder, and their method of introduction.
- (4) The supplier and grade of asphalt binder, the source and type of mineral aggregate, and the percentage of asphalt binder and mineral admixture used.
- (5) The percentage of RAP and RAP Binder being contributed to the total mix shall be included in the mix design report.
- (6) The mix design report whether Gyratory or Marshall shall state the traffic condition (low or high traffic) and size designation.
- (7) The results of all testing, determinations, etc., such as: specific gravity and gradation of each component, water absorption, sand equivalent, loss on abrasion, fractured coarse aggregate particles, Tensile Strength Ratio (ASTM D 4867), Marshall stability and flow, asphalt absorption, percent air voids, voids in mineral aggregate, and bulk density. Historical abrasion values may be supplied on existing sources. The submittal should include a plot of the gradation on the Federal Highway Administration’s 0.45 Power Gradation Chart, plots of the compaction curves and the results of moisture sensitivity testing.
- (8) The laboratory mixing and compaction temperature ranges for the supplier and grade of asphalt binder used within the mix design.
- (9) A specific recommendation for design asphalt binder content and any limiting conditions that may be associated with the use of the design, such as minimum percentages of crushed or washed fine aggregate.
- (10) The supplier’s product code, the laboratory Engineer’s seal (signed and dated), and the date the design was performed.
- (11) If a Warm Mix Technology or additive is used; the following shall be included:
 - Technology type and supporting manufacturer information; including instructions pertaining to laboratory mixture temperatures and curing.
 - Amount (%) of additive (technology) used in the mixture.
 - Attached copy of the ADOT approved product list, showing additive/technology
 - Minimum plant production temperature shall not fall below manufacturer’s recommendation.
 - Minimum field compaction temperature shall be identified.
 - Identify any special mixing or compaction temperatures or special methods to be used when conducting OA or OC testing of field collected samples. Example: if the field collected samples of warm mix asphalt can be treated as conventional hot asphalt mix, provide the equivalent conventional hot asphalt mix compaction temperature.

SECTION 710

The mix design shall be submitted to the Agency or Engineer by the Contractor/Supplier for which it was developed as part of his project submittals. Once the mix design has been approved by the agency or Engineer, the Contractor and/or his supplier shall not change plants nor use additional mixing plants without prior approval of the Engineer. Any changes in the plant operation, the producer's pit, the asphalt binder, including modifiers in the asphalt binder, or any other item that will cause an adjustment in the mix, shall be justification for a new mix design to be submitted.

710.3.2 Mix Design Criteria: The mix design shall be performed by one of two methods, Marshall Mix Design or Gyratory Mix Design. The method shall be specified on the plans, special provisions, or by the Engineer. A minimum of 4 points will be used to establish the mix design results. The oven aging period for both Marshall and Gyratory mix design samples shall be 2 hours.

710.3.2.1 Marshall Mix Design: The Marshall Mix Design shall be performed in accordance with the requirements of the latest edition of the Asphalt Institute's Manual, MS-2 "Mix Design Methods for Asphalt Concrete." The mix shall use the compactive effort of 75 blows per side of specimen. The mix shall comply with the criteria in Table [710-3](#).

TABLE 710-3					
MARSHALL MIX DESIGN CRITERIA					
Criteria	Requirements				Designated Test Method
	3/8" Mix	1/2" Mix	3/4" Mix	Base Mix	
1. Voids in Mineral Aggregate: %, min	15.0	14.0	13.0	12.0	AI MS-2
2. Effective Voids: %, Range	4.0±0.2	4.0 ±0.2	4.0 ±0.2	4.0 ±0.2	AI MS-2
3. Absorbed asphalt: %, Range*	0-1.0	0-1.0	0-1.0	0-1.0	AI MS-2
4. Dust to Eff. Asphalt Ratio, Range **	0.6-1.4	0.6-1.4	0.6-1.4	0.6-1.4	AI MS-2
5. Tensile Strength Ratio: % Min.	65	65	65	65	ASTM D 4867
6. Dry Tensile Strength: psi, Min.	100	100	100	100	ASTM D 4867
7. Stability: pounds, Minimum	2,000	2,500	2,500	3,000	AASHTO T-245
8. Flow: 0.01-inch, Range	8-16	8-16	8-16	8-16	AASHTO T-245
9. Mineral Aggregate Grading Limits					AASHTO T-27
	Percent Passing with Admix				
Sieve Size	3/8 inch Mix	1/2 inch Mix	3/4 inch Mix	Base Mix	
1-1/4 inch				100	
1 inch			100	90-100	
3/4 inch		100	90 – 100	85-95	
1/2 inch	100	85 – 100	---	---	
3/8 inch	90-100	62 – 85	62 – 77	57-72	
No. 8	45-60	40 – 50	35 – 47	33-43	
No. 40	10-22	10 – 20	10 – 20	9-18	
No. 200	2.0 – 10.0	2.0 – 10.0	2.0 – 8.0	1.0 – 7.0	

* Unless otherwise approved by the Engineer.

** The ratio of the mix design composite gradation target for the No. 200 sieve, including admixture, to the effective asphalt content shall be within the indicated range.

SECTION 710

710.3.2.2 Gyratory Mix Design: Gyratory Mix Designs shall be performed in accordance with the requirements of latest edition of the Asphalt Institute's SP-2 manual. Mix design laboratory compacted specimens shall be prepared using a gyratory compactor in accordance with AASHTO T-312.

The mix design shall be formulated in a manner described for volumetric mix designs in the current edition of the Asphalt Institute Manual SP-2, except the number of trial blend gradations necessary will be determined by the mix design laboratory. Duplicate gyratory samples shall be prepared at a minimum of four (4) binder contents to select the recommended binder content. The gyratory specimens shall be compacted to 160 gyrations. Volumetric data for the design number of gyrations, N_{des} , and the initial number of gyrations, N_{ini} , are then back calculated based on the bulk specific gravity, G_{mb} , of the N_{max} specimens and the height data generated during the compaction process of those same specimens.

For Low traffic designs, volumetric data for 115 gyrations, N_{max} for Low Traffic designs, is also back calculated from the specimens compacted to 160 gyrations.

The corrected density of the specimens shall be less than 89.0 percent of maximum theoretical density at N_{ini} . The corrected density of the specimens shall be less than 98.0 percent of maximum theoretical density at N_{max} . The Gyratory mix shall comply with the criteria in Table [710-4](#).

TABLE 710-4				
GYRATORY MIX DESIGN CRITERIA				
Criteria	Requirements			Designated Test
	3/8" Mix	1/2" Mix	3/4" Mix	Method
1. Voids in Mineral Aggregate: %, Min.	15.0	14.0	13.0	AI SP-2
2. Effective Voids: %, Range	4.0 ± 0.2	4.0 ± 0.2	4.0 ± 0.2	AI SP-2
3. Absorbed Asphalt: %, Range *	0 - 1.0	0 - 1.0	0 - 1.0	AI SP-2
4. Dust to Eff. Asphalt Ratio, Range **	0.6 – 1.4	0.6 – 1.4	0.6 – 1.4	AI SP-2
5. Tensile Strength Ratio: %, Min.	75	75	75	ASTM D 4867
6. Dry Tensile Strength: psi, Min.	75	75	75	ASTM D 4867
7. Mineral Aggregate Grading Limits				AASHTO T-27
	Percent Passing with Admix			
Sieve Size	3/8 inch Mix	1/2 inch Mix	3/4 inch Mix	
1 inch			100	
3/4 inch		100	90-100	
1/2 inch	100	90-100	43-89	
3/8 inch	90-100	53-89	-	
No. 8	32-47	29-40	24-36	
No. 40	2-24	3-20	3-18	
No. 200	2.0-8.0	2.0-7.5	2.0-6.5	
8. Number of Gyrations	Low Traffic		High Traffic	
N_{ini}	7		8	
N_{des}	75		100	
N_{max}	115		160	

* Unless otherwise approved by the Engineer.

** The ratio of the mix design composite gradation target for the No. 200 sieve, including admixture, to the effective asphalt content shall be within the indicated range.

SECTION 710

710.3.2.3 Moisture Sensitivity Testing: Moisture sensitivity testing will be performed in accordance with ASTM D4867 for both Marshall and Gyratory mix designs, without the freeze/thaw cycles. The minimum required Tensile Strength Ratio is indicated in the tables above.

- End of Section -

SECTION 711

PAVING ASPHALT

711.1 GENERAL:

The asphalt shall be produced from crude asphalt petroleum or a mixture of refined liquid asphalt and refined solid asphalt. It shall be free from admixture with any residues obtained by the artificial distillation of coal, coal tar, or paraffin oil and shall be homogeneous and free from water.

Polymer modified asphalt cement shall be produced from crude asphalt petroleum and a polymer or blend of polymers mixed to produce a homogeneous material free from water.

Asphalt shall not be heated during the process of its manufacture, storage, or during construction so as to cause injury as evidence by the formation of carbonized particles.

711.2 TESTING REQUIREMENTS:

Paving asphalt shall be classified by the Performance Grading System and shall conform to the requirements set forth in Table 711-1 and AASHTO M-320 with the PAV temperature changes noted in the table. On all Grades Flash Point Temperature AASHTO T48: Minimum 230 °C and Mass Loss, Maximum 1.00 percent.

TABLE 711-1				
PERFORMANCE GRADING SYSTEM				
	PG 58-22	PG 64-16	PG 70-10	PG 76-16
Original Asphalt				
Viscosity, AASHTO T-316 (Note 1) Max. 3 Pa-s, Test Temp, °C	135	135	135	135
Dynamic Shear AASHTO T-315 (Note 2) G*/Sin δ, Min., 1.0 kPa Test Temp. @ 10 rad/s, °C	58	64	70	76
Tests Using Rolling Thin Film Oven Residue (AASHTO T-240)				
Mass Loss, Maximum %	1.0	1.0	1.0	1.0
Dynamic Shear AASHTO T-315 G*/Sin δ, Min., 2.20 kPa Test Temp. @ 10 rad/s, °C	58	64	70	76
Tests Using Pressure Aging Vessel Residue (AASHTO R-28)				
PAV Aging Temperature, °C (AASHTO R-28)	100	100	110	110
Dynamic Shear AASHTO T-315 G*/Sin δ, Max., 5000 kPa Test Temp. @ 10 rad/s, °C	22	28	34	34
Creep Stiffness, AASHTO T-313 (Note 3) S, Maximum, 300.0 Mpa m-value, Minimum, 0.300 Test Temp. @ 60s, °C	-12	-6	0	-6
Direct Tension, AASHTO T-314 (Note 3) Failure Strain, Minimum 1.0% Test Temp. @ 1.0 mm/min. °C	-12	-6	0	-6

NOTES:

(1) This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.

(2) For quality control of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be substituted for dynamic shear measurements of G*/sin (δ) at test temperatures when the asphalt is a

SECTION 711

Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometer (AASHTO T-210 or AASHTO T-202).

(3) If the Creep Stiffness is below 300 MPa, the direct tension test is not required. If the Creep Stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used in lieu of the Creep Stiffness requirement. Direct tension test is recommended for polymer modified asphalt binders. The m-value requirement must be satisfied in all cases.

Polymer modified paving asphalt shall be classified by the Performance Grading System and shall conform to the requirements set forth in Table 711-2 and AASHTO M320 with the PAV temperature changes noted in the table. On all Grades Flash Point Temperature AASHTO T48: Minimum 230 °C and Mass Loss, Maximum 1.00 percent. P is for Polymer and TR is for Tire Rubber.

TABLE 711-2				
PERFORMANCE GRADING SYSTEM				
	PG 64-28P	PG-76-22P	PG76-22TR Type 1 (Note 4)	PG76-22TR Type 2 (Note 4)
Viscosity, AASHTO T-316 (Note 1) Max. 3 Pa-s, Test Temp, °C	135	135	135	135
Dynamic Shear, AASHTO T-315 (Note 2) G*/Sin δ, Min., 1.0 kPa Test Temp. @ 10 rad/s, °C	64	76	76	76
Elastic recovery, ASTM D6084 Procedure "B" @ 10°C	65	65	65	55
Phase Angle, Max	75	75	75	75
Separation test, Texas 540 % Max	4	4	4	4
Solubility in Trichloroethylene, ASTM 2042 or n-propyl bromide, ASTM D7553 % Minimum	–	–	97.5	–
Tests Using Rolling Thin Film Oven Residue (AASHTO T-240)				
Mass Loss, Maximum %	1.0	1.0	1.0	1.0
Dynamic Shear, AASHTO T-315 G*/sin δ, Min., 2.20 kPa Test Temp. @ 10 rad/s, °C	64	76	76	76
Tests Using Pressure Aging Vessel Residue (AASHTO R-28)				
PAV Aging Temperature, °C (AASHTO R-28)	100	110	110	110
Dynamic Shear, AASHTO T-315 G*/sin δ, Max., 5000 kPa Test Temp. @ 10 rad/s, °C	22	31	31	31
Mass Loss, AASHTO T-240 Weight % Max	1.0	1.0	1.0	1.0
Creep Stiffness, AASHTO T-313 S, Maximum, 300 Mpa m-value, Minimum, 0.300 Test Temp. @ 60s, °C	-18	-12	-12	-12
Direct Tension, AASHTO T-314 (Note 3) Failure Strain, Minimum 1.0% Test Temp. @ 1.0 mm/min. °C	-18	-12	-12	-12

SECTION 711

NOTES:

- (1) This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.
- (2) For quality control of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be substituted for dynamic shear measurements of $G^*/\sin \delta$, at test temperatures when the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometer (AASHTO T-210 or AASHTO T-202).
- (3) If the Creep Stiffness is below 300 MPa, the direct tension test is not required. If the Creep Stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used in lieu of the Creep Stiffness requirement. Direct tension test is recommended for polymer modified asphalt binders. The m-value requirement must be satisfied in all cases.
- (4) "TR" binders shall have 9% to 11% reclaimed tire rubber and enough virgin polymer to meet all performance grade criteria specified. The blend percentages shall be listed on the Certificate of Compliance by the manufacturer. Type 1 shall meet solubility limits.

711.3 TEST REPORT AND CERTIFICATION:

At the time of delivery of each shipment of asphalt, the supplier supplying the material shall deliver to the purchaser 3 certified copies of the test report which shall indicate the name of the refinery and supplier, type and grade of asphalt delivered, date and point of delivery, quantity delivered, delivery ticket number, purchase order number, and results of the above specified tests. The test report shall be signed by an authorized representative of the supplier certifying that the product delivered conforms to the specifications for the type and grade indicated.

Until the certified test reports and samples of the material have been checked by the Engineer, that material will be only tentatively accepted by the Contracting Agency. Final acceptance will be dependent upon the determination of the Engineer that the material involved fulfills the requirements prescribed. The certified test reports and the testing required in connection with the reports shall be at no additional cost to the Contracting Agency.

711.4 TEMPERATURES:

Paving asphalt shall be heated in such a manner that steam or hot oils will not be introduced directly into the paving asphalt during heating.

711.5 CONVERSION OF QUANTITIES:

When pay quantities of paving asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM D1250. In converting volume to weight, the computations shall be based on Table [711-3](#).

TABLE 711-3		
ASPHALT CEMENT QUANTITY CONVERSION		
Grade of Material	Gals. Per Ton of 60 °F.	Lbs. Per Gal at 60 °F.
PG 58-22	236	8.47
PG 64-16	235	8.51
PG 70-10	235	8.51
PG 64-28P	236	8.47
PG 76-22P,TR	236	8.47
PG 76-16	233	8.58

- End of Section -

SECTION 712

LIQUID ASPHALT

712.1 GENERAL:

Liquid asphalt shall consist essentially of either natural crude or refined asphalt petroleum, or a residual product thereof.

The liquid asphalt shall be medium curing product designed by the letters MC, and shall consist of a paving asphalt conforming to the provisions in Section [711](#), fluxed or blended with a kerosene type solvent.

The asphalt shall not be heated during the process of its manufacture or during construction so as to cause injury as evidence by the formation of carbonized particles.

712.2 TEST REQUIREMENTS:

The liquid asphalt shall consist of materials specified above and shall conform to the requirements set forth in Table [712-1](#).

712.3 TEST REPORTS AND CERTIFICATIONS:

Test reports and certifications will be furnished in accordance with Section [711](#).

712.4 CONVERSION OF QUANTITIES:

When pay quantities of liquid asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM D1250. In converting volume to weight, the computations shall be based on the data contained in Table [712-2](#)

TABLE 712-1										
AASHTO M-82 TABLE 1										
	MC-30		MC-70		MC-250		MC-800		MC-3000	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Kinematic Viscosity at 60°C (140°F) centistokes	30	60	70	140	250	500	800	1600	3000	6000
Flash point (Tab. open-cup), degrees C° (F)	38 (100)	...	38 (100)	...	66 (150)	...	66 (150)	...	66 (150)	...
Water percent	...	0.2	...	0.2	...	0.2	...	0.2	...	0.2
Distillation test: Distillate percentage by volume of total distillate to 360°C (680°F)										
to 225°C (437°F)	...	25	0	20	0	10
to 260°C (500°F)	40	70	20	60	15	55	0	35	0	15
to 315°C (600°F)	75	93	65	90	60	87	45	80	15	75
Residue from distillation to 360°C (680°F) Volume percentage of sample by difference	50	...	55	...	67	...	75	...	80	...
Tests on residue from distillation:										
Absolute viscosity at 60°C (140°F) poises	300	1200	300	1200	300	1200	300	1200	300	1200
Ductility, 5 cm/min, cm.	100	...	100	...	100	...	100	...	100	...
Solubility in Trichloroethylene, percent	99	...	99	...	99	...	99	...	99	

SECTION 712

TABLE 712-2		
LIQUID ASPHALT QUANTITY CONVERSION		
Grade of Materials	Gals. Per Ton at 60 Degrees F.	Lbs. Per Gals. at 60 Degrees F.
70	253	7.90
250	249	8.03
800	245	8.16
2000	241	8.30

- *End of Section* -

SECTION 713

EMULSIFIED ASPHALTS MATERIALS

713.1 GENERAL:

Emulsified asphalts shall be composed of a paving asphalt base uniformly emulsified with water and an emulsifying or stabilizing agent. It shall be homogeneous throughout and if stored, shall show no separation of ingredients within 30 days after delivery. Emulsified asphalt shall be classified as quick setting, rapid setting, medium setting or slow setting type in either anionic or cationic emulsions.

Emulsified asphalt shall be specified as follows:

(A) Penetration type and high viscosity type emulsion shall be designated by the letters RS-Rapid Setting.

(B) Mixing type emulsion shall be designated by the letters SS-Slow Setting, MS-Medium Setting and QS-Quick Setting.

713.2 TESTING REQUIREMENTS:

The emulsified asphalt shall conform to the requirements set forth in Table [713-1](#).

713.3 TESTS REPORT AND CERTIFICATION:

Test reports and certifications shall be made in accordance with Section [711](#).

TABLE 713-1									
REQUIREMENTS FOR ANIONIC EMULSIFIED ASPHALT (Specification Designation)									
Type	Rapid-Setting				Medium-Setting				Slow-Setting
Grade	RS-1		RS-2h		MS-1		MS-2		SS-1h
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Tests on emulsions									
Viscosity, Saybolt Furol at 77°F (25°C.), sec	20	100			20	100	100		20 100
Viscosity, Saybolt Furol at 122°F (50°C.), sec			75	400					
Demulsibility, 35 ml. 0.02 N. CaCl ₂ , percent	60		60						
Coating ability and water resistance									
Coating, dry and aggregate					good		good		good
Coating, after spraying					fair		fair		fair
Coating, wet aggregate					fair		fair		fair
Coating, after spraying					fair		fair		fair
Cement mixing test, percent									2 2
Sieve test, percent		0.1		0.1		0.1		0.1	
Residue by distillation, percent	55		63		55		65		57 57
Tests on Residue from Distillation Test:									
Penetration 77°F (25°C), 100g, 5 s	100	200	40	90	100	200	100	200	40 90
Ductility, 77°F (25°C), 5 cm/min. cm.	40		40		40		40		40
Solubility in trichloroethylene, %	97.5		97.5		97.5		97.5		97.5

SECTION 713

TABLE 713-1 (continued)									
REQUIREMENTS FOR ANIONIC/CATIONIC EMULSIFIED ASPHALT (Specification Designation)									
Type	Quick Setting		Rapid Setting		Medium Setting		Slow Setting		Quick Setting
Grade	QSH	CQSH	CRS-1	CRS-2h	CMS-2	CMS-2h	CSS-1	CSS-1h	PMCQS-1h
	Min Max	Min Max	Min Max	Min Max	Min Max	Min Max	Min Max	Min Max	Min Max
Tests on emulsions:									
Visc., Saybolt Furol at 77°F., sec.	20 100	20 100					20 100	20 100	20 100
Visc., Saybolt Furol at 122°F., sec			20 100	100 400	50 450	50 450			
Storage Stability Test, 1 day, %	1	1	1	1	1	1	1	1	1
Demulsibility, 35 ml 0.8% sodium dioctyl sulfosuccinate, %			40	40					
Coating ability and water resistance:									
Dry aggregate					Good	Good			
after spraying					Fair	Fair			
wet aggregate					Fair	Fair			
after spraying					Fair	Fair			
Particle charge test		Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Sieve Test, %	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Cement Mixing test, %							2.0	2.0	
Distillation:									
Oil distillate, by volume of emulsion, %			3	3	12	12			
Residue, %	57	57	60	65	65	65	57	57	60
Test on residue from distillation test:									
Penetration, 25°C (77°F), 100 g. 5 sec.	40 110	40 110	100 250	40 90	100 250	40 90	100 250	40 90	55 75
Ductility, 25°C (77°F.) 5 cm per min, cm.	40	40	40	40	40	40	40	40	40
Ring and Ball Softening Point, AASHTO T-53									130
Elastic Recovery, % AASTHO T30									55
Solubility in trichloroethylene, %	98	98	98	98	98	98	97.5	97.5	97.5

* If the Particle Charge Test result is inconclusive for CSS-1 or CSS-1h, material having a maximum ph value of 6.7 will be accepted.

* If using PMCQS-1h the Residue from distillation shall be obtained from ARIZ-504.

SECTION 713

713.4 TEMPERATURES:

Unless otherwise specified, the various grades of emulsified asphalt shall be applied at temperatures within the limits specified in Table [713-2](#) the exact temperature to be determined by the Engineer. Emulsified asphalt shall be reheated if necessary. But at no time, after loading into a tank car or truck for transportation to the work site, shall the temperature of the emulsion be raised above the maximum temperature shown in Table [713-2](#). During all reheating operations, the emulsified asphalt shall be agitated to prevent localized overheating. Emulsified asphalt shall not be permitted to cool to a temperature of less than 40 degrees F.

TABLE 713-2		
APPLICATION TEMPERATURE OF EMULSIFIED ASPHALT		
Grade of Emulsified Asphalt	Minimum °F.	Maximum °F.
RS-1, MS-1, SS-1, SS-1h, CSS-1, CSS-1h	70°F.	140°F.
RS-2, MS-2, MS-2h, CRS-1, PMCQS-1h CRS-1h, CRS-2h, CMS-2, CMS-2h, QSH, CQSH	125°F.	185°F.

Emulsified asphalt shall be heated in such a manner that steam or hot oils will not be introduced directly into the emulsified asphalt during heating.

713.5 CONVERSION OF QUANTITIES:

When pay quantities of emulsified asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM D1250. In converting volume to weight, the computations shall be based on Table [713-3](#).

TABLE 713-3		
EMULSIFIED ASPHALTS QUANTITY CONVERSION		
Grade of Material	Gals Per Ton at 60°F.	Lbs Per Gal. at 60°F.
All grades	240	8.33

- End of Section -

SECTION 714

MICROSURFACING MATERIALS

714.1 GENERAL:

Microsurfacing materials shall consist of a properly proportioned mixture of cationic polymer modified asphalt emulsion, mineral aggregates, mineral filler, water, and other additives.

714.2 AGGREGATE:

714.2.1 Mineral Filler: Mineral filler, as required by the mix design, shall be any recognized brand of non-air-entrained Type I/II normal Portland cement that is free of lumps and clods, with a minimum of 85% passing the #200 sieve, added by weight of aggregate as specified by the mix design.

714.2.2 Mineral Aggregate: Coarse and fine aggregates or approved mineral filler shall be per Section [701](#). Aggregates shall be 100% crushed with no rounded particles. No natural sand will be allowed. The mineral aggregate shall conform to Table [715-1](#) for gradation only. Application rates shall be 18-24 pounds of aggregate/square yard for Type II, and 24-35 pounds/square yard for Type III.

The mineral aggregate and mineral filler shall have a sand equivalency value not less than 50 (ASTM D2419) and be non-plastic.

If more than one kind of aggregate is used, the correct amount of each kind of aggregate needed to produce the required gradation shall be proportioned separately in a manner that will result in a uniform and homogeneous blend. The final blended aggregate shall meet the above requirements for grading, sand equivalency, and plasticity.

714.3 BITUMINOUS MATERIAL:

The Polymerized Emulsion is a slow-setting, cationic type emulsion for mixing applications and seal coats. A minimum of 4% saturated polymer shall be high sheared into the asphalt prior to the emulsification process. The Agency may choose to sample the polymerized asphalt for testing. The amount of polymer will be based on weight of polymer and asphalt (total weight) and be certified by the supplier. The polymerized emulsion will meet the following specifications listed in Table [714-1](#).

SECTION 714

Table 714-1		
Polymerized Emulsion		
Test	AASHTO Method	Specification Limits
Tests on Emulsion		
Viscosity, SSF, @ 77°F. sec.	T59	15-100
Sieve Test, %	T59	0.30 Maximum
Particle Charge	T59	Positive
Storage Stability, 24 hr. %	T59	1.0 Maximum
Evaporation Residue, %	Arizona 512	60 Minimum
Tests on Evaporation Residue Arizona 504		
Kinematic Viscosity 275°F.cst	T201	650 Minimum
Penetration, 77°F 100g @ 5 sec	T49	40-90
Softening Point, degrees F.	T53	140 Minimum
Ductility, 77%, 5 cm/min.	T51	60 Minimum
Tests on Evaporation Residue after RTFO		
Kinematic Viscosity, 275°F. aging ratio, cst	T201	2.5 Maximum
Softening Point, degrees F.	T53	140 Minimum
The emulsion, upon standing undisturbed for a period of twenty-four (24) hours, shall show no white or milky colored substance on its surface, and shall be a homogeneous brown color throughout.		

714.4 MODIFIER TYPE AND CONTENT:

The modifier shall be saturated. The use of latex type modifier will be allowed only if both the test results and field performance are accepted by the Engineer. The asphalt cement shall contain a minimum of 4% solid polymer by weight of asphalt residue, sheared into the asphalt prior to emulsification. Plant verification by the Agency, and certification of the polymer content and type by the supplier, will be required throughout the duration of the contract. Each tank of emulsion produced shall be certified as to its compliance with these specifications; this certification shall be provided to the Agency.

714.5 WATER:

Water shall be potable water, free of any injurious impurities. The Contractor shall identify the water source to the Agency.

714.6 ADDITIVES:

Additives may be used to accelerate or retard the breaking point and set times of the mix, or to improve the resulting finished surface.

The use of additives in the mix shall be supplied in quantities predetermined by the laboratory mix design.

714.7 TEST CERTIFICATES AND REPORTS:

Test certificates and reports for the bituminous material shall be furnished in accordance with Section [711.3](#).

- End of Section -

SECTION 715

SLURRY SEAL MATERIALS

715.1 GENERAL:

Slurry seal shall consist of a properly proportioned mixture of emulsified asphalt, mineral aggregate, mineral fillers, additives (if necessary), and water.

All material sources must be approved prior to their use. The Contractor will submit a job mix formula and if requested prequalifications for materials at least seven days prior to start of construction. When requested, additional samples will be furnished during the construction period at no cost to the Contracting Agency. This is a non-pay item.

715.2 AGGREGATE:

715.2.1 Mineral Filler: Mineral filler shall consist of finely divided matter, such as hydrated lime, Portland cement, limestone dust or fly ash, conforming to the requirements of ASTM D4318. Mineral filler shall be used only when needed to reduce the setting time, to improve the workability or to reduce the stripping characteristics of the aggregate emulsion mixture. The minimum amount of the required filler will be used and it will be considered as part of the blended aggregate. The expected range shall be between .25% and 2.0% by weight of aggregate.

715.2.2 Mineral Aggregate: Coarse and fine aggregates or approved mineral filler shall be per Section [701](#). The mineral filler will be considered as part of the blended aggregate. The material shall be non-plastic (ASTM D4318) with a sand equivalent (ASTM D2419) of at least 50. The abrasion loss (ASTM C131) shall not exceed 35 percent. Historical test data from source aggregate may be used that was run within the past two years. Mineral aggregates used shall be 100% crushed. No natural sand shall be allowed. The gradation of mineral aggregate without mineral filler shall conform to Table [715-1](#).

TABLE 715-1			
SLURRY SEAL AGGREGATE			
SIEVE SIZE	Type I % PASSING	Type II % PASSING	Type III % PASSING
3/8	100	100	100
No. 4	100	85/100	70/90
No. 8	90/100	65/90	45/70
No. 16	65/90	45/70	28/50
No. 30	40/60	30/50	19/34
No. 50	25/42	18/30	12/25
No. 100	15/30	10/21	7/18
No. 200	10/20	5/15	5/15
Emulsified Asphalt content as a % of Dry Wt. Of Aggregate (approx.) ASTM D3910 (W.T.A.T. TEST)	18	16	14
Residual Asphalt Range requirements % of Dry Wt. of Aggregate ASTM D3910 (W.T.A.T. TEST)	10-16	7.5-13	6.5-12
Pounds of Aggregate per Square Yard (approx.)	8-10	12-18	18-25

715.3 BITUMINOUS MATERIAL:

The emulsified asphalt used for seal coating shall be quick setting or slow setting as per Section [713](#).

SECTION 715

Polymer modified cationic quick setting emulsion (PMCQS-1h) may be used when approved by the Engineer.

The quick setting emulsified asphalt shall be of the anionic or cationic quick set type such as QSH, CQSH, or PMCQS-1h that will react to chemically active mineral fillers such as Portland cement in such a way that the applied slurry mixture can support controlled traffic in 45-60 minutes after application. The amount of chemically active filler shall be determined by job mix formula and field performance.

Polymer modified cationic quick setting emulsion (PMCQS1-h) shall be homogeneous and the polymer used shall consist of either a solid polymer milled / blended into the asphalt or latex blended into the emulsifier solution prior to the emulsification process. The PMCQS-1h shall contain a minimum of three percent polymer and shall conform to Section [713](#).

Slow setting emulsion may be used when traffic control is not a critical item.

Quick Set Emulsion Mix Properties	
Slurry Seal Mixing, 70-85 degree F., Sec.	120 Sec. Min.
Slurry Seal Setting test, 70-85 degree F., 1 hour cure	No Brown Stain
Slurry Seal Water Resistance Test, 70-85 degree F., 30 minute cure	No More Than Slight Discoloration

Placement of slurry seal is temperature dependent and should be tested under field conditions.

715.4 WATER:

Water shall be potable and be compatible with the slurry ingredients used.

715.5 DETERMINATION OF JOB MIX FORMULA:

The job mixture shall be designed to provide a suitable surface for traffic conditions, climate and curing. All materials shall be pre-tested in a qualified laboratory to determine their suitability for use in the slurry seal. The Wet Track Abrasion Test (W.T.A.T.) will be used for design purposes to establish the mix design to be used in the specified slurry seal.

The test will show a maximum wear loss of 75 grams per square foot. Samples of materials to be used on the job shall be used to run the W.T.A.T. The test will be performed in accordance with ASTM D3910 Design Testing and Construction of Slurry Seal.

715.5.1 Composition of Slurry Seal Mixtures: The job mixture shall conform to the requirements of the contract documents. The mixture shall attain an initial set in not less than 5 minutes not more than one hour. In cases where the surface is not critical to be open to traffic, a longer set time may be allowed, however not to exceed 12 hours. The setting time may be adjusted by the addition or removal of approved mineral fillers or chemical agents. The mixture shall be one of three types whose combined aggregates conform to the graduation requirements of Table [715-1](#). The mixture shall be sufficiently free flowing to fill cracks in the pavement. The mixture shall not segregate during or after laydown. The mixture shall produce a skid-resistant surface.

715.5.2 Trial Applications: The Contractor shall place a test strip of 60 square yards in the area designated by the Engineer. The test section shall be placed using the same equipment and methods as will be used on the job. The slurry mixture placed in a test strip shall conform to the design mix as determined by the W.T.A.T. with minor variations to obtain crack filling, set time, pavement bond and a skid resistant texture. If the materials do not meet the requirements for fluidity, non-segregation, or surface texture, a new job mix shall be formulated and tested. Work shall not proceed before approval of design mix and acceptance following the placing of a test strip.

715.6 TEST CERTIFICATES & REPORTS:

Test certificates and reports for the bituminous material shall be furnished in accordance with Section [711](#).

SECTION 715

715.7 CONVERSION OF QUANTITIES:

Volumetric conversions shall be accomplished in accordance with Section [713](#).

- *End of Section* -

SECTION 716

COVER MATERIAL

716.1 GENERAL:

Cover material “chips” shall consist of precoated or uncoated aggregate spread in conjunction with a bituminous or asphalt-rubber seal coat.

716.2 COVER MATERIAL AGGREGATE:

716.2.1 Properties:

- (1) When tested in accordance with AASHTO T-96, the loss shall not exceed 40 percent at 500 revolutions.
- (2) When tested in accordance with AASHTO T-104 (Sodium Sulfate Soundness), the loss shall not exceed 12 percent.
- (3) When tested in accordance with ARIZ-212, a minimum of 75 percent, by weight, of the material retained on the No. 8 sieve, shall have at least one fractured face.

716.2.3 Gradation: When tested in accordance with AASHTO T-27 and T-11, the gradation shall comply with Table [716-1](#) and/or Table [716-2](#).

TABLE 716-1	
COVER MATERIAL (CHIPS) GRADATION For Low Volume Traffic Only	
Sieve Size	Percent Passing
½ inch	100
3/8 inch	97/100
1/4 inch	70/100
#8	0-5
#200	0-2

TABLE 716-2	
COVER MATERIAL (CHIPS) GRADATION For High Volume Traffic	
Sieve Size	Percent Passing
3/4 inch	100
½ inch	97/100
3/8 inch	70/100
1/4 inch	0-10
#8	0-5
#200	0-2

SECTION 716

716.3 PRECOATED CHIPS:

When specified, the aggregate shall be heated and precoated with asphalt cement as specified in Section [711](#). The quantity of bituminous material used shall not be less than 0.30 percent or greater than 0.70 percent of the combined weight of the bituminous material and the aggregate to achieve a “salt and pepper” appearance.

The final percentage of asphalt used for coating shall be as directed by the Engineer. The precoating shall be done in a drum mix hot plant. With approval of the Engineer a pug mill mixing facility may be used.

716.4 UNCOATED CHIPS:

When liquid or paving grade asphalt is used as the bituminous binder, the uncoated chips shall not contain moisture in excess of a saturated surface dry condition.

When emulsified asphalt is used as the bituminous binder, the uncoated chips shall be surface wet but free from running water.

- *End of Section* -

SECTION 717

ASPHALT-RUBBER ASPHALT CONCRETE

717.1 DESCRIPTION:

The work under this section shall consist of furnishing, proportioning and mixing all the ingredients necessary to produce an asphalt-rubber Asphalt Concrete (ARAC) material. ARAC mixes may be used for low or high traffic conditions, as determined by the agency. Low traffic conditions are conditions where the asphalt mix will be subject to low volume and low weight vehicle usage. Examples of this condition are residential streets, most parking lots and residential minor collector streets. High traffic conditions are conditions where the asphalt mix will be subject to high volume and/or heavy weight vehicle usage as found on major collector, arterial and commercial streets. Street classifications (i.e. minor collector and major collector) shall be determined by the specifying agency.

717.2 MATERIALS:

717.2.1 Asphalt-Rubber Binder (ARB): The blended ARB shall meet the criteria list below. The ARB may be blended in a dedicated blending and storage unit connected to the hot plant or at the asphalt binder supplier's facility.

717.2.1.1 Asphalt Cement: Asphalt cement shall conform to the requirements of Section [711](#).

717.2.1.2 Crumb Rubber: Crumb Rubber shall meet the gradation requirements as shown in Table [717-1](#) below when tested in accordance with Arizona Test Method 714.

TABLE 717-1	
GRADATION REQUIREMENTS OF CRUMB RUBBER	
Sieve Size	Percent Passing Type B
2.36 mm (#8)	
2.00 mm (#10)	100
1.18 mm (#16)	65 - 100
600 µm (#30)	20 - 100
300 µm (#50)	0 - 45
75 µm (#200)	0 - 5

The crumb rubber shall have a specific gravity of 1.15 ± 0.05 and shall be free of wire or other contaminating materials, and shall contain not more than 0.5 percent fabric. Calcium carbonate, up to four percent by weight of the crumb rubber, may be added to prevent the particles from sticking together.

Certificates of Compliance conforming to Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted. In addition, the Certificates shall confirm that the rubber is a crumb rubber, derived from processing at ambient temperature, whole scrap tires or shredded tire materials; and the tires from which the crumb rubber is produced is taken from automobiles, trucks, or other equipment owned and operated in the United States. The Certificates shall also verify that the processing does not produce, as a waste product, casings or other round tire material that can hold water when stored or disposed of above the ground. The crumb rubber to be used in ARB shall be the type produced through a process of mechanical grinding at ambient temperature. Use of crumb rubber granules produced from a cryogenic process is prohibited.

717.2.1.3 ARB Proportions and Properties: Ground crumb rubber in ARB shall be a minimum of 18 percent by weight of total binder,

ARB shall be Type 1 unless otherwise specified and conform to the requirements of Table [717-2](#) below:

SECTION 717

TABLE 717-2
PHYSICAL PROPERTIES OF ARB

Property	Requirement		
	Type I	Type 2	Type 3
Grade of base asphalt cement	PG 64-16	PG 58-22	PG 52-28
Rotational Viscosity*; 350° F, Pascal seconds	1.5-4.0	1.5-4.0	1.5-4.0
Penetration; 39° F (4° C), 200g, 60 sec. (ASTM D5); dmm, min	10	15	25
Softening Point; (ASTM D36); °F, min.	135	130	125
Resilience; 77°F (ASTM D3407); %,min	25	20	15
* The Viscometer used must be a hand held rotational viscometer, such as a Rion (formerly Haake) Model VT – 04, or an equivalent, using Rotor No. 1. The rotor, while in the off position, shall be completely immersed in the binder at a temperature from 350° to 355° F for a minimum heat equilibrium period of 60 seconds, and an average viscosity determined from three separate constant readings (± 0.5 pascal-seconds) taken within a 30 second time frame with the viscotester level during testing and turned off between readings. Continuous rotation of the rotor may cause thinning of the material immediately in contact with the rotor, resulting in erroneous results.			

717.2.1.4 ARB Design: At least two weeks prior to paving, the Contractor shall submit an ARB design prepared by an ADOT approved laboratory. Such design shall meet the requirements specified herein. The design shall show the values obtained from the required tests, along with the following information: percent, grade and source of the asphalt cement used; and percent, gradation and source(s) of the crumb rubber used, as well as the ARB blending location: on-site or at the asphalt binder supplier's facility.

717.2.2 Aggregate: Coarse and fine aggregates shall conform to the applicable requirements of Tables [717-3](#) and [717-4](#) below. Coarse mineral aggregate shall consist of crushed gravel, crushed rock, or other approved inert material with similar characteristics, or a combination thereof, conforming to the requirements of these specifications.

Coarse aggregate is material retained above the Number 8 sieve and fine aggregate is material passing the Number 8 sieve. Aggregates shall be free of deleterious materials, clay balls, and adhering films or other material that prevent thorough coating with the asphalt cement. Mineral aggregate shall conform to the following requirements when tested in accordance with the applicable test methods.

TABLE 717-3
MIX DESIGN GRADATION REQUIREMENTS

Overlay Thickness	1" & 1- 1/2"	2"
Sieve Size	Percent Passing	Percent Passing
1" (25 mm)	100	100
3/4" (19 mm)	100	95-100
1/2" (12.5 mm)	95-100	78-92
3/8" (9.5 mm)	78-92	61-75
No. 4 (4.75 mm)	28-45	30-40
No. 8 (2.36 mm)	15-25	15-25
No. 30 (600 μ m)	5-15	5-15
No. 200 (75 μ m)	3.0-7.0	2.0-6.0

The combined aggregate properties shall conform to the requirements of Table [717-4](#) below.

SECTION 717

TABLE 717-4 COARSE/FINE AGGREGATE REQUIREMENTS		
Characteristics	Test Method	Requirements
Fractured Faces, % (Plus No. 8)	ARIZ-212	85, 1 fracture 80, 2 or more
Uncompacted Voids, %	ARIZ-247	45.0 (High Traffic Volume) 42.0 (Low Traffic Volume)
Sand Equivalent (Minus No. 4)	AASHTO T-176	65 minimum
Plasticity Index	AASHTO T-89 & T-90	Non Plastic
L.A. Abrasion, % Loss	AASHTO T-96	9 max. @ 100 Rev. 40 max. @ 500 Rev.
Combined Bulk Specific Gravity	AI MS-2	2.35-2.85
Combined Water Absorption, %	AI MS-2	0-2.5

717.2.3 Mineral Admixture: Mineral admixture used in ARAC shall be dry hydrated lime conforming to the requirements of ASTM C1097 or Portland cement conforming to ASTM C150 for Type II, or ASTM C595 for Type IP. The minimum mineral admixture content will be 1.0percent, by weight of total aggregate.

717.3 MIX DESIGN REQUIREMENT:

717.3.1 General: The mix design for ARAC shall be prepared by a laboratory that is accredited through the AASHTO Accreditation Program (AAP) in Hot Mix Asphalt Aggregates and Hot Mix Asphalt. The laboratory shall be under the direct supervision of a Civil Engineer, registered by the State of Arizona, and who is listed by ADOT as a “Qualified Asphalt Concrete Mix Design Engineer” within ADOT’s latest list of approved laboratories. The latest list of approved laboratories is available on ADOT’s web page: http://www.azdot.gov/highways/materials/quality_assurance.asp.

The date of the design shall not be older than two years from the date of submittal, unless supportive documentation is provided and approved by the Engineer.

The mix design method used shall be in accordance with the Marshall Mix procedure, 75 blows, as described in Arizona Test Method 832 “Marshall Mix Design Method for Asphaltic Concrete (Asphalt Rubber) [AR-AC]”. Mix designs are subject to approval by the Engineer.

717.3.2 Mix Design Criteria: The mix shall comply with the criteria in Table [717-5](#) below.

TABLE 717-5 MARSHALL MIX DESIGN CRITERIA		
Criteria	Low Volume Traffic	High Volume Traffic
ARB Content		
1” and 1-1/2” Overlay Thickness	8.4% minimum	8.0% minimum
2” Overlay Thickness	N/A	7.0% minimum
Mixture Air Voids, %	3.5-4.5	4.5-5.5
Voids in Mineral Aggregate, %	19.0 min	19.0 min
Tensile Strength Ratio, AASHTO T-283	65% minimum	65% minimum
Marshall Stability, pounds minimum	800	800
Marshall Flow, 0.01 inch minimum	16	16

The mix design report shall include the following elements as a minimum.

- (1) The name and address of the testing organization and the person responsible for the mix design report.
- (2) The mix plant identification and/or location, as well as the supplier or producer name.
- (3) The traffic condition (low or high traffic) and lift thickness.
- (4) A description of all products that are incorporated in the ARAC along with the sources of all products, including the base asphalt cement, crumb rubber, mineral aggregate, and admixtures.

SECTION 717

(5) The results of all testing, determinations, etc., such as: specific gravity and gradation, water absorption, sand equivalent, loss on abrasion, fractured coarse aggregate particles, Tensile Strength Ratio (AASHTO T-283), Marshall bulk density, stability and flow, asphalt absorption, percent air voids, voids in mineral aggregate. Historical abrasion values may be supplied on existing sources. The submittal should include a plot of the gradation on the Federal Highway Administration's 0.45 Power Gradation Chart and plots of the compaction curves.

■ (6) The laboratory mixing and compaction temperature ranges for the ARB used within the mix design.

(7) A specific recommendation for design ARB content and any limiting conditions that may be associated with the use of the design, such as minimum percentages of crushed or washed fine aggregate.

(8) The supplier's product code, the laboratory Engineer's seal (signed and dated), and the date the design was completed.

■ (9) The ARB design.

The mix design shall be submitted to the Agency or Engineer by the Contractor/Supplier for which it was developed as part of his project submittals. Once the mix design has been approved by the agency or Engineer, the Contractor and/or his supplier shall not change plants nor utilize additional mixing plants without prior approval of the Engineer. Any changes in the plant operation, the producer's pit, the ARB, or any other item that will cause an adjustment in the mix, shall be justification for a new mix design to be submitted.

- *End of Section* -

SECTION 718

PRESERVATIVE SEAL FOR ASPHALT CONCRETE

718.1 GENERAL

Asphalt Concrete preservative seal shall be one of the following types or equal, with typical application rates.

TYPE A - Asphalt rejuvenating agent shall be an emulsion composed of a petroleum resin oil base uniformly emulsified with water. Each supplier must submit a certified statement from the asphalt rejuvenator manufacturer showing that the asphalt rejuvenating emulsion conforms to the required physical and chemical requirements. They also must provide documentation of tests that determine the acceptable range of application of the product. Typical application rates are .07 to .18 gallons per square yard.

TYPE B - Petroleum Hydrocarbon emulsion. Applied at .05 to .20 gallons per square yard, diluted.

TYPE C - Tire modified surface sealer (TRMSS) or equal not diluted, and applied at a rate of .10 to .20 gallons per square yard.

TYPE D - Acrylic polymer, modified emulsion. Diluted to the manufacture's recommendation and applied at a rate of .08 to .20 gallons per square yard.

718.2 TEST METHODS AND REQUIREMENTS

Preservative seal for asphalt concrete material, shall meet type A, B, or C on Table [718-1](#) by certification from the manufacturer.

All tests shall be performed by AMRL accredited laboratory, accredited in the specified test being performed.

TABLE 718-1					
PRESERVATIVE SEAL SPECIFICATIONS					
Properties * (note 2)		Type-A	Type-B	Type -C	Type-D
Saybolt Viscosity @77°F (sfs)	ASTM D7496-09	45-55 (KU)* (note 1)	15-40	15-40	15-40
Residue by evaporation 138°C	ASTM D6934-08	30-40	.10 Max	53 min.	60-65
Sieve test %	ASTM D6933-08	N/A		.10 max.	0.1
5 day settlement test	ASTM D6930-10		2.0% max	N/A	N/A
Test on residue from evaporation ASTM D6934-08					
Flash point °F	ASTM D92	450°F	450°F	450°F	385°F
Softening point	ASTM D36M-09	130°F min	N/A	130°F min.	N/A
Accelerated weathering test	ASTM D4799-03	Report * (note 3)	N/A	Report (note 3)	Plant certification within 6 months
Ductility (@77°F) 100g 5 sec.	ASTM D113-07	N/A	N/A	20 min.	N/A
Storage stability, test 1 day%	ASTM 6930-10	N/A	N/A	N/A	N/A
Viscosity @ 140°F, cSt	D-445	N/A	1,000-9,500	N/A	210-390

SECTION 718

Asphaltenes, % w (max)	D-2006-70	N/A	10.0 Max.	N/A	1.00
Maltene Dist. Ratio	D-2006-70	N/A	0.2-1.4	N/A	0.3-0.6
PC/S Ratio ⁴⁵ (Min) (Note 4)	D-2006-70	N/A	0.5 Min.	N/A	0.5
Saturated Hydrocarbons, S ⁵ (note 4)	D-2006-70	N/A	28 Max.	N/A	21-28

Notes:

1. Kreb units (ASTM D562)
2. A full set of tests shall be performed by as specified by the special provisions in the undiluted condition. These tests and any other specified will be performed at the contractor's expense.
3. The Ultraviolet resistance testing results will be provided at no cost to the engineer.
4. Only residue by evaporation shall be run on diluted samples. Specification limits should be diluted rate times minimum residual value of concentrate.
5. PC/S ratio: $\frac{PC + A_1}{S + A_2}^5$

- End of Section -

SECTION 725

PORTLAND CEMENT CONCRETE

725.1 GENERAL:

Portland cement concrete shall be composed of cementitious materials, fine and coarse aggregates, water, and, if specified or allowed, certain chemical admixtures and additives.

TABLE 725-1		
CONCRETE CLASSES - MINIMUM REQUIREMENTS		
Class of Concrete	Minimum Cementitious Materials Content (lbs. per cubic yard)	Minimum Compressive Strength (1) at 28 Days (psi)
AA	600	4000
A	520	3000
B	470	2500
C	420	2000

(1) In accordance with section [725.8](#).

725.2 CEMENTITIOUS MATERIALS:

Cementitious materials to be used or furnished under this specification shall be:

Portland cement, meeting the requirements of ASTM C150

Type II, low alkali, when no other specific type is specified

Type III, low alkali, for high early strength, when applicable or specified

Type V, low alkali, when specified in the special provisions for applications requiring high sulfate resistance

Portland Pozzolan Cement ASTM C595

Type IP (MS), when no other specific type is specified

Supplementary Cementitious Materials (SCM) shall not be used as an additional cementitious materials replacement in concrete in combination with Portland Pozzolan Cement.

Cementitious materials shall be sampled and tested as prescribed in the applicable ASTM specifications. The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the material manufacturer, identifying the cementitious material and stating that the cementitious material delivered to the batching site complies with the appropriate specifications. When requested by the Engineer, the Contractor shall furnish three copies of the cementitious materials certification. The cost of furnishing tested cementitious materials shall be considered as included in the contract bid price and no additional allowance will be made therefore.

When suitable facilities, as recommended by the Concrete Plant Manufacturer's Bureau, and approved by the Engineer, are available for handling and weighing bulk cementitious materials, such facilities shall be used. Otherwise the cementitious material shall be delivered in original unopened sacks that bear the name or brand of the manufacturer. The type of cementitious material, and the weight contained in each sack shall be plainly marked thereon.

Cementitious materials shall be stored in such manner as to permit ready access for the purpose of inspection and identification, and so as to be suitably protected against damage by contamination or moisture. Should any lot of bulk cementitious material be delivered to the site show evidence of contamination, the Engineer may require that such lot be removed from the site.

725.2.1 Supplementary Cementitious Materials (Pozzolans): Supplementary Cementitious Materials to be used in concrete or furnished under this specification shall conform to the appropriate ASTM requirements as follows:

Fly ash or natural pozzolan

ASTM C618 and C311

Silica Fume

ASTM C1240

SECTION 725

Up to 25 percent by weight of the Table [725-1](#) minimum cementitious materials requirements may be an approved fly ash or natural pozzolan. Additional pozzolanic material in excess of the minimum Table [725-1](#) requirements may be incorporated into a concrete mix design to achieve enhanced performance, upon approval of the Engineer.

The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the pozzolan supplier identifying the pozzolanic material and stating the pozzolan delivered to the batching site complies with the appropriate specifications. The cost of furnishing tested pozzolan shall be considered as included in the contract bid price and no additional allowance will be made therefore.

Pozzolanic materials shall be handled and stored in the same manner as other cementitious materials. When facilities for handling a bulk pozzolan are not available, the pozzolan shall be delivered in original unopened sacks bearing the name and brand of the supplier, the type and source of the pozzolan, and the weight contained in each sack plainly marked thereon.

725.3 AGGREGATES:

Coarse and fine aggregate shall conform to the applicable requirements of ASTM C33. Coarse aggregate grading requirements shall conform to the appropriate rock size designation in the Grading Requirements for Coarse Aggregate, Table 2. Fine aggregate grading requirements shall conform to the Fine Aggregate Grading section.

The average value of 3 successive sand equivalent samples shall not be less than 70 when tested in accordance with ASTM D2419. No individual sample shall have a sand equivalent less than 65.

The loss by abrasion in the Los Angeles Abrasion Machine, determined as prescribed in ASTM C131, shall not exceed 10 percent, by weight, after 100 revolutions nor 40 percent after 500 revolutions.

Prior to the delivery of the aggregates and whenever required during concrete production, the Contractor shall make stockpiles available to the Engineer for testing. All required samples shall be furnished at the expense of the Contractor, and the cost of sampling and testing shall be at the expense of the Contracting Agency.

Reclaimed Concrete Materials (RCM) and Reclaimed Asphalt Pavement (RAP) as defined in [Section 701](#) shall not be used in Portland Cement Concrete without the prior approval of the Engineer.

725.4 WATER:

The water used for mixing concrete shall be potable or shall meet the requirements of ASTM C1602, when tested by a qualified independent testing laboratory.

725.5 ADMIXTURES AND ADDITIVES:

Admixtures or additives of any type, except as otherwise specified, shall not be used unless identified in the approved mix design or authorized by the Engineer.

Water reducing admixtures incorporated into the approved concrete mix design shall meet the requirements of ASTM C494 for the appropriate type.

Air entraining admixtures incorporated into the approved concrete mix design shall meet the requirements of ASTM C260.

Pigments incorporated into the approved concrete mix design for integrally colored concrete shall meet the requirements of ASTM C979.

Fibers incorporated into the approved concrete mix shall meet the requirements of ASTM C1116.

Any admixtures used shall be included in the price for that item.

SECTION 725

725.6 MIX DESIGN PROPORTIONING:

A concrete mix design carrying the producer's designated mix number for each type of concrete being furnished under these specifications shall be submitted to the Engineer at least once each year for approval. Each design shall utilize the proper proportioning of ingredients to produce a concrete mix that is homogeneous and sufficiently workable to provide a consistent and durable concrete product that meets the specified compressive strength and other properties as required by the application.

In the event there is a modification to the mix design proportions:

(A) Modifications that do not require a new mix design submittal/approval:

- (1) Modifications which do not result in batch target weights for the fine aggregate or combined coarse aggregates changing by more than 5 percent from the original approved mix design.
- (2) Modifications to the percentage of coarse aggregate fractions that do not change the total coarse aggregate volume.
- (3) Modifications to dosages of chemical or air-entraining admixtures, within the manufacturer's recommendations.
- (4) The incorporation or elimination of chemical admixtures which are listed on the mix design to effect a change in the time-of-set (retarders or accelerators).

(B) Modifications that require a new mix design submittal/approval and may require performance verification:

- (1) Modification to the class of concrete per Table [725-1](#).
- (2) Modification to the type/class/source of cement, fly ash, natural pozzolan, or silica fume.
- (3) Modification to the percentage of fly ash, natural pozzolan, or silica fume.
- (4) Modification to a coarse aggregate size designation.
- (5) Modification of the type of chemical admixture, or the incorporation or elimination, of an air-entraining admixture.
- (6) Modification of coarse or fine aggregate source.

725.7 MIXING:

All proportioning/batching/mixing equipment shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or National Ready Mixed Concrete Association. The proportioning shall consist of combining the specified sizes of aggregates with cementitious materials, admixtures/additives, and water as herein provided. No method which may cause the segregation or degradation of materials shall be used.

Weighing and metering devices used for the purpose of proportioning materials shall fulfill requirements as to accuracy and tolerance prescribed by the Weights and Measures Division of the State of Arizona and shall be sealed and certified in accordance with the procedures established by this agency. This certification shall not be over 12 months old and shall be renewed whenever required by the Engineer. When portable plants are set up at a new or temporary location, the scales and scale assembly shall be inspected and certificate issued regardless of the date when the scales were last tested. The Engineer may require the Contractor to run a quick scale check at any time with certified weights furnished by the Contractor and order the scale recertified if necessary.

Any admixture/additive shall be measured accurately by mechanical means into each batch by equipment or in a method pre-approved by the Engineer.

The equipment for measuring and supplying the water in the mixer shall be so constructed and arranged that the amount of water to be added to the mixture can be measured, in gallons or by weight. The amount of water shall be varied in accordance with the percentage of free moisture in the material and the requirements of the workability of the aggregate.

SECTION 725

Machine mixing will be required in all cases unless pre-approved by the Engineer. Regardless of the method employed, mixing shall be commenced as soon as possible after the cementitious material is placed in contact with the aggregates or water. All concrete mixers shall be of such design and construction, and so operated, as to provide a thoroughly and properly mixed concrete in which the ingredients are uniformly distributed.

725.7.1 Paving and Stationary Mixers: Paving and stationary mixers shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or the National Ready Mixed Concrete Association.

Mixers shall be maintained in proper and serviceable working condition, and any part or portion thereof that is out of order, or becomes worn to such extent as to detrimentally affect the quality of mixing, shall be promptly repaired or replaced.

The proper proportions of aggregate, cementitious materials, admixtures/additives and water for each batch of concrete shall be placed in the mixer, and shall be mixed for a period of not less than 50 seconds after all such materials are in the drum.

The rotating speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

The total volume of materials mixed in any one batch shall neither exceed the water level capacity of the mixer nor the manufacturer's catalog rated capacity of the mixer.

725.7.2 Transit Mixers: Transit mixers shall meet the requirements of the Truck Mixer Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or the National Ready Mixed Concrete Association. Ready mix concrete and shall comply with ASTM C94 except as herein specified.

Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates, installed by the manufacturer, on which is plainly marked the capacity of the drum in terms of the volume of mixed concrete and the speed of rotation for the agitating and mixing speeds of the mixing drum or blades.

Each mixer shall have an identification number painted on the truck in such a location that it can be easily read from the batching platform.

The total volume of materials introduced into the mixer for mixing purposes shall not exceed the manufacturer's guaranteed mixing capacity. If the concrete so mixed does not meet the uniformity requirements of this section, the amount of materials charged into the mixer shall be reduced.

The rotation speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

Each batch of concrete placed in the mixer shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades, at the speed designated by the manufacturer of the equipment as mixing speed. Additional mixing shall be at the agitating speed designated by the manufacturer of the equipment. The revolving of the drum shall be continuous until the concrete is completely emptied from the drum. Before any portion of the materials for any batch of concrete is placed therein, the drum of the mixer shall be completely emptied of the previously mixed batch.

At the time of delivery to the job site, the Engineer shall be provided with a legible delivery ticket which shall contain the following information:

Date and Truck Number.

Name of the Supplier.

Name of the Contractor.

Specific designation of job (name and location).

Number of cubic yards in the batch.

Time the transit mixer is loaded.

SECTION 725

Amount of water added at the job site at request of receiver, and his signature or initials.

Suppliers' mix design code number.

Type and amount of admixture or additive that is not already included in the approved mix design, if any.

Serial number of the ticket.

Additional water may be added on the jobsite in accordance with ASTM C94 Tolerances in Slump section to adjust slump providing the slump after such water addition does not exceed the maximum allowed by these specifications in Section [725.9](#) (A) (1) and that water so added is mixed into the batch for a minimum of 30 additional revolutions at mixing speed. Loss of cement mortar during discharge which in the opinion of the Engineer would be of sufficient amount to affect the homogeneity of the concrete shall be cause for rejection of the load. The Contractor shall be responsible for all concrete to which water is added at the job site.

725.7.3 Job Mixed Concrete: All job mixed materials and procedures shall be pre-approved by the Engineer. A prepackaged commercial product shall be used for job mixed concrete placement in accordance with the manufacturer's recommended procedure.

In lieu of the use of a prepackaged commercial product, individual ingredients for concrete placement shall be prepared in a watertight container of suitable volume in batches not to exceed 1/3 cubic yard each. Proportioning of batches shall be in accordance with the applicable required mix design in Table [725-1](#) and Section [725.6](#). All mixing shall be done prior to placement in the forms and in accordance with the following procedure:

- (A) Mixing shall be done in a mechanical batch mixer of approved type.
- (B) The mixer shall be rotated at a speed recommended by the manufacturer.
- (C) Mixing shall continue for at least 1-1/2 minutes after all materials are in the mixer, unless a shorter time is shown to be satisfactory by the mixing uniformity tests of ASTM C94.
- (D) Materials handling, batching, and mixing shall conform to the applicable provisions of ASTM C94.
- (E) Suitable records shall be kept to identify the number of batches, proportions of materials used, and time and date of mixing and placement along with the approximate location in the structure.

725.7.4 Dry Batched Unmixed Concrete: All dry batched unmixed concrete materials and procedures shall be pre-approved by the Engineer. An accurate batch weight shall be provided to record the quantities of cementitious materials, aggregate, admixtures/additives, and water batched into the containers. The date of batching, the container number and the batching certificate number shall be recorded at the time of batching. Copies of the batch weight records shall be submitted to the Engineer upon request.

All dry batched unmixed concrete delivered to the job site shall be stored in containers so constructed that the cement cannot come in contact with the water and aggregate within the container. Any admixture/additive added in powder form shall be added to the cement; if added in liquid form, it shall be added to the water.

The contents of the container shall be discharged into a mixer at the job site. Following discharge of the first container into the mixer, the mixer shall be operated at mixing speeds during the discharge of the remaining containers. After the contents of the last container have been discharged into the mixer, the concrete shall be mixed as specified in this specification for transit mixers, and drum or turbine type mixers.

Any spillage of cementitious materials, aggregate, water or admixtures/additives during the filling, transporting, or the discharging of the container, shall be cause for rejection of the container or the contents of the mixer if any portion of the rejected container is discharged into the mixer.

725.7.5 Volumetric Batching and Continuous Mixing Concrete and Equipment: Volumetric-batching and continuous-mixing concrete and equipment may be utilized upon approval of the Engineer for job site concreting applications. Material handling, procedures, and operations shall be in accordance with ACI 304.6R, Guide for the use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment and all concrete produced and all test performed shall be in accordance with ASTM C685, Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing. All equipment shall meet the requirements of the Volumetric Mixer Standards of the Volumetric Mixer Manufacturers Bureau

SECTION 725

and shall have a suitable copyrighted rating plate furnished by the Bureau and attached to the volumetric mixing equipment.

725.8 TESTS AND TEST METHODS:

725.8.1 Field Sampling and Tests: Concrete shall be sampled in accordance with ASTM C172 for determination of temperature, slump, unit weight and yield (when required) and air content (when required) as well as for fabrication of test cylinders for compressive strength determination at 28 days. Samples shall be of sufficient size to perform all the required tests and fabricate the necessary test cylinders but in no case less than 1 cubic foot. Concrete shall be sampled during discharge of the middle portion of the batch. At the discretion of the Engineer, a sample may be obtained at the beginning of the discharge if the properties of the concrete do not appear to be within the specification limits for slump or temperature.

All sampling and testing shall be done by a certified technician meeting the requirements of the ACI Concrete Field Testing Technician, Grade I or equivalent.

Temperature of the concrete mixture shall be determined in accordance with ASTM C1064.

Slump of the concrete mixture shall be determined in accordance with ASTM C143.

Air content of the concrete mixture (when required) shall be determined in accordance with ASTM C231 or C173, whichever is applicable.

Unit weight and yield of the concrete mixture (when required) shall be determined in accordance with ASTM C138.

All compressive strength test specimens shall be made, cured, handled, protected, and transported in accordance with the requirements of ASTM C31. The contractor shall provide and maintain for the sole use of the testing laboratory/technician adequate facilities for safe storage and proper curing of concrete test cylinders on the project site including sufficient access on weekends and holidays to allow the timely pick-up of cylinders specimens. Any and all deviations from the standard procedure of any test method shall be promptly identified and corrected. Any deviations shall be clearly noted by the testing laboratory on all written reports. Testing results obtained from non-standard testing procedures shall be considered invalid and discarded by Engineer.

Sampling and testing performed for concrete acceptance will be at the expense of the Contracting Agency. Sampling and testing for the Contractor's purposes of quality control or other needs shall be at the Contractor's expense.

725.8.2 Concrete Cylinder Test: A cylinder strength test shall be the average of the strengths of at least two 6 inch by 12 inch cylinders or at least two 4 inch by 8 inch cylinders made from the same sample of concrete and tested at 28 days. An adequate number of cylinder specimens shall be made for each 50 cubic yards or not less than each half-day's placement of each class of concrete. All specimens will be tested in a laboratory approved by the Engineer in accordance with ASTM C39 for concrete acceptance. Should an individual cylinder show evidence of improper sampling, molding, curing, or testing, the results shall be discarded and the compressive strength shall be the result of the average of the remaining cylinder(s). Additional cylinder specimens may be made and tested at other ages to obtain additional compressive strength information and shall not be considered as acceptance tests. Cylinder testing performed for concrete acceptance will be at the expense of the Contracting Agency. Cylinder testing for the Contractor's purposes of quality control or other needs shall be at the Contractor's expense.

725.8.3 Additional Concrete Testing: If the 28-day strength test does not meet the compressive strength requirements, additional concrete testing may be performed to further evaluate the concrete in question for purposes of acceptability or payment. This may involve testing of additional cylinders at later ages, (for example - hold cylinders at 56 days or more), or core testing to determine in-place concrete strengths. This additional testing and all coring repairs shall be pre-approved by the Engineer and at the expense of the Contractor. If core testing is performed, at least three representative cores shall be obtained, conditioned and tested in accordance with ASTM C42 from each concrete member or area of concrete to be tested at locations designated by the Engineer. Cores damaged subsequent to or during removal shall be rejected and additional core samples taken. Cores shall be obtained and delivered to a laboratory acceptable to the Engineer in time to allow complete strength testing within 48 days of original concrete placement. The Contractor may elect to have a representative present during sampling and testing. A core strength test shall be the average of the results of the three cores. Should an individual core show evidence of improper sampling, curing, or testing, the results shall be discarded and the compressive strength shall be the result of the average of the remaining core(s). Results of the core strength testing shall replace the results of the cylinder strength test for that sample.

SECTION 725

725.9 ACCEPTANCE:

(A) Plastic Concrete Properties

(1) The slump of the concrete shall meet the requirements of ASTM C94 Tolerances in Slump section. When the approved mix design or project specification requirements for slump are a “maximum” or “not to exceed”, the following tolerances apply:

Specified slump:	If 3” or less	If more than 3”
Plus tolerance	0 inch	0 inch
Minus tolerance	1 1/2 inch	2 1/2 inch

When the approved mix design or project specification requirements for slump are not written as a “maximum” or “not to exceed”, the following tolerances apply:

For design slump of:	Tolerance
2 inch and less	+/- 1/2 inch
More than 2 through 4 inch	+/- 1 inch
More than 4 inch	+/- 1 1/2 inch

(2) Limit the maximum allowable temperature of the concrete mixture immediately before placement to 90 degrees F unless otherwise specified or unless a higher allowable temperature is pre-approved by the Engineer. At the discretion of the Engineer, recommended practices in ACI 305, Specification for Hot Weather Concreting, can provide good reference information and may be used to modify maximum allowable concrete temperature and acceptance.

Per ACI 306, Specification for Cold Weather Concreting, when the atmospheric temperature at the time of placing concrete is above 30°F the temperature of the concrete, as placed, shall not be less than 60°F. When the atmospheric temperature at the time of placing concrete is between 0°F and 30°F the temperature of the concrete, as placed, shall not be less than 65°F.

(3) Air entrained concrete shall meet the requirements of ASTM C94 Air-Entrained Concrete section. The air content of air-entrained concrete when sampled from the transportation unit at the point of discharge shall be within the approved mix design tolerance or +/- 1.5 % of the specified value. When a representative sample taken prior to discharge shows an air content below the specified level by more than the allowable tolerance, additional air entraining admixture shall be added to the concrete mix to achieve the desired air content level, followed by a minimum of 30 revolutions at mixing speed.

(4) Per ASTM C94 Mixing and Delivery section, discharge of the concrete shall be completed within 1 1/2 hour after the introduction of the mixing water to the cementitious materials or the introduction of the cementitious materials to the aggregates. The Engineer may allow the continuation of concrete placement after the 1 1/2 hour time limit has been reached if the concrete is of such slump or workability that it can be placed without the addition of water to the batch.

Any concrete failing to meet the tolerances for plastic concrete properties in 725.9 (A) (1) through (4) shall be reviewed by the Engineer and is subject to rejection.

(B) Hardened Concrete Properties – Compressive Strength

Compressive strength of concrete shall be determined on the basis of cylinder strength tests obtained in accordance with section [725.8.2](#) and shall be acceptable if the tests meet or exceed the minimum specified strength. When the validity of cylinder strength tests are suspect, the strength of concrete in question shall be determined in accordance with Section [725.8.3](#).

When compressive strength test results are less than the specified minimum, an Engineering Analysis to determine the impact of the strength reduction may be required by the Engineer prior to the decision to accept or reject the concrete. The Engineering Analysis will be at the Contractor’s expense. Any concrete that is rejected by the Engineer shall be removed and replaced by the Contractor at the Contractor’s expense.

When concrete is accepted by the Engineer on the basis of test results of less than 100% of the required minimum compressive strength, an adjustment in the concrete unit price may be made for the quantity of concrete represented by such strength tests in accordance with Table [725-2](#).

SECTION 725

TABLE 725-2

Adjustment in Concrete Unit Price Based on Strength Deficiency

Class AA and Class A		Class B and Class C	
Percent of Specified Minimum 28-day Compressive Strength Attained (Nearest 1%)	Percent of Concrete Unit Price Allowed	Percent of Specified Minimum 28-day Compressive Strength Attained (Nearest 1%)	Percent of Concrete Unit Price Allowed
100 % or greater	100	100 % or greater	100
98-99	90	95-99	95
96-97	85	90-94	90
95	80	85-89	85

- *End of Section* -

SECTION 726

CONCRETE CURING MATERIALS

726.1 GENERAL:

Curing materials shall consist of waterproof paper, polyethylene film or liquid membrane-forming compounds which, when applied to fresh concrete, will inhibit moisture loss and reduce temperature rise during the curing period. All curing materials and methods shall be approved by the Engineer prior to use. Wet coverings such as burlap, cotton mats, or other moisture-retaining fabrics also may be used, or may be required by special provisions.

726.2 MATERIALS:

(A) Waterproof paper, or polyethylene film, shall conform ASTM C171.

(B) Liquid membrane-forming compounds shall conform ASTM C309. Type 1 compound with either a Class A or Class B vehicle shall be used for concrete structures, except bridge decks, approach slabs, and portland cement concrete pavement. Type 2 white pigmented compound, with either a Class A or Class B vehicle shall be used for portland cement concrete pavement, bridge decks and approach slabs.

(C) Burlap cloth made from jute or kenaf shall conform to AASHTO M-182.

- *End of Section* -

SECTION 727

STEEL REINFORCEMENT

727.1 GENERAL:

The following specifications set forth the requirements for bar reinforcement, wire reinforcement, and wire mesh reinforcement. The reinforcement shall conform accurately to the dimensions and details indicated on the plans or otherwise prescribed and before being placed in any concrete work, shall be thoroughly cleaned of all loose rust, mill scale, mortar, oil, dirt, or coating of any character, which would be likely to destroy, reduce, or impair its proper binding with the concrete.

No reinforcing steel will be accepted under this specification until it has been approved by the Engineer. When required by the Engineer, the Contractor or supplier shall furnish a spot sample taken on the project and notify the Engineer as to when and where they will be available. Such samples shall be furnished at the expense of the Contractor or supplier, but the cost of any testing that may be required will be borne by the Contracting Agency. Samples shall only be taken in the presence of the Engineer. The Contractor shall furnish 3 certified mill test reports or certificates of compliance for each heat or size of steel which can be clearly identified with the lot. When such information has been furnished, placing of the steel will not be held up until results of spot samples have been received. Unless otherwise specified, all reinforcing steel bars shall be deformed intermediate grade 40 billet steel conforming with ASTM A615 and the shapes shall conform with ASTM B670.

In testing bar reinforcement, only the theoretical cross-sectional area will be used in all computations.

Bending of steel shall conform to the requirements of Section [505.5.2](#).

The various grades of steel shall not be used interchangeably in structures.

727.2 WIRE REINFORCEMENT:

Wire reinforcement shall in all respects fulfill requirements prescribed in ASTM A82.

727.3 WIRE MESH REINFORCEMENT:

Mesh reinforcements shall conform to ASTM A185. The gage of the wire and the dimension of the mesh will be specified in the special provisions or shown on the plans. The wire mesh reinforcement shall be so constructed as to retain its original shape and form during necessary handling. The effective cross-sectional area of the metal shall be equal to that specified or indicated on the plans.

727.4 WIRE TIES:

Wire for ties shall be black, annealed, not lighter than 16 gage.

- End of Section -

SECTION 728

CONTROLLED LOW STRENGTH MATERIAL

728.1 GENERAL:

Controlled Low Strength Material (CLSM) is a mixture of cementitious materials, aggregates, admixtures\additives, and water that, as the cementitious materials hydrate, forms a soil replacement. CLSM is a self-compacting, flowable, cementitious material primarily used as a backfill, structural fill, or a replacement for compacted fill or unsuitable native material. Placement and usage of each type of CLSM is described in Section [604](#).

728.2 MATERIALS:

Cementitious materials shall conform to Section [725.2](#).

Coarse aggregate shall conform to ASTM C-33 grading size No. 57. The size and gradation of fine aggregates (sand) shall conform to ASTM C-33. Alternate materials meeting the applicable requirements of Section [701](#) or [702](#) such as combinations of other aggregates, Aggregate Base Course (ABC) or Reclaimed Concrete Material (RCM) may be used to replace the required coarse and fine aggregate as long as the approved mix design meets the requirements of Table [728-1](#) and is approved by the Engineer.

Water shall conform to Section [725.4](#).

728.3 PROPORTIONING OF MIXTURES AND PRODUCTION TOLERANCES:

Proportioning of the mixture shall comply with Section [725.6](#) and Table [728-1](#). The CLSM shall have consistency, workability, plasticity, and flow characteristics such that the material when placed is self-compacting. A minimum of 40% coarse aggregate shall be used. A mix design shall be submitted for the Engineer's approval prior to the excavation for which the material is intended for use. Sampling shall be in accordance with ASTM D5971. The flow consistency shall be tested in accordance with ASTM D6103. Unit weight (when applicable) shall be obtained by ASTM D6023. Compressive strength shall be tested in accordance with ASTM D4832.

TABLE 728-1	
CONTROLLED LOW STRENGTH MATERIAL REQUIREMENTS	
Portland Cement Content, Sack/cu yd	Flow, inches
1/2 Sack	9±2
1 Sack	9±2
1 1/2 Sack	9±2

Note for Table [728-1](#):

- (1) CLSM mixes meeting the table requirements will not generally be placeable by means of a concrete pump or may not provide the needed workability for certain conditions. When pumpable mixes or increased workability are required, the addition of fly ash or a natural pozzolan in excess of the required Portland Cement Content may be used.
- (2) Ready-mixed structural concrete or grout shall not be used in lieu of CLSM without prior approval from the Engineer and shall be subject to rejection.

728.4 MIXING:

CLSM mixing shall comply with Section [725.7](#). Mixing shall continue until the cementitious material and water are thoroughly dispersed throughout the material. Mixes shall be homogenous, readily placeable and uniformly workable.

- End of Section -

SECTION 729

EXPANSION JOINT FILLER

729.1 PREMOLDED JOINT FILLER:

Expansion joint filler materials shall consist of preformed strips of a durable resilient compound and comply with ASTM D1751, D1752, or D2628, as specified by the Contracting Agency or as approved by the Engineer.

729.2 POUR TYPE JOINT FILLERS FOR PORTLAND CEMENT CONCRETE PAVING (PCCP):

Pour type joint fillers shall comply with ASTM D3406 or as approved by the Engineer. Joint sealant shall not contain any coal tar materials. The following requirement shall be added to paragraphs 7.1 of ASTM D3406:

The minimum ambient temperature during application and ambient temperatures under various storage conditions shall be clearly marked on the container.

729.3 TEST REPORT AND SHIPMENT CERTIFICATE:

Each shipment shall be accompanied by a certificate from the supplier that the material will comply with the above specifications and such certificate shall be delivered to the Engineer.

- End of Section -

SECTION 735

REINFORCED CONCRETE PIPE

735.1 GENERAL:

These specifications cover reinforced concrete pipe and related structures intended to be used for conveyance of sewage, industrial waste, and storm and irrigation water.

Except as modified herein reinforced concrete pipe shall be manufactured and tested in conformance with the requirements of ASTM C76 for circular pipe, ASTM C506 for elliptical pipe.

Whatever struts or other protective methods proved necessary to furnish and install the pipe to meet the limitation of cracks as specified herein, shall be provided and maintained throughout pipe handling and transportation.

735.2 JOINTS:

Bell Reinforcement: All reinforced concrete pipes less than 36 inch inside diameter and the same approximate equivalent size shall include an area of reinforcing steel in the bell not less than the area required for the circumferential reinforcement in the wall of the pipe.

Rubber gaskets shall be in accordance with ASTM C443.

Cement Mortar Joints for RCP will be in accordance with Subsection 736.3

735.3 FABRICATED SPECIALS – WYES, TEES, CURVES, BENDS AND CLOSURES :

Fabricated pipe specials shall be made equal in strength, diameter, and other physical characteristics to the standard straight pipe lengths by the use of extra concrete, extra reinforcing or steel items.

Horizontal and vertical long-radius curves shall be formed by bevel adapters or by beveling the straight pipe joint. The bevel of the pipe shall not exceed 5 degrees and the total angular deflection, for beveled pipe, shall not exceed 10 degrees. Small angular changes may be made with straight pipe provided that the joint opening does not exceed 3/4 inch. Short radius curves and closures shall be formed with fabricated specials; however, the angular deflection of any segment of the fabricated section shall not exceed 10 degrees.

735.4 MATERIALS:

Except when otherwise permitted by the Engineer, no materials other than water, Portland cement, Pozzolanic materials, mineral aggregates and steel shall be used in the manufacturing of the pipe, with the following exceptions:

(A) Portland Cement: Portland cement shall comply with ASTM C150, Type II, and low alkali. The pipe manufacturer shall supply a cement mill certificate in triplicate for each load of cement delivered, showing the specification, type, chemical analysis, and quantity. In lieu of the above, on stockpiled pipe the manufacturer shall certify that the type of cement used meets this specification. The pipe manufacturer shall also certify in writing that the cement content of the concrete complies with the specifications as to yield per cubic yard of concrete poured.

(B) Concrete Admixtures: The pipe manufacturer shall certify in writing that no calcium chloride or admixture containing calcium chloride has been used in the manufacture of the pipe. Other admixtures may be used if approved by the Engineer. The pipe manufacturer shall certify to the brand and chemical content of such admixtures used.

(C) Steel Reinforcement: The pipe manufacturer shall supply three copies of mill certificates showing heat numbers, chemical analysis, and physical tests on reinforcing steel. In lieu of the above, on stockpiled pipe the manufacturer shall certify that the type of steel used meets this specification.

735.5 MANUFACTURER'S QUALIFICATIONS AND EQUIPMENT REQUIREMENTS:

The manufacturer shall be competent to manufacture the type, size and quality of pipe; in addition, the manufacturer shall have satisfactory curing and storage facilities, and satisfactory financial resources.

SECTION 735

Calibration of Cement and Aggregate Scales: The pipe manufacturer shall make whatever alterations are necessary to his equipment to enable the Contracting Agency's Sealer or State Inspector of Weights and Measures to check, calibrate, and seal the aggregate and cement scales used in the pipe production.

735.6 CURING OF PIPE:

(A) Steam Curing: The manufacturer shall provide adequate steam plant, piping, enclosures, and other facilities for curing the pipe. The enclosures shall be such that the temperature is maintained continuously between 110 and 150°F.

(B) Curing of the pipe shall not commence until the concrete has attained its initial set, but in any event not sooner than 1 hour and no later than 8 hours after placing of the concrete. Rate of rise of temperature shall not exceed 30°F per hour.

(C) Water Curing: The pipe shall be kept moist during daylight hours. The pipe, including the ends, shall be covered with burlap for the first 3 days, except that, if the pipe is kept constantly and completely wet with fog sprays during the daylight hours, the burlap covering may be omitted. If the manufacturer fails to proceed immediately with the required water curing the surfaces of the concrete, except joint surfaces that are to be grouted shall be sealed with an approved white pigmented sealing compound in accordance with Section [726](#).

735.7 TESTS AND ACCEPTANCE:

(A) Basis of Acceptance: The basis of acceptance for the reinforced concrete pipe shall be in accordance with ASTM C76, ASTM C506, or ASTM C507, as applicable, including the method stated in the special provision and as amended herein. However, the purchaser may, at his option, make concrete cylinder tests for the purpose of determining release dates for shipment of the pipe and for his information in regard to general quality of the concrete.

(B) Segregation of Material: The slump of the concrete mix shall not exceed 4 inches so as to preclude excessive segregation of the materials used and shall be proportioned so that the result shall be a homogeneous concrete mixture of such quality that the pipe will conform to the tests and design requirements of these specifications.

(C) A pipe has failed the D-load test when the opening crack exceeds .01 inch for a distance of 1 foot when measured at close intervals. These measurements are taken within the 1 foot measured span only when the crack line is more or less parallel to the axis of the pipe, as it is obvious that where the crack deviates substantially from parallel, and approaches a direction normal to the axis, that the edges of the crack tend to slip past each other, instead of opening up under load. The intent of the test is to measure the crack opening under stress.

(D) Porous or honeycomb concrete areas 6 inches or less in diameter may be removed and repaired. Pipe having defects or repairs greater than 6 inches in diameter will not be accepted.

(E) Any crack exceeding 1 foot in length that goes completely through the pipe, is not considered acceptable whether repaired or not, except that a single end crack that does not exceed the depth of the joint as measured from the end to the inside shoulder is acceptable.

(F) Any crack that is .01 inch in width for one-sixteenth inch in depth or deeper, for a length of 1 foot or more and continues as a hairline crack down to the reinforcing steel for over 1/2 the length of the pipe is not considered acceptable whether repaired or not.

(G) A single continuous hairline crack which does not extend to the reinforcing steel and not in excess of .01 inch in width for a distance of 1 foot is acceptable without repair. This type of crack, longer than 1 foot shall be repaired.

(H) Repairs shall be made by filling the defect with epoxy under pressure or by chipping out a V-Section to the full depth of the defect and repairing with an approved patching compound. The composition of the patching compound shall be furnished to the Engineer for approval.

(I) The words regarding acceptability and repair ability in the above paragraphs shall also apply when the crack occurs after loading of the pipe in the trench with backfill. Cracks wider than .01 inch shall be assumed to indicate overstress of the steel. In

SECTION 735

such case, the defective portion of the installation shall be replaced or repaired in a manner acceptable to the Engineer. After structural repairs are completed, the remaining cracks shall be filled as required above. All corrective measures shall be at the expense of the Contractor.

(J) Blisters: All pipe joints having blisters involving less than 1/4 the interior surface area shall be repaired by removing all loose material and exposing all hollow area and replacing with fresh concrete properly bonded, with an acceptable bonding agent, and curing the repair with membrane coating. Blisters with larger areas are not considered to be repairable or acceptable.

(K) Painting of pipe, or portion of pipe, with grout to cover defects, minor or major, will not be permitted until approved by the Engineer.

(L) Where the modified or special design method, under the ASTM Standard is elected, acceptance on the basis of material tests and inspection of manufactured pipe for defects and imperfections shall be as stated in the ASTM Standard, and as amended herein. However, one joint of each size and D-load shall be selected by the Engineer for test purposes, and shall be tested for strength by the 3 edge bearing method, ASTM C497, with the results being used for confirmation of the submitted design for this D-load. If the pipe section tested fails in compression or shear before reaching the D-load specified, the test shall be considered a failure. Additional sections of the same diameter size and class shall be tested as specified above until the load requirements are met for the D-load strength. This test procedure shall be accomplished only once per manufacture regardless of the number of contractors he supplies. Placing of reinforcing steel in the test section of pipe to control shear cracks will not be permitted.

Requirements regarding defects shall be the same as stated above for standard pipe.

Concrete test requirements specified under compression tests of the ASTM Standard shall be amended in part to read as follows: "The average of any 5 consecutive strength tests of the laboratory-cured specimens shall be equal to or greater than the specified strength set forth in the design strength requirements table for the type and class of pipe being produced, and not more than 20 percent of the strength tests shall have values less than the specified strength. If more than 20 percent have values less than the specified strength, the lot represented shall be considered to be defective and not acceptable. In no case shall any cylinder tested fall below 80 percent of the specified design strength. If anyone cylinder falls below 80 percent of the specified design strength, then the entire production represented by that cylinder will not be accepted for purchase by the Contracting Agency unless the Contractor can demonstrate by coring to the satisfaction of the Engineer, that the cylinder in question is not representative of the entire production, or is representative of only a portion of the entire production."

During the fabrication of the pipe, concrete cylinders shall be made from a representative sample of the concrete. Concrete cylinders and slump tests shall be made by the Engineer or under his direct supervision. A set of cylinders shall consist of five. A minimum of one set shall be made for each day's production.

In vibrated and spun pipe, where the slump of the concrete approaches 0, the cylinders shall be made as follows:

Fill the cylinder can in 3 equal layers. Each layer shall be vibrated and assisted by rodding or other mechanical contrivance simultaneously until the moisture comes to the surface. Care shall be taken that the material is not over-vibrated which will cause segregation. When the moisture rises to the surface of the third layer, it is struck off and leveled. The cap is put on the cylinder and it is marked for identification. It shall then be steam cured in the same manner as the pipe, at the conclusion of which, the cylinders shall be brought into the laboratory for standard moist curing until the prescribed time for the compressive test.

The cylinders shall be made according to ASTM C31 where the pipe is manufactured with concrete that has enough slump for the material to be hand rodded. For reinforced concrete pipe made by the centrifugal method, the manufacturer may substitute centrifugally cast test cylinders for standard test cylinders. Centrifugally cast cylinders shall be made in accordance with AWWA C302 and cured in the same manner as normal test cylinders, except that the net area of the hollow cylinder will be used to determine the compressive strength.

735.8 SANITARY SEWER PIPE:

In addition to the above, sewer pipe shall meet the requirements of ASTM C76, reinforced concrete pipe having O-ring Rubber Gasket Joints with an interior lining of plastic liner plate in accordance with Section [741](#).

(A) Pipe Design: The wall thickness and the amount of circumferential reinforcement shall not be less than that required for the D-load indicated on the plans and required by the specifications. The calculations for wall thickness and amount of steel area

SECTION 735

per foot of pipe, having concrete lining, shall be for a pipe 2 inches larger in internal diameter than that specified on the plans. The additional concrete lining shall not be considered in the calculation for the area of steel required, nor in any of the load calculations.

D-load class of pipe and the date poured shall be plainly marked inside each pipe section. Specific approval must be obtained, prior to submitting a bid; to decrease the cover over the reinforcing steel at the joint should the steel interfere with the rubber gasket in the groove at the spigot end.

(B) Pipe Construction: Tamped or packer head pipe will not be allowed. Pipe having concrete lining shall have the internal diameters indicated on the plans, measured to the inside of the additional 1 inch of covering. The various sizes of pipe shall be centrifugally spun. Pipe having plastic liner plate shall be vibrocast to 1/2 inch tolerance to match the unlined pipe of the D-load indicated on the plans.

(C) Test and Acceptance: In addition to the statements above, any crack that goes completely through the pipe, regardless of length of crack is not considered acceptable whether repaired or not, except that a single end crack that does not exceed the depth of the joint as measured from the end to the inside shoulder is acceptable.

735.9 ACCEPTANCE MARK:

The Engineer may, at the place of manufacturer, indicate his acceptance of the pipe for delivery to the job by marking the pipe with the Contracting Agency's mark. Such acceptance, however, shall not be considered a final acceptance.

If the pipe is subsequently rejected, the mark placed thereon by the Engineer shall be defaced.

- End of Section -

SECTION 736

NON-REINFORCED CONCRETE PIPE

736.1 GENERAL:

The size and classes of the non-reinforced concrete pipe to be furnished shall be as shown on the plans, or as specified under the item of work for the project of which the concrete pipe is a part.

Strength classes of non-reinforced concrete shall be as identified in ASTM C14, Class 1 non-reinforced concrete pipe. Class 2 non-reinforced concrete pipe or Class 3 non-reinforced concrete pipe.

Unless otherwise specified, Class 3 non-reinforced concrete pipe will be used.

736.2 MATERIALS:

Materials used in manufacturing the pipe shall be as specified in ASTM C14, with the following exception:

Cement shall conform to ASTM C150, Type II, and low alkali. Samples and testing shall conform to the methods designated therein. The pipe manufacturer shall supply a cement mill certificate, in triplicate, for each load of cement delivered, showing the specification, type, chemical analysis, and quantity. On stockpiled pipe in lieu of the above, the manufacturer shall certify that the type of cement used meets this specification. Satisfactory facilities shall be provided for identifying, inspecting, and sampling cement at the mill, the warehouse, and the site of the work. The Contracting Agency shall have the right to inspect the cement and obtain samples for testing at any of these points. The cement shall be stored in a weathertight, dry, well ventilated structure approved by the Engineer. Cement salvaged by cleaning cement sacks, mechanically or otherwise, shall not be used in the work. Cement containing lumps will be rejected and shall immediately be removed from the site of the work. If the temperature of the cement exceeds 150°F., it shall be stored until cooled to that temperature.

736.3 PIPE JOINTS:

The joints may be tongue and groove mortared joints, or rubber gaskets joints. With rubber gasket joints, inside mortaring and outside grouting is not required. Tongue and groove joints shall be mortared inside and grouted outside. Grouting of outside joints shall be by the diapering method.

736.3.1 Cement Mortar Joints:

(A) The mortar or grout shall consist of 1 part Portland cement and 2 parts sand, by volume. The quantity of water in the mixture shall be sufficient to produce a soft workable mortar, but shall in no case exceed a water-cement weight ratio of 0.53. Where outside joints are made by the diaper method, the grout shall be composed of 1 part cement to 3 parts sand, and shall be mixed to the consistency of thick cream. The sand shall conform to Section [776.3](#), and the cement shall conform to Section [725](#).

(B) The pipe ends shall be thoroughly cleaned and wetted with water before the mortar or grout is placed. No backfilling around the joints shall be done until the joints have been fully inspected and approved.

(C) Mortar joints shall be cured by keeping them wet for three days or by using a curing compound.

736.3.2 Rubber Gasket Joints: Rubber gaskets shall be in accordance with ASTM C443 or AASHTO M-315.

736.4 CURVES, BENDS AND CLOSURES:

Horizontal and vertical long-radius curves shall be formed by slight deflection at the joints, provided that the maximum joint opening caused by such deflection shall not exceed 3/4 inch. Short radius curves shall be formed by straight pipe in which the joints are beveled. The bevel of the pipe shall not exceed 5 degrees, and the total angular deflection for beveled pipe shall not exceed 10 degrees at any joint.

SECTION 736

736.5 CARE OF PIPE AND MATERIALS:

All pipe and materials shall be manufactured, handled, loaded, shipped and unloaded in such manner as to be undamaged and in sound condition, in the completed work. Particular effort shall be exercised to protect the ends of pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer otherwise they shall not be used in the work and shall be replaced with an equal pipe or special in an acceptable condition. At all times rubber gaskets shall be stored in a cool, dark place until ready for use.

736.6 TESTS:

Before pipe is delivered to the job site for use in any work under the contract, test pipes shall meet the requirements of the hydrostatic pressure test and the loading test described in ASTM C14. The test shall be made at the point of manufacturer and shall be made under the presence of the Engineer.

- End of Section -

SECTION 738

HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS FOR STORM DRAIN AND SANITARY SEWER

738.1 GENERAL:

This specification covers the requirements of profile-reinforced and corrugated (Type S or Type D) high density polyethylene (HDPE) pipe manufactured per ASTM F894, AASHTO M-252 or AASHTO M-294 for gravity flow, low pressure storm drain and sanitary sewer systems. When noted on the plans or in the special provisions, gravity flow, low pressure storm drains and sanitary sewers may be constructed using HDPE pipe. The HDPE pipe will be of the sizes 8 inch diameter through 120 inch diameter. For the purpose of this specification, low pressure is defined as the test pressures of 3.5 psi of air or 4 feet of water as specified in Section [615.11](#).

All pipe joints shall conform to the controlled pressure test of 10.8 psi of air or 25 feet of water as stipulated in ASTM D3212.

The size and class of the HDPE pipe to be furnished shall be designed by the Engineer and shown on the plans or in the project specifications. At no time will the class designed be less than RSC-63 for profile pipe, or minimum equivalent Pipe Stiffness (PS) for corrugated pipe per the requirements of AASHTO M-252 or AASHTO M-294.

738.2 MATERIALS:

738.2.1 Base Material Composition: Profile pipe base material and fittings shall, in accordance with ASTM F894, be made from a PE plastic compound meeting the requirements of Type III, Class C, Category 5, Grade P34 as defined in ASTM D1248 and with established hydrostatic design basis (HDB) of not less than 1250 psi for water at 73.4 degrees F° as determined in accordance with Method ASTM D2837. Materials meeting the requirements of cell classification PE 334433 C or higher cell classification, in accordance with ASTM D3350 are also suitable. Corrugated pipe base material shall comply with the requirements of AASHTO M-252 (Type S) or AASHTO M-294 (Type S or D) and have a minimum cell classification PE 335420C.

738.2.2 Other Pipe Materials: Materials other than those specified under Base Materials shall comply with ASTM F894, AASHTO M-252 or AASHTO M-294.

738.2.3 Gaskets: Rubber gaskets shall be manufactured from a natural rubber, synthetic elastomer or a blend of both and shall comply in all respects with the physical requirements in ASTM F477.

738.2.4 Water Stops: Water stops shall be manufactured from a natural or synthetic rubber and shall conform to the requirements of ASTM C923. The water stop shall have expansion rings, a tension band, or a take-up device used for mechanically compressing the water stop against the pipe.

738.2.5 Thermal Welding Material: The material used for thermally welding the pipe material shall be compatible with the base material.

738.2.6 Lubricant: The lubricant used for assembly shall comply to manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

738.3 JOINING SYSTEMS:

738.3.1 Gasket Type: Joints for the piping system and fittings shall consist of an integrally formed bell and spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket located on the spigot is compressed radially on the pipe or fitting bell to form a water tight seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM F477.

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configurations for the fittings shall be compatible to those used for the pipe.

SECTION 738

Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear, shall be smooth and free of any imperfections, which would adversely affect sealability. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

738.3.2 Thermal Weld Type: The pipe ends shall consist of an integrally formed bell and spigot, with or without the elastomeric centering gasket, which join together to form an interface between bell and spigot, such that it is suitable to seal by thermal weld using the extrusion welding process, in accordance with the manufacturer's recommended procedure.

Thermal welded joints may be effected by welding from inside the pipe or outside, or both.

The assembly of the welded joints shall be in accordance with the manufacturer's recommendations.

Thermal welded joints shall be used only when specified on plans or in specifications.

738.4 FITTINGS:

Fittings for HDPE profile wall or corrugated pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket type or thermal weld type joints in accordance with Subsection [738.3](#).

A clamp gasket or approved method shall be provided at manhole entry or connection to reduce infiltration and exfiltration. Where precast manholes are used, entrance holes must be large enough to allow for proper grouting around the manhole gasket. A non-shrink grout shall be used for grouting.

738.5 CERTIFICATION:

The manufacturer shall furnish an affidavit (certification) that all materials delivered shall comply with the requirements of ASTM F894 or AASHTO M-252.

Pipe and resin producers that manufacture according to AASHTO M-294 shall be certified according to the Plastic Pipe Institute protocol for their Third Party Certification Program.

738.6 DIMENSIONS AND TOLERANCES:

Profile wall HDPE pipe dimensions shall comply with dimensions given in Table 1 of ASTM F894. The "average or nominal inside diameter" of profile wall HDPE pipe shall not deviate from its normal pipe size by more than as specified in Table 1 of ASTM F894. Corrugated HDPE pipe dimensions shall be "nominal inside diameter" dimensions and shall not deviate from its nominal pipe size by more than the minimum and maximum tolerances as described in AASHTO M-252 or AASHTO M-294, Section 7.2.3.

Profile pipe shall have a Ring Stiffness Constant (RSC) or Pipe Stiffness (PS) as shown on the plans. The minimum RSC for profile HDPE pipe shall be RSC-63. The minimum PS for corrugated pipe shall be as shown in AASHTO M-252 (Section 7.5) or AASHTO M-294 (Section 7.4), and tested per ASTM D2412. In no case shall the minimum PS be less than the equivalent PS value for RSC-63.

738.7 CLASSIFICATIONS:

HDPE profile-reinforced pipe products shall be made in four standard Ring Stiffness Constant (RSC) classifications, 40, 63, 100 and 160. These are referred to as RSC-40, RSC-63, RSC-100 and RSC-160. The RSC test shall be conducted in accordance with ASTM D2412 with the exceptions listed in accordance with ASTM F894. HDPE corrugated pipe (Type S or Type D) shall meet the minimum Pipe Stiffness (PS) requirements of AASHTO M-252 or AASHTO M-294. The PS test shall be conducted in accordance with ASTM D2412 with the exceptions listed in accordance with AASHTO M-252 or AASHTO M-294.

SECTION 738

738.8 MARKINGS:

Markings on pipe shall be per ASTM F894, AASHTO M-252 or AASHTO M-294. These markings shall be clearly shown on the pipe at intervals of approximately 12 feet and include but not limited to the following: the manufacturer's name or trademark, nominal size, the specification designation, plant designation code, date of manufacture or an appropriate code. All fittings shall be marked with the designation number of the specification and with the manufacturer's identification symbol. In addition, manufacturers of corrugated HDPE, AASHTO M-294, shall print on or affix the appropriate Plastic Pipe Institute Program Mark on each length of pipe produced that meets the requirements of the program.

738.9 CARE OF PIPE AND MATERIALS:

Care of pipe materials shall comply with Subsection [736.5](#).

HDPE profile reinforced RSC type pipe in shipping or storage shall not be stacked higher than three rows for pipes 21 inches in diameter or less, nor higher than two rows for pipes 24 to 36 inches in diameter inclusive. Pipe shall not be stacked, shipped, or stored with weight on the bells of the pipe.

Corrugated HDPE pipe in shipping and storage shall be stacked per manufacturer's recommendation, but in no case higher than 5 rows for pipe 24 inches or less in diameter, or 3 rows for pipe greater than 24 inches in diameter.

Pipe that is gouged marred or scratched forming a clear depression shall not be installed and shall be removed if damaged in the installation.

- End of Section -

SECTION 739

STEEL REINFORCED POLYETHYLENE PIPE AND FITTINGS FOR STORM DRAIN, IRRIGATION AND SANITARY SEWER

739.1 GENERAL:

This specification covers the requirements of Steel Reinforced Polyethylene (SRPE) pipe manufactured per ASTM F2562 for storm drains, irrigation and sanitary sewer systems. When noted on the plans or in the special provisions, storm drains, irrigation and sanitary sewers may be constructed using SRPE pipe. SRPE pipe shall be designed in accordance with AASHTO LRFD Bridge Design. Specifications, Section 12. Trench excavation, backfilling and compaction for this flexible pipe shall be in accordance with Section [601](#). Construction and installation shall be in accordance with Section [618](#) for storm drain and irrigation water or Section [615](#) for sanitary sewers.

The pipe stiffness class shall be Class 1, per Table 1 of ASTM F2562, unless otherwise specified.

739.2 MATERIALS:

739.2.1 Base Steel Materials: Continuous high strength galvanized ribs shall be cold rolled steel meeting the requirements of either ASTM A1008 or ASTM A1011 with minimum yield strength of 80,000 psi. The steel shall have a galvanized coating meeting the requirements of ASTM A653 with a G60 minimum coating weight. Steel ribs shall be completely encased within the HDPE profile.

739.2.2 HDPE Material Composition: SRPE pipe HDPE material and fittings shall, in accordance with ASTM F2562, be made from HDPE plastic compound meeting the minimum requirements of cell classification 335464C or higher cell classification, in accordance with ASTM D3350.

739.2.3 Gaskets: Elastomeric gaskets shall comply with the requirements in ASTM F477 and be as recommended by the pipe manufacturer.

739.2.4 Water Stops: Elastomeric Water stop gaskets shall conform to the requirements of ASTM C923.

739.2.5 Thermal Welding Material: The material used for thermal welding of the pipe shall be compatible with the pipe's base material.

739.2.6 Lubricant: The lubricant used for assembly shall comply with manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

739.3 JOINING SYSTEMS:

739.3.1 Gasket Type: Steel reinforced bell and spigot joints for the piping system and fittings shall consist of an integrally formed bell and spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket located on the spigot is compressed radially on the pipe or fitting bell to form a water tight seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM F477. Gasketed watertight pipe joints shall meet a minimum laboratory test pressure of 10.8 psi when tested in accordance with ASTM D3212.

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made. The bell and spigot configurations for fittings shall be compatible to those used for the pipe.

Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear, shall be smooth and free of any imperfections, which would adversely affect the seal. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

739.3.2 Thermal Weld Type: Thermal weld joints, when specified, shall utilize plain ended pipe welded together by internal pressure testable couplers. The internal couplers shall have a minimum wall thickness equal to or greater than the pipe wall thickness as defined in ASTM F2562. The assembly of the welded joints shall be in accordance with the manufacturer's recommendations. Thermal welded pipe joints shall meet a minimum laboratory test pressure of 10.8 psi when tested in accordance with ASTM D3212.

SECTION 739

739.3.3 Pipe to Concrete Structure Connections: An approved flexible connector, mechanical seal or water stop shall be provided at manhole entry or concrete structure connection to reduce infiltration and exfiltration. When grouting is necessary at a water stop connection, non-shrink grout shall be used.

739.4 FITTINGS:

Fittings for SRPE pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket type or thermal weld type joints in accordance with Subsection [739.3](#).

739.5 CERTIFICATION:

The manufacturer shall furnish a certification that all delivered materials comply with the requirements of ASTM F2562. The certification shall also identify the steel as galvanized with a G60 minimum coating weight, 80,000 psi yield strength and the cell classification of the HDPE material as 335464C minimum.

739.6 MARKINGS:

Markings on pipe and fittings shall be per ASTM F2562. The markings shall be clearly shown on the pipe, at least, at the end of each length of pipe and spaced at intervals of not more than 10 feet. Markings shall include the following information: ASTM F2562, the nominal pipe size in inches, the pipe stiffness class, the manufacturer's name, trade name or trademark, the manufacturer's production code: identifying plant location, machine, and date of manufacture.

739.7 CARE OF PIPE AND MATERIALS:

All pipe, fittings, gaskets and water stop materials shall be manufactured, handled, loaded, shipped, unloaded, and installed in such a manner as to be undamaged and in sound condition, in the completed work. Particular effort shall be exercised to protect the ends of the pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer or removed from the project site. Rubber Elastomeric gaskets shall be covered in a factory applied protective wrap.

- End of Section -

SECTION 740

POLYPROPYLENE PIPE AND FITTINGS FOR STORM DRAIN, IRRIGATION AND SANITARY SEWER

740.1 GENERAL:

This specification covers the requirements of profile wall (both dual wall - Type S and triple wall - Type D) polypropylene (PP) pipe manufactured per ASTM F2736 and AASHTO M330 for storm drain, or ASTM F2736 or ASTM F2764 for sanitary sewer systems. When noted on the plans or in the special provisions, storm drains, irrigation and sanitary sewers may be constructed using PP pipe. PP pipe approved sizes are 12 inch diameter through 60 inch diameter. Trench excavation, backfilling and compaction for flexible pipe shall be in accordance with Section [601](#) and manufacturer's installation recommendations. Construction and installation shall be in accordance with Section [618](#) for storm drain and irrigation water or Section [615](#) for sanitary sewers.

740.2 MATERIALS:

740.2.1 Base Material Composition: Profile pipe base material and fittings shall meet polypropylene materials requirements as stated in Section 4, Table 1 of ASTM F2736, Section 5, Table 1 of ASTM F2764 or Section 6, Table 1 of AASHTO M330.

740.2.2 Gaskets: Elastomeric gaskets shall comply with the requirements in ASTM F477 and be as recommended by the pipe manufacturer.

740.2.3 Water Stops: Elastomeric water stop gaskets shall conform to the requirements of ASTM C923.

740.2.4 Lubricant: The lubricant used for assembly shall comply with manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

740.3 JOINING SYSTEMS:

740.3.1 Gasket Type: Joints for the piping system and fittings shall consist of an integrally formed bell and spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket located on the spigot is compressed radially on the pipe or fitting bell to form a water tight seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM F477. Gasketed watertight joints shall meet laboratory test pressure of 10.8 psi when tested in accordance with ASTM D3212.

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configurations for fittings shall be compatible to those used for the pipe.

Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear, shall be smooth and free of any imperfections, which would adversely affect the seal. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

740.3.2 Pipe to Concrete Structure Connections: An approved flexible connection, mechanical seal, or water stop shall be provided at manhole entry or concrete structure connections to reduce infiltration and exfiltration. When grouting is necessary at a water stop connection, non-shrink grout shall be used.

740.4 FITTINGS:

Fittings for PP pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket type joints in accordance with Subsection [740.3](#).

The material used for thermally welding the fitting shall be compatible with the base pipe material.

740.5 CERTIFICATION:

The manufacturer shall furnish a certification that all delivered materials comply with the requirements of ASTM F2736, ASTM F2764, or AASHTO M330.

SECTION 740

740.6 MARKINGS:

Markings on pipe and fittings shall be per ASTM F2736, ASTM F2764 or AASHTO M330. The markings shall be clearly shown on the pipe, at least, at each end of each length of pipe and spaced at intervals of not more than 10 feet. Markings shall include the following information: the manufacturer's name or trademark, nominal size, the specification designation, plant designation code, date of manufacture or an appropriate code. All fittings shall be marked with the designation number of the specification and with the manufacturer's identification symbol.

740.7 CARE OF PIPE AND MATERIALS:

All pipe, fittings, gaskets, and water stop materials shall be manufactured, handled, loaded, shipped, unloaded, and installed in such manner as to be undamaged and in sound condition, in the completed work. Particular effort shall be exercised to protect the ends of pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer or removed from the project site. At all times elastomeric gaskets shall be covered in a factory applied protective wrap until ready for use.

- End of Section

SECTION 741

LINING FOR REINFORCED CONCRETE SANITARY SEWER PIPE

741.1 GENERAL:

The interior area of the reinforced concrete pipe as indicated on the plans, shall be sealed and protected with lining, as specified below.

The installation and application of the pipe lining shall be accomplished by the supplier of the reinforced concrete pipe.

All work for and in connection with the installation of lining in concrete pipe and the field sealing of joints shall be done in strict conformance with all applicable published specifications, instructions and recommendations of the approved lining manufacturer. The pipe supplier shall furnish all labor, material and equipment to successfully accomplish the lining.

741.2 MATERIALS:

741.2.1 Material Composition: The material shall be a liner plate which is a combination of inert, synthetic resins, pigments, and plasticizers, compounded to make permanently flexible sheets.

The liner plate shall be resistant to the following: Oxidizing agents, sulfuric, phosphoric, nitric, chromic, oleic, and stearic acids; sodium and calcium hydroxides; ammonia, sodium, calcium, magnesium, and ferric chlorides; ferric sulfate, petroleum oils and greases; vegetable and animal oils, fats, greases and soaps.

Liner plate shall be impermeable to sewage gasses and liquids and shall be non-conductive to bacterial or fungus growth. All liner plates shall be factory checked electrically to insure freedom from any porosity with a high voltage holiday detector set at a minimum of 20,000 volts.

Joint strips and welding strips shall have the same composition and corrosion resistance as liner plate, but shall not have locking extensions.

The lining shall have good impact resistance, shall be flexible and shall have an elongation sufficient to bridge up to 1/4 inch setting crack which may take place in the pipe or in the joint after installation, without damage to the lining.

Once cast into the pipe, the lining shall be permanently and physically attached to the concrete by a locking extension and shall not rely on an adhesive bond.

741.2.2 Material Details and Dimensions: The liner plate shall not be less than 0.065 inches in thickness. Locking extension shall be of the same material as the liner and shall be integrally extruded with the sheets. If steel bands are used to secure the liner plate to the forms transversely, strap channels shall be integrally molded into the sheet.

Liner plate shall be supplied as pipe size sheets fabricated by shop welding together the basic size sheets.

Joint straps shall be 4 inches \pm 0.25 inches in width and shall have each edge beveled prior to application.

Welding strips shall be 1 inch \pm 0.125 inch in width and shall have the edges beveled at time of manufacture.

The Contractor shall submit a shop drawing showing liner plate details for approval by the Engineer, prior to fabrication of the pipe.

741.3 INSTALLATION OF LINER PLATE:

The installation of liner plate, including the welding of all joints, shall be done in accordance with the manufacturer's recommendations. Nailing through the plate will not be tolerated. Liner plate shall be installed with locking extensions parallel with the longitudinal axis of the sewer, unless otherwise shown on the plans. All joints between individual sheets or sections of liner plates shall be continuously heat-welded by the use of welding strips of the same kind and equivalent thickness of material as the liner plates (with the exception of the integral extension ribs).

SECTION 741

Liner plate shall be held snugly in place against inner forms by means of light gage steel wire, light steel banding straps or other suitable means. If steel banding straps are used, they shall be applied in strap channels provided for this purpose.

Locking extensions (T-shaped) shall be integrally extruded to all lower, terminal or longitudinal edges of liner plate as applied to concrete pipe. If banding straps are used, a steel rod 1/4 inch in diameter may be inserted in each locking extension along the longitudinal edges of each sheet of liner plate for concrete pipe or some other approved method for holding the lower edge of the liner plate snugly against the form shall be provided.

Concrete poured against liner plate shall be compacted in a careful manner so as to protect the liner plate and to produce a dense, homogeneous concrete securely anchoring the lock extensions into the concrete.

In removing forms, care shall be taken to protect liner plate from damage. Sharp instruments shall not be used to pry forms from lined surfaces. All holes and cut, torn or seriously abraded areas in the liner plate shall be patched. Patches made entirely with welding strip shall be fused to the liner plate over the entire patch. Larger patches may consist of smooth liner plate applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the sound liner plate adjoining the damaged area.

The Contractor shall take all necessary measures to prevent damage to installed liner plate from equipment and materials used in or taken through the work.

The applied lining shall be free from bubbles due to poor workmanship, and the Contractor shall cut out said bubbles and weld a similar sheet in place of the bubble, unless otherwise directed by the Engineer.

Application on Concrete Pipe-Special Requirements: Liner plate shall be set flush with the inner edge of the bell or groove end of a pipe section and shall extend to the spigot or tongue end or to approximately 3 inches beyond the tongue end, depending upon the type of liner plate to be made with the adjoining concrete pipe.

Wherever concrete pipe, which are protected with liner plate, join structures not so lined, such as brick structures, concrete pipe, cast-in-place structures or clay pipe, the liner plate shall be extended over and around the end of the pipe and back into the structure for not less than 4 inches.

Where a pipe spur, not of plastic lined concrete, is installed through lined concrete pipe, the liner plate shall be returned 4 inches at the surface of contact. The seal between the liner plate and the spur shall be made using an approved adhesive material and strapped in place.

If the joint space is too wide or the joint space surface too rough to allow satisfactory sealing with this adhesive, the joint space shall be filled with 2 inches of densely caulked lead wool or other approved caulking material.

Lined concrete pipe may be cured by standard curing methods. Care shall be exercised, in handling, transporting and placing lined pipe to prevent damage to the liner plate. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or with a suitable fork lift.

No pipe with damaged lining will be accepted until and unless the damage has been repaired to the satisfaction of the Engineer.

741.4 FIELD JOINTS:

The Contractor shall obtain the services of qualified personnel to weld the liner plate field joints. Pipe joints must be dry before the liner plate joints are made. All mortar and other foreign material shall be removed from liner plate surfaces adjacent to the pipe joint, leaving them clean and dry.

No liner plate joints shall be made until the trench has been backfilled.

Field joints in the liner plate at pipe joints may be either of the following described types:

Type P-1- The joint shall be made with a separate 4 inch joint strip and 2 welding strips. The 4 inch strip shall be centered over the joint, secured to the liner plate with an approved adhesive, or other approved means, and welded along each edge to adjacent liner plate with a 1 inch weld strip. The width of the space between adjacent liner plate sheets shall not exceed 2 inches. The

SECTION 741

4 inch joint strip shall lap over each liner plate a maximum of 1 inch. Type P-2 - The joint shall be made with a plastic strip, without locking extensions integrally extruded with the liner plate and extending approximately 3 inches beyond the spigot end. A 1 inch welding strip is required. The joint strip shall overlay the liner plate a minimum of 1 inch on the downstream side of the pipe joint. An approved adhesive, or other approved means, shall be used to hold the lap in place during the welding. The joint strip on beveled pipe shall be trimmed to a width, measured from the end of the spigot, of approximately 3 inches for the entire circumferential length of the liner. Distortion in bending back the strip to expose the pipe joint during the laying and joint mortaring shall be avoided. All welding of joints is to be in strict conformance with liner plate manufacturer's specifications.

Type P-4 - The joint shall be made with a 4 inch weld strip. The 4 inch weld strip shall be centered over the joint and welded in place to the lining in adjacent joints of pipe. The weld strip shall lap over each liner plate in minimum of 1 inch.

741.5 TESTING AND REPAIRING DAMAGED LINER SURFACES: :

After the pipe is installed in the trench, all surfaces covered with liner plate shall be tested with an approved electrical holiday or flaw detector set at a minimum of 20,000 volts. All welds shall be physically tested by a non-destructive probing method. All patches over nail and form tie holes, or repairs to the liner plate wherever damage has occurred, shall be done in conformance with the instructions and recommendations of the liner plate manufacturer.

Each transverse welding strip which extends to a lower edge of the liner plate shall be tested. The welding strips shall extend below the liner plate, providing a tab. A 10-pound pull will be applied normal to the face of the pipe by means of a spring balance. Liner plate adjoining the welding strip will be held against the concrete during application of the force. The 10-pound pull will be maintained if a weld failure develops, until no further separation occurs. Defective welds will be re-tested after repairs have been made. Tabs shall be trimmed away neatly after the weld strip has passed inspection. The Contractor shall provide all equipment required to test liner plate in the manner recommended by the manufacturer and as described above. The Contractor shall also provide personnel qualified to perform the testing. Testing shall be performed in the presence of a representative of the Contracting Agency.

- End of Section -

SECTION 742

PRECAST MANHOLE

742.1 GENERAL:

This specification covers requirements for precast manhole sections. All precast manhole manufacturers shall be NPCA (National Precast Association) certified and shall provide all NPCA certifications upon request. Loading criteria for the precast manholes shall meet or exceed the AASHTO H20 loading requirements. All precast manhole risers shall be monolithically cast to ensure water tightness and have a certified structural design and the manhole shall be cast in a fashion to achieve water tightness. This shall include a monolithic cast manhole or a multi section cast manhole which also shall have a certified structural design.

742.2 MATERIALS:

742.2.1 Concrete Materials: Concrete materials shall conform to the requirements of Section 725 and Table 725-1 for Class AA.

742.2.2 Precast Sections: Precast sections shall conform to ASTM C478, AASHTO M199. The design shall be in accordance with ACI 318 and ASTM C890 using traffic load A-16 (HS20-44).

742.2.3 Joints and Connections: Details of proposed joints and connections shall be submitted to the engineer for approval and shall conform to ASTM C990, C993, or C425 as applicable.

742.3 MANHOLE PENETRATIONS:

The location of penetrations shall be determined by the plans and specifications. Manhole penetrations may be formed or cut out. Cut outs of the precast base shall be done using a mechanical hole saw. After the core is removed from the casting, the precaster shall coat all exposed reinforcing with a corrosion inhibiting epoxy suitable for end use application. The thickness of the epoxy shall be per the epoxy manufacturer's recommendation. Knock outs shall be formed in the location noted on the plans or specifications.

742.4 REINFORCING:

Reinforcing steel shall meet the following specifications:

- Bars ASTM A615 or A706
- Wire and wire fabric ASTM A1064

Design of the reinforcing shall be in accordance with ACI 318 and ASTM C890

742.5 GASKETS:

A flexible pipe to manhole connector shall be used whenever a pipe penetrates into a precast concrete manhole or structure. The design of the connector shall provide a flexible, watertight seal between the pipe and the concrete. The connector shall assure that a seal is made between the structure wall and the pipe by:

- Casting the connector integrally with the structure wall during the manufacturing process in a manner that will not pull out during pipe coupling.
- Compressing the connector against the inside circumference of the structure by means of wedge or toggle style connection, expansion ring or other means approved by the engineer.

The connector shall be made from materials that conform to the physical and chemical requirements in ASTM C923 or C425 as applicable. The connector shall be sized specifically for the type of pipe being used and shall be installed in accordance with the recommendations of the manufacturer.

The connection hardware shall be constructed of type 316 stainless steel meeting ASTM A480. The hardware shall ensure a water tight connection between the concrete and the pipe material and shall provide an adequate seal enough to withstand the negative air pressure test per ASTM C-1244.

SECTION 742

742.6 LIFTING POINTS:

Lifting points shall be designed and evaluated by a registered professional engineer and have a minimum safety factor of four. There shall be a minimum of two lifting points on every precast manhole base. After base installation, the lifting holes shall be thoroughly packed with a pre-packaged non-shrink grout. Bent reinforcing steel bars shall not be used as lifting devices. Through lifting holes will not be allowed.

742.7 IMPERFECTIONS:

Any imperfections which in the opinion of the engineer may adversely affect the performance of the precast section shall be cause for rejection.

– End of Section –

SECTION 743

VITRIFIED CLAY PIPE

743.1 GENERAL:

Vitrified clay pipe, 30 inch diameter or less, shall be extra strength in accordance with the requirements set forth in ASTM C700, except as modified herein. Pipe larger than 30 inches shall be of the type specified in the Special Provisions.

743.2 MANUFACTURING REQUIREMENTS:

743.2.1 Shape: Pipe ends shall be square with the longitudinal axis, and sockets shall be true, circular, and concentric with the barrel of the pipe.

The ends of the pipe shall be so formed that when the pipes are laid together and the joints made, they shall constitute a continuous and uniform line of pipe and shall have a smooth and regular interior surface.

743.2.2 Stoppers, Branches, Ends: Stoppers shall be used with all branch pipes that are to be left unconnected. Stoppers for branch pipes having flexible compression joints may be either clay discs with flexible compression joints, factory applied, that will mate with the branch joint; or, a resilient material of controlled design and dimensions for mating with the branch pipe to which it is to be applied; or, of other material approved by the Engineer. Wooden stoppers will not be accepted.

Branches shall be furnished with connections of the sizes specified, securely and completely fastened to the barrel of the pipe in the process of manufacture.

“T” branches shall have their axis perpendicular to the longitudinal axis of the pipe. “Y” branches shall have their axis 45 degrees (unless otherwise specified) from the longitudinal axis of the pipe, measured from the socket end.

All branches shall terminate in sockets. Barrel of the branch shall be of sufficient length to permit making proper joint when the connecting pipe is inserted in the branch socket.

743.2.3 Imperfections: The following additional imperfections in a pipe or fittings will be considered injurious and cause for rejection:

(A) Any surface fire crack in the ends of the spigot or bell which exceeds 1 inch in length.

(B) Any piece broken from the bell end of the pipe or fittings when it adversely affects the performance of the joint or connection.

743.2.4 Certification: A certificate from the manufacturer shall be furnished attesting that the pipe meets the requirements of this specification, including test reports for the hydrostatic pressure test and the loading test herein specified.

743.3 TESTS:

In addition to the required tests at the manufacturer's plant, the Engineer's representative may select specimens at random at the point of delivery or at the job site. Tests on these specimens shall be performed at a local testing facility under the supervision of the Engineer's representative. The cost of such supervision will be borne by the Contracting Agency and all other costs shall be borne by the Contractor.

When the pipe is subjected to an internal hydrostatic pressure of 10 psi for the time shown in Table [743-1](#), the accumulated moisture on the exterior surface shall not run down the sides in such quantity that will exceed 10 milliliters.

SECTION 743

TABLE 743-1

TABLE OF TESTING TIME FOR PIPES

Thickness of Wall Inches	Test Time Minutes
Up to and including 1	7
Over 1 and including 1 1/2	9
Over 1 1/2 and including 2	12
Over 2 and including 2 1/2	15
Over 2 1/2 and including 3	18
Over 3	21

The loading test shall conform in manner to that specified in ASTM C301 for 3-edge bearing and shall be applied to all specimens selected for testing.

743.4 IDENTIFICATION MARKS:

Pipe and fittings shall be clearly marked with the name or trademark of the manufacturer, a code number identifying production control and plant location, and extra strength designation.

743.5 JOINTS:

Acceptable joints shall be flexible compression type for bell and spigot pipe or flexible compression couplings for plain-end pipe.

Compression joints and couplings shall conform to the requirements of ASTM C425.

- End of Section -

SECTION 744

ABS TRUSS PIPE AND FITTINGS

744.1 GENERAL:

Truss pipe is defined as an internally-braced double-walled ABS composite pipe conforming to ASTM D2680. When noted on the plans or in the special provisions, gravity sanitary sewer system may be constructed using truss pipe for diameters not exceeding 15 inches.

Truss pipe shall have both ends of each pipe length sealed at the factory such that the inert filler material between the two concentric thermoplastic tubes is impervious. All field cuts shall be sealed according to the manufacturer's recommendations.

744.2 COUPLINGS AND FITTINGS:

Fittings for truss pipe may include couplings, wyes, tees, elbows, caps, plugs adapters, manhole water stops and clamps. All couplings and fittings shall be assembled by a chemically welded method. Solvent shall be of the type recommended by the pipe manufacturer. Each solvent weld type coupling or fitting shall be accurately formed and entirely compatible in joining the pipe to assure a leak-proof joint. Couplings and fittings shall be manufactured from the same material as the pipe except that caps, plugs and adapters may be fabricated or molded from rubber, polyurethane or other suitable compounds. The couplings and fittings shall have chemical and physical properties equal or superior to the pipe itself.

744.3 SOLID WALL PIPE AND FITTINGS:

744.3.1 General: When noted on the plans or in the special provisions, Sewer and Drain Solid Wall Pipe and Fittings may be used for 4 inch and 6 inch service lines, risers and fittings.

744.3.2 Material: Sewer and Drain Solid Wall Pipe shall be manufactured of virgin ABS compound as specified in ASTM D1788, Types I and IV, excepting that the minimum heat deflection temperature (ASTM D648) shall be 180°F.

744.3.3 Strength: Test samples of pipe, 6 inches long, shall be cut from full length sections and tested by the method outlined in ASTM D2412. The pipe shall be deflected at least 35 percent without failure and the stiffness at 5 percent deflection shall equal or exceed the value listed in Table 744-1 below after the test samples have been immersed in a 5 percent solution by weight of sulfuric acid and n-Heptain for a period of 24 hours prior to testing. Failure is defined as rupture of the pipe wall.

Stiffness factor may be computed by the method outlined in ASTM D2412 or by dividing the load in lbs/linear inch by the deflection in inches and 5 percent deflection ($F/\Delta Y$ in Table 744-1).

TABLE 744-1	
MINIMUM STIFFNESS REQUIREMENTS	
Nominal Size	$F/\Delta Y$ 2.5% min
4 inches	55 lb./in.
6 inches	55 lb./in.

744.3.4 Couplings and Fittings: All couplings and fittings shall be assembled by a chemically welded method. Each solvent weld type coupling or fitting shall be accurately formed and entirely compactable with the Sewer and Drain Solid Wall Pipe to assure a leak proof joint. Couplings and Fittings shall be manufactured from the same material as the pipe except that caps, pugs and adapters may be fabricated or molded from rubber, polyurethane or other suitable compounds. The couplings and fittings shall have chemical and physical properties equal or superior to the pipe itself.

SECTION 744

744.4 MANHOLE CONNECTIONS:

A clamp gasket or approved equivalent method shall be provided at manhole entry or connection to reduce infiltration and exfiltration. Where precast manholes are used, entrance holes must be large enough to allow for proper grouting around the manhole gasket.

744.5 CERTIFICATION:

A certificate from the manufacturer shall be furnished attesting that the pipe meets the requirements of ASTM D2680.

744.6 IMPERFECTIONS:

Any imperfections which in the opinion of the Engineer may adversely affect the performance of the pipe or joints shall be cause for rejection.

744.7 INSTALLATION AND TESTING:

Truss pipe shall be installed in accordance with applicable provisions of Section [615](#). In addition to the tests prescribed in Section [615](#), the Engineer may, at his option, require a deflection test on all or any part of the line. Any pipe which shows deflection in excess of 5% shall be removed and replaced at no cost to the Contracting Agency.

- End of Section -

SECTION 745

PVC SEWER PIPE AND FITTINGS

745.1 GENERAL:

This specification covers the requirements of polyvinyl chloride (PVC) plastic sewer pipe and fittings for gravity flow sewers and building connections. When noted on the plans or in the special provisions, gravity sanitary sewers may be constructed using PVC pipe for diameters not exceeding 15 inches. Pipe, fittings, couplings and joints shall be in conformance with the requirements of ASTM D3034, SDR-35, except as modified herein.

745.2 MATERIALS:

745.2.1 Caps and Plugs: Caps and plugs for building connections may be molded or fabricated from rubber, polyurethane or other suitable compound.

745.2.2 Gaskets: Rubber gaskets shall be manufactured from a synthetic elastomer and shall comply in all respects with the physical requirements specified in ASTM F477.

745.2.3 Lubricant: The lubricant used for assembly shall have no detrimental effect on the gasket or on the pipe.

745.3 JOINING SYSTEMS:

Joints for the piping system and fittings shall consist of an integral bell gasketed joint designed so that when assembled, the elastomeric gasket located within the bell is compressed radially on the pipe or fitting spigot to form a positive seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service.

All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configurations for the fittings shall be compatible to those used for the pipe.

Joints shall provide a permanent seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear shall be smooth and free of any imperfections which could adversely affect sealability.

The assembly of the joints shall be in accordance with the pipe manufacturer's recommendations.

745.4 FITTINGS:

Fittings for PVC pipe may include elbows, wyes, tee wyes, double bell couplings, manhole couplings, manhole adapter rings, plugs, caps, adapters and increasers.

Manholes couplings shall be manufactured from asbestos cement and incorporate an elastomeric gasket moisture barrier.

745.4.1 Manhole Connections: A manhole adapter gasket or approved equivalent method shall be provided at manhole entry or connection to prevent infiltration and exfiltration. Where precast manholes are used, entrance holes shall be large enough to allow for proper grouting around the manhole ring.

745.5 CERTIFICATION:

A certificate from the manufacturer shall be furnished certifying that the pipe and fittings meet the requirements of ASTM D3034, SDR-35, F/ΔY 2.5% min. Y = 46 psi at 5% deflection.

745.6 IMPERFECTIONS:

Any imperfections which in the opinion of the Engineer may adversely affect the performance of the pipe or joints shall be cause for rejection.

- End of Section -

SECTION 750

IRON WATER PIPE AND FITTINGS

750.1 CAST IRON WATER PIPE:

All cast iron water pipe shall be designed in accordance with AWWA C-101.

Cast iron water pipe may be designed for either 18/40 or 21/45 physicals and shall conform to AWWA C-106 or AWWA C-108.

Except as otherwise provided cast iron or water pipe shall be designed to meet internal pressure of 150 psi, external cover of 5 feet, and standard Laying Condition B.

Cast iron pipe shall be nominal 18 foot lengths.

Pipe shall be cement mortar lined and seal coated in accordance with AWWA C-104.

750.2 DUCTILE IRON WATER PIPE:

All ductile iron water pipe shall be designed in accordance with AWWA C-150 and shall be manufactured in accordance with AWWA C-151. The class shall be as designated in the plans or special provisions.

Pipe shall be cement mortar lined and seal coated in accordance with AWWA C-104.

750.3 JOINT REQUIREMENTS:

Push-on joints for cast iron or ductile iron water pipe shall conform to AWWA C-111 and shall include synthetic rubber gaskets and lubricant.

Mechanical joints for cast iron or ductile iron water pipe shall conform to AWWA C-111 and shall include cast iron glands, synthetic rubber gaskets, and T-head bolts and nuts.

Flanged joints for cast iron or ductile iron water pipe shall be as detailed on the plans or as designated in the special provisions.

Restrained Joints:

When noted on plans or approved by the Engineer, joints for push-on or mechanical jointed ductile pipe may be modified to provide a fully restrained joint. These modifications to push-on and mechanical joints, including but not limited to segmented or special glands and split sleeves, shall conform to AWWA C-111. The Engineer shall review and/or approve each manufacturer's modifications to the joint. Upon request of the Engineer, the manufacturer of the modified joint shall provide test data showing compliance with AWWA C-111.

750.4 FITTINGS:

Iron fittings shall be either Gray-Iron or Ductile Iron conforming to AWWA C-110 or AWWA C-153 with a minimum pressure rating of 250 psi. Flanged ends shall conform to AWWA C-110. Push-on and mechanical joints ends shall conform to AWWA C-111.

Fittings shall be cement mortar lined and coal-tar coated in accordance with AWWA C-104.

- End of Section -

SECTION 752

ASBESTOS-CEMENT WATER PIPE AND FITTINGS

752.1 GENERAL:

These specifications cover asbestos-cement pressure pipe intended for use in supply lines and distribution systems that carry water under pressure.

752.2 CLASSES:

Asbestos-cement pipe shall be manufactured and tested in accordance with AWWA C-400, except as modified herein, for pipe intended for use in water service at maximum operating pressures of 100, 150, or 200 psi. Pipe shall be designated as Classes 100, 150, or 200 respectively, for the corresponding maximum operating pressures. Unless shown otherwise on the plans or specified in the special provisions the minimum acceptable shall be Class 150.

752.3 MANUFACTURE:

The joining ends of the pipe shall be of such design that they may be properly connected to cast iron fittings and valves which are manufactured within the continental United States that meet applicable AWWA specifications. Pipe in sizes less than 6 inches in diameter may be supplied in either 10 foot or 13 foot lengths, and pipe in sizes 6 inches or greater in diameter shall be supplied in 13 foot lengths, except for random and special short lengths in all sizes as permitted in AWWA C-400.

752.4 INSPECTING AND TESTING:

The uncombined calcium hydroxide in the pipe and couplings shall not exceed 1 percent when tested in accordance with AWWA C-400. Certification of all manufacturers' tests in accordance with AWWA C-400 shall be required. In addition, the Contracting Agency may require all inspection and testing to be performed at the manufacturer's plant or at an approved testing laboratory.

All pipe manufactured outside the United States of America will be subject to inspection and testing by the Contracting Agency at the plant site or at an approved testing laboratory. In addition, all pipes shall have the Underwriters Laboratory, Inc. seal of approval and certification that all tests were in accordance with AWWA C-400.

752.5 FITTINGS:

Fittings shall be cast iron or ductile iron and conform to AWWA C-110 or C-153 for 250 psi minimum working pressure rating cast on fittings. All fittings shall have Ring-Tite, Fluid-Tite, or Weld-Tite bells to fit the class of pipe specified. All fittings shall be cement lined in accordance with AWWA C-104.

752.6 RUBBER RINGS:

Each coupling shall have 2 synthetic rubber joint sealing rings conforming to the requirements of ASTM D1869. This paragraph shall also apply to the rings furnished for use with fittings. Neoprene shall not be used.

- End of Section -

SECTION 753

GALVANIZED PIPE AND FITTINGS

753.1 GENERAL:

All galvanized pipe shall be new galvanized welded or seamless steel pipe, conforming to the requirements of ASTM A53 standard weight, schedule 40.

753.2 CORROSION PROTECTION:

All buried galvanized pipe and fittings shall be protected from corrosion by the application of a tight fitting, extruded or wrapped coating. Coating shall be not less than 0.030 inches in thickness at any point. Extruded coatings shall be of polyethylene or polyvinyl chloride, Extrucoat or equal. Wrapped coatings shall be of polyethylene, polyvinyl chloride, coal tar or asphalt tape, Pretecto Wrap No. 200, Saft-t-Clad FOS No. 655, Tapecoat, Trantex VID-10 or E-12, Polyken No. 900, Scotchrap No. 50 or approved equal Tape shall be edge lapped no less than 1/4 inch.

753.3 FITTINGS:

All fittings for screwed galvanized pipes shall be 150 psi, banded, galvanized malleable iron screwed fittings.

753.4 VALVES:

Valves on galvanized pipelines shall be all bronze, double disc, nonrising stem with wheel handle on top, such as Jones, J373 or equal, with bodies, bonnets, yokes and wedges made of material conforming to ASTM B62.

- End of Section -

SECTION 754

COPPER PIPE, TUBING AND FITTINGS

754.1 PIPE AND TUBING:

All copper pipe and tubing shall be new seamless copper pipes and tubes, designed for underground water services, plumbing purposes, etc. They shall conform to all the requirements of ASTM B88, Type K.

All pipe or tubing shall be made of copper free from cuprous oxide, as determined by microscopic examination at a magnification of 75 diameters.

Type K tubing, when furnished in coil, shall be annealed after coiling.

754.2 FITTINGS:

All fittings used in connection with copper pipe or tubing, shall be copper or bronze fittings as shown on standard details.

Service Material containing Brass or Bronze must comply with the current NSF 61-8 Standards at the time the Project begins.

All Brass or Bronze service material must meet the current AWWA C-800 Standards.

- End of Section -

SECTION 755

POLYETHYLENE PIPE FOR WATER DISTRIBUTION

755.1 GENERAL:

This specification is intended to describe water service pipe with a hydrostatic design stress of 620 psi for water at 73.4 °F produced from a high density ultrahigh molecular weight polyethylene pipe compound. Polyethylene pipe used for water distribution shall conform to all the requirements of ASTM D2239 and with the additional provisions listed herein. This specification describes pipe of the nominal I.D. and O.D. size as manufactured by Carlon, Celanese, Orangeburg, Phillips 66 Drisco pipe and Triangle Aycee and shall provide a water pressure tight joint when used with compression type fittings.

Service Material containing Brass or Bronze must comply with the current NSF 61-8 Standards at the time the project begins.

All Brass or Bronze service material must meet the current AWWA C-800 Standards.

Pipe may be rejected for failure to comply with any requirements of these specifications.

755.2 MATERIAL:

The polyethylene extrusion compound from which the pipe is extruded shall meet the requirements of Type III, Grade 34, Class C, material as described in ASTM D1248, except that the melt index shall be determined under a higher temperature than ASTM D1238. The test condition shall be as specified below under tests of pipe.

The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other defects. The pipe shall be uniform in color, opacity, density, and other physical properties.

755.3 PIPE DIMENSION AND TOLERANCES:

The average inside diameters, wall thickness, and respective tolerances shall be, for any cross-section, as shown in ASTM D2239, when measured in accordance with ASTM D2122.

The standard thermoplastic pipe dimension ratio (SDR), the ratio of the pipe diameter to wall thickness, shall not exceed 7 for 160 psi design pressure.

755.4 MINIMUM BURST PRESSURE:

The minimum burst pressure for pipe made from Type III, Grade 34, Class C, polyethylene compound, Designation Code: PE-3406, when determined with at least 5 specimens shall be at least equal to 630 psi for water at 73.4°F. Pressures shall be determined in accordance with ASTM D1599.

755.5 SUSTAINED PRESSURE:

In addition to passing the sustained pressures given in ASTM D2239 for a temperature of 100°F. and 73.4°F. the pipe shall withstand, without failing, ballooning, bursting or weeping for a period of at least 300 hours, at $194 \pm 2^\circ\text{F.}$, 113 psi test pressure for 3/4 inch pipe and 112 psi for 1 inch pipe. These test pressures have been calculated on a basis of a 450 psi fiber stress. The test procedure outlined in ASTM D1598, shall be followed.

755.6 TESTS OF PIPE:

The pipe must be able to meet all tests that are specified in ASTM D2239, and the following test for melt index, as determined in ASTM D1238. Pellets of the original resin, placed into the testing device shall have flow rates as follows:

(A) Less than 0.5 grams per 10 minutes at 310°C with a plunger load of 27.5 pounds for pipe or tubing extruded by the Allied Chemical Process.

(B) Less than 3 grams per 10 minutes at 190°C with a plunger load of 47.65 pounds for pipe and tubing extruded by the Phillips Extrusion Process.

SECTION 755

755.7 CERTIFICATION BY MANUFACTURER:

Each Contractor must be able to furnish a certification from the manufacturer of the pipe that the polyethylene plastic pipe is of uniform quality and will fully comply with these specifications, and that the pipe is manufactured of virgin polyethylene, that no scrap material has been used, and that it is satisfactory for potable water, in accordance with the specifications of the National Sanitation Foundation Testing Laboratories, Inc.

The pipe manufacturer shall further supply a copy of certification from the manufacturer of the polyethylene extrusion compound used to make the pipe that the compound fully complies with these specifications.

The manufacturer must have adequate equipment and quality control facilities to be sure that each extrusion of pipe is uniform in texture, dimension and strength, and have so manufactured this class of pipe in sufficient quantities to be certain that it will meet all normal field conditions of usage.

755.8 PIPE IDENTIFICATION:

The pipe shall be permanently marked indicating size and pressure-temperature rating. The appropriate lettering shall occur on the pipe at least once in every 24 inches. The seal of approval or marking of the testing laboratory shall be included in the marking on all pipes that is intended for transporting potable water.

PE PIPE MARKINGS

REQUIRED MARKINGS, EXAMPLE

Size	—	Pressure	—	Temp Rating	—	Test Lab. Seal
3/4"		160 psi		PE 3406		NSF

OTHER MARKINGS(Not required by Spec. to be marked)
(However pipe must comply)

SDR-7 (Shall not exceed 7)

CS-255-63 (This is a commercial standard designation of the U.S. National Bureau of Standard. Any other number (CS——) is wrong)

NOTE: 3/4 inch Pipe has I.D. 0.824 inch, O.D. 1.060 inch and 3.328 inch circumference.
3/4 inch Tubing is not acceptable and has I.D. 0.681 inch, O.D. 0.875 inch, 2.747 inch circumference and an SDR-9 if shown.

- End of Section -

SECTION 756

DRY BARREL/FIRE HYDRANTS

756.1 GENERAL:

Fire Hydrants furnished by the Contractor shall be designed, manufactured, and tested in compliance with the latest edition of the American Water Works Association (AWWA) - C. 502 Standard for Dry-Barrel Fire Hydrants, supplemented as follows:

756.2 DRAWINGS:

Detail drawings or blue prints showing all components, principal dimensions, construction details and materials used shall be submitted to the Contracting Agency for approval. The Contracting Agency reserves the right to consider the quality, appearance and past performance of fire hydrants when reviewing drawings for approval.

756.3 HYDRANTS:

Fire hydrant makes and models (and approved alternates) shall be specified by the owner and designated on an approved products list, which will be maintained by the owner. Alternate hydrants by request only to Owner. The diameter of the main valve seat opening shall be not less than 5 inches in diameter. The entire valve assembly shall be effectively sealed against moisture.

All interior ferrous surfaces of the shoe exposed to fluid flow (including the valve plate and cap nut), shall be epoxy coated to a minimum dry thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C 550-81, NSF 61 approved, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

Style of inlet shoe connections shall be a restrained mechanical joint with accessories, gland, bolts, gaskets and having a 6 inch diameter inlet connection. Solid flange or ring tight "bump in" connections will not be allowed unless through exception by owner. Facing of the main valve against seats shall be rubber or synthetic rubber. The top of the stem or bonnet shall be equipped with the O ring seal. Hydrants shall be constructed so that extension sections in multiples of 6 inches, with rod and coupling, can be added to increase barrel length. The hose and streamer nozzle connections shall match the standard size and threads per inch of the Contracting Agency. Operating and outlet nozzle cap nuts shall be of solid pentagonal shape. The pentagon shall measure fifteen sixteenths to thirty one thirty seconds inch on side, 1 1/2 inch from point to flat. All barrels above ground shall have a prime coat and painted with two coats of fire hydrant yellow paint or as specified by owner. Hydrants shall be constructed so that the standpipe can be rotated 360 degrees to at least 8 different positions.

Hydrants shall be designed for a 250 psi working pressure and factory bench tested to a 500 psi hydrostatic pressure.

Hydrants shall be field tested consistent with the specified pressure ratings for the connecting pipes or as specified by AWWA.

Hydrants shall be of the break flange traffic model type with a replaceable breakable unit immediately above the ground line to minimize repairs necessary due to traffic damage. The breakable stem coupling will be made of a corrosion resistant material such as stainless steel or bronze, or have a permanently applied non corrosive finish such as nickel plating or fusion bonded epoxy coating.

Hydrants shall be of the compression type; constructed such that the main valve closes with the water pressure to assure no loss of water in the event of damage to the upper portion of the fire hydrant.

Main valve opening shall have a minimum diameter of 5-inches to assure optimum flow. Facing of the main valve against the seats shall be of rubber or synthetic rubber minimum of 1 inch in thickness. Plastic or Neoprene type main valves will not be allowed.

Hydrants shall be of the dry top design with o-ring seals to ensure that the operating threads will be protected from water entry. Dry top design to include factory- lubricated operating mechanism which allows supplemental lubricant to be added in the field without removal of the upper barrel.

SECTION 756

Standard lubricant shall be a NSF 61 approved oil or grease suitable for a temperature range of 20 degrees to 150 degrees F.

Hydrants shall have a cast iron weather shield at the operating nut to protect the clearance area between the top casting and the operating nut.

The operating nut shall be a one-piece bronze casting. Both the operating nut and the nozzle cap nuts shall be National Standard Pentagon in shape and measure 1-1/2 inches from point to flat at the base of the nut.

Hydrants shall have two hose nozzles, 2.5 inches in diameter, and one pumper nozzle approved by the Owner. Rubber gasket nozzle caps shall be provided. Screw Threads shall be per owner requirements.

Hydrant nozzle section shall be capable of rotation through 360 degrees to at least 8 points of rotation with respect to the standpipe to allow the positioning of the hose or pumper nozzles

Minimum distance allowable between the centerline of the lowest nozzle and ground / bury line is 18-inches. Bury line shall be visibly marked on lower barrel of hydrant.

Hydrants shall have markings indicating direction of opening right to left (counter-clockwise).

Hydrants shall have permanent markings identifying the manufacturer name, model identification, size of the main valve opening and the year of manufacture.

Hydrants shall have an automatic drain that is operated by the main valve rod. The drain valve is to open as the main valve is closed and close as the main valve is opened. The port and seat of the drain valve shall be bronze. Drain facings shall not be leather.

The outside of the hydrant top section shall be painted a minimum of one coat of non- lead base premium primer and two (2) finished coats of non-lead base premium durable paint. The surface will be properly prepared, smooth, clean, and dry before primer is applied. The primer coat will be applied to a DFT (Dry Film Thickness) of 3-4 mils. The final 2 coats will be applied to achieve a DFT of 6-8 mils on top of the primer coat. Paint will be a semi-gloss, bright chrome safety yellow in color or as specified by owner. Paint will have high color retention. Paint will be fade and UV resistant, rust resistant, resistant to abrasions and chipping and have flexibility qualities.

Hydrants shall have a bronze valve seat and shall be threaded into a bronze drain ring or shoe bushing to prevent electrolysis between these components

Hydrants shall be designed to permit the use of extension sections.

Hydrants shall be designed to allow all working parts to be removed through the bonnet/dome or upper nozzle section of the hydrant without removal of the entire upper barrel section.

Hydrants shall be suitable for installation in 36-inch to 72-inch trench depth or as specified by owner.

All nuts and bolts of the factory hydrant to be buried below ground will be a minimum of 304 stainless steel and coated for gall protection.

The friction loss must be guaranteed by the manufacturer to match statistics in Table [756-1](#).

756.4 MANUFACTURER:

The manufacturer shall guarantee that the hydrant is so constructed that the valve stem will not be bent when hydrant is damaged or broken at or near the grade level. A safety breaking flange or thimble, shall be provided. The friction loss must be guaranteed, by the manufacturer, to satisfy Table [756-1](#).

SECTION 756

TABLE 756-1

MAXIMUM PERMISSIBLE LOSS OF HEAD FOR HYDRANTS			
Number of Outlet Nozzles	Nominal Diameter of Outlet	Total Flow From Outlet Nozzles GPM	Maximum Permissible Head Loss PSI
2	2 1/2 inches	500	2.0
1	4 inches	600	2.5

756.5 WARRANTY:

All items shall be warranted by the manufacturer for a minimum period of five (5) years from date of acceptance by the Owner, against defects in material and workmanship. At any time during that period, if a defect should occur in any item, it shall be repaired or replaced by the manufacturer at no obligation to the Owner, except where it would be shown that the defect was caused by misuse and not by fault of manufacturer. The manufacturer shall make necessary repairs within the time frame specified by the owner or reimburse the owner if emergency repairs are required. The manufacturer expressly warrants all items to be new, free from defect in design, materials, and workmanship and to be fit and sufficient for their intended purpose. All warranties shall survive acceptance and payment by the city.

756.6 INSPECTION:

All items shall be inspected before acceptance by an authorized representative of the Owner for workmanship, acceptance and proper functioning of components, and conformance to all requirements of this specification.

Should deficiencies be found, it shall be the responsibility of the supplier to pack the item(s) in question, make necessary corrections, and then return to the Owner for re-inspection and acceptance at no additional expense or obligation to the Owner.

- End of Section -

SECTION 757

SPRINKLER IRRIGATION SYSTEM

757.1 GENERAL:

All materials and fittings shall be new, of the manufacturer's most current design, and shall bear the appropriate National Association seal of approval for example, NSF, UL, etc. Similar units shall be procured from the same manufacturer and internal parts shall be common and interchangeable. Parts listing and source of supply for replacement parts will be furnished to the Engineer.

757.2 PIPE AND FITTINGS:

The type of pipe material and fittings shall be as designated on the plans or in the special provisions. The type utilized shall comply with one of the following:

757.2.1 Steel Pipe: All steel pipes shall be newly galvanized, standard weight, Schedule 40 conforming with Section [753](#).

757.2.2 Plastic Pipe: Plastic pipe shall be rigid, unplasticized polyvinyl chloride, PVC 1120 or 1220, with an SDR of 26 or less, complying with ASTM D1785. Schedule 40 or 315 psi pipe shall be used for the continuously pressurized run on the supply side of Control Valves. PVC 1120 to 1220, SDR 26, pressure rated at not less than 125 psi shall be used on the discharge side of all control valves.

757.2.3 Pipe Fittings and Couplings:

(A) Steel Pipe Fitting and Couplings - Steel pipe fittings and couplings shall be galvanized, malleable iron, screwed fittings or couplings, conforming with Section [753](#).

(B) Plastic Pipe Fittings and Couplings - Plastic pipe fittings and couplings shall be either threaded type or slip fitting tapered socket solvent weld type. Schedule 80 pipe only will be used for threaded joints. Tapered solvent weld fittings may be either Schedule 80 or Schedule 40, but in any case, will be equal to or greater than the Schedule and Pressure Rating of the plastic pipe being joined. Tapered fittings shall be sized so that a dry, unsoftened taper cannot be inserted more than halfway into the socket. Plastic saddles and flange fittings are not permitted.

(C) Copper Pipe Fittings and Couplings - Copper pipe fittings and couplings shall conform with Section [754](#).

757.2.4 Solvent Cement: The solvent cement shall be a solution of Type 1, Grade 1, unplasticized, polyvinyl chloride molding or extrusion compound as specified in ASTM D1784, or an equivalent PVC resin. The cement shall be free flowing and shall not contain lumps, microscopic undissolved particles or any foreign matter that will adversely affect the ultimate joint strength. It shall show no stratification or separation that cannot be removed by stirring. Container labeling shall be in accordance with ASTM D2564.

757.3 VALVES AND VALVE BOXES:

757.3.1 General: Valves shall be of the size, type, and capacity designated on the plans or in the special provisions and shall comply with the requirements specified herein.

All valves except garden valves shall be capable of satisfactory performance at a working pressure of 200 psi. Valves shall be designed to permit disassembly to replace sealing components without removal of the valve body from the pipeline.

757.3.2 Gate Valves: Gate valves in size two inches and smaller shall be all bronze double disc wedge type with integral taper seats and non-rising stem. Sizes two and one-half inches and larger shall be iron body, brass trimmed, with the other features the same as for the two inch. Section [753](#) applies.

757.3.3 Manual Control Valves: Manual control valves shall be brass or bronze, and shall be straight or angle pattern glove valves, full opening; key operated with replaceable compression disc and ground joint union on the discharge end.

757.3.4 Electrical Remote Control Valves: Remote control valves shall be electrically operated, designed for a 24 volt, 60 cycle system. They shall be brass or bronze with accurately machined valve seat surfaces, equipped for flow control adjustment,

SECTION 757

and with the capability for manual operation. They shall be readily disassembled for repair and the internal parts shall be easily accessible for service even when installed in the line.

The internal valve shall be a normally closed, diaphragm type with slow opening and closing action as protection against surge pressures. Actuation shall be by an encapsulated type solenoid with the solenoid shunt band, tube, and plunger of stainless steel for corrosion protection. A removable and cleanable strainer shall be provided at the control chamber inlet to prevent debris from entering the solenoid operating section.

757.3.5 Garden Valves: Garden valves shall be brass or bronze except for the handle. They shall have a replaceable compression disc, and shall be 3/4 inch straight-nosed, key operated and pressure rated for operation at 150 psi.

757.3.6 Quick-Coupling Valves and Assemblies: Quick-coupling valves shall be brass or bronze with built-in flow control and self-closing valve and supplied in 3/4-inch size unless otherwise required. When a quick-coupler assembly is specified, it shall consist of the valve, quick-coupler connection and hose swivel. Keys and hose swivel ells shall be furnished as specified on the plans.

757.3.7 Valve Boxes: Valve boxes with locking covers shall be molded, non-corrosive plastic. Applicable ASTM references: D638.

757.4 BACKFLOW PREVENTER ASSEMBLY:

The backflow preventer assembly shall consist of pressure type or reduced pressure type backflow preventer unit and associated components conforming to the governing code requirements and as shown on the plans. It shall be equal in quality and performance to a "Foundation for Cross-Connection Control and Hydraulic Research."

757.5 SPRINKLER EQUIPMENT:

Sprinkler heads, bubbler heads and spray nozzles shall be of the types and sizes as shown on the plans. All major components shall be brass, bronze, stainless steel, or high impact plastic.

Equipment of one type with similar flow characteristics shall be from the same manufacturer and shall bear the manufacturer's name and identification code in a position where they can be identified after installation.

Fixed head sprinklers shall have a one-piece housing with provisions for interior parts replacement. Pop-up sprinklers shall be designed to rise at least 2 inches during operation. Full or part circle sprinklers shall be interchangeable in the same housing.

Bubbler heads shall be of corrosion-resistant, durable bodies, injection molded out of cyclocac, and tapped for 1/2 inch I.P.S. threads. The bubbler shall be fully adjustable from 0 to 5 gallons per minute and shall have a minimum discharge of 1.7 gallons per minute under pressure of 15 pounds per square inch and a minimum discharge of 2.4 gallons per minute under pressure of 30 pounds per square inch supplied at the head.

757.6 ELECTRICAL MATERIAL:

All equipment and material shall comply with the requirements of the governing code and shall be listed by Underwriters' Laboratories, Inc.

757.6.1 Conduit: Conduit shall be galvanized steel conforming to Section [753](#).

757.6.2 Conductors: Service line conductors shall be supplied in the size shown on the plans and shall be THW 600 volts insulation rating conforming to ASTM D2219 or D2220. Low voltage control conductors shall be Type UF No. 14 AWG copper unless otherwise shown on the plan and shall be UL approved for direct burial installation.

757.6.3 Controller Unit: The controller unit shall be fully automatic, with provisions for manual operation, sized to accommodate the number of stations or control valves included in the system and designated on the plans or in the special provisions. Outdoor models shall be housed in a vandal-resistant, weatherproof enclosure which has a locking cover.

SECTION 757

The unit shall require a standard 117 volt, 60 cycle input and provide a 26.5 volt, 60 cycle output and shall incorporate a 14-day programming capacity. The unit shall have a "Master On-Off" switch which will deactivate the controller but allow the day and hour clocks to continue operation.

In addition, it shall include a resettable circuit breaker for unit protection.

Each station timing dial shall have an "Omit" or "Off" position and incremental dial settings for timing controls up to 30 minutes.

- End of Section -

SECTION 758

CONCRETE PRESSURE PIPE - STEEL CYLINDER TYPE

758.1 GENERAL:

These specifications apply to Concrete Pressure Pipe intended for use in water supply pipelines that carry water under pressure. Concrete pressure pipe is specified as follows:

(A) Reinforced concrete pressure pipe-steel cylinder type, pretensioned, shall be designed, manufactured and tested in accordance with AWWA C-303. With agreement by the purchaser and the manufacturer, pipe may be manufactured to larger sizes and for higher pressures than indicated herein.

Reinforced concrete pressure pipe may be furnished in pipe diameters of eighteen (18) inches through seventy-two (72) inches.

Pipe shall be designed by the methods described in Appendix A, AWWA C-303 to resist the internal pressures and external loading conditions designated on the approved plans or in the project specifications.

(B) Prestressed concrete pressure pipe steel cylinder type, shall be designed, manufactured and tested in accordance with AWWA C-301 and AWWA C-304.

Prestressed concrete pressure pipe may be furnished in pipe diameters forty-two (42) inches and larger.

Pipe shall be designed by the methods described in AWWA C-304 to resist the internal pressures and external loading conditions designated on the approved plans or in the project specifications.

758.2 MANUFACTURE:

The Contractor shall submit design calculations, a tabulated layout schedule, and details of specials and fittings to the Engineer for review and approval.

When specified in the project specifications, the manufacturer shall furnish all samples, test reports, test specimens and perform tests as provided in AWWA C-303 or AWWA C-301.

An approved rust inhibitor shall be applied on the exposed portions of the steel joint rings.

The Contractor shall submit an affidavit of compliance from the manufacturer that the pipe and fittings furnished comply with all applicable provisions of AWWA C-301 or AWWA C-303.

The Engineer or his representative shall be allowed access to the manufacturer's plant for the purpose of inspecting the pipe and fittings.

- End of Section -

SECTION 759

STEEL PIPE

759.1 GENERAL:

These specifications apply to Steel pipe intended for use in water supply pipelines that carry water under pressure. Steel pipe is specified as follows:

Steel pipe shall be designed, manufactured and tested in accordance with AWWA C-200.

Steel pipe and fittings may be furnished in pipe diameters of six (6) inches and larger.

Pipe shall be designed by the methods described in AWWA C-200 and AWWA Manual M11, to resist the internal pressures and external loading conditions designated on the approved plans or in the project specifications.

Trench excavation, backfilling and compaction shall be in accordance with Section [601](#) unless otherwise specified in the plans and specifications. For Steel Pipe with a flexible coating the backfill pipe zone material shall consist of Granular Material, maximum 3/4 inch size.

As an option, the backfill in the pipe zone may be Controlled low strength material (CLSM) in accordance with Section [728](#) and placement per Section [604](#).

759.2 LINING AND COATING OPTIONS:

(A) Cement mortar lining and cement mortar coating shall be in accordance with AWWA C-205.

(B) Polyurethane coatings for interior and exterior of steel pipe shall be in accordance with AWWA C-222. The MDFT shall be 20 mils. on the interior lining and 25 mils. on the exterior coating.

(C) Polyethylene tape coating shall be in accordance with AWWA C-214. The total thickness of the tape coating shall be minimum 50 mils for pipe up to 54 inches diameter and minimum 80 mils for pipe 54 inches diameter and larger.

(D) Liquid-Epoxy coating systems for the interior and exterior of steel water pipelines shall be in accordance with AWWA C-210. Interior lining will be applied in one or two coats MDFT of 16 mils.

All linings for potable waterlines shall be NSF approved.

759.3 MANUFACTURE:

The contractor shall submit design calculations, a tabulated layout schedule, and details of specials and fittings to the Engineer for review and approval.

When specified in the project specifications, the manufacturer shall furnish all samples, test reports, test specimens and perform tests as provided in AWWA C-200 or AWWA manual M11.

Standard pipe shall be furnished with rolled-groove bell and spigot rubber gasket joints. Restrained joints shall be lap-welded slip joints with the bell formed by cold formed expanded dies.

Unless otherwise specified, fabricated steel pipe shall be manufactured in uniform lengths to fit the pipeline alignment shown on the plans, subject to a maximum length of 40 feet. For Steel Pipe with flexible coatings the pipe length may be 60 foot maximum, subject to the Manufacturer's recommendations. Shorter lengths may be furnished to facilitate special conditions.

The Contractor shall submit an affidavit of compliance from the manufacturer that the pipe and fittings furnished comply with all applicable provisions of AWWA C-200 or AWWA Manual M11.

The Engineer or his representative shall be allowed access to the manufacturer's plant for the purpose of inspecting the pipe and fittings.

- End of Section -

SECTION 760

COATING CORRUGATED METAL PIPE AND ARCHES

760.1 GENERAL:

Corrugated metal pipe, pipe arches, and connectors to be used or furnished under this specification shall be manufactured and inspected in conformance with the requirements of AASHTO M-36, and as hereinafter specified. The size, type, and wall thickness of the pipe to be furnished shall be as specified on the project plans or specifications.

760.2 MATERIALS:

Corrugated metal products covered by this specification shall be plain galvanized conforming to the requirements of AASHTO M-36 as modified herein.

The types of bituminous coated pipe shall be as specified by the standard details or special provisions. In addition to the types listed in AASHTO M-190, there will be Type E.

Type E Pipe - Corrugated Metal Pipe with Smooth Metal Liner: The pipe shall be manufactured as per AASHTO M-36, Type 1A except that the lock seam shall be on the tangent of the helical corrugation. The ends of each pipe shall be reformed with two annular corrugations for joining the pipes with approved band couplers. The minimum thickness of the pipe shell shall be as required to support external load with no credit for load carrying support given to the liner. The minimum thickness for the liner shall be 22 gauge (0.034 inches).

760.3 BASE METAL, SHELTER AND FABRICATION:

The nominal pipe diameter shall meet the tolerances of this specification. Elliptical pipe, when specified, shall be shaped after fabrication and coating have been completed.

Helically Corrugated Metal Pipe: The pipe shall be fabricated from flat sheets in coils. The base metal, shelter coating, method of sampling, accepted brands of metal, sheet manufacturer's certified analysis and guarantee, workmanship, marking, inspection and rejection, shall meet the requirements of AASHTO M-36. Structures furnished shall be either full circle, or pipe-arch in accordance with Table 4 of AASHTO M-36, or other shape as shown on the plans. The pipe dimensions shall conform to AASHTO M-36 in all respects, except that the corrugations shall be helical instead of annular. The thickness of the galvanized metal shall be in accordance with project plans or specifications as otherwise specified. Pipe with helical corrugations shall have a continuous lock or weld seam extending from end to end of each length of pipe. The seams shall be fabricated in such a manner that they will not affect the shape or nominal diameter of the pipe and so that they will not create an element of weakness in the pipe.

Spiral Rib Metal Pipe: The pipe shall be fabricated from flat sheets in coils. The base metal, shelter coating, method of sampling, accepted brands of metal, inspection and rejection, shall meet the requirements of AASHTO M-36. Structures furnished shall be full circle on sizes of 18 inch and above as shown in Table 4 of AASHTO M-36. The pipe shall be fabricated with helical rectangular ribs projecting outwardly from the pipe wall with a continuous lock seam extending from end to end of each length of pipe. Spiral Rib Pipe shall consist of two rectangular ribs and one half-circle rib equally spaced between seams. Rectangular ribs shall be 3/4 inch wide by 1 inch high. The half-circle rib diameter shall be 1/2 inch and shall be midway between the rectangular ribs. Maximum rectangular rib spacing shall be 11 1/2 inches. The thickness (gage) of the metal shall be in accordance with project plans and/or specifications or as otherwise specified.

760.4 COUPLING BANDS:

Watertight joints shall be fabricated for corrugated metal pipe by the use of galvanized couplers or connecting bands, bituminous coated where required, with each band overlapping by at least 2 inches. Corrugated coupling bands shall be constructed and connected as specified in AASHTO M-36, except as otherwise required herein. The couplers or bands shall be manufactured of material 2 gages lighter than the gage specified for the pipe material, shall have corrugations or dimples to match the pipe corrugations or end treatment or may be flat, and shall be fastened with bolts. Dimpled coupling bands shall be 10 1/2 inches wide for diameters 12 through 60 inches, and 17 inches wide for diameters above 60 through 96 inches. The 10 1/2 wide bands shall have 2 rows of dimples of not less than 7 dimples per row, and the 17 inch wide bands shall have 4 rows of dimples of not less than 7 dimples per row. The dimple arrangements shall be such that a maximum spread can be attained.

SECTION 760

The shape of the dimple shall be such that it shall, in general conform to the standard pipe corrugation. The connecting angles for dimpled coupling bands may be riveted as for standard corrugated coupling bands, or may have slotted angles. The bands shall be attached by means of 1/2 inch nominal diameter carriage bolts. Two bolts are required for pipe up to 36 inches in diameter, 3 bolts for 36 through 60 inch diameters and 5 bolts for pipes above 60 inches in diameter. Plain flat coupling bands and spiral rib flange bands shall have the same width and number of bolts as specified above. Flat coupling bands having a single circumferential corrugation rolled in each edge to match a similar corrugation in the end of each pipe may be 10 1/2 inches wide regardless of pipe diameter and shall be fastened with 2 bolts.

When flanges are provided on the pipe ends, the coupling shall be made by interlocking the flanges with a preformed channel band or other band incorporating a locking channel not less than 3/4 inches in width. The depth of the channel shall be not less than 1/2 inch. The channel band shall have a minimum nominal thickness of 0.079 inches.

760.5 PERMISSIBLE VARIATIONS IN DIMENSION:

The internal diameter of 12 through 24 inch pipe shall not vary more than ± 1.5 percent from the design diameter. The internal diameter of 27 through 108 inch shall not vary more than ± 1 percent or 3/8 inch, whichever is greater from the design diameter.

Type D Pipe: The design diameter of the metal pipe before paving shall be the diameter shown on the plans plus 1/4 inch. The design diameter may vary as above.

- End of Section -

SECTION 761

STRUCTURAL PLATE PIPE, ARCHES, AND PIPE ARCHES

761.1 GENERAL:

Structural plate pipe, arches, and pipe arches shall be of the sizes, gages, and dimensions designated on the plans or in the special provision and as specified herein.

761.2 MATERIALS:

Plates, nuts and bolts shall conform to the specifications of AASHTO M-167.

Galvanized surfaces which are damaged shall be repaired in accordance with the provision in Section [771](#).

Bituminous coating shall conform to the provisions of AASHTO M-190.

Damaged bituminous coatings shall be repaired by the Contractor at his expense by applying bituminous material conforming to AASHTO M-190.

761.3 IDENTIFICATION:

The gages of structural plates will be identified on the plans in accordance with the following:

Each installation will be designated not only by size, but also by symbol indicating the number and gage of plates required. Thus, (412-18) will be used to designate an installation for 1 plate length composed of 4, 12 gage plates and 1, 8 gage plate, the heaviest to be placed in the invert.

761.4 DISTORTION:

In advance of placing backfill material around circular structural plate pipes, the pipe shall be distorted.

Distortion may be performed either at the fabricating shop or in the field.

If the plates are distorted in the fabricating shop, the plates shall be distorted to provide an increase in the vertical diameter of the pipe, after assembly, of approximately 5 percent for the full length. Plates shall be marked in order to assure that they will be placed in proper position.

If the pipes are distorted in the field the method of distortion shall conform to the details shown on the plans. The vertical diameter shall be increased the approximate percentages listed in the following table, throughout that portion of the pipe between shoulder lines.

Pipes using 1 or 3 gage top and side plates - 1 percent

Pipes using 5 or 7 gage top and side plates - 2 percent

Pipes using 8, 10, or 12 gage top and side plates - 3 percent

Between the shoulder lines and the outer ends of the pipe the distortion may decrease uniformly to zero.

- *End of Section* -

SECTION 770

STRUCTURAL AND RIVET STEEL, RIVETS, BOLTS, PINS, AND ANCHOR BOLTS

770.1 GENERAL:

All steel, unless otherwise designated on the plans or in the special provisions, shall conform to the requirements of ASTM A36.

Report of Tests: Before fabrication, the Contractor shall furnish to the Engineer a certified mill report in triplicate, for each identifiable melt of steel or iron from which the material is to be fabricated. The report shall include the chemical and physical tests required by the ASTM specifications.

Additional Tests: The Contracting Agency reserves the right to require and to make additional mill and laboratory tests. The number of such additional tests will be limited as follows, except that in the case of failure of the material to comply with the ASTM requirements, more tests will be made:

Structural steel, 1 complete test for each heat or each 10 tons of identifiable stock. Rivets, 1 complete test for each size. Bolts, 1 complete test for each lot.

Identifiable stock is material for which authentic records of the chemical and physical properties are available.

Test specimens shall be furnished, cut, and machined in accordance with the ASTM specification, for the material to be tested, as referred to herein. Test specimens shall be furnished and machined by the Contractor at no additional cost to the Contracting Agency.

Mill Tolerances: Rolling and cutting tolerances, permissible variations in weight and dimensions, defects and imperfections shall not exceed the limits for structural steel contained in ASTM A6.

Stock Material: When the Contractor proposes to use material already in stock, he shall notify the Engineer of such intention at least 10 days in advance of beginning fabrication, to permit sampling and testing.

770.2 STRUCTURAL STEEL:

Stock Materials: The Contractor shall select the material he wishes to use from stock. The Contractor shall furnish 3 certified mill reports for each of the heat numbers. Two samples shall be taken by a representative of the Engineer from each heat number, one for the tension test and one for the coldbend test. If the heat numbers cannot be identified, the representative of the Engineer shall select random test specimens from the unidentifiable heats. The number of such test specimens shall be at the discretion of the Engineer. The cost of all tests on stock material shall be borne by the Contractor.

High Strength Low-Alloy Structural Steel: The material shall conform to the requirements of ASTM, A572, A709 or A992, as specified in the special provisions.

General Purpose Structural Steel: Structural steel shall conform to the requirements of ASTM A36 with a minimum of 0.2 percent copper.

770.3 RIVETS:

Stock Material: Rivets taken from identifiable stock shall be accepted by the Engineer in accordance with this specification.

Rivets from unidentifiable stock, for which authentic records of the chemical and physical properties are not available, shall not be used except where shown on the plans or when approved by the Engineer.

High-Strength Structural Rivet Steel: The material shall conform to the requirements of ASTM A502.

Structural Rivet Steel: The material shall conform to the requirements of ASTM A502, except that the test specimen shall be bent upon itself when performing the bend test.

SECTION 770

770.4 BOLTS:

Unfinished Bolts: The bolts shall have square heads and square nuts unless otherwise specified. The bolts shall be long enough to extend entirely through the nut but not more than 1/4 inch beyond. Washers shall not be furnished unless specified.

Steel bolts shall conform to the requirements of ASTM A307, except that steel manufactured by the acid Bessemer process shall not be used.

High Strength Bolts: High strength bolts shall conform to the provisions of the specification for the design, fabrication and erection of structural steel for buildings of the AISC.

770.5 ANCHOR BOLTS:

Anchor bolts shall be manufactured from steel conforming to ASTM A36 or A307.

770.6 MILD-STEEL FORGINGS FOR STRUCTURAL PURPOSES:

Steel forgings shall be made from steel of forging quality and shall conform to the requirements of ASTM A668. They shall be Class C forgings with a maximum carbon content of 0.35 percent and shall be given a thorough annealing. The metal shall have a minimum Brinell hardness number of 130, and a maximum of 190, when tested in accordance with ASTM E10.

- End of Section -

SECTION 771
GALVANIZING

771.1 GENERAL:

Materials shall be hot-dip galvanized and the weight and uniformity of coating determined in accordance with the standard specifications given in Table [771-1](#).

TABLE 771-1		
GALVANIZING SPECIFICATIONS		
Material	ASTM Spec.	Wt. of Coating Oz./Sq. Ft. (Min.)
Corrugated Metal Pipe	A929	1.80
Flat Steel or Iron Sheets	A653, A924	1.25
Iron or Steel Wire	A116	.80
Chain Link Fabric	A392	1.20
Barbed Wire	A121	.50
Steel Pipe - Rails and Posts	A53	1.80
Structural Shapes, Tie Rods, Ornamental Iron Railings, Handrails, Manhole and Catch Basin Steps, and Curb Armor	A123	2.00
Bolts, Nuts, Washers, Anchor Bolts, Packing Spools, Gray Iron and Malleable Iron Castings and Steel Castings	A153	1.25

771.2 WORKMANSHIP:

The galvanizing shall be applied in such a manner that the spelter will not peel off. The finished product shall be free from blisters and excess spelter, and the coating shall be even, smooth, and uniform throughout. Machine work, die work, cutting, punching, bending, welding, drilling, thread cutting and other fabricating shall all be done as far as is practicable before the galvanizing. No member shall be galvanized which is out of alignment. All members (nuts, bolts, washers, etc.) shall be galvanized before a structural unit is assembled. All uncoated spots or damaged coatings due to poor workmanship, rough handling, or any other reason shall be cause for rejection.

771.3 TEST COUPONS:

Test coupons for determining the quality of the galvanizing shall be wired to the materials to be galvanized before immersion in such a manner as to represent the amount of coating deposited on the materials.

771.4 REPAIR OF GALVANIZED SURFACES:

Unless otherwise specified, where galvanized surfaces are field or shop cut, broken, burned or abraded, thus breaking the galvanizing, the locations thus damaged shall be repaired to the satisfaction of the Engineer with zinc dust-zinc oxide coating conforming to AASHTO M-36.

- *End of Section* -

SECTION 772

CHAIN LINK FENCE

772.1 GENERAL:

All material shall be new and, upon request, the Contractor shall furnish to the Contracting Agency, a certification of inspection stating that the materials have been manufactured, sampled, tested and inspected so as to meet the requirements for its type as specified below.

772.2 POSTS, RAILS AND BRACES:

Posts, rails and braces shall be constructed of pipe in conformance with types A, B or C below. Unless specifically designated by type in the plans or specifications, the Contractor may utilize any of the three types. The posts and rails in this section will cover fencing up to 12 feet in height with post spacing not to exceed 10 feet. The nominal outside dimensions and minimum weights shall be in accordance with Table [772-1](#). The manufacturer or his representative shall legibly mark each length of pipe by rolling, stamping or stenciling to identify the product by product name, ASTM standard, etc. and the country of manufacture.

Type A: Pipe shall be black steel, welded or seamless, hot-dipped zinc coated, manufactured in conformance to ASTM F1083, plain end, standard weight (schedule 40). The hot-dipped zinc coating (galvanized) shall be applied both inside and outside with not less than 1.8 ozs. per square foot ± 0.1 ozs.

Type B: Steel used in the manufacturing of the pipe shall be hot-rolled strip steel in compliance with ASTM A1011 having a minimum yield strength of 50,000 psi. The pipe will be manufactured by electric welded cold-formed process per ASTM A500. The exterior surface will be triple coated and the interior surface single coated per ASTM F1043. The triple coated external surface shall be hot-dipped zinc coated (galvanized) having a weight of not less than 1.0 ozs. per square foot ± 0.1 ozs., followed by a chromate conversion coating, having a weight not less than 1.05 micro ounces per square foot ± 0.353 micro ounces (30 micrograms per square inch ± 15 micrograms) and an acrylic coating having a thickness of 0.0005 inches ± 0.0002 inches. The internal surface shall be coated with a zinc base paint having a 90% zinc powder loading and having a minimum thickness of 0.0005 inches.

Type C: Steel used in the manufacturing of the pipe shall be strip steel in compliance with ASTM A653 Grade D having a minimum yield strength of 50,000 psi. Both sides of the strip shall be hot-dipped zinc coated (galvanized) per ASTM A653 and A-924 having the weight of not less than 1.0 oz. per square inch ± 0.1 oz. The zinc coating will form the first coat of a triple coated external surface and the final coat of the interior surface. The pipe will be manufactured by electric welded cold formed process per ASTM A789. After manufacturing, the final two external coatings shall be a chromate conversion having a weight of not less than 1.05 micro ounces per square inch ± 0.353 micro ounces and an acrylic coating having a thickness of 0.0005 inches ± 0.0002 inches.

772.3 CHAIN LINK FABRIC:

Chain link fabric shall conform to the requirements of ASTM A392 (Zinc-Coated) or ASTM A491 (Aluminum-Coated). The coating process must leave the fabric completely free of barbs, icicles, or other projections which might be hazardous. The wire used in the manufacture of the fabric shall be 11 gage for all fence 60 inches or less in height and shall be 9 gage for all fence over 60 inches in height unless otherwise specified.

All chain link fabric shall be woven into approximately 2 inch mesh. Fabric less than 60 inches wide shall have knuckled finish on the top edge, and twisted and barbed finish on the bottom edge. Fabric 60 inches or greater in width shall have twisted and barbed finish on both edges. Barbing shall be done by cutting the wire on the bias.

772.4 TENSION WIRES AND FABRIC TIES:

Tension wires shall be at least 7 gage galvanized coil spring steel wire per ASTM A824. Ties used to fasten the fabric to posts, rails, and gate frames shall be not smaller than 11 gage galvanized steel, 6 gage aluminum wire, or approved non-corrosive metal bands.

Tension bars used in fastening fabric to end and corner posts and gate frames shall be galvanized high carbon steel bars not smaller than 3/16 inch x 3/4 inch.

SECTION 772

TABLE 772-1					
FENCE MEMBER SIZES & WEIGHTS					
USE	FENCE HEIGHT (Feet)	NPS DESIGNATOR	OUTSIDE DIAMETER (Inches)	WEIGHT (Lb/Lf Minimum)	
				TYPE A Schedule 40	TYPE B and C
FENCE POSTS					
End, corner, slope, pull and strain posts	Less than 6	2	2.375	3.65	3.12
	6 and over but less than 9	2 1/2	2.875	5.79	4.64
	9 and over but not over 12	3 1/2	4.000	9.11	6.56
Line posts	less than 6	1 1/2	1.900	2.72	2.28
	6 and over but less than 9	2	2.375	3.65	3.12
	9 and over but not over 12	2 1/2	2.875	5.79	4.64
GATE POSTS					
Single swing gates 6 feet or less in width or double swing gates 12 feet or less	less than 6	2	2.375	3.65	3.12
	6 and over but not over 12	3 1/2	4.000	9.11	6.56
Single swing gates over 6 feet but not over 13 feet in width or double swing gates over 12 feet but not over 26 feet in width	—	3 1/2	4.000	9.11	6.56
Single swing gates over 13 feet but not over 18 feet in width or double swing gates over 26 feet but not over 36 feet in width	—	6	6.625	18.97	—
Single swing gates over 18 feet in width or double swing gates over 36 feet in width	—	8	8.625	28.55	—
OTHER MEMBERS					
Top rail and braces	—	1 1/4	1.666	2.27	1.84
Frame for gates	—	1 1/2	1.900	2.72	2.28
Stiffeners for gates	—	1 1/4	1.666	2.27	1.84

Notes to Table 772-1:

- All unit weights shall be subject to the standard mill tolerance of ± 5 percent.
- Posts shall be fitted with tops designed so as to fit securely over the posts and carry a top rail where specified. They shall have a total length of not less than the depth of the concrete footings, as specified, plus the length required above ground. Where no top rail is required, pipe posts shall be fitted with suitable caps.
- Top rail shall be furnished in random lengths of approximately 20 feet where required.

SECTION 772

772.5 TRUSS OR TENSION RODS:

Truss or tension rods used in trussing gate frames and line posts adjacent to end, corner, slope or gate posts shall be adjustable 3/8 inch diameter galvanized steel rod. When used in trussing line posts, adjustment shall be provided by means of galvanized, turnbuckle or other suitable tightening devices.

772.6 FITTINGS:

Fittings shall conform to ASTM F626.

Fittings, hardware, nuts and bolts shall be galvanized.

Couplings to connect the individual lengths of top rail shall be of the outside sleeve type at least 7 inches long. The bore of the sleeves shall be sufficiently true to maintain adjacent lengths of rail in alignment.

Extension arms for barbed wire on pipe posts shall be of 13 gage steel or heavier, single piece construction and a type that can be attached to the tops of the posts. Extension arms shall carry 3 wires at approximately 5 1/2 inch centers in a plane approximately 45 degrees from the vertical, inclined as shown on the plans or as directed by the Engineer.

772.7 BARBED WIRE:

Barbed wire shall be 4 point pattern; composed of 2 strands of 12 1/2 gage galvanized steel wire with barbs spaced 5 inches apart and shall conform to ASTM A121.

- End of Section -

SECTION 775

BRICK AND CONCRETE MASONRY UNITS (BLOCKS)

775.1 BRICK:

Brick shall be whole, sound, and hard burned and shall give a clear ringing sound when struck together. They shall be uniform in quality and shall be culled or sorted before delivery to the work.

775.1.1 Manhole Brick: Agency approval is required prior to using brick within manholes. When approved, brick may be used for maintenance and adjustment of the existing manholes or rings and covers.

Manhole brick shall conform to Table [775-1](#).

TABLE 775-1			
MANHOLE BRICK DIMENSIONS			
Brick	Inches Depth	Inches Width	Inches Length
Standard Size	2 1/4	3 1/2	7 1/2
Allowable Variations	±1/8	±1/8	±1/4

The following paragraphs shall be added to the section on visual inspection:

No individual brick shall be rejected unless it shows visual evidence of major cracking. A major crack is defined as one that has at least one complete separation, for a distance of 1 3/4 inches, through the brick in any direction, including any cored area. Such a crack shall be regarded as affecting the serviceability of the brick and shall be rejected and not used in the structure.

Fifty bricks may be sampled at random intervals from any cube for visual inspection. Of the 50 samples, 45 must pass visual inspection for major cracks. Should less than 45 pass, the cube of brick shall be rejected and the brick must not be used in the structure.

775.1.2 Building Brick: Building brick shall conform to the requirements of ASTM C62, grade MW.

775.1.3 Facing Brick: Facing brick shall conform to the requirements of ASTM C216, Grade MW, Type FBS. The size, color, and texture shall be as specified on the plans or as approved by the Engineer.

775.2 CONCRETE MASONRY UNITS:

Unless otherwise noted on the plans or special provisions, concrete masonry units shall conform to ASTM C90, Normal Weight, Type I with a minimum compressive strength of 1900 psi.

The units shall be fully cured and shall have been made not less than 28 days prior to delivery.

The moisture content at the time of delivery shall not exceed 30 percent of the minimum absorption value of the units. The Contractor shall provide any protection he deems necessary to maintain the units in this condition until time of use.

The linear change from saturated to cool oven dry shall not exceed 0.0054 inches per linear foot or 0.045 of 1 percent conducted in accordance with test method in ASTM C426.

The units shall be made with normal weight aggregate conforming to ASTM C33.

The nominal size of the units shall be as indicated on the plans. The overall dimensions for width, height and length shall differ by not more than ±1/8 inch from the specified standard dimensions. Standard dimensions of units are the manufacturer's designated dimensions. Nominal dimensions of units are equal to the standard dimensions plus the thickness of one mortar joint.

No less than 5 samples of the units shall be submitted to the Engineer for approval and to show the full variance of texture and full range of color. Units used in the work shall match the approved samples. These samples may be tested for strength.

SECTION 775

All units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or would significantly impair the strength or permanence of the construction. When units are to be used in an exposed setting, the face or faces that are to be exposed shall not show chips or cracks, not otherwise permitted, or other imperfections when viewed from a distance of not less than 6 feet under diffused lighting.

Units that are intended to serve as a base for plaster or stucco shall have a sufficiently rough surface to afford a good bond.

- End of Section -

SECTION 776

MASONRY MORTAR AND GROUT

776.1 GENERAL:

Masonry mortar and grout shall consist of a mixture of cementitious material and aggregate to which sufficient water has been added to bring the resulting mixture to the desired consistency.

Table [776-1](#) and [776-2](#) indicates the average compressive strength obtained when the cementitious material, aggregate, and water (the required amount to provide a flow of 110±5 percent) are combined in the proportion shown in Table [776-3](#) and Table [776-4](#).

The mortar or grout to be used will be designated by class in the special provisions and the correct proportions of cementitious materials and aggregate will be combined with the minimum amount of water to provide a workable mixture.

Retempering of the mortar or grout will not be a standard practice and the Engineer's approval will be required for any exception.

TABLES 776-1 & 776-2			
MASONRY MORTAR AND GROUT COMPRESSIVE STRENGTH			
Table 776-1 Masonry Mortar		Table 776-2 Grout	
Type	Compressive Strength 28 Days (psi)	Type	Compressive Strength 28 Days (psi)
A	5500	Fine Grout	2500
B	5000	Coarse Grout	2500
C	4000		
D	3000		
M	2500		
S	1800		

TABLE 776-3			
MASONRY MORTAR PROPORTIONS BY VOLUME			
Type	Portland Cement	Hydrated Lime	Aggregate ASTM C144
A	1	0	1
B	1	0	1 1/2
C	1	0	2
D	1	0	2 1/2
M	1	1/4	2 1/4 to 3
S	1	1/2	2 1/4 to 3

*Masonry cement type S may be substituted for the cementitious material. Prior approval of the Engineer is required.

TABLE 776-4			
GROUT FOR REINFORCED MASONRY PROPORTIONS BY VOLUME FOR FIELD BATCHING			
Type	Portland Cement	Fine Aggregate (ASTM C404)	Coarse Aggregate (ASTM C404)
Fine Grout	1	2 1/4 to 3	0
Coarse Grout	1	2 1/2	1 to 2

SECTION 776

776.2 PORTLAND CEMENT:

The cement used shall conform with Section [725](#). For volumetric proportioning an unopened sack of cement weighing 94 pounds shall be considered as having a 1 cubic foot volume.

In proportioning the cement, it shall be measured loose, without shaking or compacting, in measuring devices of known capacity.

776.3 AGGREGATE:

All aggregate shall be approved by the Engineer prior to being utilized on the job.

Fine aggregate (sand) to be used in mortar shall be thoroughly and uniformly washed and shall be entirely free from oil and deleterious substances. The size and grading of fine aggregate shall conform to the applicable requirements of ASTM C144.

Fine or coarse aggregate to be used in masonry grout shall be thoroughly and uniformly washed and shall be entirely free from oil and deleterious substances. The size and grading of fine or coarse aggregate shall conform to the applicable requirements of ASTM C404.

The average value of sand equivalent determined on 3 successive samples shall not be less than 70 when tested in accordance with ASTM D2419. No individual sample shall have a sand equivalent less than 65.

In proportioning the aggregate, it shall be measured damp, loose without shaking or compacting, in measuring devices of known capacity.

776.4 MASONRY CEMENT:

Masonry cement used shall conform to ASTM C91 with the exception that the average compressive strength shall not be less than 2500 psi at 28 days.

776.5 HYDRATED LIME:

Hydrated lime used shall conform to ASTM C207, Type S.

776.6 WATER:

The water used shall conform to Section [725](#).

776.7 ADMIXTURES:

Admixtures, unless prescribed in the special provisions, will not be used without prior approval of the Engineer.

776.8 TESTS:

776.8.1 Mortar: If in the opinion of the Engineer there is sufficient cause to question the quality of the mortar being utilized, random field test in accordance with ASTM C780 Annex A-1 and A-6 will be performed. For this area, the penetration of the cone penetrometer correlating to a flow of 110 ± 5 percent is 40 ± 3 mm.

776.8.2 Grout: If required, tests shall be performed in accordance with Uniform Building Code Standard No. 24-23 Section 24.2301.

- End of Section -

SECTION 778

LUMBER

778.1 GENERAL:

Unless otherwise specified or shown on the plans, all lumber shall be Douglas Fir or graded pine and shall be selected as to grade and shall conform in all particulars to the standard grading and dressing rules of the West Coast Lumber Inspection Bureau.

Plywood shall be not less than 3 ply, manufactured and graded in accordance with the standard grading rules of the APA.

Lumber for uses listed shall not be lower than the following grades:

Uses	Grade
(A) Permanent Construction, such as bridges and cluverts.	Select Structural, for beams and stringers; Construction, for balance of structure.
(B) Minor permanent construction, such as fences, guard rails and posts, pavement headers, bulkheads, retaining structures, etc.	Construction.
(C) Falsework and studs, and wales for formwork.	Construction, for framing, beams, or timbers.
(D) Form sheeting for nonshowing surfaces of concrete.	Standard, for boards; shiplap; or any grade of plywood.
(E) Form sheeting for showing surfaces of ornamental concrete.	C and Better Industrial clear; concrete form grade of plywood; or overlay plywood.
(F) Form sheeting for curved soffits of bridge & tunnel arches, plastered or unplastered.	Select Merchantable, board; concrete form grade of plywood; or overlay plywood.
(G) Soffits of beams and girders and slabs between beams and girders; for beam and girder sides, except ornamental concrete; and for headwalls or endwalls of culverts or covered conduits.	Concrete form grade of plywood or overlay plywood.
(H) Form sheeting for showing surfaces of channel walls or interior surfaces, except floors; for covered conduit and all other showing surfaces not specified above.	Tongue and groove flooring equal to C and Better flat grain; concrete form grade of plywood; or overlay plywood.
(I) All other lumber.	Construction.

778.2 REDWOOD:

Redwood lumber shall be selected as to grade and shall conform in all particulars to the standard specifications for grades of California Redwood of the California Redwood Association.

Redwood lumber for the uses listed shall not be lower than the following grades:

Uses	Grade
(A) Bridges, culverts, and guardrail posts	Dense Structural
(B) All other Redwood Lumber	Foundation

SECTION 778

778.3 GRADE MARKING:

Lumber: Each piece of lumber shall bear an official grade mark which, unless authorized otherwise, shall be the grade mark adopted by one of the following associations:

(A) For Douglas Fir and Pine -The West Coast Lumber Inspection Bureau or other agency approved by the Engineer.

(B) For Redwood -The California Redwood Association.

Plywood: Each sheet of plywood shall bear the official stamp of the APA stating the grading of the sheet.

- End of Section -

SECTION 779

WOOD PRESERVATIVES

779.1 GENERAL:

This work shall consist of treating lumber, timber, and piling. Lumber, timber, and piling to be treated shall conform to the requirements of the specification of the AWP and as specified herein.

Where practical, lumber to be treated shall be cut to size and framed, prior to treatment. Proper allowance for shrinkage in the sizes of lumber shall be made by the Contractor where it is necessary to meet definite dimensions shown on the plans.

779.2 OIL TYPE PRESERVATIVE TREATMENT:

Preservatives under this specification shall be creosote, creosote-coal tar solutions, creosote petroleum solutions, or pentachlorophenol in petroleum oils, conforming to AWP specifications and as specified by the Engineer.

Treatment: The treating operations shall conform to the applicable requirements of the AWP specifications.

Unless indicated otherwise on the plans or in the special provisions, the amount of preservative to be retained and the treating process to be used for the various types of service shall conform to the appropriate AWP specification.

Incising: Unless otherwise specified, timber to be treated under this specification that is 3 inches or more in nominal thickness and 4 inches or more in nominal width, shall be incised before treatment as a means of securing penetration of the preservative. If such thickness is less than 4 inches, the material may be incised on the wide faces only; otherwise, all 4 faces shall be incised.

779.3 WATER BORNE SALT PRESERVATIVES TREATMENT:

Preservatives under this specification shall conform to the requirements of AWP specifications unless otherwise approved in writing by the Engineer, but restricted to the following preservatives:

Chromated Zinc Chloride (CZC)

Tanalith (Wolman Salts)

Ammoniacal Copper Arsenite (Chemonite)

Chromated Zinc Arsenate (Boliden Salt)

Chromated Copper Arsenate (Erdalith)

779.4 FIELD TREATMENT OF CUT SURFACES:

When sawing or drilling is necessary after plant treatment, the cut surfaces shall be thoroughly brushed with 2 coats of the same kind of preservative in conformance with AWP specification. The maximum protection requirement specified therein shall be met in all instances.

- End of Section -

SECTION 787

GRAY IRON CASTINGS

787.1 GENERAL:

The castings shall be true to pattern in form and dimension and free from pouring faults, spongings, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Castings shall be filleted boldly at angles, and the arises shall be sharp and true.

Before the castings are removed from the foundry, they shall be thoroughly cleaned and the parting lines, gates, and risers ground flush.

787.2 TEST SPECIMENS:

Test coupons shall be cast separately of the castings, using a mold as described in ASTM A48. A representative of the Engineer may be present at the time a melt is poured to identify both coupons and castings.

Two test coupons are required for each melt poured. Additional coupons shall be cast for use as replacements or in case a retest is required.

A representative of the Engineer may discard and replace specimens which show obvious lack of continuity of metal or if the machining is defective.

The manufacturer shall machine the tension specimens to the dimension specified for specimen B of ASTM A48, at no additional cost to the Contracting Agency.

When approved by the Engineer transverse tests may be made in lieu of tensile tests, in which case the castings shall meet the requirements of ASTM A48.

787.3 MANHOLE FRAME AND COVER SETS:

Castings shall conform to ASTM A48, Class 30. The bearing surfaces of the frames and covers shall be machined and the cover shall seat firmly onto the frame without rocking.

Covers shall be the types and shall be imprinted as shown on the plans or standard details.

787.4 RAILINGS, RAILING POSTS, AND WHEEL GUARDS:

Castings shall conform to ASTM A48, Class 40.

787.5 ROCKERS, ROCKER PLATE BEARINGS, AND BEARING PLATES FOR BRIDGES:

Castings shall conform to ASTM A48, Class 50.

Castings shall be machined and finished as specified on the plans provided that tool marks on sliding contact surfaces shall run in the direction of plate movement, or in the case of rocker plate bearings, perpendicular to the rocker movement. Tool marks shall be not more than 1/32 inch apart.

787.6 UNCLASSIFIED CASTINGS:

All castings not specifically classified, shall conform to the requirements of ASTM A48, Class 30.

- End of Section -

SECTION 790

PAINT

790.1 GENERAL:

Paint shall be homogeneous, free of contaminants, and of a consistency suitable for the intended use. Finished paint shall be well-ground and the pigment shall be properly dispersed in the vehicle according to the requirements of the paint; and this dispersion shall be of such nature that the pigment does not settle appreciably, does not cake or thicken in the container, or become granular or curdled. Paint and paint materials shall be delivered to the job site in new, unopened air-tight containers appropriately identified with the manufacturer's name, date of manufacture, type of paint or paint material, specifications paint number, and lot or batch number. The container shall have a formula label.

No paint shall be used until at least 7 days have elapsed from the date of manufacture. Paint containing lead shall comply with Subsection [107.5.2](#).

790.2 PROPRIETARY BRANDS:

For the purpose of this specification, proprietary brands of paint and paint materials shall be construed to mean paint or paint materials conforming to the requirements of this specification and produced for distribution and consumption through regular wholesale and retail outlets. Whenever paint or paint materials are designated on the plans or special provision by a manufacturer's name or catalog reference, any proprietary brand of equal quality will be permitted, subject to the approval of the Engineer. Information required by the Engineer as proof of the comparative quality shall be furnished by the Contractor.

790.3 PAINT COATS:

The first coat of paint applied to an unpainted surface shall be called the prime coat. The paint applied to field connections, welds, rivets, and all damaged or defectively painted or rusty areas on a prime coated surface shall be called a touch-up coat. The paint applied over the prime coat and touch-up coat shall be called the second coat. The final coat of paint shall be called the finish coat.

790.4 MATERIALS:

Materials shall conform in all respects to the requirements of references specifications indicated for such material.

Upon request of the Engineer, the Contractor shall furnish a certification from the manufacturer that the material conforms with this specification.

(A)	Vehicles:	Specification:
	Raw Linseed Oil	ASTM D234
	Boiled Linseed Oil	ASTM D260
	Water-Resistant Spar Varnish	Navy Department Specification 52V20
	Alkyd Resin	TT-R-266C
	Driers	ASTM D600, Class A or Class B, as applicable
	Thinners:	
	Xylene	TT-X-916B, Grade A
	Turpentine (shall be used in paints used for timber)	ASTM D13, Gum Spirits
	Petroleum Spirits (Mineral Spirits)	ASTM D235
(B)	Pigments	Specifications:
	Carbonblack	TT-P-343 Form 1, Class B
	Lampblack	ASTM D209
	Red Lead	ASTM D83
	Titanium Dioxide, Non-extended	ASTM D476, Type II, Class II
	Titanium Dioxide, Extended (Titanium Calcium, Rutile)	ASTM D476
	Titanium Dioxide	TT-P-422B, Type III, Class A

SECTION 790

White Lead Basic Carbonate	ASTM D81
Zinc Yellow (Zinc Chromate)	ASTM D478, Type II
Zinc Oxide	ASTM D79
Iron Blue	TT-P-385
Iron Oxide, Yellow	TT-P-458A
Iron Oxide, Orange	ASTM D3721, D3722, D3724
Hansa Yellow G	MIL-H-10330
Organic Green Gold	Dupont YT 562-D or equal, specific gravity 161 ±0.05
Chromium Oxide, Green Graphite	TT-P-347

Graphite shall be natural amorphous material (American product) which shall contain not less than 35 percent nor more than 45 percent graphite carbon. The remainder shall be insoluble siliceous material containing a total of not more than 5 percent calcium and magnesium carbonate and sulfate. The pigment shall be ground to such a fineness that not less than 97 percent shall pass a No. 325 sieve. The graphite paste shall be made by grinding the pigment in pure raw linseed oil in the following proportions:

Amphorus Graphite	68.0 percent
Linseed Oil	32.0 percent

(C) **Inert Materials:**

Diatomaceous Silica
Magnesium Silicate

Specifications:

ASTM D604, Type A
ASTM D605

790.5 MIXED PAINTS:

All mixed paints shall, in general, be machine-mixed and shall consist of the pigment of the required fineness and composition, ground to the desired paste consistency in pure raw or boiled linseed oil, to which shall be added the remainder of the vehicle to make paint conforming to the required formula as herein specified.

Paint which has hardened and thickened in the container such that it cannot be readily broken up to a smooth uniform paint of good brushing consistency shall not be used.

All materials used in mixed paints shall conform to the requirements as herein specified. The paint shall be made to satisfactory workable consistency conforming to one of the following formulas for paint as required on the plans or in the special provisions. All percentages shown are by weight.

Any of the following paints which are too thick to have a satisfactory workable consistency shall be thinned with a suitable thinner from the group of thinners herein specified. In no case shall gasoline be used as a thinner.

Fineness of grind for enamel shall conform to Hegman 7 minimum.

The following paints shall conform to the latest ADOT standard specifications for Road and Bridge Construction. All paints, except Paint No. 10 (Aluminum), shall be shipped ready for use.

When Paint No. 1 is specified, it may be Paint No. 1-A or Paint No. 1-B. Paint No. 1-D shall be used only when specifically designated.

SECTION 790

Paint Number	Type
1-A	(Red Lead — Linseed Oil)
1-B	(Red Lead — Alkyd Resin)
1-D	(Zinc Chromate)
4	(Dull Black)
5	(Jet Black)
6	(Black — For Timber Primer Only)
7	(White — For Timber Primer Only)
8	(White)
9	(Light Grey)
10	(Aluminum)
11	(White Enamel)
15	(Zinc)

- *End of Section* -

SECTION 792

DUST PALLIATIVE

792.1 GENERAL:

Dust palliatives shall consist of various chemical dust suppressants which work by binding together lighter soil particles.

All materials must meet the environmental requirements of Section [792.3](#) and must be approved by the Engineer prior to their use.

792.2 TYPE OF MATERIALS AND APPLICATION RATES:

Emulsions shall be miscible with water in all proportions as noted in Table [792-1](#). The dilution ratio will vary based upon the local soil and weather conditions. The ratios shall be proposed by the Contractor and agreed upon by the Engineer.

The rate of application noted in Table [792-1](#) shall be for the treatment, method and use specified by the Contracting Agency, or as directed by the Engineer. To compensate for local conditions or changes in soil type, the Contractor may adjust the application rate within the ranges specified.

Products specifically formulated as tackifiers which prevent wind-blown erosion shall not be acceptable as dust palliatives for vehicular traffic, but may be used for their intended purposes.

TABLE 792-1				
DUST PALLIATIVE DILUTION RATIOS AND APPLICATION RATES				
Product Type	Use/Treatment ⁽¹⁾	Dilution Ratio ⁽²⁾		Application Rate ⁽³⁾ (gal/sy)
		Range	Typical	
Acrylic Copolymer And Polymers	Topical - Road or parking Lot	20:1 to 4:1	9:1	0.20 to 0.15
	Topical - Road Shoulder	20:1 to 4:1	15:1	0.16 to 0.12
	Surface Course (per inch of depth)	20:1 to 4:1	9:1	0.08 to 0.06
Lignin-Based Type (Lignosulfonate)	Topical - Road or parking Lot	1:1	1:1	0.10 to 0.05
	Topical - Road Shoulder	7:1 to 4:1	8:1	0.05 to 0.03
	Surface Course (per inch of depth)	1:1	1:1	0.30 to 0.10
Organic Resin	Topical - All	10:1 to 2:1	5:1	0.25 to 0.15
	Surface Course (per inch of depth)	2:1 to 1:1	1:1	0.15 to 0.10
Petroleum Resin	Topical - Road or parking Lot	4:1	4:1	0.15 to 0.10
	Topical - Road Shoulder	10:1 to 7:1	8:1	0.15 to 0.07
	Surface Course (per inch of depth)	4:1	4:1	0.11 to 0.07
Tall Oil Pitch Emulsion	Topical - Road or parking Lot	20:1 to 5:1	5:1	0.20 to 0.15
	Topical - Road Shoulder	20:1 to 3:1	3:1	0.16 to 0.12
	Surface Course (per inch of depth)	20:1 to 2:1	10:1	0.08 to 0.06
Other	As approved by the Engineer			

(1) Topical application rates shown are to obtain 1/2 to 1 inch penetration. Higher rates should be used if greater penetration is anticipated.

(2) The dilution ratio (water: product) is variable and shall be appropriate for the local soil and weather conditions, as proposed by the Contractor and agreed upon by the Engineer.

(3) Application rate of undiluted concentrate.

SECTION 792

Contractor shall submit proof of conformance in the form of test reports to verify that the dust palliative product proposed for use meets the minimum material requirements specified in this Section. Testing must be specific to the proposed product and not generic to similar type palliative products. Testing shall be performed by independent AASHTO accredited laboratories, and signed and sealed by Professional Engineers registered in the State of Arizona. The Contractor is responsible for any costs associated with the testing of soil and palliative product prior to the application of as specified herein.

(A) Acrylic Copolymer and Polymer Types:

The material shall be a white or clear emulsion that can penetrate, saturate and bond together treated soils to create a hard, dust-free and water resistant surface. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Composition	--	Acrylics, acrylates & acetates
pH	E70	4.0 – 9.5
Residue (active solids content), %	D2834	40 min.
Flash Point	D92	None
Absolute Viscosity (Brookfield), cP, 77°F	--	1500 max.
Specific Gravity, 60/60°F	D1298	1.00 – 1.15

(B) Lignin-Based Types:

Lignin-based dust palliative shall be an aqueous lignosulfonates (a residual co-product of wood pulping by the sulfite process in the manufacturer of cellulose products) that dispersed readily in water to yield a stable, brown-colored solution. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Absolute Viscosity (Brookfield), cP, 77°	--	<1000
Residue (total solids content), %	D2834	48 min.
Lignin sulfonate content (% of solids)	D2834	60 min.
pH	E70	5.0 - 7.0
Specific Gravity (liquid), 77/60°F	D1298	1.00 min.

(C) Organic Resinous Types:

The material shall be a tan emulsion designed specifically for dust control of unpaved roads, traffic surfaces, and road shoulders that utilize non-petroleum based organic esters and resins combined with other additives to penetrate, bond and coat treated soils. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Absolute Viscosity (Brookfield), cP, 77°	--	50 – 200
pH	E70	3.0 - 9.0
Residue (active solids content), %	D2834	45 min.
Flash Point	D92	None
Specific Gravity, 60/60°F	D1298	1.00 min.

(D) Petroleum Resinous Types:

The materials shall be a light yellow petroleum resinous emulsion suitable for use as agglomerate for soil particles. The material shall have the following properties in its undiluted emulsified state:

SECTION 792

Specification Designation	ASTM Test Method	Requirements
Kinematic Viscosity, SFS at 77°F	D244	188 min.
pH	E70	4.0 – 7.0
Residue, % wt ⁽¹⁾	D2834	60 min.
Sieve Test, % wt. Retained ⁽²⁾	D244	0.1 max.
Particle Charge Test	D244	Positive
Flash Point of base product, CO, °F.	D92	400 min.
Specific Gravity, 60/60°F	D1298	1.00 min.

(1) ASTM test modified by heating 50 g of sample to 300 °F until foaming ceases, then cooling immediately and calculation results.

(2) Replace 2% sodium oleate solution with distilled water in test.

The emulsion shall be stable, i.e., should not break when stored in clean closed containers at temperatures between 35°F and 200 °F for a minimum of 3 months. The sequestering agents shall make the preparation stable against hard water, thus permitting dilution of the emulsion with almost all types of water. The emulsion shall be non-corrosive to metal containers. The materials shall penetrate into the soil and not form a skin at the surface or a crusted surface.

(E) Tall Oil Pitch Emulsion:

The material shall be a light brown tree resinous emulsion produced from distilled tall oil and not associated with the use of chlorine-based chemicals to bleach pulp from the production of paper. The product shall be designed specifically for dust control of unpaved roads, traffic surfaces, and road shoulders that can penetrate, saturate and bond together soils to create a hard, dust-free and water repellant surface. The product shall be non-water soluble once cured. The emulsion shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
pH	E70	2.5 - 9.0
Residue (active solids content), %	D2834	35 min.
Flash Point	D92	None
Specific Gravity, 60/60°F	D1298	0.998 min.

(F) Other Types:

Other types of dust palliative may be approved for use by the Engineer. Test methods, requirements, dilution ratios and application rates shall be as specified by the manufacturer.

792.3 PERFORMANCE STANDARDS AND TEST METHODS:

Product shall be blended at the specified stabilizer content application rate with soil that is either representative of the site soils to be treated or be a local A-7 in accordance with AASHTO M-145 (as determined by the Engineer) and tested in accordance with ASTM D1883. Results of treated soil must show a minimum 25% increase in CBR (California Bearing Ratio) value over the untreated soil for the product to be accepted for either topical dust suppression or soil stabilization.

Testing shall be in accordance with ASTM D1883, as modified herein. Test reporting shall include all the information required by ASTM D1883, Section 10.0 for both treated and untreated CBR samples. In addition, the penetration vs. stress plot for each test shall be included (ASTM D1883, Fig. 2) along with the rate of product application and the percent stabilizer solids. CBR specimens, after molding, shall be left in their mold, on their sides and cured in the laboratory air for 7 days prior to being immersed in water for 96 hours and then tested for CBR. At least three CBR test specimens shall be compacted at the optimum moisture content, both treated and untreated (ASTM D698, method C), with the result reported as the average value. The surcharge weight shall be 10 pounds.

SECTION 792

792.4 ENVIRONMENTAL CRITERIA:

Contractor shall submit proof to the Engineer in the form of test reports and certificates to verify that the dust palliative product is in environmental compliance. The Contractor is responsible for any costs associated with the testing of soil and palliative product prior to the application of as specified herein.

Products shall not contain or emit chlorinated fluorocarbons (CFC's or Freon's) and shall not contain or emit volatile organic compounds (VOC's) that exceed Federal, State or Local air quality limitations.

Products and their degradation products shall not be composed of elements, compounds, mixtures or produce runoffs with the characteristics identified under Arizona Revised Statutes 36-2822 of the Arizona Hazardous Waste Management Act, emit or off-gas during placement, use or degradation of any hazardous air pollutant listed under Section 112 of the Federal Clean Air Act [42 U.S.C. § 7412], be a hazardous chemical substance or mixture pursuant to Section 7 of the Federal Toxic Substances Control Act [15 U.S.C. § 2606], be designated by rule an extremely hazardous chemical substance pursuant to the Arizona Environmental Quality Act, be prohibited for use by the Arizona Department of Environmental Quality, the Environmental Protection Agency, or any applicable law, rule or regulation.

Product runoff and their degradation product runoffs shall not contain concentrations that exceed the parameters designated in Section 2.18 'Table 5' of the National Pollution Discharge Elimination System (NPDES) Multi-Sector General Permit for Industrial Activities (*see Note A*). Adequate proof can be shown by providing one of the following:

- (A) Complete aquatic toxicity test for lethal concentration at 50% (LC50).
- (B) Provide complete and accurate listing of all individual chemical constituents (including proprietary chemical information) and percentage of each in a given volume of pure chemical product.
- (C) Surface water runoff test. This test involves running distilled water over a treated soil area, collecting the test water, and submitting to a certified lab for analysis.

Contractor shall obtain from the dust palliative product manufacturer independent verification and certification of performance and environmental claims by a recognized agency of the United States, Canadian Precertification, Environmental Technology Verification, or EcoLogo Certification programs for chemical dust suppressants.

Products or their components and degradation products shall be tested and certified by the manufacturer not to be substances or composed of substances known to be, or reasonably anticipated to be carcinogenic or toxic by the U.S. Department of Health and Human Services.

Products must have hazardous Materials Identification System (HMIS) ratings equal to or less than the following for each category: H=1; F=1; R=1; PPE=X.

- End of Section -

Note A: Parameter benchmark values shall be provided by the Engineer and based on the Contracting Agency's Requirements.

SECTION 795

LANDSCAPE MATERIAL

795.1 GENERAL:

Material used for landscaping purposes shall be in conformance with this Section.

The common and scientific names of plants shall conform to the approved names in Standard Plants Names (SPN) or its successor, American Association of Nurserymen (ASN). For identification and inspection, durable, legible labels, bearing the plant's name in water-resistant ink, shall be attached to all nursery stock or container of stock delivered to the project site.

795.2 TOPSOIL:

Topsoil shall be a fertile, friable soil, obtained from well-drained arable land, and shall be free from nut grass, refuse, roots, heavy clay, clods, noxious weeds or any other material toxic to plant growth. At least 10 days prior to delivery of topsoil to the site, the Contractor shall furnish the Engineer at no additional cost, with a soil sample from each source for analysis and tests.

To be acceptable the pH factor shall not exceed 8.0 or be lower than 5.5, soluble salts shall not exceed 1500 PPM, the plasticity index shall be in the range of 3 and 15 inclusive, and it shall contain approximately 1 1/2%, by dry weight, or organic matter either natural or added. Gradation shall be in accordance with the following:

Sieve Size	Percent Passing
1 inch	100
1/2 inch	95-100
No. 4	90-100
No. 10	70-100
No. 200	15-70

795.3 SOIL FERTILIZING MATERIAL:

Fertilizing material shall comply with the applicable requirements of the State Agricultural Code. All fertilizing material shall be packaged, first grade, commercial quality products identified as to source, type of material, weight and manufacturer's guarantee analysis. It shall not contain toxic ingredients or fillers in quantities harmful to human life, animals or plants. It shall be delivered in unopened containers and shall have the chemical analysis as specified in the plans or specifications. Material which has become caked or otherwise damaged shall not be used.

795.4 ORGANIC SOIL CONDITIONERS:

In general, soil conditioners shall consist of a ground or processed wood product derived from redwood, ground or shredded fir, redwood or ponderosa bark. It shall have a nitrogen content of 1%, a pH not exceeding 7.5, and organic matter not less than 85%. Its gradation shall be such that at least 85% passes the 1/4 inch screen. In addition, it shall be treated with a non-toxic agent so as to be hygroscopic.

When manure is used as a soil conditioner, it shall be the product of yard fed cattle, free of weed seeds, straw or any other inert material and aged at least 3 months. This manure shall have been processed by grinding and screening and shall be of a consistency that will readily spread with a mechanical spreader.

795.5 CHEMICAL SOIL CONDITIONER:

Chemical soil conditioners such as soil sulfur, gypsum or iron additive shall be commercially approved brands designated for agricultural use. Material which has become caked or otherwise damaged shall not be used.

SECTION 795

795.6 SEEDS:

Seeds shall be fresh, clean seeds, pre-mixed to the specified proportion. They shall be delivered to the site in original, unopened containers bearing the dealer's guaranteed analysis and germination percentage. They shall have a certificate or a stamp or a release accomplished by an agricultural commission.

795.7 PLANTS, TREES, AND SHRUBS:

795.7.1 General: All landscape stock shall be grown in nurseries approved by the State Department of Agriculture. They shall have a growth habit normal to the specie. Stock shall be sound, healthy, and vigorous; free from insect pests, sun scald, excessive bark abrasions and other objectionable disfigurements. They shall have normal, well-developed branch systems and vigorous, fibrous root systems which are neither root nor pot-bound and are free of kinked or girdling roots.

All stock shall have been grown in pots, cans, tubs, or boxes for a minimum of three months and a maximum of one year. They shall have sufficient roots to hold earth together after removal from the containers. This earth shall be free from noxious weeds including Bermuda grass.

Stock shall be inspected and approved by the Engineer at the Contractor's storage site prior to delivery to the project.

795.7.2 Flatted Plants: Flatted plants shall be grown and remain in the flats until transported to the project site. The soil and spacing of the plants in the flats shall insure the minimum disturbance of the root system at transplanting.

795.7.3 Trees: Trees shall be of the specified height, spread and caliper and shall stand erect without support. The height shall be measured from the root crown to the last division of the terminal leader with the branches in a normal position and the caliper shall be measured 12 inches above the crown roots. For palm trees only, the height shall be measured from the ground line to the base of the growing bud.

795.7.4 Shrubs: Shrubs shall be of the specified type, height and spread. They shall be selected from high quality, well-shaped nursery stock.

795.8 MISCELLANEOUS MATERIAL:

795.8.1 Headers and Stakes: Lumber for landscaping shall be construction heart, rough-sawn redwood in the sizes specified; splicing will not be permitted. Stake used with header boards shall be 2 x 4 inches, pointed and at least 18 inches long.

795.8.2 Tree Stakes: Unless otherwise specified, tree stakes shall be 2 x 2 inch redwood posts, free of knots and reasonably straight, and of sufficient length to properly support the tree.

795.8.3 Tie Wires: Tie wire shall be No. 12 AWG zinc coated wire and the cover for this wire shall be 1/2 inch garden hose.

795.8.4 Decomposed Granite: All material used for a specific project or location shall be from a single source and shall present a uniform appearance. The gradation shall be as shown below. If a specific color or type is required, it will be so indicated in the Contracting Agency's specifications.

Sieve Size	Percent Passing
3/4 inch	100%
1/2 inch	60-70
No. 40	5-20

- End of Section -

SECTION 796

GEOSYNTHETICS

796.1 GENERAL:

This section defines the requirements for geosynthetic fabrics, grids and membranes typically used as pavement fabric beneath asphalt concrete overlays, filtration/drainage separation between soil/aggregate layers, erosion control filter/separators for riprap protection, and soil or base reinforcement to improve the stability of weak soils or reinforce aggregate bases.

796.2 MATERIALS AND REQUIREMENTS:

Identification, packaging, delivery, storage and handling of geosynthetic materials shall be in accordance with manufacturer's recommendations and ASTM D4873. Each roll shall be labeled or tagged to provide product identification sufficient to determine the product type, manufacturer, quantity, lot number, roll number date of manufacture, and shipping date.

Geosynthetic materials shall be inert to commonly encountered chemicals, resistant to rot and mildew, and shall have no tears or defects which adversely affect or alter its physical properties.

Geosynthetic materials shall be packaged with material that will protect the geosynthetic (including ends of rolls) from damage due to shipment, water, sunlight and contaminants. During storage, geosynthetic materials shall be elevated off the ground and protected from the following: site construction damage, precipitation, extended ultraviolet radiation, strong acid or strong base chemicals, flames (including welding sparks), temperatures in excess of 160°F, and any other environmental condition that may damage geosynthetic material property values. Protection shall be in accordance with manufacturer's specifications and shall be maintained during periods of shipment and storage.

Materials required for complete and proper installation of geosynthetic materials that are not specifically described herein (such as pins, nails, washers, etc.) shall conform to the manufacturer's recommendations and be as selected and supplied by Contractor subject to final approval by the Engineer.

Requirements represent minimum average roll values in the weaker principal direction. Average of test results from any sampled roll in a lot shall meet or exceed the minimum values noted herein. Lot sampling shall be in accordance with ASTM D4354.

796.2.1 Pavement: Pavement fabric geosynthetics are non-woven polyester or polypropylene fabrics that are field saturated with an asphalt binder and placed as an interlayer beneath a pavement overlay or between pavement layers. When placed, the fabric becomes an integral part of the roadway section, forming a barrier to water infiltration and absorbing stresses to reduce reflective and fatigue cracking of the new pavement surface layer.

Pavement fabric shall be constructed of at least 95 percent (by weight) nonwoven synthetic fibers of polyester or polypropylene, thermally bonded on one side. The fabric material shall additionally conform to the physical properties shown in Table [796-1](#).

TABLE 796-1			
PAVEMENT GEOSYNTHETIC PROPERTIES			
Property	Class A	Class B	Test Method
Weight: oz/yd ²	4.1 min.	4.0 min.	ASTM D3776
Grab tensile strength: lbs.	100 min.	90 min.	ASTM D4632
Elongation at break: %	50 min.	50 min.	ASTM D4632
Melting point: degree F	300 min.	300 min.	ASTM D276
Asphalt retention: gal/yd ²	0.25 min. ⁽¹⁾	0.20 min.	ASTM D6140

(1) May be reduced within street intersections, on steep grades or in other zones where vehicle braking is common, but not less than 0.20 gal/yd², when approved by the Engineer.

796.2.2 Filtration (Drainage) and Separation: Filtration and separation fabrics are nonwoven or woven polypropylene or polyester fabrics with specified strength characteristics used as permeable separators to restrain soil or other particles subjected

SECTION 796

to hydrodynamic forces while allowing the passage of fluids into or across a geotextile and to prevent inter-migration of adjacent soil layers of vastly different particle sizes and particle distributions.

Filtration and separation fabrics shall be nonwoven or woven fabric consisting only of long chain polymeric filaments such as polypropylene or polyester formed or woven into a stable network such that the filaments retain their relative position to each other. The fabric material shall additionally conform to the physical properties shown in Table [796-2](#).

TABLE 796-2			
FILTRATION & DRAINAGE GEOSYNTHETIC PROPERTIES			
Property	Class A ⁽¹⁾	Class B ⁽²⁾	Test Method
Grab tensile strength: lbs.	180 min.	80 min.	ASTM D4632
Seam strength: lbs.	160 min.	70 min.	ASTM D4632
Puncture strength: lbs.	80 min.	25 min.	ASTM D4833
Trapezoidal tear: lbs	50 min.	25 min.	ASTM D4533
Apparent opening size: US Standard sieve size	>50	>50	ASTM D4751
Ultraviolet Stability: %	50 min.	50 min.	ASTM D4355

- (1) Class A - Use where installation stresses are more severe than for Class B application (i.e. very coarse sharp angular aggregate or high compaction requirements).
- (2) Class B – Use with smooth graded surface having no sharp angular projections and sharp angular aggregate.

796.2.3 Erosion Control: Erosion control fabrics are used below areas to receive aggregate or riprap slope protection and act as filter/separators to provide sustained permeability while maintaining structural stability.

Erosion control fabrics shall be a woven monofilament fabric or a nonwoven fabric consisting only of long chain polymeric filaments such as polypropylene or polyester formed into a stable network that the filaments retain their relative position to each other. The fabric material shall additionally conform to the physical properties shown in Table [796-3](#).

TABLE 796-3			
EROSION CONTROL GEOSYNTHETIC PROPERTIES			
Property	Class A	Class B	Test Method
Grab tensile strength: lbs.	270 min.	200 min.	ASTM D4632
Elongation at break: %	45min., 115 max.	15 min., 115 max.	ASTM D4632
Puncture strength: lbs.	110 min	75 min.	ASTM D4833
Burst strength: psi	430 min.	320 min.	ASTM D3786
Trapezoidal tear: lbs	75 min.	50 min.	ASTM D4533
Permittivity: second ⁻¹	0.07 min.	0.07 min.	ARIZ-730 ⁽¹⁾
Apparent opening size: US Standard sieve size	30 – 140	30 - 140	ASTM D4751
Ultraviolet Stability: %	70 min.	70 min.	ASTM D4355

- (1) Arizona Department of Transportation test method.

796.2.4 Soil or Base Reinforcement: Geogrid geosynthetic materials are used for improving the stability of weak soils or reinforcing aggregate bases. Geogrids are defined as biaxial or triaxial polymeric grids formed by a regular network of integrally connected polymer tensile elements with apertures of sufficient size to permit significant mechanical interlock with the surrounding soil, aggregate, or other fill materials to function primarily as reinforcement.

SECTION 796

The geogrid structure shall be dimensionally stable and able to retain its geometry under manufacture, transport and installation. Geogrids shall be integrally formed and deployed as a single layer; comprised of 100 percent polypropylene or high-density polyethylene. Geogrids shall additionally conform to the physical properties shown in Table [796-4](#).

TABLE 796-4			
REINFORCEMENT GEOGRID PROPERTIES			
Property	Type 1	Type 2	Test Method
Aperture size: inches	1 min.	1-3/8 min.	ID callipered
Ultimate Tensile Strength: lb/ft	850 min.	1300 min.	ASTM D4945
Flexural Rigidity: Mg-cm	250,000 min.	750,000 min.	ASTM D1388
Tensile Strength @ 2% Strain: lb/ft MD ⁽¹⁾	270 min.	410 min.	ASTM D6637
Tensile Strength @ 2% Strain: lb/ft CMD ⁽²⁾	380 min.	620 min.	ASTM D6637
Tensile Strength @ 5% Strain: lb/ft MD ⁽¹⁾	550 min.	810 min.	ASTM D6637
Tensile Strength @ 5% Strain: lb/ft CMD ⁽²⁾	720 min.	1340 min.	ASTM D6637
Junction Efficiency: % Ultimate Tensile Strength	75 min.		GRI-GG2 ⁽³⁾
Ultraviolet Stability: % Retained Strength	70 min.		ASTM D4355

(1) MD = Test in the machine direction along roll length

(2) CMD = Test in the cross-machine (transverse) direction across roll width

(3) Geosynthetic Research Institute test method

796.3 TEST AND CERTIFICATION REQUIREMENTS:

Certificates of compliance shall be submitted to the engineer upon delivery of material for use on a specified project. Samples of materials shall be submitted for testing. Each geosynthetic material lot or shipment must be approved by the Engineer before the materials may be incorporated in the work.

Testing methods and results shown in the certificate of compliance shall conform to the listed specifications for the proposed geosynthetic use. Manufacturer's supporting documentation including, but not limited to, product information sheets, installation procedures and recommendations, recommended use, and project references shall be submitted to the Engineer for product evaluation and approval.

- End of Section -

INDEX

- Abbreviations and Definitions, [101-1](#)
- ABS Truss Pipe and Fittings, [744-1](#)
- Acceptance, [105-6](#)
 - Final Acceptance, [105-6](#)
 - Partial Acceptance, [105-6](#)
- Access to Property, [340-2](#)
- Actual Cost Work, [109-3](#)
- Addendum, [101-4](#)
- Adjusting Frames, Covers, Valve Boxes Meter Boxes and Pull Boxes, [345-1](#)
 - Frames, [345-1](#)
 - Manhole and Valve Covers, [345-1](#)
 - Valve Boxes, [345-1](#)
 - Water Meter Boxes, [610-6](#)
- Aggregate, [701-1](#)
 - Coarse, [701-1](#)
 - Fine, [701-1](#)
 - Mineral, [714-1](#)
 - Reclaimed Concrete Material, [701-1](#)
 - Reclaimed Asphalt Pavement, [701-1](#)
- Aggregate Base, [310-2](#), [342-1](#), [350-2](#), [355-1](#), [601-4](#), [601-6](#), [702-1](#), [702-2](#), [728-1](#), [796-1](#), [796-2](#)
- Aggregate Paving
 - Exposed, [343-1](#)
- Air Release and Vacuum Valves, [610-5](#), [630-1](#), [630-7](#)
- Air Test
 - Sewer Lines, [615-3](#)
- Alley Entrances, [301-2](#), [336-1](#), [336-4](#), [340-1](#)
- Aluminum Handrails, [520-1](#)
- Anti-Stripping Agent, [710-2](#)
- Approval of
 - Bonds and Insurance, [109-5](#)
 - Contract, [103-4](#)
 - Proposal, [102-1](#), [103-1](#)
 - Shop Drawings, [101-8](#), [105-1](#)
 - Subcontracts, [108-1](#)
 - Subletting, [108-1](#)
 - Substitutes, [106-2](#)
- Archaeological Reports, [107-1](#)
- Arizona Test Method, [101-4](#)
- Asbestos-Cement Pipe and Fittings for Storm Drain and Sanitary Sewer, [737-1](#)
- Asbestos-Cement Water Pipe and Fittings, [752-1](#)
- Asphalt
 - Concrete, [710-1](#)
 - Emulsified, [333-1](#), [713-1](#)
 - Liquid, [320-1](#), [320-2](#), [321-5](#), [330-1](#), [330-2](#), [330-3](#), [711-1](#), [712-1](#), [712-2](#)
 - Milling, [317-1](#)
 - Paving, [711-1](#)
 - Rubber, [717-1](#)
- Asphalt Chip Seal, [330-1](#)
- Asphalt Concrete, [710-1](#)
 - Preservative Seal, [334-1](#), [718-1](#)
- Asphalt Concrete Pavement, [321-1](#)
 - Curbs, [324-2](#)
- Asphalt Distributing Equipment, [330-3](#)
- Asphalt Emulsion
 - Slurry Seal Coat, [332-1](#)
 - Asphalt Pavement Core Bonding Materials, [708-1](#)
- Asphalt Milling, [317-1](#)
- Asphalt-Rubber Asphalt Concrete, [717-1](#)
- Assignment of
 - Contract, [108-1](#)
 - Payments, [109-2](#)
- Authority of the
 - Engineer, [109-5](#)
 - Inspector, [105-4](#)
- Award and Execution of Contract, [103-1](#)
 - Cancellation of, [103-1](#)
 - Execution, [103-1](#)
 - of Contract, [103-1](#)
- Backfill
 - Structure, [206-1](#)
- Barricades and Warning Signs, [107-2](#)
- Base Materials, [702-1](#)
- Beginning Work, [108-1](#)
- Bench Marks, [105-4](#)
- Bid Guarantee
 - Amount of, [103-1](#)
 - Forfeiture of, [103-4](#)
 - Proposal, [103-4](#)
 - Return of, [103-1](#)
- Bidding Requirements and Conditions, [102-1](#)
 - Disqualification, [102-3](#)
 - Eligibility and Preference, [102-1](#)
 - Successful, [102-3](#)
- Bidding Requirements and Conditions, [102-1](#)
- Bituminous Prime Coat, [315-1](#)
- Blasting
- Discontinue [107-3](#)
 - Operations, [107-3](#)
- Bolts
 - Anchor, [770-1](#)
- Bonds
 - Acceptable to, [103-1](#)
 - Amount, [103-2](#)
 - Executed by, [103-2](#)
 - Proposal Guarantee, [103-1](#)
 - Requirement of, [103-1](#)
- Borrow Excavation, [210-1](#)
 - Local and Imported, [210-1](#)
 - Placing and Compacting, [210-1](#)
- Brick and Concrete Masonry Units (Blocks), [775-1](#)
 - Building, Facing and Manhole, [775-1](#)
 - Concrete Paving, [342-1](#)
 - Decorative Pavement, [342-1](#)
- Brick Masonry, [511-1](#)
 - Bricklaying, [511-1](#)
 - Curing, Grouting and Reinforcing, [511-1](#)
- Bridges

INDEX

- Concrete, [505-1](#)
- Steel, [515-1](#)
- Cable
 - Installation, [360-1](#)
- Cancellation of
 - Award, [103-1](#)
 - Contract, [108-3](#)
- Cast Iron Water Pipe, [750-1](#)
- Castings
 - Gray Iron, [787-1](#)
- Cast-in-Place Concrete Pipe, [620-1](#)
 - Construction Methods, [620-1](#)
 - Excavation, [620-1](#)
 - Materials, [620-1](#)
 - Methods of Tests, [620-3](#)
 - Placement, [620-2](#)
- Catch Basins, [505-1](#), [601-2](#)
- Cement Concrete
 - Cement, [725-1](#)
- Cement Mortar and Grout, [776-1](#)
- Cement Treated Base, [312-1](#)
- Certificate of
 - Compliance or Analysis, [106-1](#)
 - Insurance, [103-2](#)
 - Weighmaster's, [109-1](#)
- Chain Link Fences, [420-1](#), [772-1](#)
- Change Order
 - Alteration of Work, [104-2](#), [109-3](#)
 - Extension of Time, [108-3](#)
 - Extra Work, [104-3](#), [109-3](#)
 - Payment, [104-2](#)
 - Unreasonable Circumstances, [109-7](#)
- Changed Conditions
 - Additional Compensation, [110-2](#)
 - Additional Time, [110-2](#)
 - Dispute Resolution, [110-1](#)
 - Notification, [110-1](#)
- Channels
 - Open, [215-1](#)
- Chip Seal, [330-1](#)
 - Application, [330-1](#)
 - Materials, [330-1](#)
 - Weather Conditions, [330-1](#)
- Chlorine
 - Disinfecting Water Mains, [611-2](#)
- City Sealer of Weights, [109-1](#)
- Classes, Grades and Types
 - Liquid Asphalt, [712-1](#)
 - Pavement, [710-1](#)
 - Paving Asphalts, [711-1](#)
- Clay Pipe Vitrified, [743-1](#)
- Clean Up
 - During Construction, [104-2](#)
 - Final, [104-2](#)
- Clearing and Grubbing, [201-1](#)
- Coating Corrugated Metal Pipe and Arches, [760-1](#)
- Collusion
 - Evidence of, [107-1](#)
- Commencement, Prosecution and Progress, [108-1](#)
- Compensation for
 - Alteration of Work, [109-2](#)
 - Change Orders, [104-2](#)
 - Extra Work, [109-3](#)
- Concrete Block Masonry, [510-1](#)
- Concrete Crub, Gutter, Sidewalk, Curb Ramps, Driveway and Alley Entrance, [340-1](#)
 - Alley Entrance, [340-1](#)
 - Asphalt, [710-1](#)
 - Blocks, [775-1](#)
 - Curb, [340-1](#)
 - Curb Ramps, [340-1](#)
 - Curing Materials, [726-1](#)
 - Driveway, [340-1](#)
 - Gutter, [340-1](#)
 - Masonry Units, [775-1](#)
 - Non-Reinforced Pipe, [736-1](#)
 - Paving Stone or Brick, [342-1](#)
 - Portland Cement, [725-1](#)
 - Pressure Pipe, [758-1](#)
 - Sidewalk, [340-1](#)
- Concrete Block Masonry, [510-1](#)
 - Construction, [510-1](#)
 - Curing, [510-2](#)
 - Mortar and Grout, [510-2](#)
 - Reinforcing, [510-1](#)
 - Tests, [776-2](#)
- Concrete Curing Materials, [726-1](#)
- Concrete Pipe
 - Cast-in-Place, [505-12](#), [620-1](#),
 - Lining, [741-1](#)
 - Non-Reinforced Concrete, [736-1](#)
 - Reinforced, [735-1](#)
- Concrete Pressure Pipe-Steel Cylinder Type, [758-1](#)
- Concrete Structures, [505-1](#)
 - Concrete Deposited Underwater, [505-9](#)
 - Curing, [505-9](#)
 - Dimensional Tolerances, [505-12](#)
 - Falsework, [505-3](#)
 - Finishing Concrete, [505-10](#)
 - Forms, [505-1](#)
 - Placing Concrete, [505-6](#)
 - Placing Reinforcement, [505-4](#)
 - Subgrade, [505-1](#)
- Conformity with Plans and Specifications, [105-2](#)
- Construction
 - Cleanup and Dust Control, [104-2](#)
 - Contractor's Schedule, [108-1](#)
 - Fill, [211-1](#)
 - Maintenance During, [105-5](#)
 - Manhole, [625-1](#)
 - Reclaimed Water Line, [616-1](#)
 - Riprap, [220-1](#)

INDEX

- Stakes, Lines and Grades, [105-4](#)
- Storm Drain, [618-1](#)
- Contract
 - Approval, [103-4](#)
 - Assignment, [109-2](#)
 - Award and Execution of, [103-1](#)
 - Bonds Requirement, [103-1](#)
 - Execution, [103-4](#)
 - Failure to Complete, [108-4](#)
 - Failure to Execute, [103-4](#)
 - Final Acceptance, [105-6](#)
 - Final Payment, [109-6](#)
 - Insurance, [103-2](#)
 - Labor Requirements, [107-1](#), [108-2](#)
 - Partial Acceptance, [105-6](#)
 - Partial Payments, [109-5](#)
 - Subletting of, [108-1](#)
 - Termination, [108-5](#)
 - Time Extension, [108-3](#)
 - Time of Completion, [108-1](#)
- Contractor's
 - Accident Prevention Requirements, [107-3](#)
 - Construction Schedule, [108-1](#)
 - Correspondence to, [108-1](#)
 - Default, [108-5](#)
 - Eligibility and Preference, [102-1](#)
 - Examine Site Prior to Bidding, [102-1](#)
 - Liability, [103-2](#), [103-3](#)
 - Marshaling Yard, [107-2](#)
 - Notice to Proceed, [108-1](#)
 - Notify Public Utilities, [105-3](#), [107-5](#)
 - Personnel and Equipment, [108-2](#)
 - Requested Changes, [104-2](#)
 - Responsibilities, [107-5](#)
 - Superintendent, [105-2](#), [105-5](#)
- Control of Work, [105-1](#)
 - Control of Materials, [106-1](#)
 - Work, [105-1](#)
- Controlled Low Strength Material, [728-1](#)
 - Mixtures and Production Tolerances, [728-1](#)
 - Payment, [604-2](#)
 - Performance Testing, [604-2](#)
 - Placement of, [604-1](#)
- Cooper Pipe, Tubing and Fittings, [754-1](#)
- Cooperation
 - Between Contractors, [105-4](#)
 - with Utilities, [105-3](#)
- Coordination of Plans and Specifications, [105-2](#)
- Corrugated Metal Pipe and Arches, [621-1](#)
 - Coating, [760-1](#)
 - Installation, [621-1](#)
 - Test Specimens, [621-2](#)
- Cover Material, [716-1](#)
- Crack Sealing, [337-1](#)
 - Application, [337-1](#)
 - Cleaning and Preparing Cracks or Joints, [337-2](#)
- Equipment, [337-1](#)
- Materials, [337-1](#)
- Opening to Traffic, [337-2](#)
- Pavement Temperatures, [337-2](#)
- Curbs
 - Concrete, [340-1](#)
 - Precast Safety, [410-1](#)
- Curb Ramps, [340-1](#)
- Curing
 - Cast-in-Place Concrete Pipe, [620-2](#)
 - Concrete block Masonry, [511-1](#)
 - Concrete Curbs, Gutters and Sidewalks, [340-3](#)
 - Concrete Structures, [505-7](#), [505-9](#)
 - Gunite, [525-2](#)
 - Materials, [726-1](#)
 - Precast Prestressed Concrete Members, [506-1](#)
- Damages
 - Liquidated, [108-4](#)
- Decomposed Granite, [430-2](#), [795-2](#)
- Decorative Pavement Concrete Paving Stone, [342-1](#)
- Decreased Quantities, [109-1](#), [610-8](#)
- Definitions, [101-1](#)
- Definitions and Terms, [101-4](#)
- Delays
 - Asbestos, [107-2](#)
 - Between Contractor's, [105-4](#)
 - Beyond the Control of Contractor, [108-3](#)
 - Contracting Agency, [108-4](#)
 - Extension of Time, [108-3](#)
 - Utility Owners, [105-3](#)
- Discontinue Blasting, [107-3](#)
- Disinfecting Water Mains, [611-1](#)
 - Application of Liquid Chlorine, [611-2](#)
 - Chlorinating Valves and Hydrants, [611-3](#)
 - Chlorine Residual, [611-2](#)
 - Chlorine-Bearing Compounds in Water, [611-2](#)
 - Cleaning and Treating Pipe, [611-1](#)
 - Final Flushing, Sampling and Testing, [611-3](#)
 - Flushing Completed Pipe Lines, [611-1](#)
 - Laying Pipe, [611-1](#)
 - Methods of Applying Chlorine, [611-2](#)
 - Packing Material, [611-1](#)
 - Point of Application, [611-2](#)
 - Preventing Reverse Flow, [611-3](#)
 - Preventing Trench Water from Entering Pipe, [611-1](#)
 - Rate of Application, [611-3](#)
 - Repetition of Chlorination Procedure, [611-4](#)
 - Retention Period, [611-3](#)
- Disposal of Surplus Material, [205-2](#)
- Dispute Resolution, [110-1](#)
 - Administrative Process, [110-2](#)
 - Amount of Dispute, [110-4](#)
 - Arbitration, [110-4](#)
 - Dispute Review Board, [110-4](#)
 - Final Documentation, [110-5](#)

INDEX

- Mediation, [110-3](#)
- Disqualification of Bidders, [102-3](#)
- Drawings
 - Shop, [105-1](#)
- Driveways
 - Access, [107-4](#), [340-2](#), [401-1](#)
- Drop Sewer Connections, [625-1](#)
- Dry Barrel/Fire Hydrants, [756-1](#)
- Ductile Iron Water Pipe, [750-1](#)
- Dust Control, [230-1](#)
- Dust Palliative, [792-1](#)
- Dust Palliative Application, [230-1](#)
 - Application, [230-3](#), [792-1](#)
 - Curing, [230-3](#)
 - Deficiencies and Warranty, [230-4](#)
 - Environmental Criteria, [792-4](#)
 - Materials, [792-1](#)
 - Measurement, [230-4](#)
 - Performance Standards and Test Methods, [792-3](#)
 - Quality Control, [230-4](#)
 - Weather Conditions, [230-3](#)
- Duties of Inspector, [105-4](#)
- Earthwork for Open Channels, [215-1](#)
 - Excavation, [215-1](#)
 - Fill and Backfill, [215-2](#)
 - for Open Channels, [215-1](#)
 - Grading, [215-2](#)
 - Stripping, [215-1](#)
- Eligibility of Contractor, [102-1](#)
- Emergency
 - Contractor's Representative, [105-2](#)
 - Defects, [108-3](#)
 - Services for Public, [104-1](#)
- Emulsified Asphalt Materials, [713-1](#)
- Engineer
 - Authority of, [105-1](#)
 - Decisions, [105-1](#)
 - Suspension of Work, [104-2](#), [108-3](#)
- Equipment
 - Approval of, [106-2](#)
 - Asphalt Distributors, [330-3](#)
 - Rental Rate, [109-4](#)
 - Storage of, [106-2](#)
- Examination of
 - Plans, [102-1](#)
 - Site of Work, [102-1](#)
 - Special Provisions, [102-1](#)
- Excavation
 - Borrow, [210-1](#)
 - Roadway, [205-1](#)
 - Structure, [206-1](#)
 - Trenches, Backfilling, and Compaction [601-1](#)
- Execution of Contract, [103-4](#)
- Exfiltration Test, Sewer Lines, [615-2](#), [610.8](#)
- Existing Improvements
 - Removal of, [350-1](#)
- Expansion Joint Filler, [729-1](#)
 - Application, [729-2](#)
 - Pour Type, [729-1](#)
 - Premolded, [729-1](#)
 - Test Report and Shipment Certificate, [729-2](#)
- Explosives
 - Discontinue use of, [107-3](#)
 - Use of, [107-3](#)
- Exposed Aggregate Paving, [343-1](#)
- Extension of Time, [108-3](#)
- Extra Work
 - Actual Cost, [109-3](#)
 - Claims for, [104-3](#)
- Extruded
 - Galvanized Pipe, [753-1](#)
 - Polyethylene Pipe, [755-1](#)
- Failure to
 - Complete on Time, [108-4](#)
 - Execute Contract, [103-4](#), [108-5](#)
 - Maintain Construction, Roadway or Structure, [105-5](#)
- Federal Aid Projects, [401-2](#)
- Fence
 - Chain, [772-1](#)
- Fill Construction, [211-1](#)
 - Compacting, [211-1](#)
 - Placing, [211-1](#)
 - Tests, [211-2](#)
- Final
 - Acceptance, [105-5](#), [105-6](#)
 - Cleaning Up, [104-2](#)
 - Inspection, [105-6](#)
- Fire Hydrants, [756-1](#)
 - Installation, [756-2](#)
- Fittings, ABS Truss [744-1](#)
- Flagmen or Pilot Cars, [401-1](#)
- Flexible Metal Guardrail, [415-1](#)
- Fog Seal Coats, [333-1](#)
 - Application, [333-1](#)
 - Asphalt Emulsion Application, [333-1](#)
 - Materials, [333-1](#)
 - Preparation of Surfaces, [333-1](#)
 - Protection for Adjacent Property, [333-2](#)
 - Protection of Treated Surface, [333-2](#)
 - Sand Blotter, [333-1](#), [701-1](#)
 - Test Reports and Certification, [333-1](#)
 - Weather Conditions, [333-1](#)
- Forfeiture of
 - Contract, [108-5](#)
 - Proposal Guarantees, [103-4](#)
- Foundation Data
 - Test Holes, [601-6](#)
- Foundation Material Treatment, [206-1](#)
- Furnished Materials, [106-3](#)
- Galvanized Pipe and Fittings, [753-1](#)

INDEX

- Galvanizing, [771-1](#)
- Geogrid Reinforcement, [306-1](#)
 - Placement, [306-1](#)
 - Placing and Compacting Aggregate Fill, [306-2](#)
 - Repair, [306-2](#)
- Geosynthetic, [796-1](#)
 - Requirements, [796-1](#)
 - Test and Certification Requirements, [796-3](#)
- Grade
 - Trench, [601-1](#)
- Grading
 - Crushed Aggregate, [702-2](#)
 - Earthwork for Open Channels, [215-2](#)
 - Parkway, [424-1](#)
 - Paving Asphalt, [711-1](#)
 - Subgrade, [605-1](#)
 - Under Pavements, [301-2](#)
- Granular Material, [601-6](#)
- Gray Iron Castings, [787-1](#)
- Ground Water, [102-1](#), [505-1](#)
- Grout
 - Bonding, [506-5](#)
 - Concrete Block Masonry, [510-2](#)
 - Masonry Mortar, [776-1](#)
 - Reinforced Brick Masonry, [511-1](#)
- Grubbing and Clearing, [201-1](#)
- Guarantee
 - Bid, [102-2](#)
 - Forfeiture of, [103-4](#)
 - Proposal, [102-2](#)
 - Provisions, [108-3](#)
 - Return of, [103-1](#)
 - Workmanship and Materials, [108-3](#)
- Guardrail, Flexible Metal [415-1](#)
- Gutter, [340-1](#)
- Handrail
 - Aluminum and Steel, [520-1](#)
- Health, Safety and Sanitation, [107-1](#)
- High Density Polyethylene Pipe and Fittings for Storm Drain and Sanitary Sewer, [738-1](#)
- Holes
 - Tests, [601-6](#), [603-2](#)
- Hot In-Place Recycling, [327-1](#)
- Hydrants, Fire, [610-5](#), [756-1](#)
 - Installation, [610-4](#)
 - Types, [756-1](#)
 - Working Around, [107-5](#)
- Inspection
 - of Materials, [106-1](#)
 - of Plant, [106-1](#)
 - of Trees and Shrubs, [430-2](#)
 - of Work, [105-5](#)
 - Section to be Notified, [108-1](#)
- Inspector
 - Authority of, [105-5](#)
 - Duties of, [105-4](#)
- Installation of High Density Polyethylene Pipe, [603-1](#)
 - Cable, [360-1](#)
 - High Density Polyethylene Pipe, [603-2](#)
 - Monuments, [405-1](#)
 - Sprinkler Irrigation System, [440-2](#)
 - Telecommunications, [360-1](#)
- Insurance
 - Approval of, [103-2](#)
 - Contractor's, [103-2](#)
 - Damage Claims, [103-2](#)
 - Fire and Extended Coverage, [103-3](#)
 - Property Damage, [103-2](#)
 - Public Liability, [103-2](#)
 - Worker's Compensation, [103-2](#)
- Iron Water Pipe and Fittings, [750-1](#)
 - Cast Iron, [750-1](#)
 - Ductile Iron, [750-1](#)
- Irregular Proposals, [102-2](#)
- Irrigation Structures, [350-2](#)
- Jacked Steel Casing, [602-1](#)
- Jetting
 - for Settling Trench Backfill, [601-5](#)
- Joint Filler, [729-1](#)
- Joints
 - Cast-in-Place Concrete Pipe, Stoppage, [620-2](#)
 - Concrete Structures, [505-7](#)
 - Concrete, Curb, Gutter and Sidewalks, [340-2](#)
 - Corrugated Metal Pipe, [621-1](#)
 - High Density Polyethylene Pipe, [738-1](#)
 - Iron Water Pipe, [750-1](#)
 - Mortar, Brick, [511-1](#)
 - Mortar, Concrete Block, [510-1](#)
 - Non-Reinforced Concrete Pipe, [736-1](#)
 - Pneumatically Placed Mortar, [525-2](#)
 - Portland Cement Concrete, [324-5](#)
 - Reinforced Concrete Pipe, [735-1](#)
 - Sewer Lines, [615-2](#)
 - Subdrainage Systems, [605-1](#)
 - Vitrified Clay Pipe, [615-2](#)
 - Water Lines, [610-7](#)
- Labor and Materials
 - Payment Bond, [103-2](#)
- Labor Requirements, [107-1](#), [108-2](#)
- Laboratory Tests, [106-1](#)
- Landscape and Property Protection and Restoration, [107-3](#)
- Landscaping and Planting, [430-1](#)
 - and Planting, [430-2](#), [795-2](#)
 - Landscape Materials, [795-1](#)
- Laws
 - Contractor's Responsibility to Observe, [107-4](#)
- Legal Regulations and Responsibility to Public, [107-1](#)
- Legal Rights
 - No Waiver of, [107-5](#)
- Lime Slurry Stabilization or Modification of Subgrade, [309-1](#)

INDEX

- Limitation of Operations, [108-2](#)
- Lining for Reinforced Concrete Sanitary Sewer Pipe, [741-1](#)
 - Installation, [741-1](#)
 - Sanitary Sewer Pipe, [741-1](#)
 - Testing and Repairing, [741-3](#)
- Liquid Asphalt, [712-1](#)
- Liquidated Damages, [108-4](#)
- Location of Underground Utilities
 - Expose All Underground Utilities, [107-5](#)
 - Notify Utility Companies, [105-2](#), [107-1](#)
 - Protection Thereof, [107-4](#)
 - That Differ From Those Shown, [105-3](#)
- Lumber, [778-1](#)
- Maintenance
 - During Construction, [105-5](#)
 - of Traffic, [104-1](#)
 - Unsatisfactory, [105-2](#), [105-5](#)
- Manhole Construction and Drop Sewer Connection, [625-1](#)
- Marshaling Yard, [107-2](#)
- Marshall Mix Design, [710-3](#)
- Masonry Mortar and Grout, [776-1](#)
- Materials
 - Approval, [108-1](#)
 - Control of, [106-1](#)
 - Equal, [106-2](#)
 - Furnished, [106-3](#)
 - Handling, [106-3](#)
 - Landscape, [795-1](#)
 - Payment of, [109-4](#)
 - New and Unused, [106-1](#)
 - Patented, [106-2](#)
 - Quality, [106-1](#)
 - Reasonably Acceptable, [105-2](#)
 - Rejection, [105-5](#), [106-1](#)
 - Samples and Tests, [106-1](#)
 - Source of, [106-1](#)
 - Storage of, [106-2](#)
 - Substitutions, [106-2](#)
 - Unacceptable, [106-3](#)
- Measurements and Payments, [109-1](#)
 - Actual Cost Work, [109-3](#)
 - Assignment of Payments, [109-2](#)
 - Compensation for Alteration of Work, [109-2](#)
 - Dollar Value of Major Item, [109-7](#)
 - Payment, Scope of, [109-1](#)
 - Payment for Bond Issue and Budget Projects, [109-5](#)
 - Payment for Delay, [109-7](#)
 - Payment for Improvement District Projects, [109-5](#)
 - Payment for Mobilization/Demobilization, [109-7](#)
 - Quantities, [109-1](#)
- Mechanically Stabilized Subgrade-Geogrid Reinforcement, [306-1](#)
- Meter Services Connections
 - Water, [631-1](#)
- Methods and Equipment, [108-2](#)
- Microsurfacing Materials, [714-1](#)
- Microsurfacing Specification, [331-1](#)
 - Application, [331-4](#)
- Microsurfacing Specifications, [331-1](#)
 - Equipment, [331-2](#)
 - Mix Design, [331-1](#)
 - Proportioning, [331-1](#)
 - Testing, [331-2](#)
- Mill Reports
 - Steel Reinforcement, [727-1](#)
 - Structural Steel, [515-1](#)
 - Handrails, Steel and Aluminum, [520-1](#)
- Mineral
 - Filler, [714-1](#)
- Mineral Admixture, [710-2](#)
- Modification of Subgrade, [306-1](#)
- Monthly Payments, [109-6](#)
- Monuments, [405-1](#)
 - Construction, [405-1](#)
 - Installation, [405-1](#)
 - Protection, [107-3](#)
- Name Stamped in Concrete, [340-3](#)
- Noise, [107-2](#)
- Non-Reinforced Concrete Pipe, [736-1](#)
 - Care of Pipe and Materials, [736-2](#)
 - Curves, Bends and Closures, [736-1](#)
 - Materials, [736-1](#)
 - Pipe Joints, [736-1](#)
 - Tests, [736-2](#)
- Notice
 - Award of, [103-1](#)
 - to Contractor, [108-1](#)
 - to Engineer, [104-3](#), [105-2](#)
 - to Proceed, [108-1](#)
- Notification of Changed Conditions and Dispute Resolution, [110-1](#)
 - Administrative Process for Dispute Resolution, [110-2](#)
 - Arbitration, [110-4](#)
 - Dispute Resolution, [110-1](#)
 - Dispute Review Board, [110-4](#)
 - Final Documentation, [110-5](#)
 - Initial Notification, [110-1](#)
- Notify
 - Inspection Section, [108-1](#)
 - Survey Section, [105-4](#), [108-1](#)
- Occupational Safety and Health Act, [107-1](#)
- Open Channels, Earthwork, [215-1](#)
- Open Trench, [601-3](#)
- Opening Sections to Traffic, [104-3](#), [108-2](#)
 - or Equal, Substitutions, [106-2](#)
- Overtime
 - Contractor, [108-2](#)

INDEX

- Paint, [790-1](#)
- Painting, [530-1](#)
 - Application, [530-1](#)
 - Surface Preparation, [530-2](#)
 - Testing, [530-3](#)
 - Weather Conditions, [530-1](#)
- Parkway Grading, [424-1](#)
- Partial Payments, [109-5](#)
- Partial Use or Occupancy, [105-6](#)
- Patented Devices, Materials and Processes, [107-1](#)
- Pavement
 - Asphalt Concrete, [321-1](#), [711-1](#)
 - Decorative, [342-1](#)
 - Exposed Aggregate [343-1](#)
 - Geosynthetics, [796-1](#)
 - Portland Cement Concrete, [324-1](#)
 - Replacement, [603-2](#)
 - Sewer Line, [615-4](#)
- Pavement Matching and Surfacing Replacement, [336-1](#)
- Paving Asphalt, [711-1](#)
 - Temperatures, [711-1](#)
 - Test Report and Certification, [711-2](#)
- Payments
 - Actual Cost Work, [109-3](#)
 - Assignments, [109-2](#)
 - Final, [109-6](#)
 - for Delay, [109-7](#)
 - Improvement District Projects, [109-5](#)
 - Mobilization/Demobilization, [109-7](#)
 - Partial, [109-5](#)
 - Scope of, [109-1](#)
- Permits, [107-1](#)
- Pilot Cars or Flagman, [401-1](#)
- Pipe
 - Cast-in-Place Curing and Backfill, [620-2](#)
- Pipe Installation for
 - Sewer Lines, [615-1](#)
 - Sprinkler Irrigation System, [440-2](#)
 - Storm Sewers, [618-1](#)
 - Subdrainage, [605-1](#)
 - Water Lines, [610-1](#)
- Placement and Construction of Aggregate Base
 - Course, [310-1](#)
- Placement and Construction of Asphalt Concrete Pavement, [321-1](#)
 - Acceptance, [321-6](#)
 - Application of Tack Coat, [321-1](#)
 - Materials and Manufacture, [321-1](#)
 - Measurement, [321-12](#)
 - Mix Design, [321-1](#)
 - Mix Production, [321-2](#)
 - Placement, [321-3](#)
 - Quality Control, [321-6](#)
 - Referee, [321-12](#)
 - Transportation, [321-3](#)
 - Weather and Moisture Conditions, [321-1](#)
- Placement and Construction of Asphalt Emulsion Slurry Seal Coat, [332-1](#)
 - Equipment, [332-1](#)
 - Mixing and Application, [332-2](#)
 - Preparation of the Surface, [332-1](#)
 - Protection of Uncured Surface, [332-2](#)
 - Rolling, [332-2](#)
 - Weather Limitations, [332-2](#)
- Placement and Construction of Asphalt-Rubber Asphalt Concrete, [325-1](#)
 - Acceptance, [325-5](#)
 - Application of Tack Coat, [325-2](#)
 - Materials, [325-1](#)
 - Mix Production, [325-2](#)
 - Placement, [325-3](#)
 - Quality Control, [325-4](#)
 - Transportation, [325-3](#)
 - Weather and Moisture Conditions, [325-1](#)
- Placement, Construction. of Cement Treated Subgrade, [311-1](#)
 - Construction Methods, [311-1](#)
 - Equipment, [311-1](#)
 - Materials, [311-1](#)
- Placement, Construct.of Hot Asphalt-Rubber Seal, [335-1](#)
 - Construction, [335-1](#)
 - Equipment, [335-1](#)
 - Materials, [335-1](#)
 - Measurement, [335-2](#)
 - Mixing, [335-1](#)
- Placement of Controlled Low Strength Material, [604-1](#)
- Plans
- Materials [604-1](#)
- Performance Testing [604-2](#)
- Placement [604-1](#)
- Planting
 - and Landscaping, [430-1](#)
- Pneumatically Placed Mortar, [525-1](#)
 - Curing, [525-2](#)
 - Dry Mix Process, [525-1](#)
 - Equipment, [525-2](#)
 - Finishing, [525-2](#)
 - Forms and Ground Wires, [525-2](#)
 - Joints, [525-2](#)
 - Reinforcing Steel, [525-1](#)
 - Surface Preparation, [525-2](#)
 - Testing, [525-2](#)
 - Wet Process, [525-1](#)
- Polyethylene Pipe
 - High Density, [603-1](#), [738-1](#)
 - Installing, [603-2](#)
- Polypropylene Pipe & Fittings for Gravity Storm Drain & Sanitary Sewer, [740-1](#)
- Polypropylene Pipe and Fittings for Storm Drain,

INDEX

- Irrigation and Sanitary Sewer, [740-1](#)
- Polyethylene Pipe for Water Distribution, [755-1](#)
- Portland Cement Concrete Street Pavement, [324-1](#)
- Portland Cement Concrete, [725-1](#)
 - Pavement, [324-1](#)
- Portland Cement Treated Base, [705-1](#)
- Power of Attorney, [103-2](#)
- Precast Prestressed Concrete Members, [506-1](#)
 - Anchorage and Distribution, [506-3](#)
 - Bonding and Grouting, [506-5](#)
 - Concrete, [506-1](#)
 - Enclosures, [506-3](#)
 - Handling, [506-6](#)
 - Prestressing, [506-4](#)
 - Prestressing Steel, [506-2](#)
 - Samples for Testing, [506-5](#)
- Precast Safety Curbs, [410-1](#)
- Precoated Chip Seal
 - Asphalt Grade, [330-2](#)
 - Construction Methods, [330-1](#)
 - Temperatures, [330-2](#)
- Preservative Seal for Asphalt Concrete [334-1](#), [718-1](#)
- Preservatives
- Prime Coat, [756-1](#)
 - Wood, [779-1](#)
- Property and Landscape Protection and Restoration, [107-3](#)
- Property Marks and Monuments, [107-3](#)
- Proposal
 - Addenda, [102-2](#)
 - Consideration of, [103-1](#)
 - Disqualified Bidders [102-3](#)
 - Irregular, [102-2](#)
 - Preparation, [102-2](#)
 - Public Opening, [102-3](#)
 - Rejected, [102-2](#)
 - Revision of, [102-3](#)
 - Submission of, [102-3](#)
 - Successful Bidders [102-3](#)
 - Withdrawal of, [102-3](#)
- Proposal Guarantee
 - Amount, [103-2](#)
 - Forfeiture of, [102-2](#), [103-4](#)
 - Return of, [103-1](#)
- Public
 - Convenience, [107-2](#)
 - Property, [107-1](#)
 - Safety, [107-2](#)
- Public Officials
 - Personal Liability of, [107-5](#)
- PVC Sewer Pipe and Fittings, [745-1](#)
- Quantities
 - in Proposal, [102-1](#)
 - Increase or Decrease, [109-3](#)
 - Measurement of, [109-1](#)
- Payment, [109-5](#)
- Reclaimed Water Line Construction, [616-1](#)
 - Above Ground Pipe, [616-2](#)
 - Below Ground Pipe, [616-2](#)
 - Identification, [616-1](#)
 - Installation, [616-1](#)
 - Valve and Manhole Covers, [616-3](#)
 - Valves and Risers, [616-2](#)
- Reinforced Concrete Pipe, [735-1](#)
 - Acceptance Mark, [735-4](#)
 - Curing of Pipe, [735-2](#)
 - Curves, Bends and Closures, [735-1](#)
 - Downgrading of Pipe, [735-4](#)
 - Manufacturer's Qualifications, Equipment Require., [735-2](#)
 - Materials, [735-1](#)
 - Quality, [735-1](#)
 - Sanitary Sewer Pipe, [735-4](#)
 - Tests and Acceptance, [735-2](#)
- Reinforcing Steel, [727-1](#)
- Rejected Materials, [106-1](#)
- Removal of
 - Defective Materials, [105-5](#)
 - Salvage Items, [201-2](#)
 - Unacceptable Work, [105-5](#)
 - Unauthorized Work, [105-5](#)
- Removal of Existing Improvements, [350-1](#)
- Rental Equipment, [109-2](#)
- Reports
 - Archaeological, [107-1](#)
 - Blasting Survey, [107-3](#)
 - Extra Work, [109-3](#)
 - Final Payments, [109-6](#)
 - Partial Payments, [109-5](#)
 - Site Conditions, [109-3](#)
- Responsibility, Contractor's, [107-5](#)
- Retaining Walls, [505-1](#)
- Revision of Proposal, [102-3](#)
- Right-of-Way
 - and Traffic Control, [401-1](#)
 - Railroad, [105-3](#)
- Riprap, [703-1](#)
 - Riprap Construction, [220-1](#)
 - Rivets, [770-1](#)
- Road-Mixed Surfacing, [320-1](#)
 - Application of Liquid Asphalt, [320-1](#)
 - Materials, [320-1](#)
 - Mixing, [320-1](#)
 - Prime Coat, [320-1](#)
 - Spreading Aggregate, [320-1](#)
 - Spreading and Compaction, [320-2](#)
- Roadway Excavation, [205-1](#)
 - Overshooting, [205-1](#)
 - Slides and Slipouts, [205-1](#)
 - Slopes, [205-1](#)
 - Surplus Material, [205-2](#)

INDEX

- Unsuitable Material, [205-2](#)
- Roadway, Failure to Maintain, [105-5](#)
- Rolling, Pavements
 - Chip Seal, [330-2](#)
 - Temporary, [336-2](#)
- Rubber, Asphalt, [717-1](#)
- Rubber Gaskets, [735-2](#), [736-1](#), [738-1](#), [745-1](#)
- Safety and Public Convenience, [107-2](#)
 - Curbs, [410-1](#)
 - Employees, [107-1](#)
 - for Workman, [105-1](#)
 - Health and Sanitation, [107-1](#)
 - OSHA, [336-3](#)
 - Public, [107-2](#)
- Samples and Tests of Material, [106-1](#)
- Sand, [324-1](#), [333-1](#), [342-1](#), [342-2](#)
- Sanitary Conditions, [107-1](#)
- Sanitary Sewer
 - Fittings for, [738-2](#)
- Saw Cut
 - Pavement, [336-1](#)
 - Portland Cement Concrete, [324-1](#)
- Schedule, Construction, [108-1](#)
- Scope of Work, [104-1](#)
- Seal Coats
 - Fog, [333-1](#)
- Sewer Line Construction, [615-1](#)
 - Air Test, [615-3](#)
 - Exfiltration Testing, [615-3](#)
 - Fittings, [615-2](#)
 - Jointing, [615-2](#)
 - Laying Pipe, [615-1](#)
 - Sanitary Sewer Cleanouts, [615-2](#)
 - Sanitary Sewer Service Taps, [615-2](#)
 - Separation, [615-1](#)
 - Testing, [615-2](#)
 - Trenching, [615-1](#)
- Sewer Connections, [625-1](#)
- Sewer Pipe
 - Fittings for, [745-1](#)
- Shop Drawings
 - Approved by, [105-1](#)
 - Cost of, [105-1](#)
- Sidewalk, [340-1](#)
- Signs
 - Barricades and Warning, [107-2](#)
 - Blasting Operations, [107-3](#)
- Site of Work
 - Clean up, [104-2](#)
 - Examination, [102-1](#)
- Slurry Seal Materials, [715-1](#)
- Source of Materials and Quality, [106-1](#)
- Specifications
 - Conformity with, [105-2](#)
 - Coordination with, [105-2](#)
 - Examination, [102-1](#)
- Sprinkler Irrigation System, [757-1](#)
- Sprinkler Irrigation System Installation, [440-1](#)
- Stakes, Construction, [105-4](#)
- State Inspector of Weights, [109-1](#)
- Steel and Aluminum Handrails, [520-1](#)
- Steel Pipe, [759-1](#)
- Steel Plates for Street Crossings, [601-3](#)
- Steel Reinforced Polyethylene Pipe and Fittings for Storm Drain, Irrigation and Sanitary Sewer, [739-1](#)
- Steel Reinforcement, [727-1](#)
 - Wire Mesh Reinforcement, [727-1](#)
 - Wire Reinforcement, [727-1](#)
 - Wire Ties, [727-1](#)
- Steel Structures, [515-1](#)
 - Buildings, [515-1](#)
 - Computed Weights, [515-2](#)
 - Painting, [515-3](#)
 - Workmanship, [515-2](#)
- Stone
 - Concrete Paving, [342-1](#)
- Storage of
 - Equipment, [106-2](#)
 - Explosive, [107-3](#)
 - Materials, [106-2](#)
 - Paid Materials, [109-6](#)
- Storm Drain
 - Fittings for, [738-1](#)
- Storm Drain Construction, [618-1](#)
 - Construction Methods, [618-1](#)
 - Jacking Pipe, [618-2](#)
 - Video Inspection of New Mainline Storm Drains, [618-3](#)
- Structural and Rivet Steel, Rivets, Bolts, Pins, and Anchor Bolts, [770-1](#)
- Structural Plate Pipe, Arches, and Pipe Arches, [761-1](#)
- Structure Excavation and Backfill, [206-1](#)
 - Foundation Material Treatment, [206-1](#)
 - Inspection, [206-1](#)
- Structure, Failure to Maintain, [105-5](#)
- Structures
 - Concrete, [505-1](#)
 - Steel, [515-1](#)
- Subcontractor's
 - List of, When Required, [102-2](#)
- Subcontractor's
 - Eligibility and Preference, [102-1](#)
 - Employment of Labor, [108-1](#)
 - Insurance, [103-2](#)
 - Personnel, [108-2](#)
- Subcontracts
 - Approval of, [108-1](#)
 - in Accordance With, [108-1](#)
 - Liability, [108-1](#)
- Subdrainage, [605-1](#)
 - Filter Material, [605-1](#)

INDEX

- Pipe, [605-1](#)
- Placement, [605-2](#)
- Tests, [605-2](#)
- Subgrade Preparation, [301-1](#)
 - Curbs, Drive., Gutters, Sidewalks, Sidewalk Ramps, [340-1](#)
 - Grading of Areas Not to Be Paved, [301-2](#)
 - Preparation, [301-1](#)
 - Protection of Existing Facilities, [301-2](#)
 - Relative Compaction, [301-1](#)
 - Tolerances, [301-1](#)
- Substitutions, [106-2](#)
- Surety, Power of Attorney, [103-2](#)
- Survey
 - Monuments, [405-1](#)
 - Section to be Notified, [108-1](#)
- Suspend the Work, [104-2](#), [105-1](#), [108-3](#)
- Tack Coat, [329-1](#)
 - Equipment, [329-1](#)
 - Preparation of Surface, [329-1](#)
 - Protection for Adjacent Property, [329-1](#), [333-2](#)
- Tapping Sleeves and Valves and Valve Boxes on Water Lines, [630-1](#)
 - Air Release and Vacuum Valves, [630-7](#)
 - Butterfly Valves, [630-5](#)
 - Gate Valves, [630-1](#)
- Telecommunications Installation, [360-1](#)
 - Cable Installation, [360-1](#)
 - Cable Locating (Fiber Optic), [360-1](#)
- Temperatures
 - Asphalt, Paving, [711-1](#)
 - Emulsified Asphalts, [330-2](#)
 - Expansion Joint Filler, [729-1](#)
 - Liquid Asphalts, [330-2](#)
- Temporary Pavement Replacement, [336-2](#)
- Termination of Contract, [108-5](#)
- Testing
 - ABS Trust Pipe and Fittings, [744-2](#)
 - Asbestos-Cement Pipe, [737-2](#), [752-1](#)
 - Asphalt Pavement Core Bonding Material, [708-1](#)
 - Cast-in-Place Concrete Pipe, [620-3](#)
 - Concrete Block Masonry, [776-2](#)
 - Controlled Low Strength Material, [604-2](#)
 - Dust Palliative Performance, [792-3](#)
 - Fill Construction, [211-2](#)
 - Final Flushing Water Mains, [611-3](#)
 - Fog Seal Coats, [333-1](#)
 - Galvanized Materials, [771-1](#)
 - Geosynthetic, [796-3](#)
 - Gray Iron Castings, [787-1](#)
 - Holes, [601-6](#), [603-2](#)
 - Lining for Concrete Pipe, [741-3](#)
 - Liquid Asphalt, [712-1](#)
 - Microsurfacing Specifications, [331-2](#)
 - Non-Reinforced Concrete Pipe, [736-2](#)
 - Painting, [530-3](#)
 - Pavement Asphalts, [711-1](#)
 - Pneumatically Placed Mortar, [525-2](#)
 - Polyethylene Pipe, [755-1](#)
 - Precast Prestressed Concrete, [506-5](#)
 - Reinforced Concrete Pipe, [735-2](#)
 - Samples of Materials, [106-1](#)
 - Sewer Lines, [615-2](#)
 - Sprinkler Irrigation System, [440-4](#)
 - Subdrainage System, [605-2](#)
 - Vitrified Clay Pipe, [743-1](#)
 - Water Lines, [610-8](#)
 - Water Taps and Meter Service Connections, [631-2](#)
- Topsoils, [425-1](#), [795-1](#)
- Trade Names and Substitutions, [106-2](#)
- Traffic Control, [401-1](#)
 - Barricade Manual, [401-1](#)
 - Control Devices [401-1](#)
 - Control Measures, [401-1](#)
 - Flagmen or Pilot Cars, [401-1](#)
 - General Traffic Regulations, [401-1](#)
 - Maintenance, [430-2](#)
 - Tree and Shrub Planting, [430-2](#)
- Trench Excavation, Backfilling and Compaction, [601-1](#)
 - Contractor Certification of Installation
 - Procedures, [601-6](#)
 - Densities, [601-5](#)
 - Excavation, [601-1](#)
 - Foundation, Bedding, Backfilling and Compaction, [601-4](#)
 - Trench, [601-3](#)
 - Pavement Replacement, [601-7](#)
 - Protection of Existing Utilities, [601-3](#)
 - Surface Restoration, [601-7](#)
 - Trench Widths, [601-1](#)
 - Truss Pipe, [744-1](#)
- Trenchless Installation of Steel Casing, [602-1](#)
- Trenchless Installation of Smooth Wall Jacking Pipe, [607-1](#)
- Tunneled Steel Liner Plate, [602-1](#)
- Tunneling Operations, [602-2](#)
- Unacceptable
 - Materials, [106-3](#)
 - Work, [105-5](#)
- Uniformed Off-Duty Law Enforcement Officer, [401-1](#)
- Use or Occupy, [105-6](#)
- Utilities
 - Cooperation with, [105-3](#)
 - Moved by the Owners, [105-3](#)
 - Notify Before Blasting, [107-3](#)
 - Protection of, [107-3](#)
- Utility Potholes Keyhold Method, [355-1](#)
 - Backfill and Compaction, [355-1](#)
 - Deficiencies, [355-2](#)
 - Excavation, [355-1](#)

INDEX

- Pavement Restoration, [355-2](#)
- Surface Tolerances, [355-2](#)
- Valves
 - Air Release and Vacuum, [630-7](#)
 - Butterfly, [630-5](#)
 - Gate, [630-1](#)
 - Tapping, [630-2](#)
- Vitrified Clay Pipe, [743-1](#)
- Warranties, [108-3](#)
- Water Line Construction, [610-1](#)
 - Blocking, [610-8](#)
 - Cleanup, [610-9](#)
 - Connection to Existing Mains, [610-5](#)
 - Construction Methods, [610-1](#)
 - Couplings, Joints, Gaskets and Flanges, [610-7](#)
 - Disinfecting, [610-9](#)
 - Fire Hydrants, [610-5](#)
 - Fire Line Service Connections, [610-6](#)
 - Manholes and Vaults, [610-5](#)
 - Meter Service Connections, [610-6](#)
 - Polyethylene Corrosion Protection, [610-4](#)
 - Separation, [610-2](#)
 - Testing, [610-8](#)
 - Valve Boxes on Water Lines, [630-1](#)
 - Valves, [610-5](#)
- Water Taps and Meter Service Connections, [631-1](#)
- Weather
 - Asphalt Chip Seal Coat, [330-1](#)
 - Concrete Structures, [505-7](#)
 - Dust Palliative, [230-3](#)
 - Fog Seal Coat, [333-1](#)
 - Microsurfacing Specifications, [331-4](#)
 - Painting, [530-1](#)
- Weighmaster's Certificate, [109-1](#)
- Wire Reinforcement, [727-1](#)
- Withholding Assignments, [109-2](#)
- Wood Preservatives, [779-1](#)
 - Field Treatment of Cut Surfaces, [779-1](#)
 - Oil Type Preservative Treatment, [779-1](#)
 - Water Borne Salt Preservatives Treatment, [779-1](#)
- Work
 - Actual Cost, [109-3](#)
 - Alteration of, [104-2](#)
 - Compensation for Alteration, [109-2](#)
 - Contractor's Responsibility, [107-4](#)
 - Control of work, [105-1](#)
- Emergency [104-1](#)
 - Extra, [104-3](#)
 - Final Acceptance, [105-5](#)
 - Hours, [109-5](#)
 - Inspection of, [105-5](#)
 - Overtime, [108-2](#)
 - Rejected, [106-2](#)
 - Scope of, [104-1](#)
 - Suspension of, [104-2](#),
to be Done, [104-1](#)
 - Unacceptable, [105-5](#)
 - Unauthorized, [105-5](#)
 - Weekend or Holiday, [108-2](#), [108-3](#)
- Workmen
 - Character of, [108-2](#)
 - Compensation Insurance, [103-3](#)
 - Safety, [105-1](#)
 - Suspend [105-1](#)

This Page is Reserved for Future Use

UNIFORM STANDARD DETAILS

for

PUBLIC WORKS CONSTRUCTION

SPONSORED and DISTRIBUTED
by the



2015 EDITION

~~ARIZONA~~ ARIZONA

100 SERIES: GENERAL INFORMATION

Detail	Revised	Title
101	2011	GENERAL INFORMATION
110-1	2011	PLAN SYMBOLS (SYMBOLS)
110-2	2011	PLAN SYMBOLS (LINE TYPES)
112	1998	DIMENSIONING FOR ROAD IMPROVEMENT PLANS
120	2015 *	SURVEY MARKER
122	2011	PAVEMENT MARKER FOR FIRE HYDRANTS
130	2003	BARRICADES
131	1998	STREET SIGN BASE
140	2009	BOLLARD
141	2009	HAZARD MARKER
145	2011	SAFETY RAIL
150	1998	PRECAST SAFETY CURB
160	2013	6' CHAIN LINK FENCE AND GATE

200 SERIES: STREET INFORMATION

Detail	Revised	Title
200-1	2015 *	BACKFILL, PAVEMENT AND SURFACE REPLACEMENT
200-2	2015 *	BACKFILL, PAVEMENT AND SURFACE REPLACEMENT
201	2014	ASPHALT PAVEMENT EDGE DETAILS
202	1998	ALLEY DETAILS (PAVED AND UNPAVED)
203	1998	SCUPPERS
204	1998	EQUIPMENT CROSSING
205	2006	PAVED TURNOUTS
206-1	2007	CONCRETE SCUPPER
206-2	2007	CONCRETE SCUPPER
206-3	2007	CONCRETE SCUPPER (ISOMETRIC VIEW)
210	2012	RESIDENTIAL SPEED HUMP
211	1998	STANDARD TRENCH PLATING DETAIL
212	2015 *	UTILITY POTHOLE REPAIR
220-1	2007	CURB AND GUTTER TYPES A, B, C AND D
220-2	2007	CURB AND GUTTER TYPES E AND F
221	2014	CURB AND GUTTER TRANSITION TYPE A TO TYPE C, INTEGRAL ROLL CURB, GUTTER AND SIDEWALK
222	2008	SINGLE CURB - TYPES A, B AND TERMINATION
223	1998	MEDIAN NOSE TRANSITION
224	1998	JOINT FOR DRAINAGE INLETS AND MANHOLE COVERS
225	2005	CONCRETE PAVERS
230	2014	SIDEWALKS
234	2012	CURB MODIFICATION AT DETECTABLE WARNING
235-1	2012	CURB RAMPS (TYPE A)
235-2	2012	CURB RAMPS (TYPE B)
235-3	2012	CURB RAMPS (TYPE C)
235-4	2011	CURB RAMPS (TYPE D)
235-5	2011	CURB RAMPS (TYPE E)

200 SERIES: STREET INFORMATION (CONTINUED)

Detail	Revised	Title
240	2010	VALLEY GUTTER
250-1	2014	DRIVEWAY ENTRANCES WITH DETACHED SIDEWALK
250-2	2013	DRIVEWAY ENTRANCES WITH SIDEWALK ATTACHED TO CURB
251	2003	RETURN TYPE DRIVEWAYS
252	2005	BUS BAYS
260	2013	ALLEY ENTRANCE (WITH VERTICAL CURB AND GUTTER)
262	2012	WING TYPE ALLEY ENTRANCE (WITH COMBINED CURB AND GUTTER)
263	2002	WING TYPE ALLEY ENTRANCE (WITH ROLL TYPE CURB AND GUTTER)
270	2014	FRAME AND COVER (AND GRADE ADJUSTMENTS)

300 SERIES: WATER INFORMATION

Detail	Revised	Title
301	1998	BLOCKING FOR WATER GATE AND BUTTERFLY VALVES
302-1	1998	JOINT RESTRAINT WITH TIE RODS (DRAWING)
302-2	1998	JOINT RESTRAINT WITH TIE RODS (NOTES)
303-1	1998	JOINT RESTRAINT FOR DUCTILE IRON AND POLYETHYLENE WRAPPED DUCTILE IRON WATER PIPES (DRAWING)
303-2	1998	JOINT RESTRAINT FOR DUCTILE IRON AND POLYETHYLENE WRAPPED DUCTILE IRON WATER PIPES (TABLES)
310	1998	CAST IRON WATER METER BOX COVER NO. 1
311	1998	CAST IRON WATER METER BOX COVER NO. 2
312	1998	CAST IRON WATER METER BOX COVER NO. 3
313	1998	CAST IRON WATER METER BOX COVER NO. 4
314	1998	CAST IRON WATER METER BOX COVER NO. 5
320	1998	CONCRETE WATER METER BOXES
321	1998	STANDARD WATER METER VAULT
340	2002	INSTALLING TAPPING SLEEVES AND VALVES
342	1998	CONCRETE PRESSURE PIPE TAPPING SLEEVE
345-1	1998	3", 4", 6" WATER METER
345-2	1998	4", 6" WATER METER WITH ON-SITE HYDRANTS
346	1998	FIRE LINE DETECTOR CHECK VAULT
360-1	2013	DRY BARREL FIRE HYDRANT INSTALLATION
360-2	2013	WET BARREL FIRE HYDRANT INSTALLATION
360-3	2013	FIRE HYDRANT INSTALLATION DETAILS
362	1999	LOCATIONS FOR NEW FIRE HYDRANTS
370	1998	VERTICAL REALIGNMENT OF WATER MAINS
380	1998	THRUST BLOCKS FOR WATER LINES
381	1998	ANCHOR BLOCKS FOR VERTICAL BENDS
389	2001	CURB STOP WITH VALVE BOX AND COVER
390	1998	CURB STOP WITH FLUSHING PIPE
391-1	2015 *	VALVE BOX INSTALLATION AND GRADE ADJUSTMENT
391-2	2015 *	VALVE BOX INSTALLATION AND GRADE ADJUSTMENT
392	2015 *	DEBRIS CAP INSTALLATION

* NEWLY REVISED.

DETAIL NO.

100-1STANDARD DETAIL
ENGLISH**INDEX (PAGE 1 OF 2)**

REVISED

01-01-2015

DETAIL NO.

100-1

400 SERIES: SEWER INFORMATION

Detail	Revised	Title
403-1	1998	PIPE SUPPORT ACROSS TRENCHES
403-2	1998	PIPE SUPPORT ACROSS TRENCHES
403-3	1998	ALTERNATIVE TO PIPE SUPPORT
404-1	2006	WATER AND SANITARY SEWER SEPARATION/PROTECTION
404-2	2006	WATER AND SANITARY SEWER SEPARATION/PROTECTION
404-3	2006	WATER AND SANITARY SEWER SEPARATION/PROTECTION
405	1998	BROKEN SEWER LINE REPLACEMENT
420-1	2015 *	CONCRETE SANITARY SEWER MANHOLE
420-2	2015 *	PRE-CAST CONCRETE MANHOLE BASE
420-3	2015 *	CONCRETE MANHOLE BASE
421	2015 *	OFFSET MANHOLE 8" TO 30" PIPE
422	2015 *	MANHOLE FRAME AND COVER ADJUSTMENT
423-1	2012	24" CAST IRON MANHOLE FRAME AND COVER
423-2	2012	30" CAST IRON MANHOLE FRAME AND COVER
424-1	2012	24" CAST IRON WATERTIGHT MANHOLE FRAME AND COVER
424-2	2012	30" CAST IRON WATERTIGHT MANHOLE FRAME AND COVER
425	1998	24" ALUMINUM MANHOLE FRAME AND COVER
426	2007	DROP SEWER CONNECTIONS
427	1998	STUB OUT AND PLUGS
429	2015 *	INDUSTRIAL WASTE CONTROL VAULT WITH MANHOLE
440-1	2007	TYPE 'A' SEWER BUILDING CONNECTION - ELECTRONIC BALL MARKERS (STANDARD)
440-2	2007	TYPE 'B' SEWER BUILDING CONNECTION - TWO-WAY CLEANOUT AND METER BOX AT R/W
440-3	2007	TYPE 'C' SEWER BUILDING CONNECTION - ONE-WAY CLEANOUT AND METER BOX
440-4	2006	SEWER SERVICE CURB CROSSING STAMP DETAIL
441	2001	SEWER CLEANOUT

500 SERIES: IRRIGATION AND STORM DRAIN INFORMATION

Detail	Revised	Title
501-1	2012	HEADWALL
501-2	2012	HEADWALL
501-3	1998	HEADWALL 42" TO 84" PIPE
501-4	1998	HEADWALL IRRIGATION 18" TO 60" PIPE
501-5	2014	HEADWALL DROP INLET
502-1	1998	TRASH RACK
502-2	2004	TRASH RACK
503	1998	IRRIGATION STANDPIPE
504	1998	CONCRETE BLOCK JUNCTION BOX
505	1998	CONCRETE PIPE COLLAR
506	1998	IRRIGATION VALVE INSTALLATION
507	1998	ENCASED CONCRETE PIPE (FOR SHALLOW INSTALLATION)
510	1998	CORRUGATED METAL PIPE AND INSTALLATION

500 SERIES: IRRIGATION AND STORM DRAIN INFORMATION (CONTINUED)

Detail	Revised	Title
520	1998	STORM DRAIN MANHOLE BASE (48" AND SMALLER)
521	1998	STORM DRAIN MANHOLE BASE (51" OR LARGER)
522	2015 *	STORM DRAIN MANHOLE SHAFT
523-1	1998	PRESSURE MANHOLE
523-2	1998	PRESSURE MANHOLE
524	1998	STORM DRAIN LATERAL PIPE CONNECTIONS
530	1998	3'-6" CURB OPENING CATCH BASIN - TYPE 'A'
531	1998	5'-6" CURB OPENING CATCH BASIN - TYPE 'B'
532	1998	8'-0" CURB OPENING CATCH BASIN - TYPE 'C'
533-1	1998	CATCH BASIN TYPE 'D'
533-2	1999	APRON FOR TYPE 'D' CATCH BASIN
533-3	2007	FRAME AND GRATE FOR TYPE 'D' CATCH BASIN
533-4	2007	7'-0" CURB OPENING CATCH BASIN TYPE 'D' - GRATE DETAILS
534-1	1998	CATCH BASIN TYPE 'E'
534-2	1998	CATCH BASIN TYPE 'E' (DETAILS)
534-3	1998	CATCH BASIN TYPE 'E' (DETAILS)
534-4	1998	CATCH BASIN TYPE 'E' (DETAILS)
534-5	1998	ALTERNATE GRATE STYLES, SUMP LOCATION
535	2009	CATCH BASIN TYPE 'F' (FOR USE WITHOUT CURB)
536-1	1999	COMMON DETAILS AND SECTIONS FOR CURB OPENING CATCH BASINS
536-2	1998	ALTERNATIVE COVER FOR CURB OPENING CATCH BASINS
537	2002	CATCH BASIN TYPE 'G'
538	1998	CATCH BASIN TYPE 'H'
539	1998	GRATES FOR CATCH BASINS, TYPE G AND H
540-1	1998	CATCH BASIN GRATES
540-2	1998	CATCH BASIN GRATES
541	2005	CATCH BASIN SUBGRADE DRAIN
545	1998	END SECTION - REINFORCED CONCRETE PIPE
550	1998	SPILLWAY INLET AND OUTLET
552	2015 *	FORD CROSSING WITH CUT-OFF WALLS
555	2010	EROSION PROTECTION/GABIONS

* NEWLY REVISED.

DETAIL NO.

100-2STANDARD DETAIL
ENGLISH**INDEX (PAGE 2 OF 2)**

REVISED

01-01-2015

DETAIL NO.

100-2

1. THESE DETAILS HAVE BEEN PREPARED IN AN EFFORT TO STANDARDIZE THE CONSTRUCTION DETAILS USED BY VARIOUS CONTRACTING AGENCIES IN MARICOPA COUNTY. THEY ARE TO BE USED IN CONJUNCTION WITH THE CURRENT EDITION OF THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION" SPONSORED AND DISTRIBUTED BY THE MARICOPA ASSOCIATION OF GOVERNMENTS.
2. MANY NOTES WITHIN THESE DETAILS REFER TO VARIOUS SECTIONS OF THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION." WHERE THIS REFERENCE IS MADE, ONLY THE ABBREVIATION "SECT." IS USED. AN EXAMPLE OF THIS REFERENCE WOULD BE: "CLASS 'A' CONCRETE PER SECT. 725."
3. MANY NOTES WITHIN THESE DETAILS REFER TO OTHER DETAILS WITHIN THIS BOOK. WHERE THIS REFERENCE IS MADE, THE ABBREVIATION "DETAIL" IS USED. AN EXAMPLE OF THIS WOULD BE: "SEE DETAIL 391 FOR VALVE BOX INSTALLATION."
4. MANY DETAILS COVER MORE THAN ONE SHEET. THESE SHEETS HAVE BEEN GIVEN THE SAME NUMBER WITH A SUFFIX NUMBER, EXAMPLE: 391-1 AND 391-2.
5. AN EFFORT HAS BEEN MADE TO INCLUDE THE MOST COMMONLY USED CONSTRUCTION DETAILS IN THIS BOOK. ITEMS WHICH REQUIRE DESIGN CONSIDERATION BY THE DESIGNING ENGINEER HAVE NOT BEEN INCLUDED.
6. SOME OF THE DETAILS PRINTED HEREIN MAY BE USED BY SOME OF THE AGENCIES BUT NOT OTHERS. THE DESIGNING ENGINEER SHOULD THEREFORE CONTACT THE AGENCY WITHIN WHOSE JURISDICTION HE IS WORKING FOR DIRECTION AS TO WHICH DETAIL OR PORTIONS OF DETAILS SHOULD BE USED.
7. DETAIL DRAWINGS ARE NOT TO SCALE.

SEWER CLEANOUT



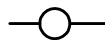
FIRE HYDRANT



WATER METER



UTILITY MANHOLE



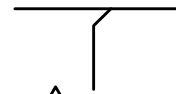
IRRIGATION STANDPIPE



UTILITY VALVE



SEWER SERVICE CONNECTION



MONITORING WELL



REDUCER



WOOD UTILITY POLE



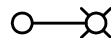
STEEL UTILITY POLE



CONCRETE UTILITY POLE



STREET LIGHT ON MAST ARM



POLE MOUNTED LIGHT



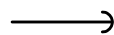
ELECTRIC, GAS METER



TRANSFORMER



DOWN GUY & ANCHOR



SURVEY MONUMENT



SURVEY MONUMENT IN HANDHOLE



MAIL BOX



SIGNAL POLE



SINGLE POST SIGN



DOUBLE POST SIGN



STREET NAME SIGN



VIDEO DETECTION CAMERA



PULL BOX



CELLULAR TOWER



BITUMINOUS (SECTION)



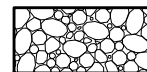
CONCRETE (SECTION)



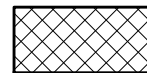
AGGREGATE BASE COURSE (SECTION)



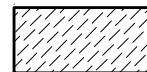
RIPRAP (PLAN & SECTION)



OBLITERATE PAVEMENT



TAPERED MILL



UNIFORM MILL



EARTH (SECTION)

**NOTES:**

1. PLAN SYMBOLS FOR EXISTING FEATURES ARE TO BE DASHED, GRAY SCALED, OR DRAWN USING THIN LINEWORK.
2. ADD LABELS TO PLAN SYMBOLS AS NEEDED FOR CLARITY.

DETAIL NO.

110-1

STANDARD DETAIL
ENGLISH

PLAN SYMBOLS

REVISED

01-01-2011

DETAIL NO.

110-1

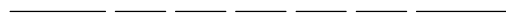
SECTION LINE



R/W



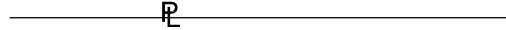
EASEMENT



PROPERTY LINE (OPTION 1)



PROPERTY LINE (OPTION 2)



JURISDICTIONAL BOUNDARY
(OPTION 1)



JURISDICTIONAL BOUNDARY
(OPTION 2)



ROADWAY CENTERLINE



UNDERGROUND ELECTRIC BURIED CABLE



UNDERGROUND ELECTRIC CONDUIT



UNDERGROUND ELECTRIC DUCT BANK



OVERHEAD ELECTRIC



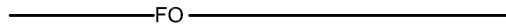
UNDERGROUND TELEPHONE LINE



OVERHEAD TELEPHONE LINE



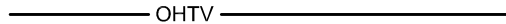
FIBER OPTIC



CABLE TELEVISION



OVERHEAD CABLE TELEVISION



TELEPHONE DUCT BANK



CHAIN LINK FENCE



BARBED WIRE FENCE



BLOCK WALL



WOOD FENCE



GAS LINE
(12" & SMALLER)



GAS LINE *
(GREATER THAN 12")



SEWER LINE
(12" & SMALLER)



SEWER LINE *
(GREATER THAN 12")



NEW STORM DRAIN PIPE *



STORM DRAIN *
(GREATER THAN 12")



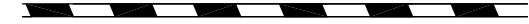
IRRIGATION LINE
(12" & SMALLER)



IRRIGATION LINE *
(GREATER THAN 12")



NEW IRRIGATION LINE *



WATER LINE
(12" & SMALLER)



WATER LINE *
(GREATER THAN 12")



* SCALE TO ACTUAL WIDTH

DETAIL NO.

110-2



STANDARD DETAIL
ENGLISH

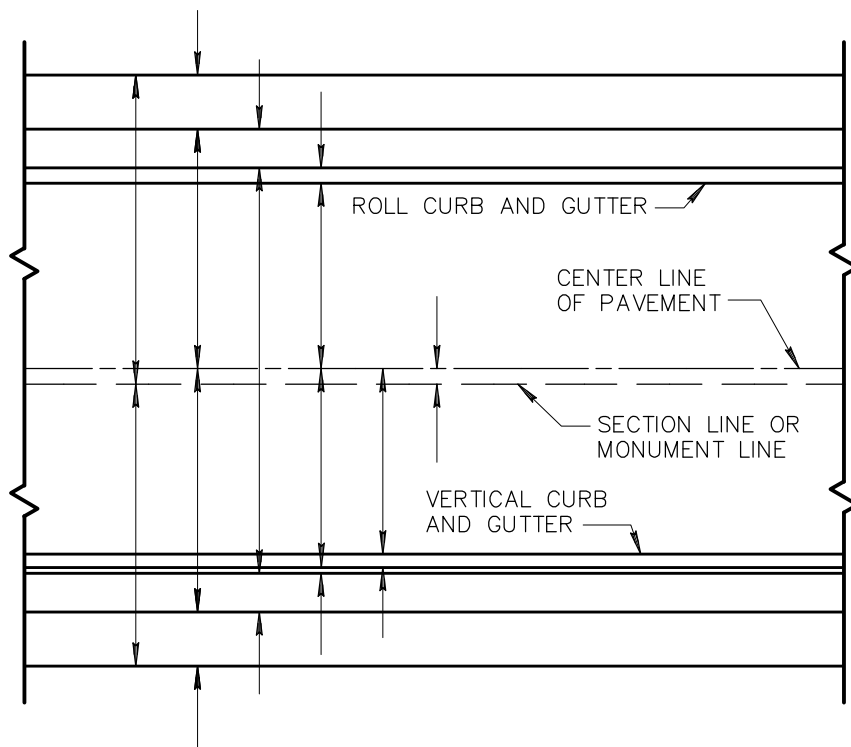
PLAN SYMBOLS

REVISED

01-01-2011

DETAIL NO.

110-2



DIMENSION SHOULD BE GIVEN ONCE ON EACH SHEET AND SHOULD BE PLACED NEAR THE CENTER OF THE SHEET. IF ANY OF THE GIVEN CONDITIONS CHANGE, THEY SHOULD BE REDIMENSIONED AT THE POINT OF CHANGE.

GIVEN DIMENSIONS IN ORDER STARTING WITH THE LONGEST AND ENDING WITH THE SHORTEST, AS SHOWN IN THE SKETCH.

GIVE COMPLETE DIMENSIONS.

IF THE CENTERLINE OF PAVEMENT DOES NOT FALL ON THE SECTION LINE OR MONUMENT LINE OF THE STREET, DIMENSION AS ABOVE AND SHOW THE DIFFERENCE BETWEEN THE SECTION OR MONUMENT LINE AND THE CENTERLINE.

DETAIL NO.

112



STANDARD DETAIL
ENGLISH

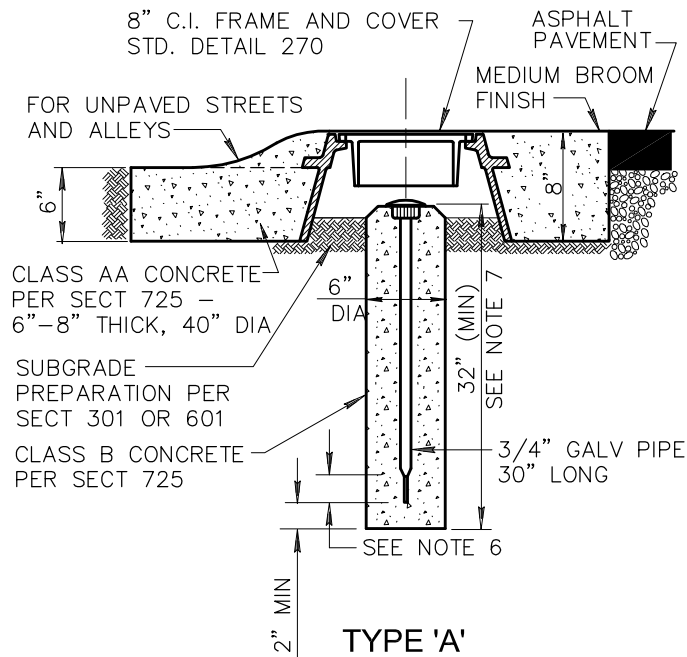
DIMENSIONING FOR ROAD IMPROVEMENT PLANS

REVISED

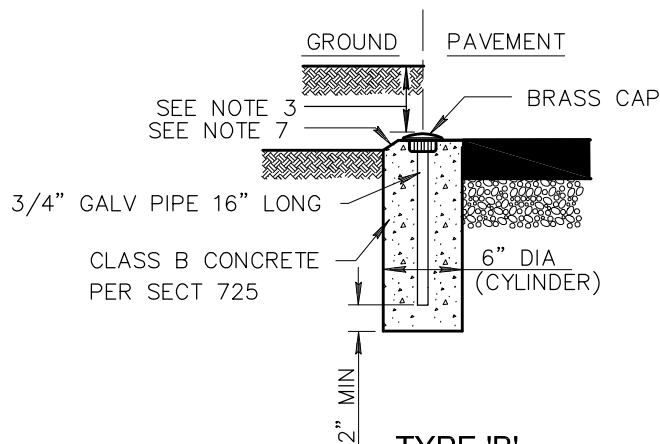
01-01-1998

DETAIL NO.

112



TYPE 'A'
(WITH FRAME)

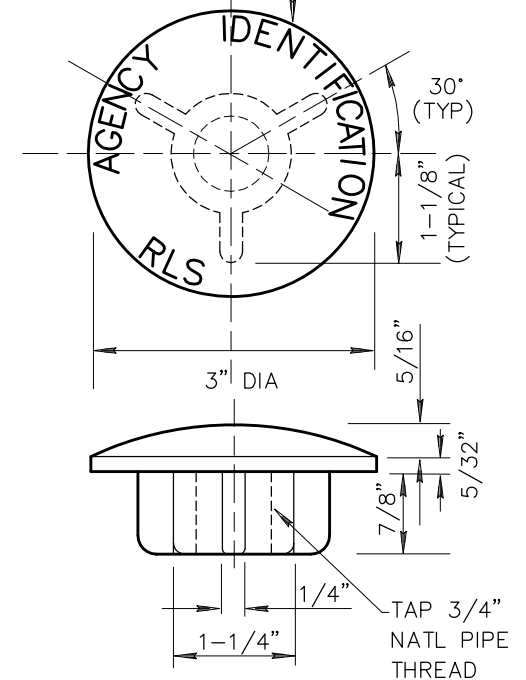


TYPE 'B'
(WITHOUT FRAME)

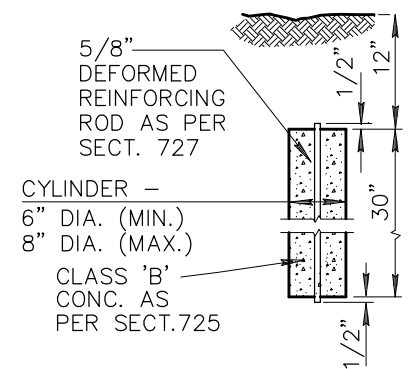
NOTES:

1. TYPE 'A' TO BE USED AT INTERSECTIONS OF MAJOR STREETS & COLLECTOR STREETS, SECTION CORNERS, SECTION 1/4 CORNERS, CENTER OF SECTIONS, AND AT OTHER POINTS AS SHOWN ON PLANS.
2. TYPE 'B' TO BE USED (EXCEPT WHERE TYPE 'A' IS SPECIFIED) AT INTERSECTION OF STREET CENTERLINES, PC'S, PT'S AND PI'S OF CURVES, SECTION 1/16 CORNERS, SUBDIVISION CORNERS, CHANGE IN ALIGNMENT OF SUBDIVISION BOUNDARIES, AND AT OTHER POINTS AS SHOWN ON PLANS.
3. FOR UNPAVED STREETS AND ALLEYS SET TOP OF MARKER SIX INCHES BELOW FINISHED GRADE.
4. CAP TO BE CONSTRUCTED OF RED BRASS OR BRONZE.
5. LETTERS TO BE APPROX. 1/32" WIDE & 1/32" DEEP.
6. FLATTENING THE BOTTOM 2" OF THE GALVANIZED PIPE IS OPTIONAL.
7. TOP OF CONCRETE POST IS CHAMFERED 3/4" EXCEPT WHEN SET FLUSH WITH PAVEMENT.
8. THE CAP SHALL SHOW THE POINT SURVEYED BY A PUNCH MARK OR SCRIBED CROSS AND THE CAP SHALL BE STAMPED WITH THE YEAR AND THE REGISTERED LAND SURVEYOR'S (RLS) REGISTRATION NUMBER.
9. WHEN APPLICABLE, THE CAP SHALL BE STAMPED WITH THE APPROPRIATE PUBLIC LAND MARKING PER CURRENT MANUAL OF INSTRUCTIONS FOR THE SURVEY OF PUBLIC LANDS OF THE UNITED STATES, PREPARED BY THE BUREAU OF LAND MANAGEMENT.
10. SUBMIT TO THE ENGINEER A COPY OF THE RECORDED CORNER RECORD OR RESULTS OF SURVEY TO DOCUMENT COMPLIANCE WITH THE ARIZONA BOARD OF TECHNICAL REGISTRATION REQUIREMENTS.

1/16" BORDER FROM
EDGE OF CAP TO TOP
OF 1/4" LETTERING.



CAP DETAIL



TYPE 'C'

DETAIL NO.

120



STANDARD DETAIL
ENGLISH

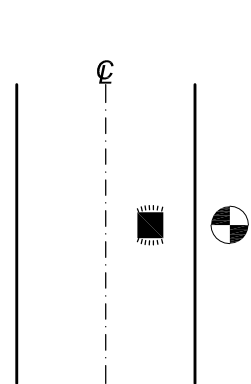
SURVEY MARKER

REVISED

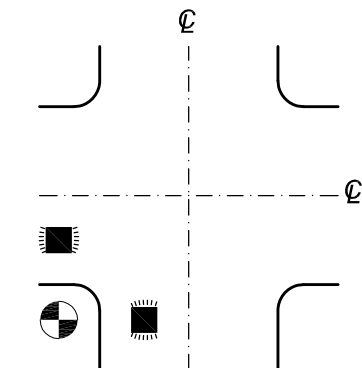
01-01-2015

DETAIL NO.

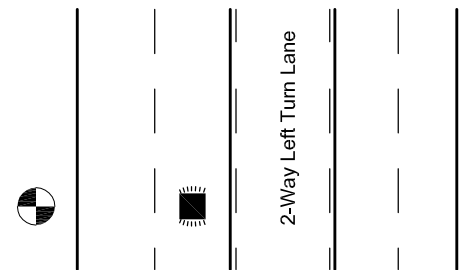
120



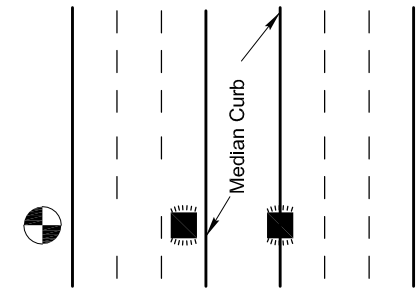
LOCAL STREET



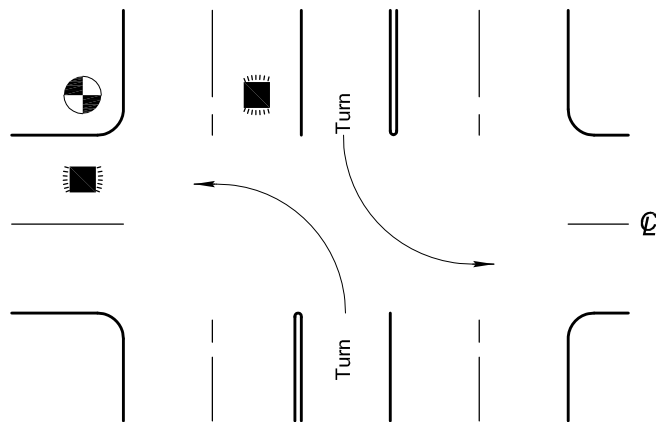
LOCAL CROSS
STREET INTERSECTION



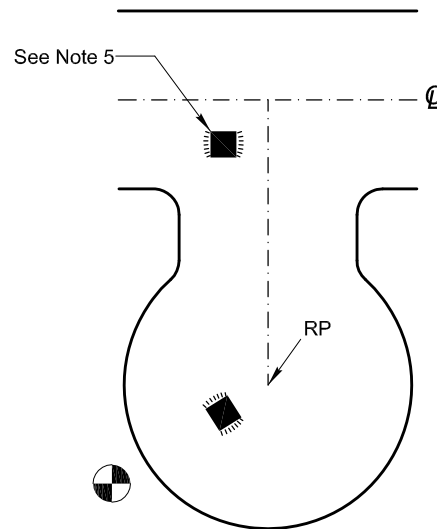
MULTI-LANE STREET
W/ TWO WAY LEFT TURN LANE



MULTI-LANE STREET
W/ RAISED MEDIAN



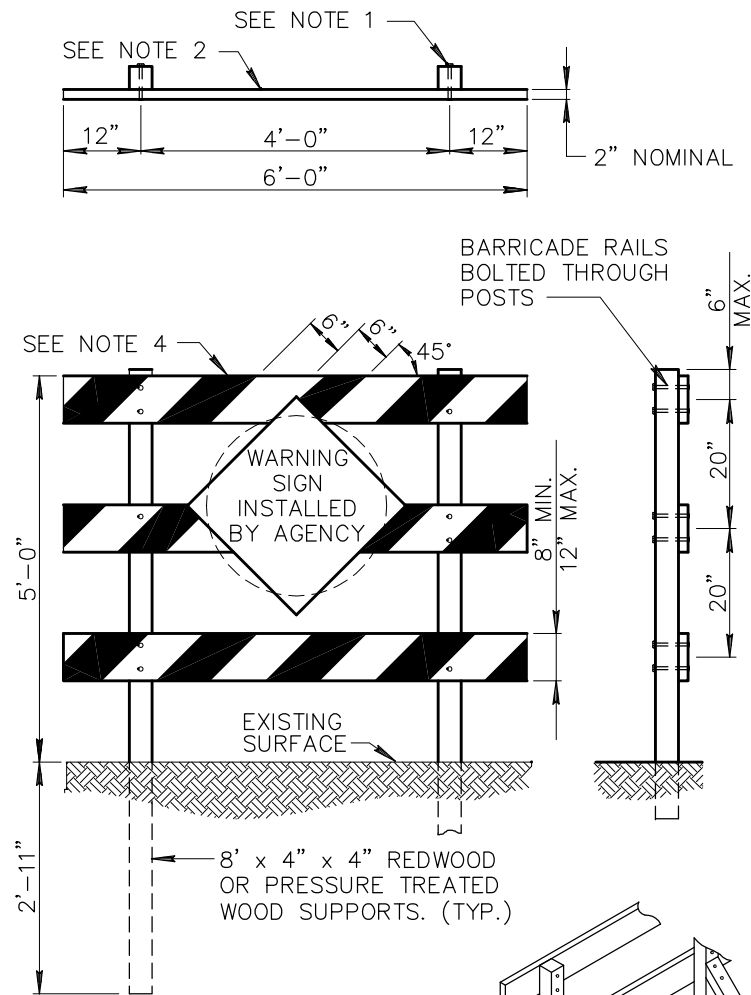
FOUR LANE STREET
WITH TURN LANE AT INTERSECTION



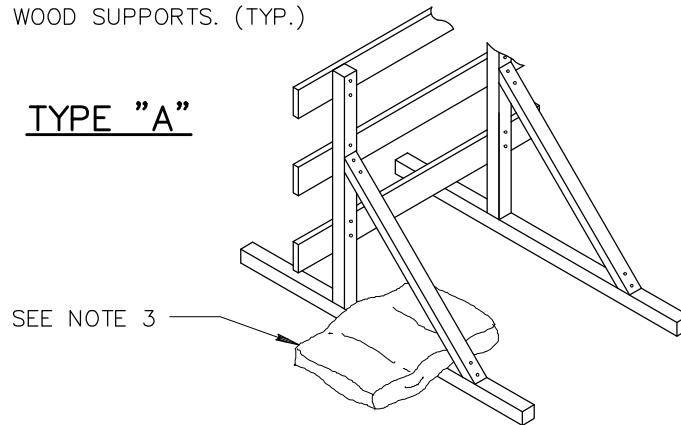
CUL-DE-SAC

NOTES:

1. LOCATE PAVEMENT MARKER IN CENTER OF TRAVEL LANE AND ALIGN WITH HYDRANT.
2. FOR MULTIPLE LANE ROADS LOCATE PAVEMENT MARKER IN LEFT MOST THROUGH TRAFFIC LANE.
3. ADJUST MARKER LOCATION TO BE LOCATED OUTSIDE OF ANY DELINEATED CROSSWALK AREA.
4. FOR HYDRANT LOCATED ON FAR SIDE OF RAISED MEDIAN, LOCATE PAVEMENT MARKER ON TOP OF MEDIAN CURB ALIGNED WITH HYDRANT.
5. OMIT FOR CUL-DE-SAC GREATER THAN 250' IN LENGTH.
6. FIRE HYDRANT PAVEMENT MARKERS SHALL BE 2-WAY RETROREFLECTIVE BLUE: ADOT TYPE BB, 911A-BLUE BY FIRE LITE AMERACE CORPORATION, OR APPROVED EQUAL.



TYPE "A"



TYPE "B"

NOTES:

1. FASTEN WITH 1/2" x 5" LAG SCREWS WITH 2 FLAT WASHERS OR (2) 5/8" BOLTS, WITH 4 FLAT WASHERS.
2. 2" x 8" DOUGLAS FIR PLANK (LENGTH TO BE DETERMINED ON PLANS.)
3. WHEN BARRICADE (TYPE "A") IS CONSTRUCTED ON BASES INSTEAD OF POSTS SET INTO THE GROUND, IT MAY BE DESIRABLE TO BALLAST THE BASES WITH SAND BAGS OR BY STAKING TO PROVIDE RESISTANCE TO OVERTURNING DURING PERIODS OF HIGH WINDS.
4. TWO COATS OF WHITE PAINT PER SECTION 790 SHALL BE APPLIED TO ALL EXPOSED SURFACES OF THE BARRICADE. AN ADDITIONAL TWO COATS OF ORANGE PAINT PER SECTION 790 SHALL BE APPLIED TO CREATE THE ALTERNATE ORANGE AND WHITE STRIPES FOR TEMPORARY BARRICADES AND TWO COATS OF RED PAINT PER SECTION 790 SHALL BE APPLIED TO CREATE ALTERNATE RED AND WHITE STRIPES FOR PERMANENT BARRICADES. HIGHWAY SAFETY SPHERES (BEADS) PER ADOT 708-2.02 SHALL BE APPLIED BY HAND TO ALL CROSS MEMBERS, FRONT AND BACK AND ON BOTH COLORS, IMMEDIATELY AFTER PAINTING. THE STRIPES SHALL SLOPE DOWNWARD IN THE DIRECTION TRAFFIC IS TO PASS.

FLANGED STEEL 'U'
CHANNEL (2 LBS. OR 3 LBS.
PER SQUARE FOOT
AS SPECIFIED)

2-1/2" DIA. STANDARD
PIPE GALVANIZED OR
2-3/8" O.D. STANDARD
PIPE GALVANIZED
(AS SPECIFIED)

2" DIA.
STANDARD PIPE
GALVANIZED

NOTES

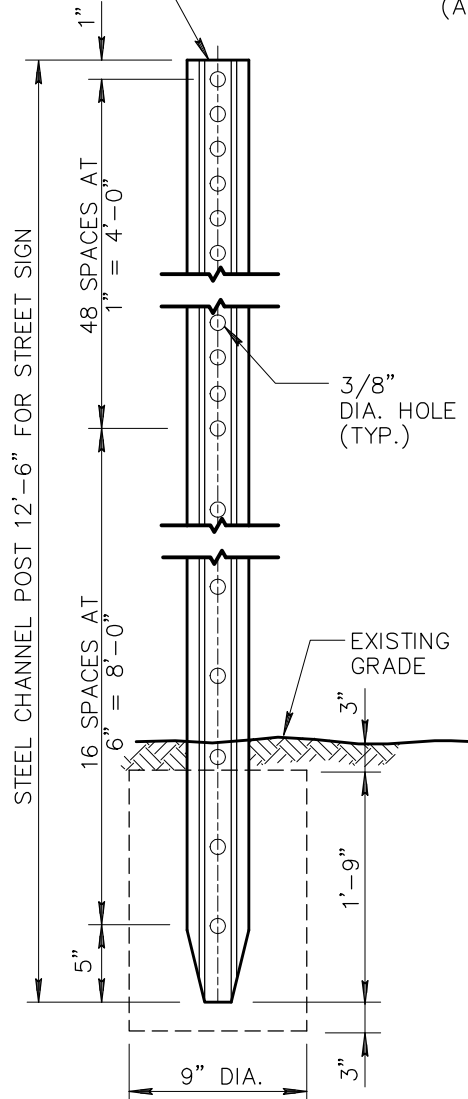
TYPE 'A'

USE DRIVING HEAD FOR DRIVING ALL
FLANGED STEEL 'U' CHANNEL POSTS.

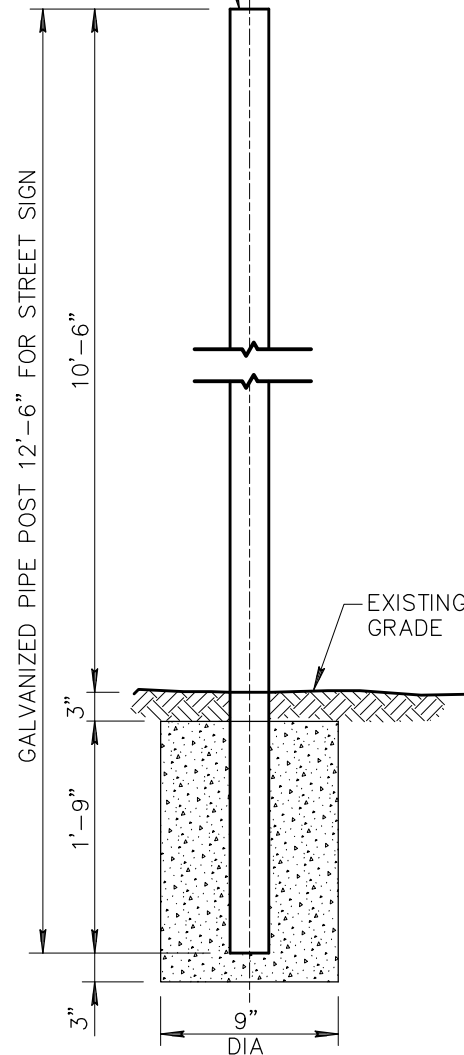
IN LIEU OF DRIVING FLANGED STEEL
'U' CHANNEL POSTS MAY BE SET IN
CONCRETE BASE FOUNDATION AS
PER TYPE 'B' BASE.

TYPE 'B' & TYPE 'C'

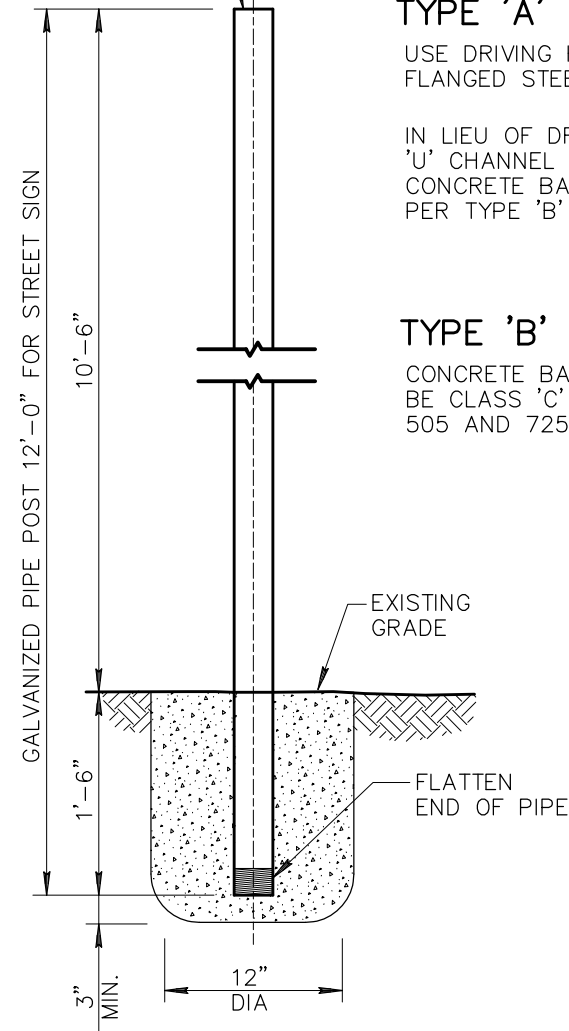
CONCRETE BASE FOUNDATIONS SHALL
BE CLASS 'C' CONCRETE AS PER SECT.
505 AND 725.



TYPE 'A'



TYPE 'B'



TYPE 'C'

DETAIL NO.

131



STANDARD DETAIL
ENGLISH

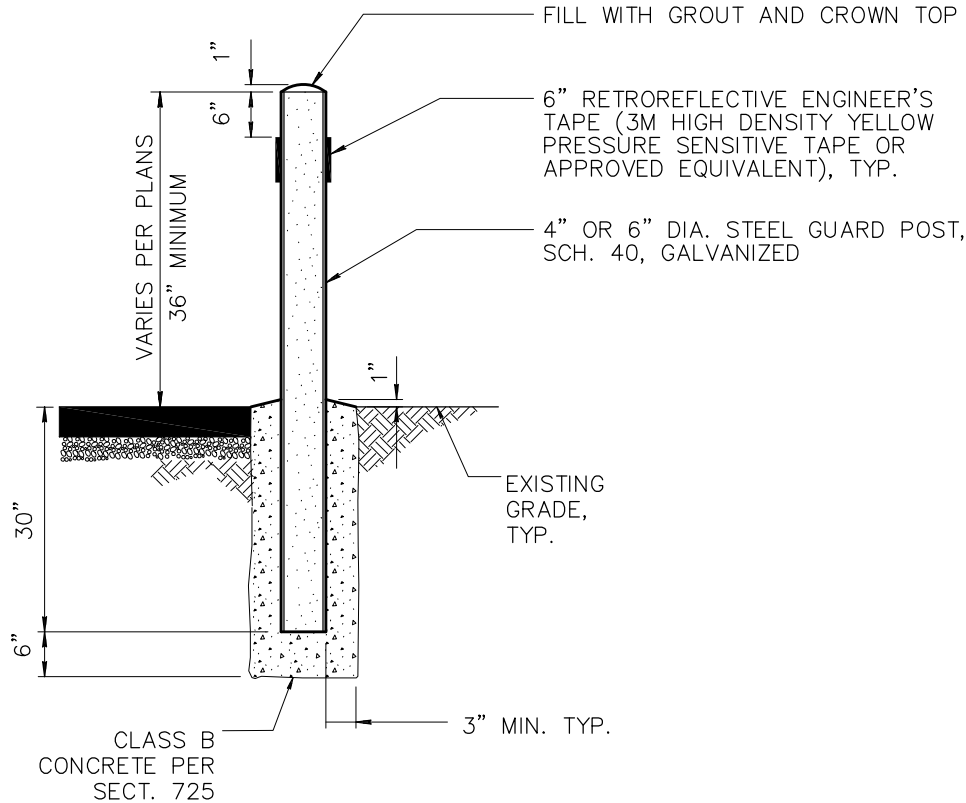
STREET SIGN BASE

REVISED

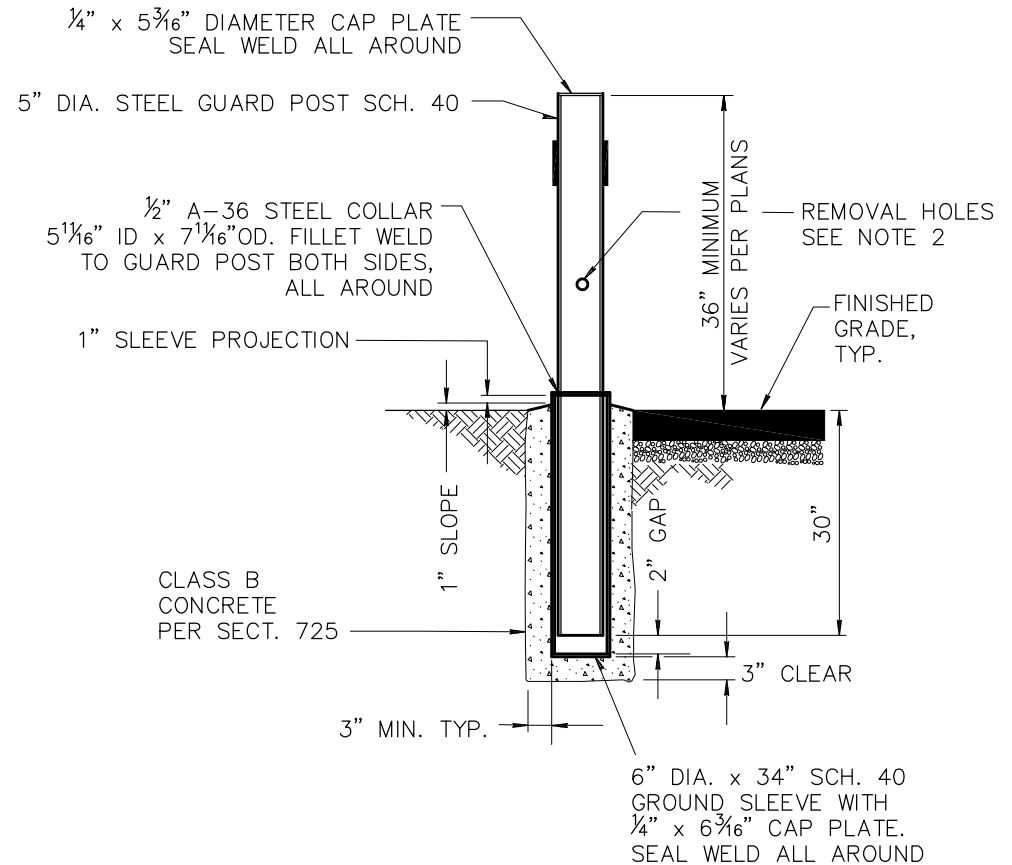
01-01-1998

DETAIL NO.

131



TYPE 1 PERMANENT



TYPE 2 REMOVABLE

NOTES

1. BOLLARDS SHALL HAVE A HEIGHT OF 3 FEET OR BE EQUAL TO THE HEIGHT OF THE BACK SCREEN WALL OF BIN ENCLOSURES. POSTS SHALL BE PLACED A MINIMUM OF 4" FROM THE WALL.
2. REMOVABLE POSTS SHALL HAVE 1" DIA. HOLES DRILLED THROUGH AT A DISTANCE 1/3 THE OVERALL POST LENGTH FROM TOP.
3. REMOVABLE POST - GRIND SMOOTH ALL SHARP EDGES PRIOR TO GALVANIZATION. GALVANIZE PER ASTM A54 AFTER FABRICATION.

DETAIL NO.

140



STANDARD DETAIL
ENGLISH

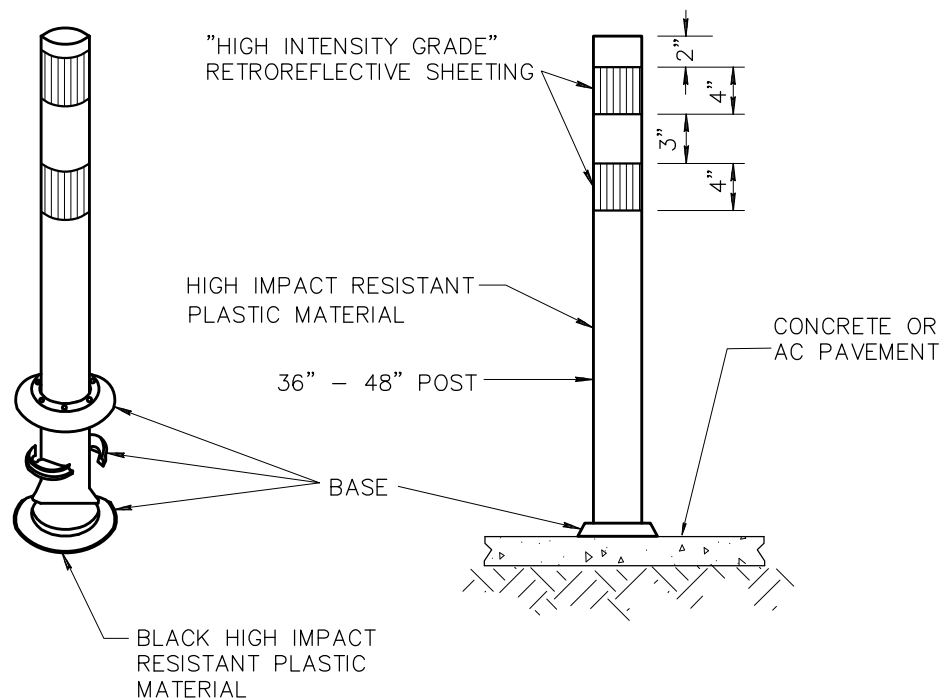
BOLLARD

REVISED

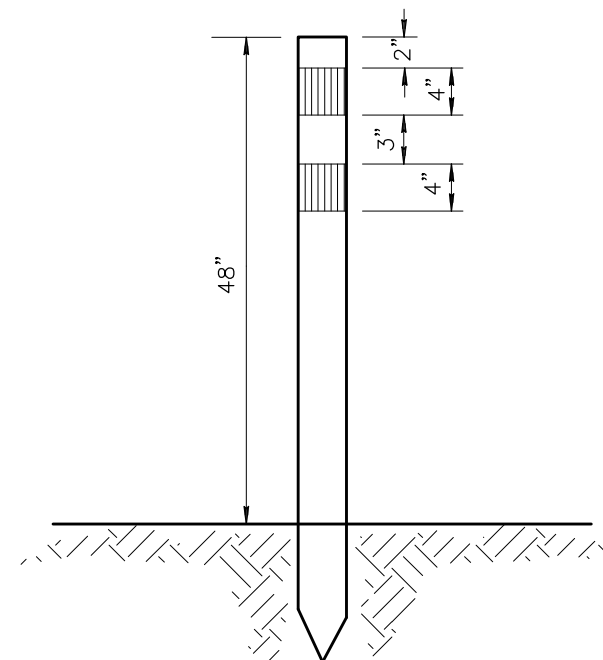
01-01-2009

DETAIL NO.

140



TYPE 1 SURFACE MOUNT



TYPE 2 GROUND MOUNT

NOTES

1. CONTRACTOR SHALL CLEAN ROADWAY SURFACE PRIOR TO PLACEMENT OF FLEXIBLE TUBULAR MARKER.
2. FLEXIBLE TUBULAR MARKERS SHALL BE CEMENTED TO THE PAVEMENT SURFACE WITH AN EPOXY ADHESIVE IN ACCORDANCE WITH THE TUBULAR MARKER MANUFACTURER'S SPECIFICATIONS.
3. YELLOW TUBULAR MARKERS SHALL HAVE A YELLOW POST AND YELLOW "HIGH INTENSITY GRADE" RETROREFLECTIVE SHEETING. ORANGE TUBULAR MARKERS SHALL HAVE AN ORANGE POST AND WHITE HIGH INTENSITY RETROREFLECTIVE SHEETING.
4. POST SHALL BE FLEXIBLE, HIGH IMPACT RESISTANT PLASTIC MATERIAL.

DETAIL NO.

141



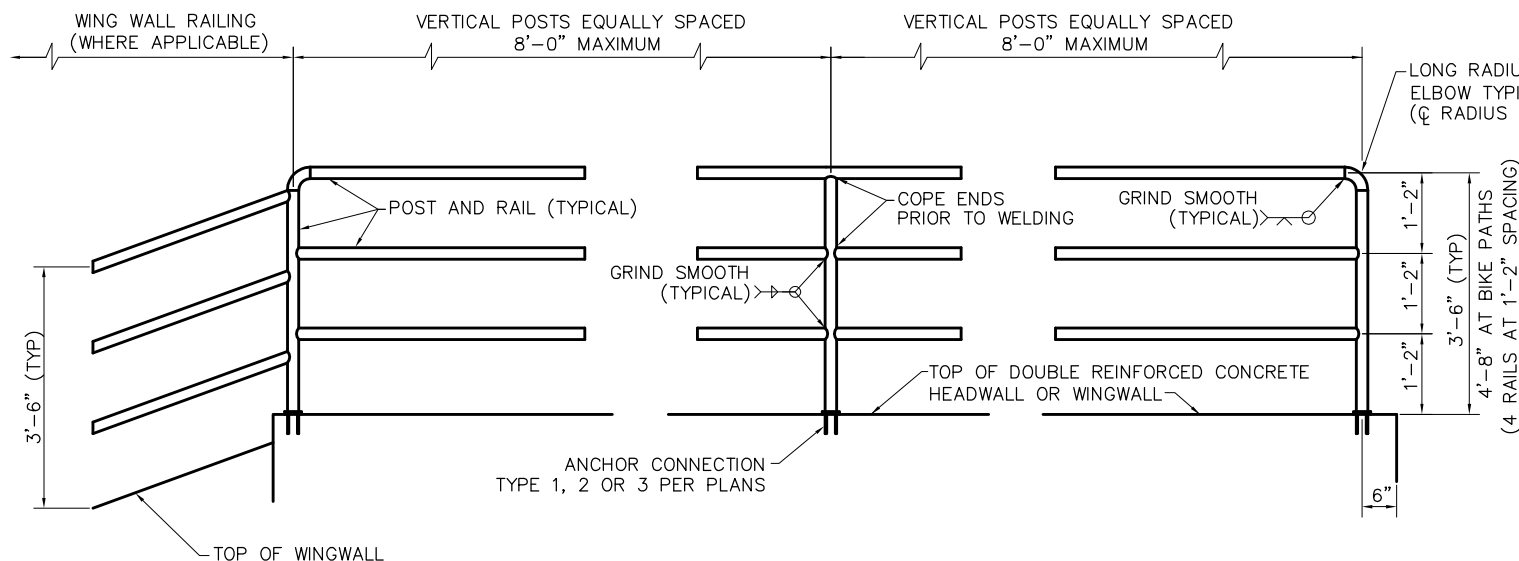
STANDARD DETAIL
ENGLISH

HAZARD MARKER

REVISED
01-01-2009

DETAIL NO.

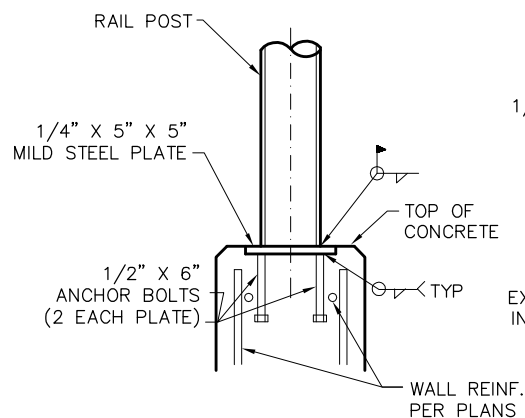
141



ELEVATION

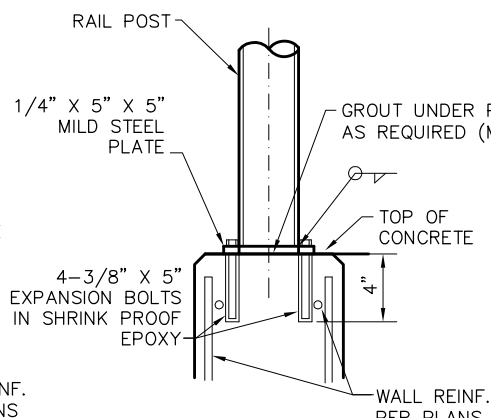
NOTES:

1. POSTS AND RAILS SHALL BE 1.5" SCHEDULE 40 HOT-DIPPED GALVANIZED STEEL PIPE ASTM A 53, GRADE B (2.72 #/LF, 1.9" O.D.). GALVANIZING SHALL BE IN ACCORDANCE WITH SECTION 771.
2. PAINT RAIL PER MAG SPECIFICATIONS SECTION 530 WHEN REQUIRED BY PLANS. SHOP PRIME WITH RUST INHIBITING PRIMER (FIELD REPAIR PRIMER AS NEEDED). COLOR PER PLANS.
3. VERTICAL POSTS TO BE EVENLY SPACED.
4. REMOVE ALL SHARP EDGES.
5. INSTALL SAFETY RAIL AS REQUIRED BY PLANS OR SPECIFICATIONS.
6. THE EMBEDMENT FOR ANCHOR TYPES 1, 2 AND 3 SHALL BE LOCATED INSIDE THE WALL REINFORCEMENT CAGE.
7. SAFETY RAIL IS NOT TO BE USED AS A PEDESTRIAN BRIDGE RAIL.



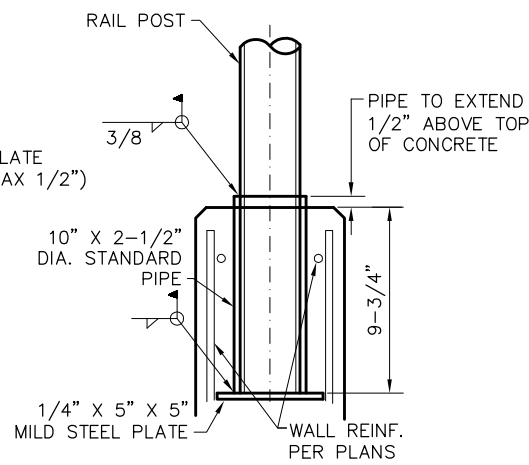
TYPE 1

ANCHOR PLATE DETAIL



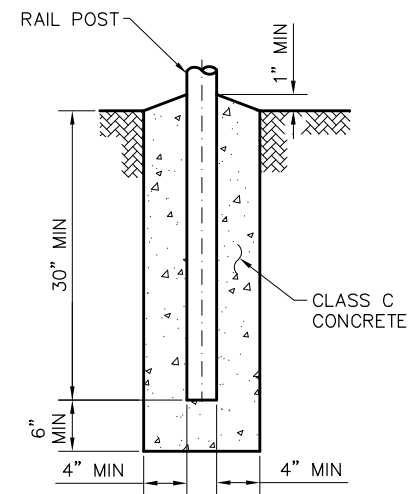
TYPE 2

EXPANSION BOLT DETAIL



TYPE 3

PIPE SLEEVE DETAIL



TYPE 4

GROUND INSTALLATION DETAIL

NOTE: SEE PLANS FOR ANCHORAGE DETAILS FOR ATTACHMENT TO SINGULARLY REINFORCED AND NON-REINFORCED WALLS.

DETAIL NO.

145



STANDARD DETAIL
ENGLISH

SAFETY RAIL

REVISED

01-01-2011

DETAIL NO.

145



1. DIMENSIONAL AND REINFORCEMENT CHANGES WILL BE PERMITTED UPON PRIOR WRITTEN APPROVAL OF THE ENGINEER.
2. UNLESS OTHERWISE NOTED, CONCRETE SHALL BE CLASS 'A' PER SECTION 725.

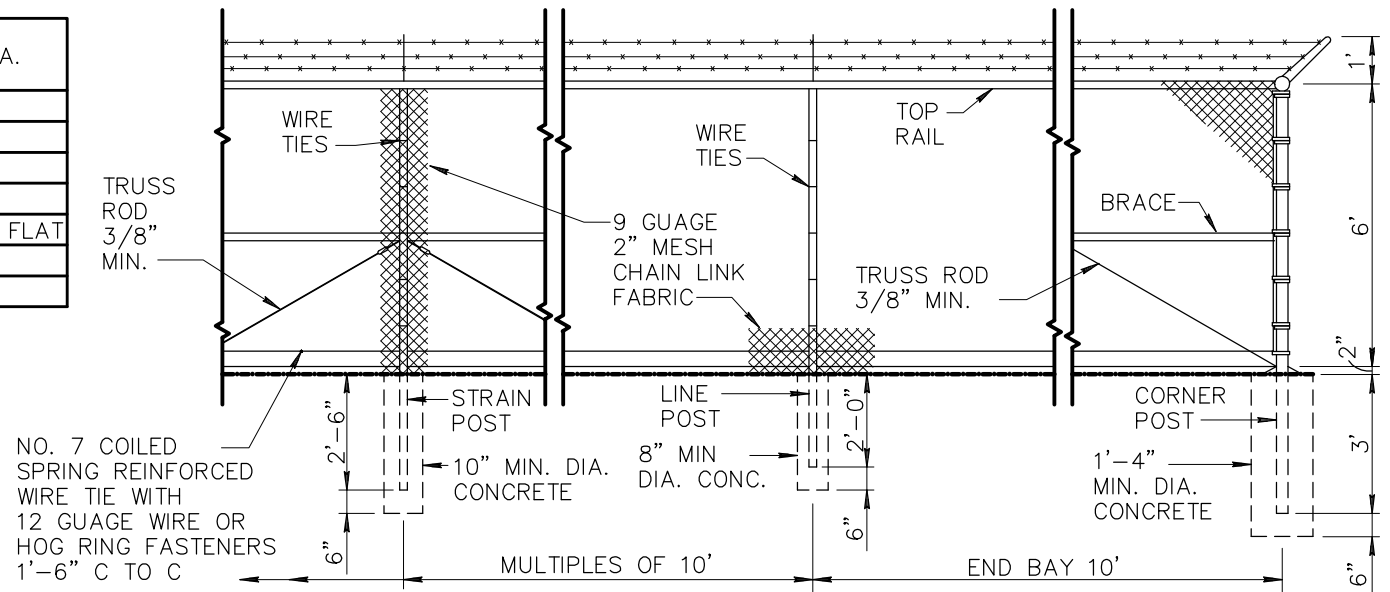
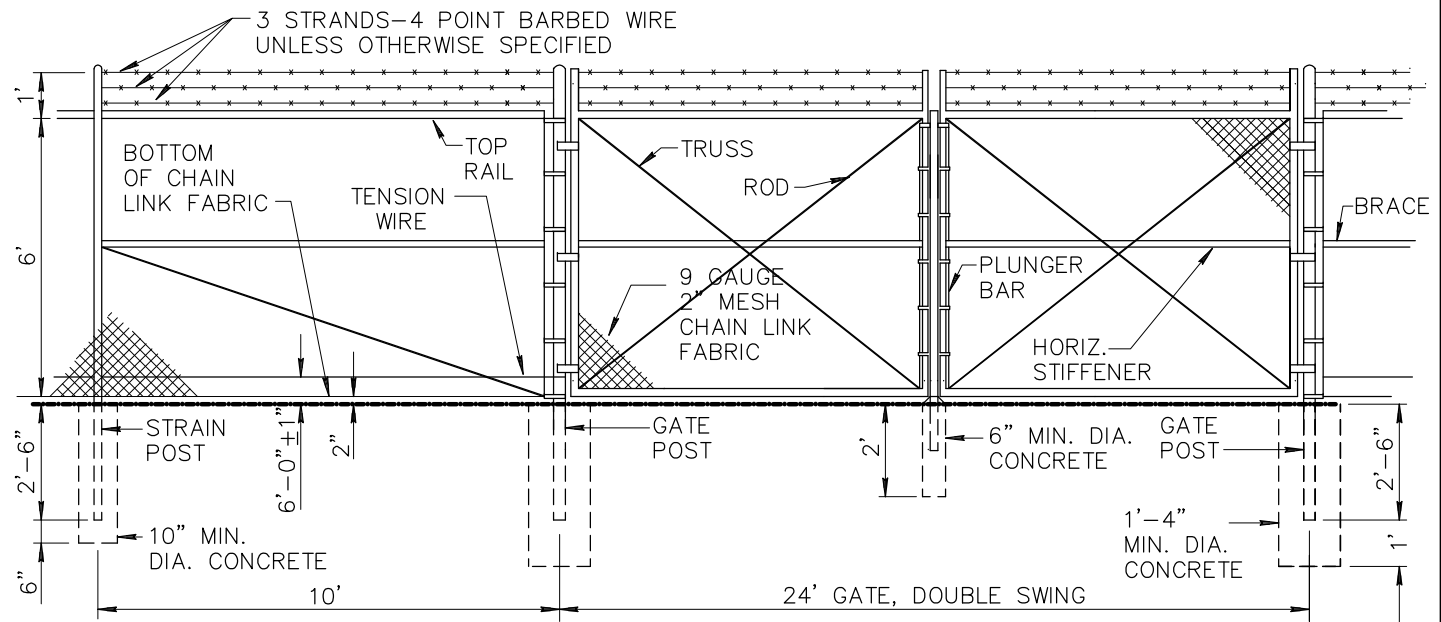


NOTES

1. ALL CONCRETE SHALL BE CLASS 'C' PER SECT. 725.
2. FITTINGS NOT SPECIFICALLY DETAILED SHALL BE HEAVY DUTY DESIGN.
3. STRAIN POSTS SHALL BE SPACED AT 500' MAXIMUM SPACING.
4. BOTH CORNER AND STRAIN POSTS SHALL HAVE STRAIN PANELS.
5. ALL POSTS SHALL BE CAPPED.
6. MEMBER SIZES SHALL BE THE FOLLOWING:

MEMBER	AISC SIZE	OUTSIDE DIA.
CORNER POST	2-1/2"	2.875"
LINE POST	1-1/2"	1.900"
STRAIN POST	1-1/2"	1.900"
BRACE	1-1/4"	1.666"
STRETCH BAR	3/16"x3/4" FLAT	3/16"x3/4" FLAT
GATE POST	3-1/2"	4.000"
TOP RAIL	1-1/4"	1.666"

7. CONSTRUCTION AND MATERIALS SHALL CONFORM TO SECT. 420 AND 772, RESPECTIVELY. SEE TABLE 772-1 FOR WEIGHTS OF MEMBERS.



DETAIL NO.

160



STANDARD DETAIL
ENGLISH

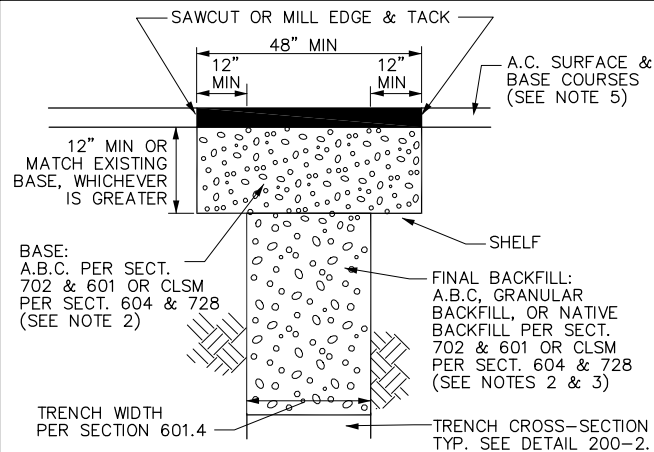
6' CHAIN LINK
FENCE AND GATE

REVISED

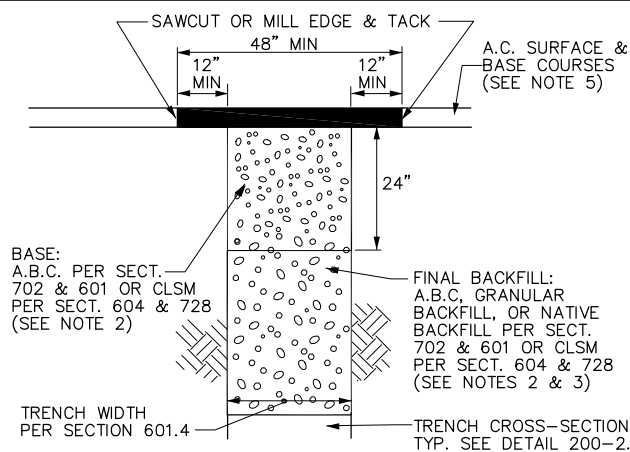
01-01-2013

DETAIL NO.

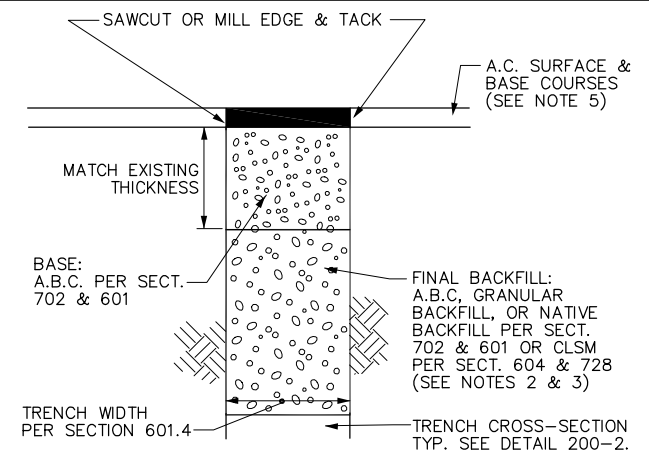
160



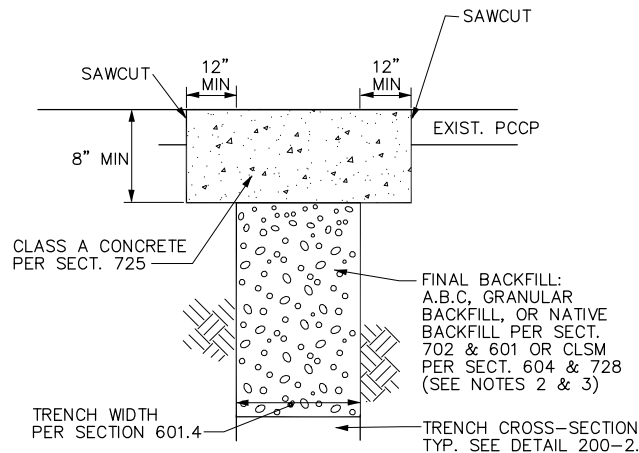
"T TOP" TRENCH REPAIR



TYPE "A" TRENCH REPAIR

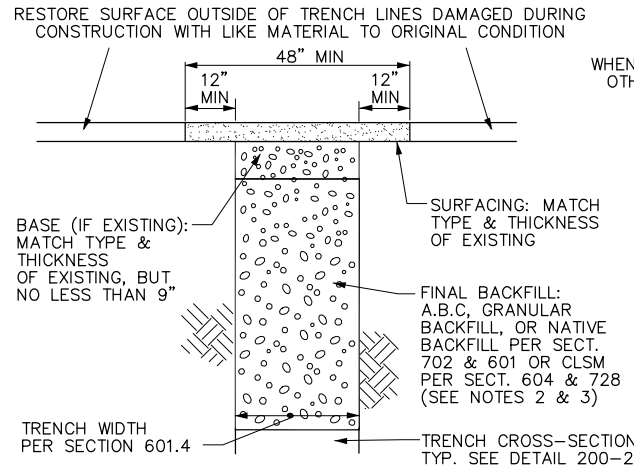


TYPE "B" TRENCH REPAIR



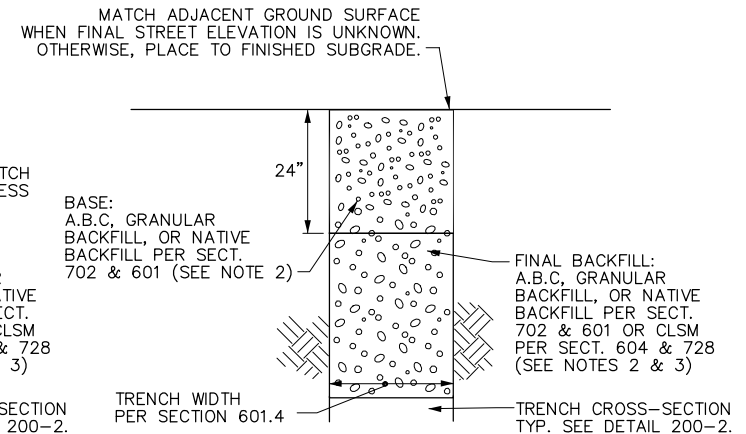
TYPE "C" TRENCH REPAIR

(TRENCH IN PORTLAND CEMENT CONCRETE PAVEMENT)



TYPE "D" TRENCH REPAIR

(TRENCH NOT UNDER CONCRETE OR ASPHALT PAVEMENT)



TYPE "E" TRENCH REPAIR

(TRENCH IN FUTURE ROADWAY PRISM OR ALLEY)

NOTES:

1. PAVEMENT MATCHING AND SURFACE REPLACEMENT SHALL BE IN ACCORDANCE WITH SECTION 336.
2. TYPE OF BACKFILL AND BASE (IF APPLICABLE) SHALL BE AS NOTED HEREIN UNLESS OTHERWISE SPECIFIED IN CONTRACT DOCUMENTS. IF NOT SPECIFIED, CLSM SHALL BE 1/2-SACK PER SECTIONS 604 AND 728.
3. TRENCHES LESS THAN 24" WIDE SHALL BE BACKFILLED FROM TOP OF INITIAL BACKFILL TO BOTTOM OF SURFACING MATERIALS WITH 1/2-SACK CLSM PER SECTIONS 604 AND 728.
4. BASE, FINAL BACKFILL, AND PIPE EMBEDMENT ZONE COMPACTION REQUIREMENTS SHALL BE IN ACCORDANCE WITH SECTION 601.
5. ASPHALT CONCRETE SURFACE AND BASE COURSES SHALL COMPLY WITH SECTION 336.2.4.1 UNLESS OTHERWISE SPECIFIED IN CONTRACT DOCUMENTS.
6. USE TYPE "A" FOR LONGITUDINAL TRENCH REPAIR AND USE "T-TOP" FOR TRANSVERSE TRENCH REPAIR (SEE DETAIL 200-2) UNLESS OTHERWISE SPECIFIED IN CONTRACT DOCUMENTS. TYPE "B" TRENCH REPAIR MAY BE USED FOR TRANSVERSE TRENCH REPAIR IF SPECIFIED BY THE AGENCY.
7. PROVIDE MINIMUM 12" WIDE SHELF AS SHOWN IN "T-TOP" TRENCH REPAIR AT ENDS OF TYPE "A" TRENCH REPAIR EXCEPT WHERE EDGE ABUTS EXISTING CONCRETE.
8. USE "T-TOP" PAVEMENT REPLACEMENT WHERE A TRENCH IS NOT PARALLEL TO A STREET OR GOES THROUGH AN INTERSECTION.
9. SEE DETAIL 200-2 FOR REMNANT PAVEMENT REMOVAL REQUIREMENTS.
10. EXPOSED COPPER OR POLYETHYLENE WATER PIPE UP TO 2" IN DIAMETER IN TRENCHES TO BE BACKFILLED WITH CLSM SHALL BE WRAPPED WITH MINIMUM 3/4" THICK PREFORMED PIPE-COVERING FOAM INSULATION BEFORE PLACING CLSM.

DETAIL NO.

200-1



STANDARD DETAIL
ENGLISH

BACKFILL, PAVEMENT
AND SURFACE REPLACEMENT

PROPOSED

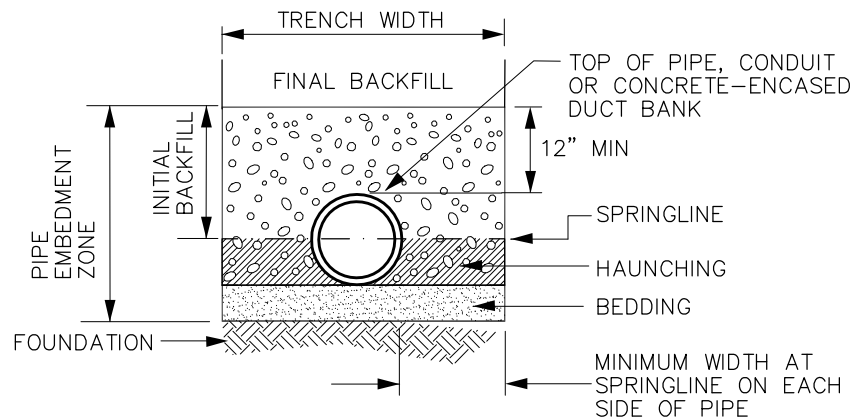
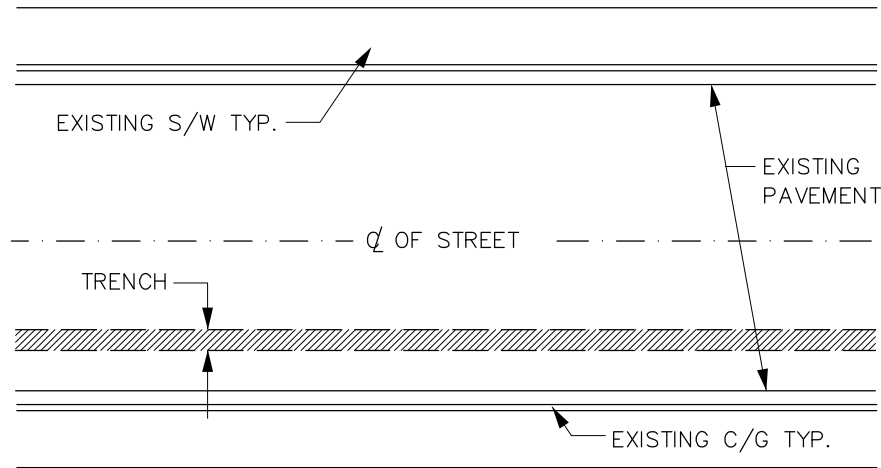
01-01-2015

DETAIL NO.

200-1

LONGITUDINAL TRENCH

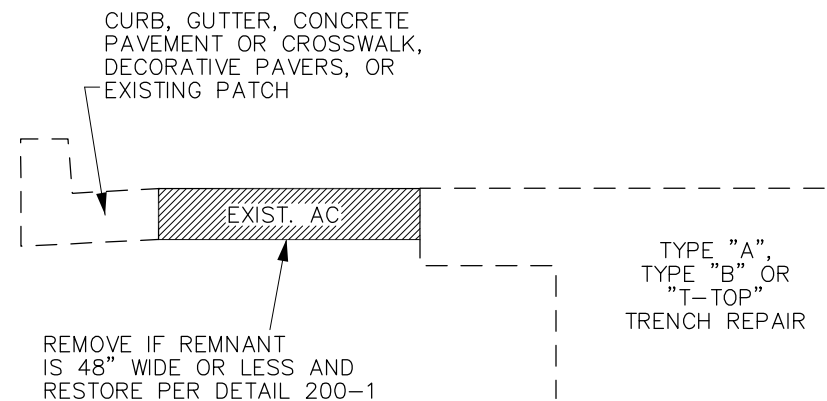
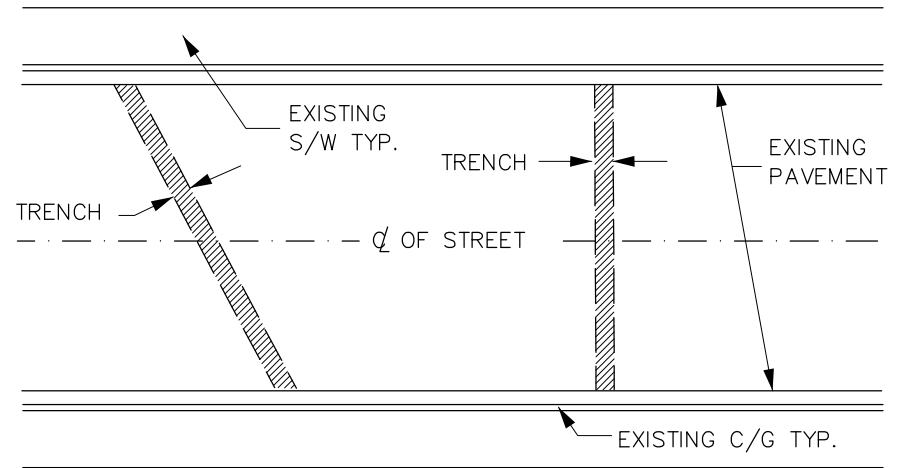
(TRENCH IN PAVEMENT PARALLEL TO TRAFFIC)



TRENCH CROSS-SECTION DETAIL

TRANSVERSE TRENCH

(TRENCH IN PAVEMENT NOT PARALLEL TO TRAFFIC)



REMNANT PAVEMENT REMOVAL

NOTES:

1. SEE SECTION 601 FOR TRENCH EXCAVATION, BACKFILLING AND COMPACTION REQUIREMENTS.
2. SEE MAG DETAIL 200-1 FOR DETAILED TRENCH REPAIR REQUIREMENTS FOR TRENCH TYPES NOTED HEREIN.
3. SEE MAG DETAIL 211 FOR REQUIREMENTS REGARDING THE USE OF PLATING TRANSVERSE TRENCHES. USE OF STEEL PLATES SHALL NOT EXCEED 72 HOURS AFTER COMPLETION OF BACKFILL AND PRIOR TO FINAL PATCHING.

DETAIL NO.

200-2



STANDARD DETAIL
ENGLISH

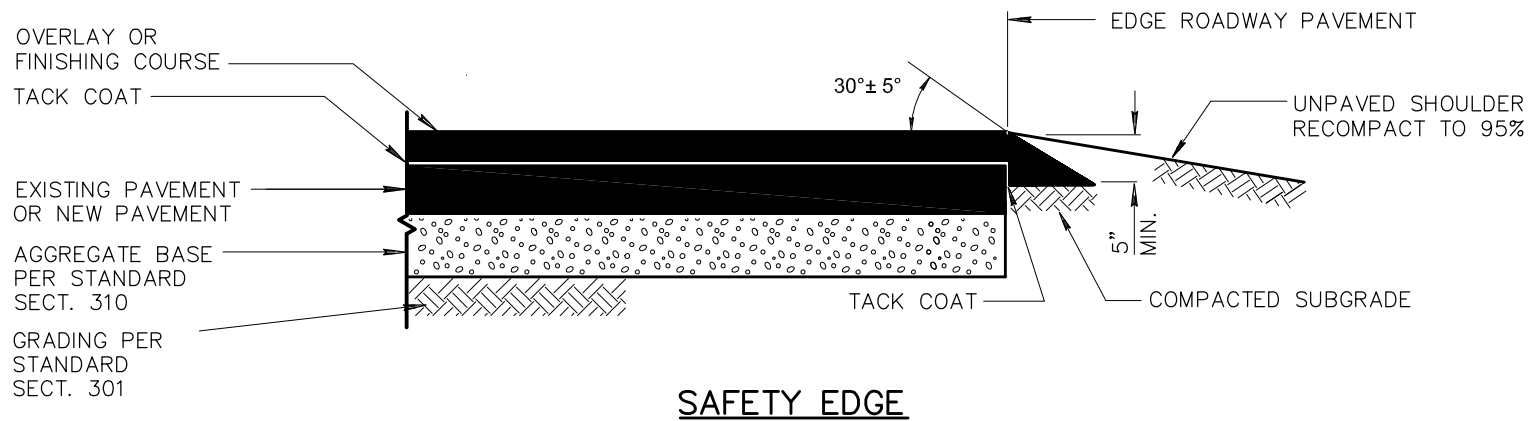
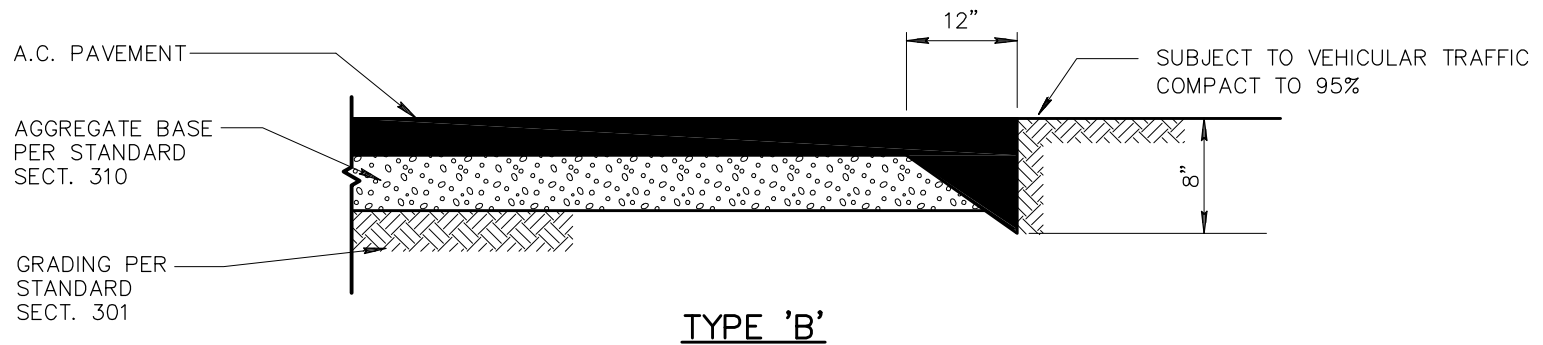
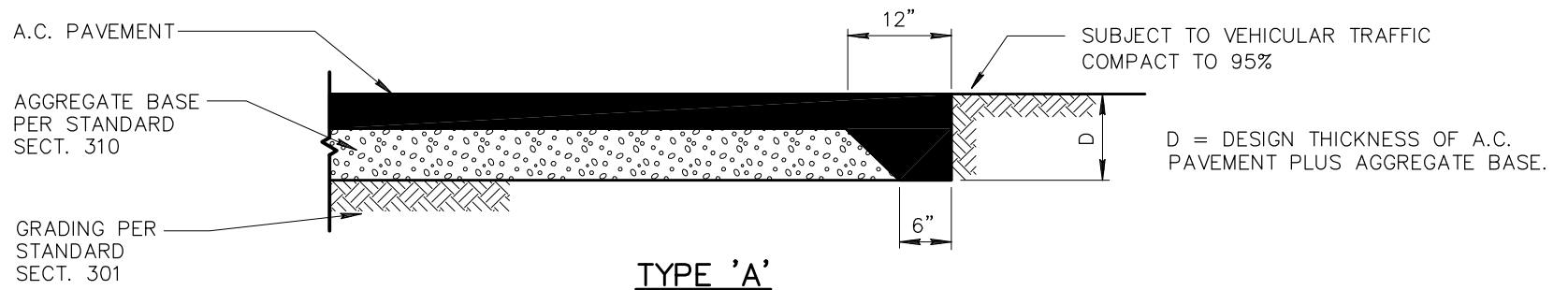
BACKFILL, PAVEMENT AND
SURFACE REPLACEMENT

PROPOSED

01-01-2015

DETAIL NO.

200-2



DETAIL NO.

201



STANDARD DETAIL
ENGLISH

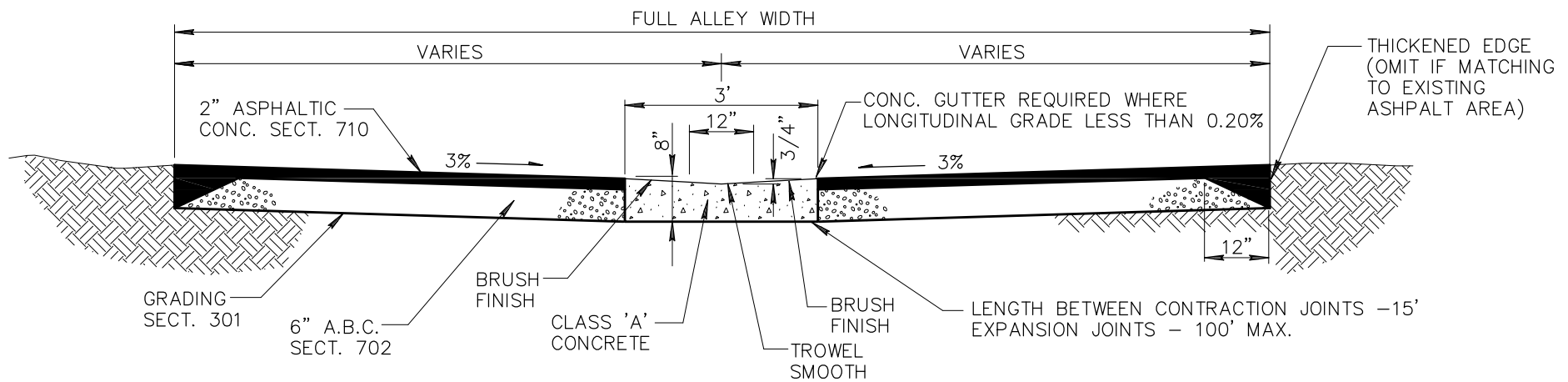
ASPHALT PAVEMENT EDGE DETAILS

DATE

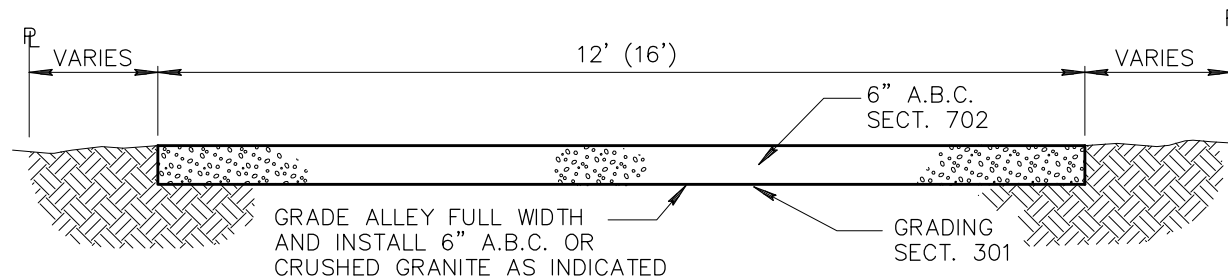
01-01-2014

DETAIL NO.

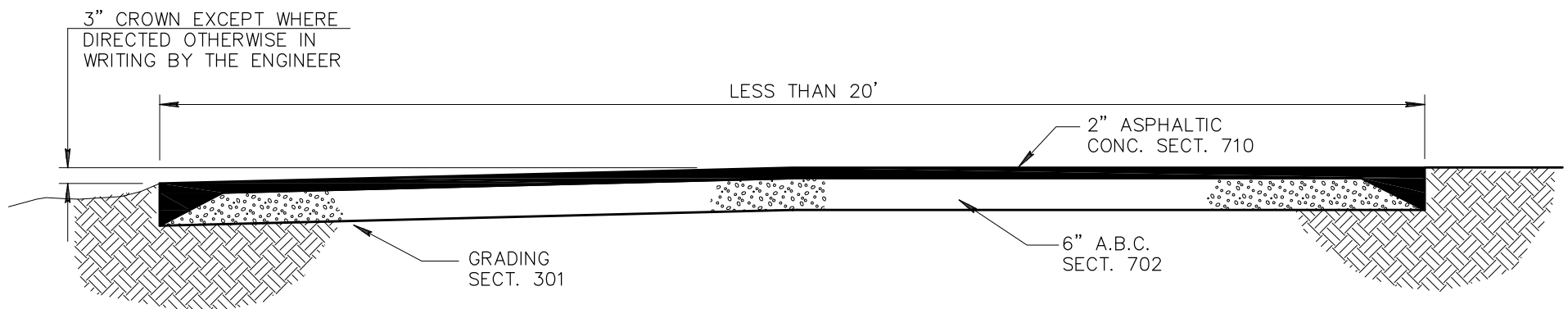
201



PAVED ALLEY DETAIL

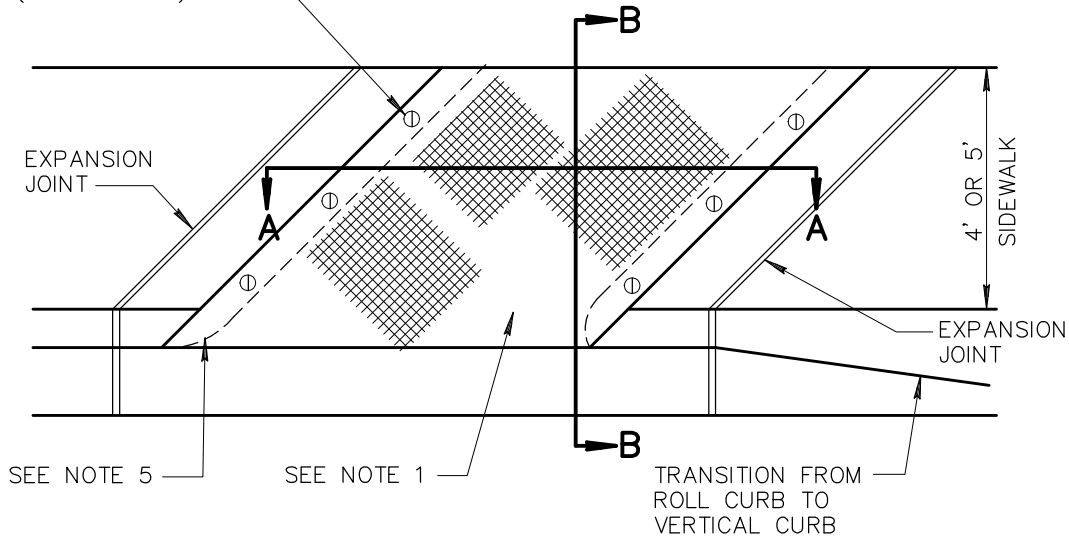


UNPAVED ALLEY DETAIL



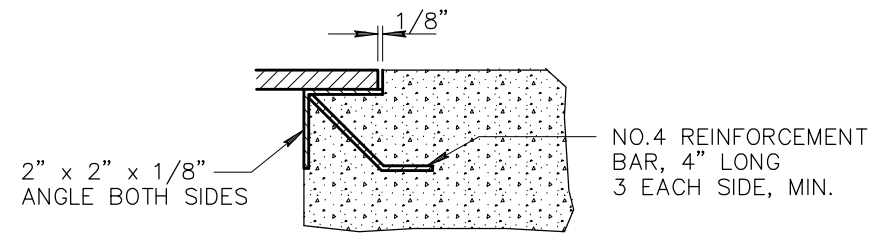
RESIDENTIAL ALLEY DETAIL

3/8" FLATHEAD STAINLESS STEEL
CAP SCREW COUNTERSINK
(6 EACH MIN.)

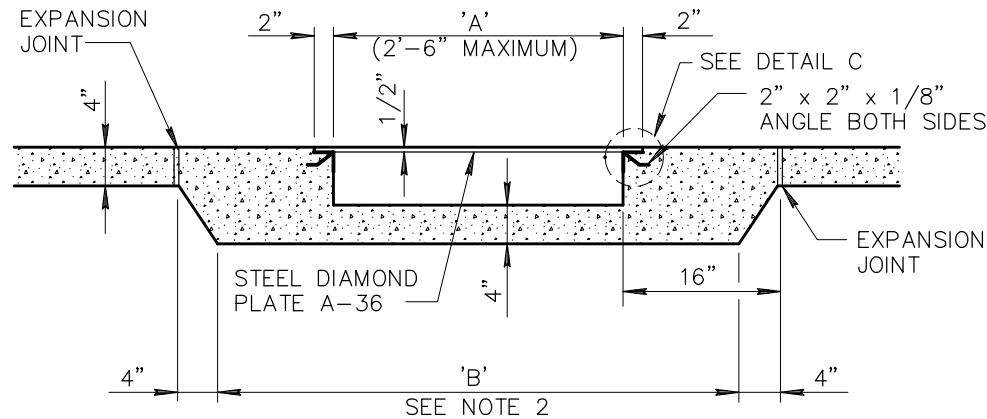


NOTES:

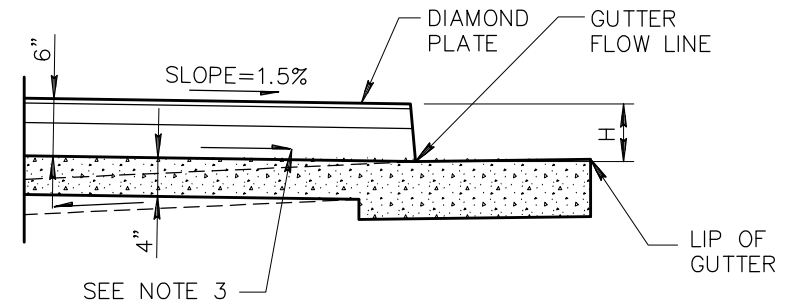
1. ANGLE EQUALS 45° UNLESS SPECIFIED ON PLAN.
2. DIMENSION 'B' EQUALS 'A' + 2'
3. (———>) INDICATES DIRECTION OF FLOW.
4. PAINT STEEL ACCORDING TO SECTION 790.
PAINT NUMBER 1-A OR 1-B.
5. R EQUALS 1" UNLESS OTHERWISE DIRECTED.
6. H EQUALS CURB FACE HEIGHT.
7. FOR ROLL CURB AND GUTTER, USE 2'
TRANSITIONS TO VERTICAL CURB.
8. CONCRETE SHALL BE CLASS B PER SECT. 725
AND INSTALLED PER SECT. 505.



DETAIL C



SECTION 'A-A'



SECTION 'B-B'

DETAIL NO.

203



STANDARD DETAIL
ENGLISH

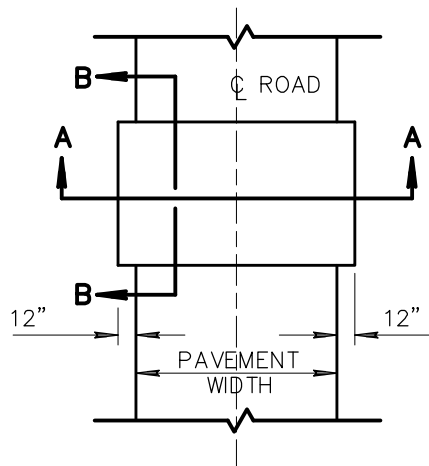
SCUPPERS

REVISED

01-01-1998

DETAIL NO.

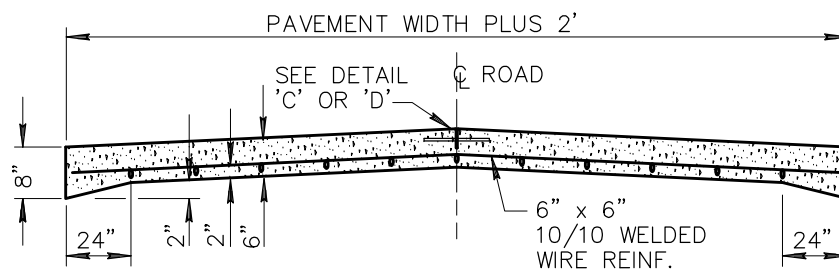
203



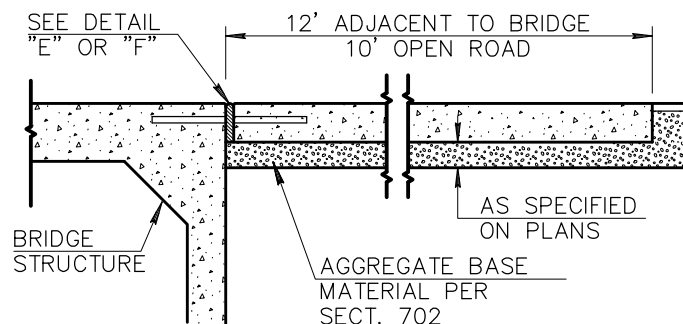
PLAN OF CONCRETE EQUIPMENT CROSSING

NOTES:

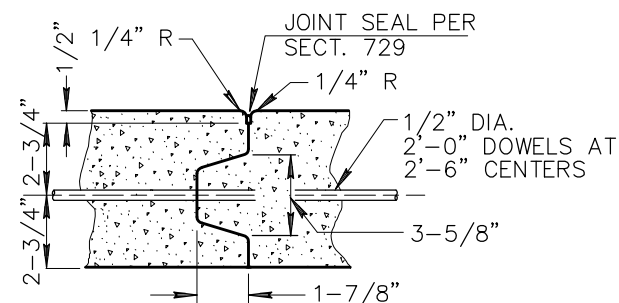
1. WHEN EQUIPMENT CROSSING LIES ADJACENT TO BRIDGE OR BOX CULVERT, CONSTRUCT THE EQUIPMENT CROSSING TO WIDTH OF BRIDGE ROADWAY.
2. ALL DOWELS IN CENTER JOINTS SHALL BE DEFORMED BARS AND SHALL HAVE UNBROKEN BOND. THEY SHALL BE HELD SECURELY IN PLACE, PARALLEL TO THE SUBGRADE AND PERPENDICULAR TO THE CENTER LINE OF THE ROAD.
3. THE EDGING TOOL USED FOR ALL LONGITUDINAL JOINTS SHALL BE SO CONSTRUCTED AS TO PROVIDE A SMOOTH TROWELED SURFACE 3" WIDE ON EACH SIDE OF THE JOINT.
4. IF APPROVED BY THE ENGINEER, OTHER DEFORMATIONS MAY BE USED IN LONGITUDINAL JOINT - DETAIL 'C'.
5. DETAIL 'C' TO BE USED ONLY WHEN FULL WIDTH CAN NOT BE POURED IN ONE POUR. USE DETAIL 'D' IF FULL WIDTH IS POURED IN ONE POUR.



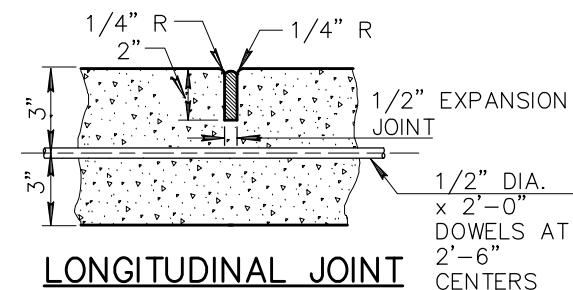
SECTION A-A



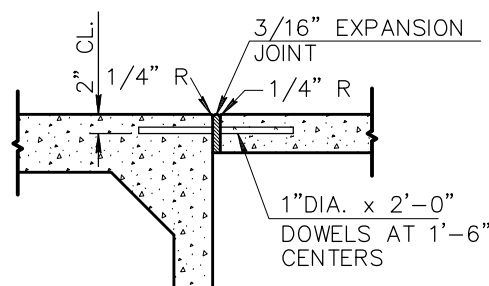
SECTION B-B



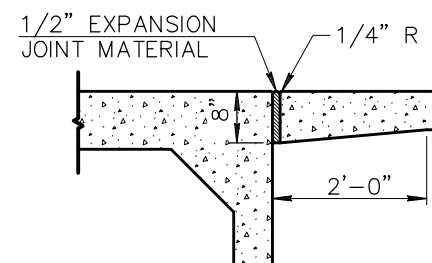
**LONGITUDINAL JOINT
DETAIL 'C'**



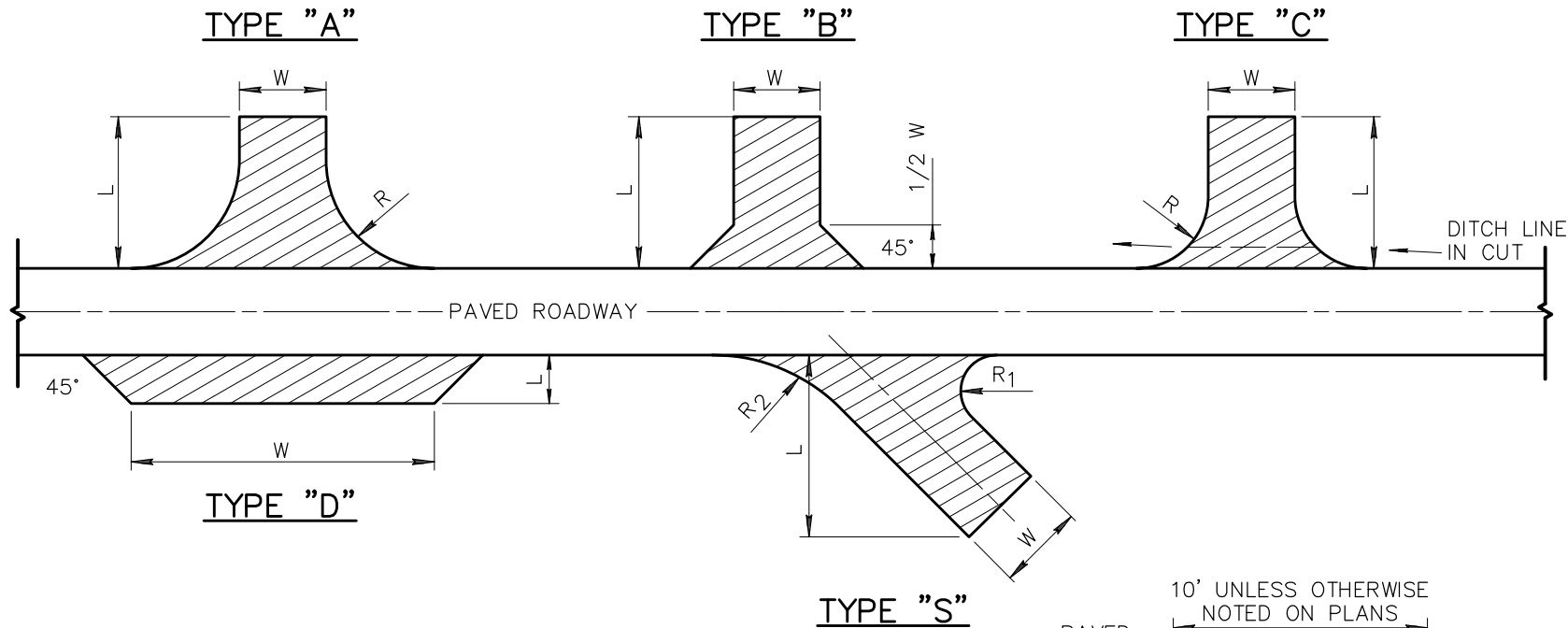
**LONGITUDINAL JOINT
DETAIL 'D'**



**JOINT AT NEW BRIDGE
DETAIL 'F'**

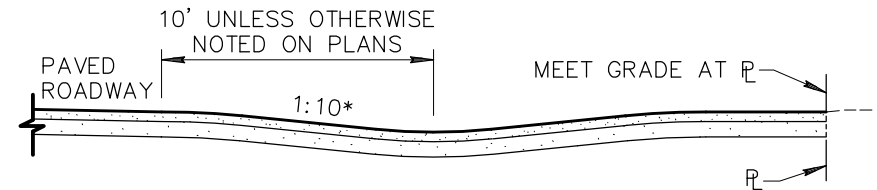


**JOINT AT EXISTING BRIDGE
DETAIL 'E'**

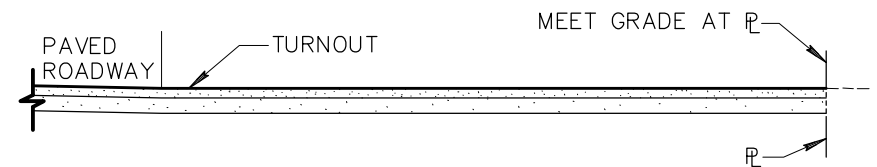


NOTES:

1. W - INDICATES WIDTH OF PAVED SURFACE OF TURNOUT.
L - INDICATES LENGTH OF PAVED SURFACE OF TURNOUT.
R - RADIUS.
2. SIZE AND TYPE OF TURNOUT SHALL BE NOTED ON PLANS AS FOLLOWS:
90° - NO RADIUS: WxL-SURFACE-TYPE; (12' x 30'-A.C.-TYPE "B" TURNOUT).
90° - WITH A RADIUS: WxLxR-SURFACE-TYPE; (12' x 20' x 15'-A.C.-TYPE "C" TURNOUT). OTHER THAN 90° WITH 2 RADII-TYPE "S": WxLxR₁xR₂-SURFACE-TYPE; (12' x 20' x 15'-A.C.-TYPE "S" TURNOUT).
OR IT MAY BE NOTED ON PLANS IN CONVENTIONAL TERMS.
3. TURNOUTS TO BE STRAIGHT TYPE UNLESS OTHERWISE NOTED ON PLANS.
4. A.C. AND BASE MATERIAL THICKNESS FOR TURNOUTS SHALL BE THE SAME AS SHOWN ON THE ROADWAY SECTION, UNLESS OTHERWISE NOTED.
5. ANY EXCAVATION OR EMBANKMENT FOR TURNOUTS IS INCLUDED IN THE ROADWAY QUANTITIES.
6. TURNOUTS ARE TO BE PLACED WHERE SHOWN ON PLANS, OR AS DIRECTED BY THE ENGINEER.



TYPICAL VALLEY GUTTER TURNOUT



TYPICAL STRAIGHT TURNOUT

* UNLESS OTHERWISE NOTED ON PLANS

DETAIL NO.

205



STANDARD DETAIL
ENGLISH

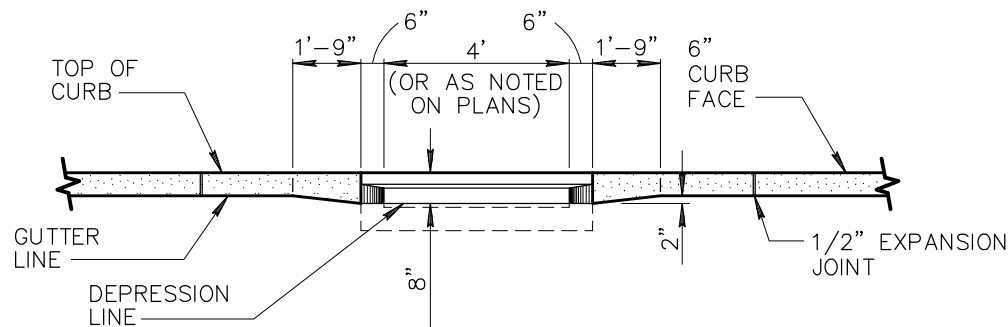
PAVED TURNOUTS

REVISED

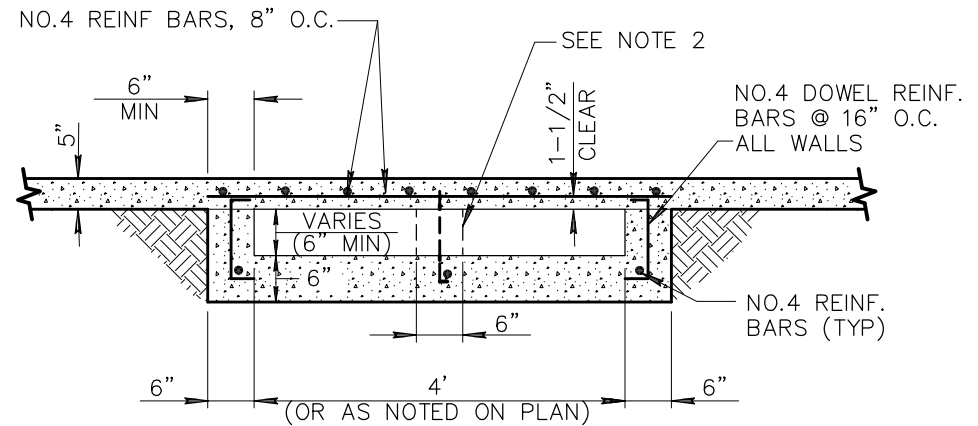
01-01-2006

DETAIL NO.

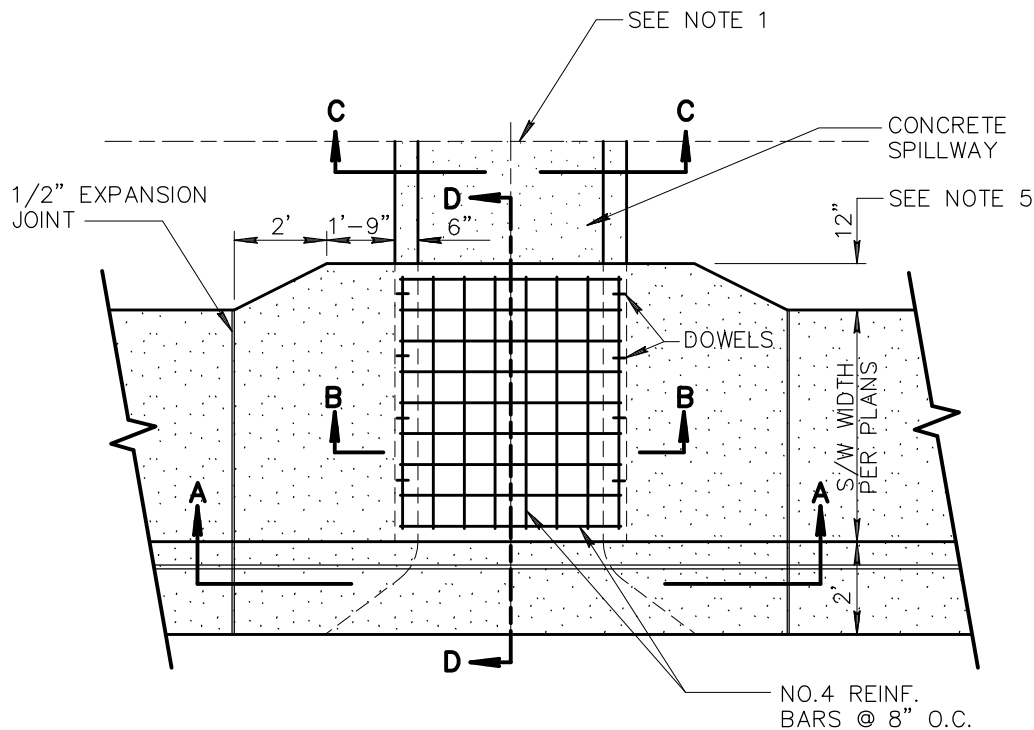
205



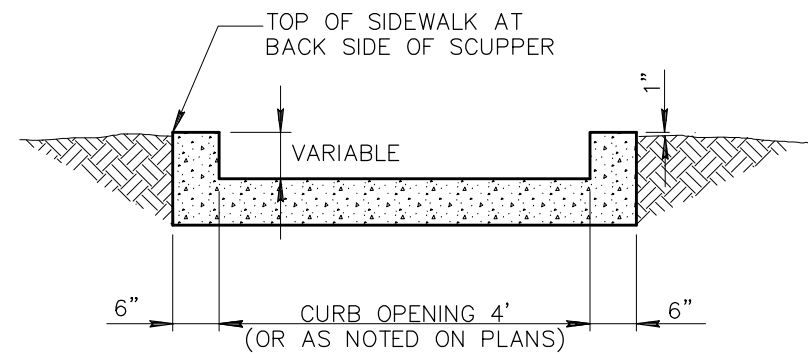
SECTION A-A



SECTION B-B



SCUPPER PLAN VIEW

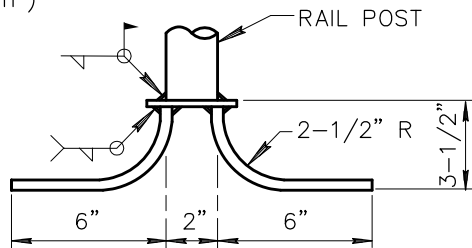
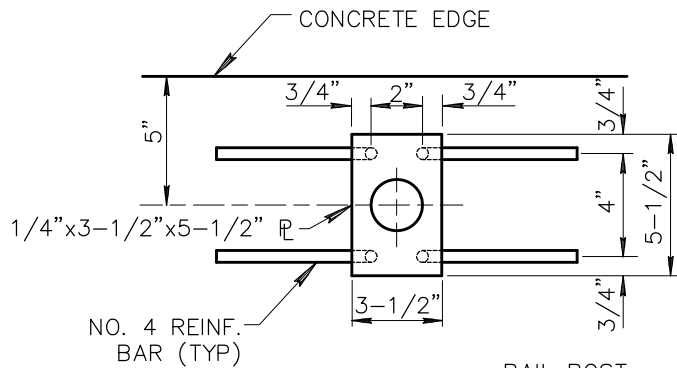
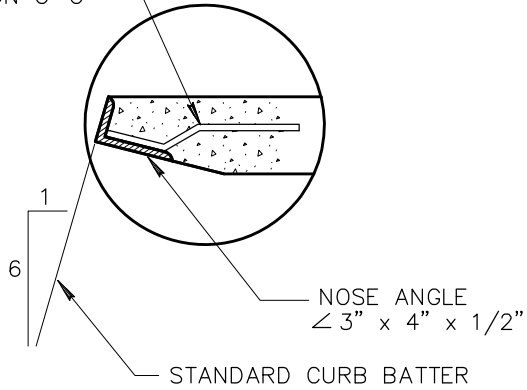


SECTION C-C SPILLWAY

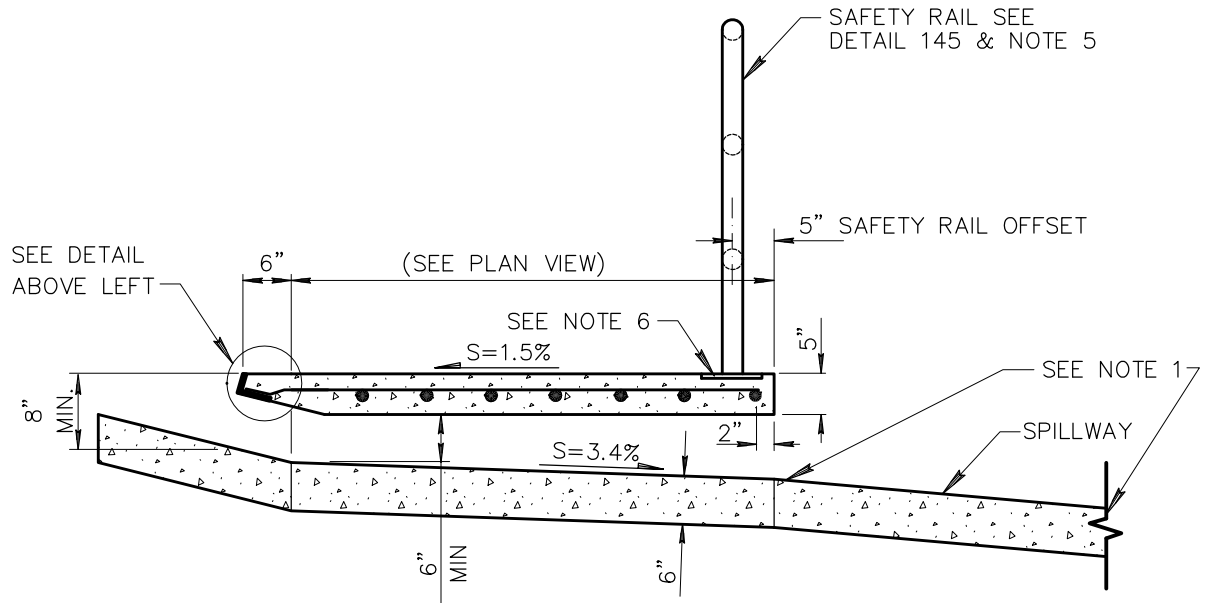
NOTES:

1. TRANSITION TO SPILLWAY/CHANNEL AS PER APPROVED PLANS.
2. A CENTER WALL SHALL BE INSTALLED IN SCUPPERS WIDER THAN 4' OR IF MORE THAN 1 SCUPPER IS BUILT IN SERIES.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, ASTM D-1751.
4. CONCRETE FOR THE SCUPPER SHALL BE CLASS 'A' PER SECTION 725. CONCRETE FOR THE SPILLWAY SHALL BE CLASS 'A' OR CLASS 'B'.
5. 12" OFFSET DISTANCE SHALL BE INCREASED TO 2'-6" FOR DESIGNATED BICYCLE PATHS.

NO. 4 REINFORCEMENT
WELDED TO ANGLE SEE
DETAIL 536-1,
SECTION C-C



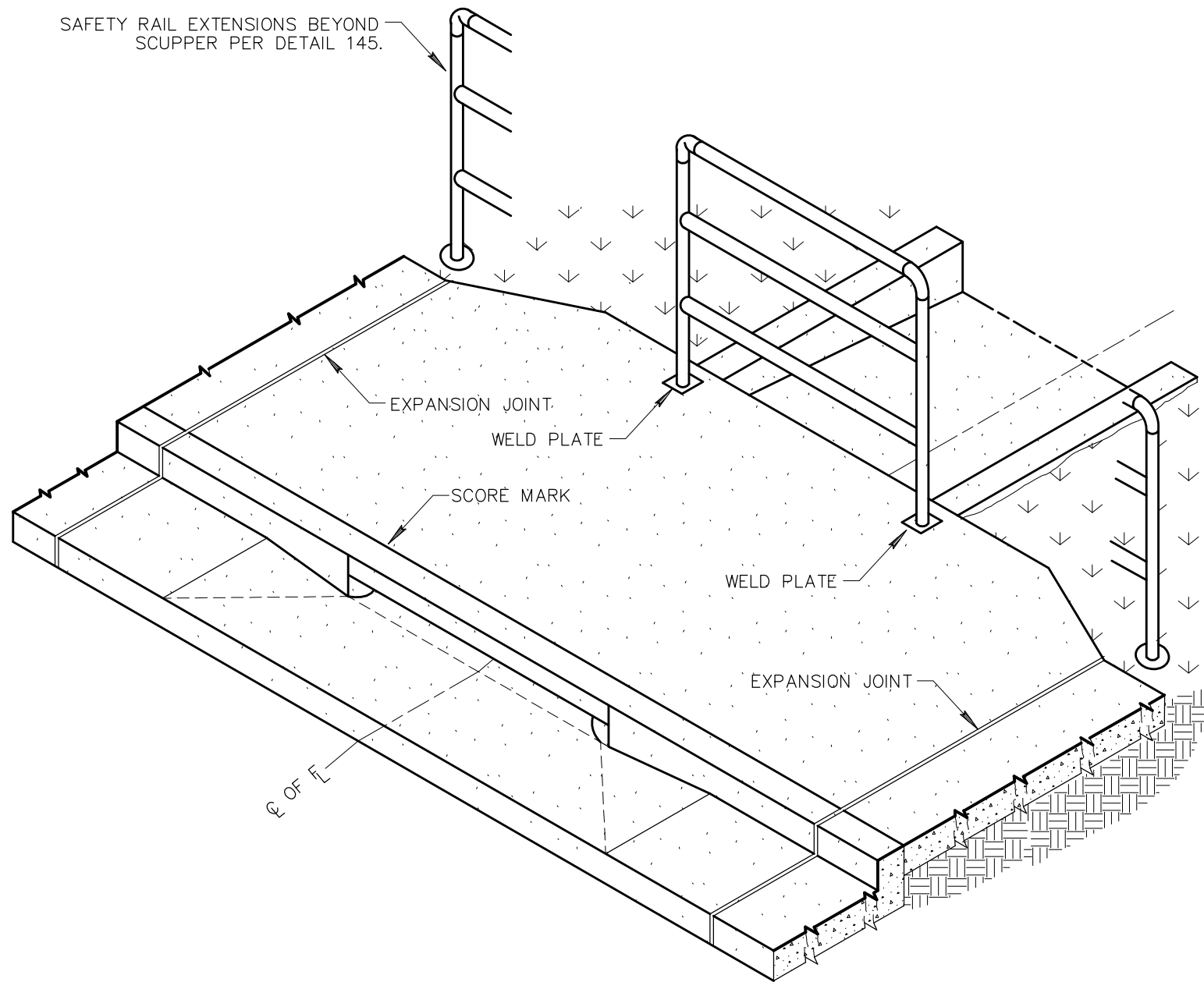
WELD PLATE



SECTION D-D

NOTES:

1. TRANSITION TO SPILLWAY/CHANNEL AS PER APPROVED PLANS.
2. A CENTER WALL SHALL BE INSTALLED IN SCUPPERS WIDER THAN 4' OR IF MORE THAN 1 SCUPPER IS BUILT IN SERIES.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, ASTM D-1751.
4. CONCRETE FOR THE SCUPPER SHALL BE CLASS 'A', PER SECTION 725. CONCRETE FOR THE SPILLWAY SHALL BE CLASS 'A' OR CLASS 'B'.
5. SAFETY RAIL SHALL BE CONTINUOUS BETWEEN THE SPILLWAY EXTERIOR WALLS.
6. USE WELD PLATES FOR SAFETY RAIL ANCHORS LOCATED IN THE 5" THICK CONCRETE.



DETAIL NO.

206-3



STANDARD DETAIL
ENGLISH

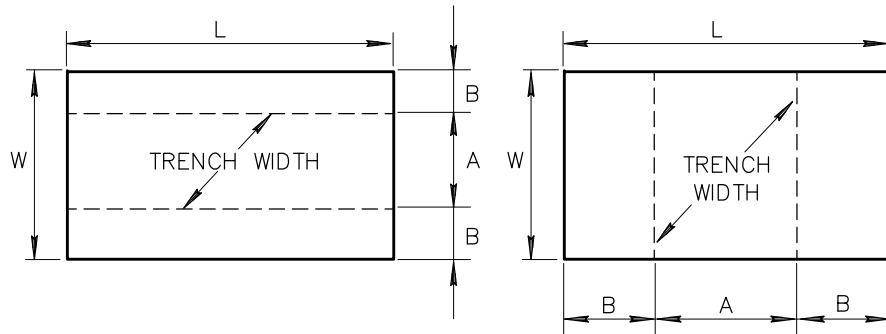
CONCRETE SCUPPER

REVISED

01-01-2007

DETAIL NO.

206-3



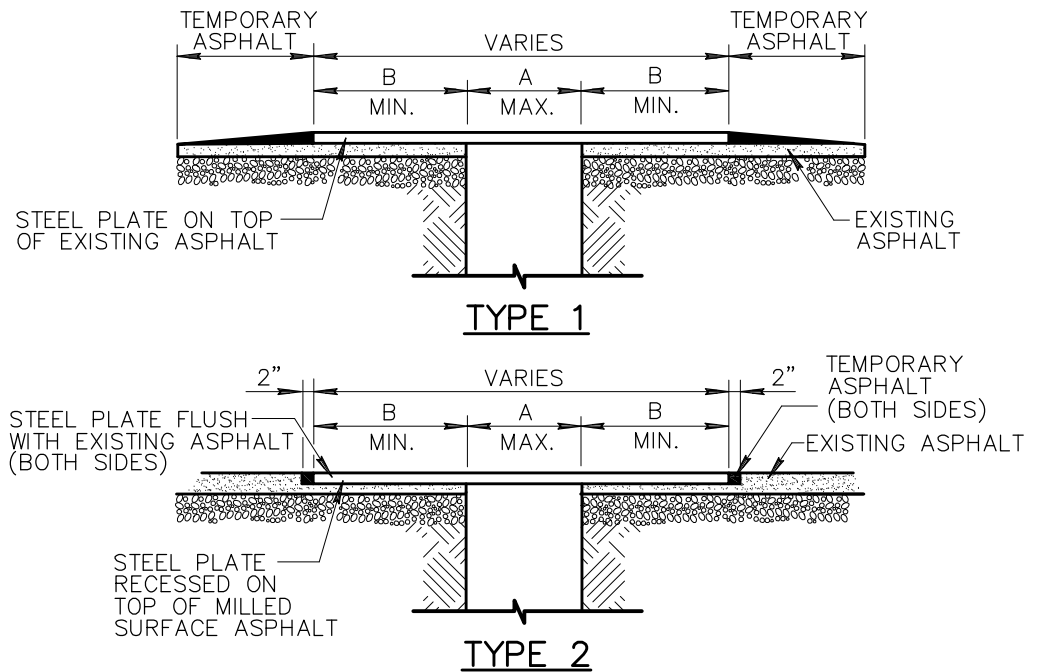
LONGITUDINAL
STEEL PLATE

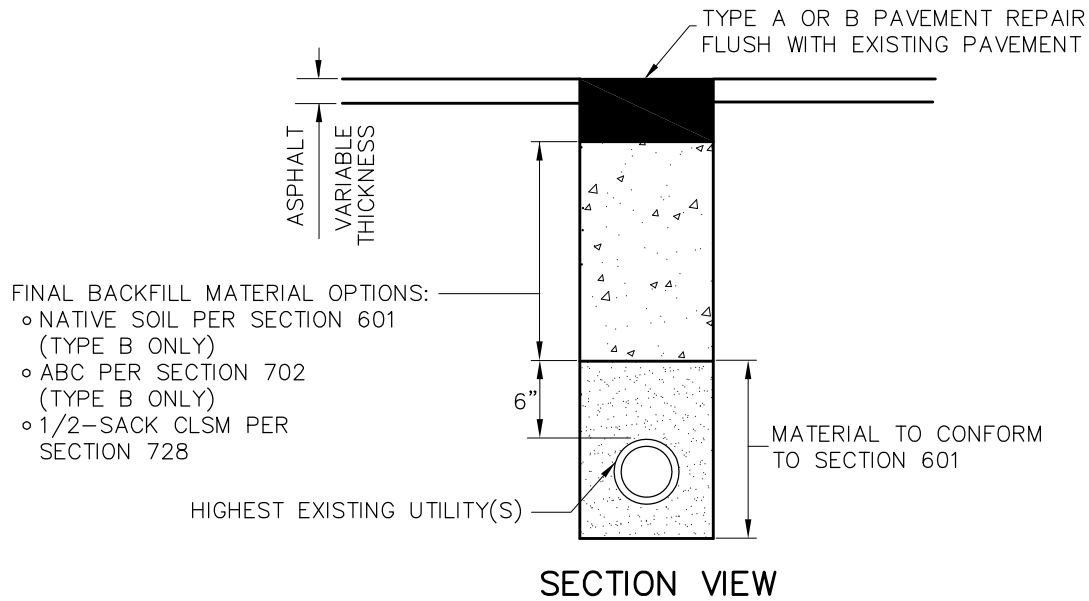
TRANSVERSE
STEEL PLATE

PLATE SIZE						
LONGITUDINAL					TRANSVERSE	
(A)	(B)	THICKNESS	(W)	(L)	(A)	(B)
12"	18"	1"	4'	8'	58"	19"
12"	18"	1"	4'	10'	58"	31"
24"	18"	1"	5'	10'	70"	25"
36"	18"	1"	6'	10'	44"	38"
48"	18"	1"	7'	10'	52"	34"
60"	18"	1"	8'	10'	58"	31"
12"	18"	1-1/4"	4'	15'	88"	47"
24"	18"	1-1/4"	5'	12'	104"	20"
36"	18"	1-1/4"	6'	12'	66"	39"
36"	18"	1-1/4"	6'	16'	66"	63"
48"	18"	1-1/4"	7'	12'	76"	33"
48"	18"	1-1/4"	7'	16'	76"	58"
60"	18"	1-1/4"	8'	12'	86"	29"
60"	18"	1-1/4"	8'	15'	86"	47"
60"	18"	1-1/4"	8'	16'	86"	63"
60"	18"	1-1/4"	8'	20'	86"	77"
60"	18"	1-3/8"	8'	20'	102"	69"

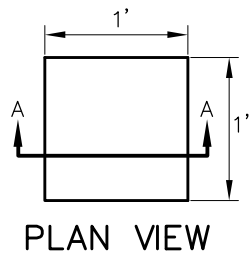
NOTES:

1. USE TYPE 1 PLATE INSTALLATION WHERE POSTED SPEED LIMIT IS LESS THAN 30 MPH. USE TYPE 2 PLATE INSTALLATION WHERE POSTED SPEED LIMIT IS 30 MPH OR GREATER.
2. FOR TYPE 2 PLATE INSTALLATION, THE STEEL PLATE SHALL BE RECESSED BY MILLING INTO THE EXISTING ASPHALT TO SET FLUSH WITH THE SURFACE OF THE EXISTING ASPHALT. FULL DEPTH CUTTING OF PAVEMENT SECTION OUTSIDE OF TRENCH IS NOT PERMITTED. MILLING DEPTH SHALL MATCH THICKNESS OF PLATE. THE GAP BETWEEN THE EDGE OF THE PLATE AND THE ADJACENT EXISTING ASPHALT PAVEMENT MUST BE FILLED WITH TEMPORARY ASPHALT.
3. TRENCH WIDTHS ARE BASED ON AN ANALYSIS PER THE 14TH EDITION OF STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES BY AASHTO. AN ASSUMED AXLE LOADING OF 12 TONS WITH A 30% IMPACT FACTOR WAS USED. THE AXLE LENGTH IS 6 FEET; THEREFORE THE NUMBER OF WHEELS CARRIED BY A PLATE DEPENDS ON THE ROADWAY WIDTH.
4. STEEL PLATE MUST BE ABLE TO WITHSTAND H-20 TRAFFIC LOADINGS WITHOUT ANY MOVEMENT.
5. PLATES SHALL BE FABRICATED FROM ASTM A36 STEEL (MIN).
6. PLATES SHALL BE SECURED FROM LATERAL MOVEMENT AND VERTICAL VIBRATION (ASSOCIATED NOISE) WHILE IN USE BY TEMPORARY ASPHALT (COLD MIX.)

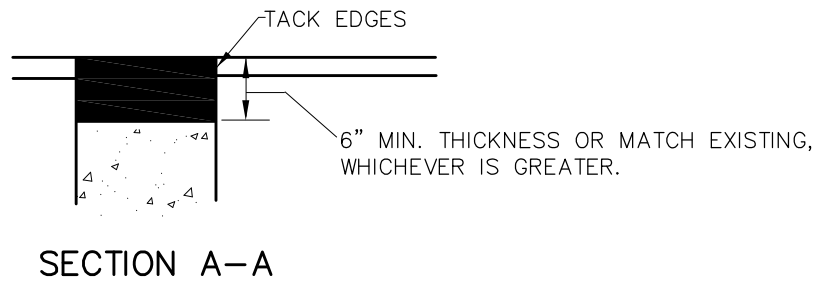




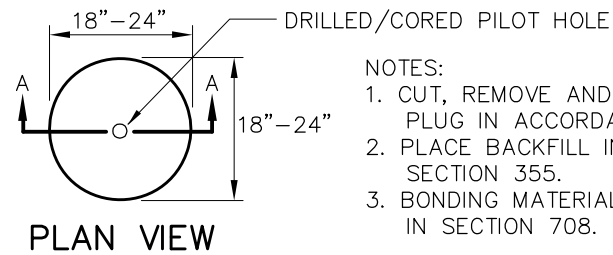
TYPE A PAVEMENT REPAIR



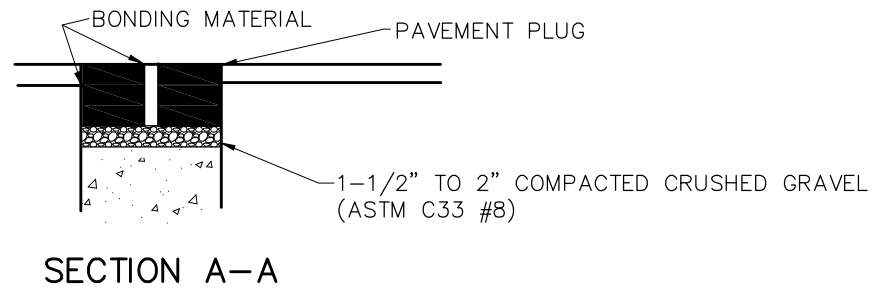
- NOTES:
1. DIMENSIONS ARE NOMINAL.
 2. EDGES SHALL BE CUT TO A NEAT VERTICAL FACE.
 3. PLACE CLSM BACKFILL IN ACCORDANCE WITH SECTION 604.
 4. PLACE AGENCY-APPROVED ASPHALT CONCRETE IN MAXIMUM 2" LIFTS.



TYPE B PAVEMENT REPAIR



- NOTES:
1. CUT, REMOVE AND REPLACE PAVEMENT. PLUG IN ACCORDANCE WITH SECTION 355.
 2. PLACE BACKFILL IN ACCORDANCE WITH SECTION 355.
 3. BONDING MATERIAL SHALL BE AS SPECIFIED IN SECTION 708.



DETAIL NO.

212



STANDARD DETAIL
ENGLISH

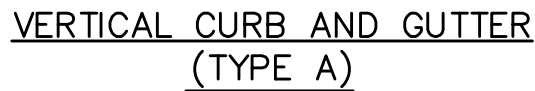
UTILITY POTHOLE REPAIR

REVISED

01-01-2015

DETAIL NO.

212

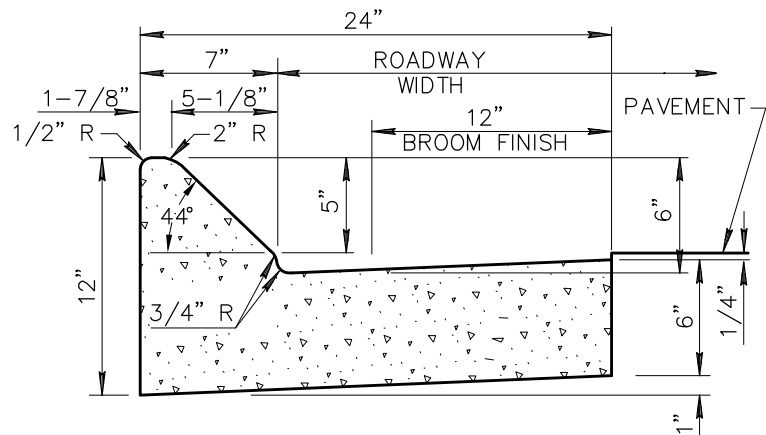


1. ALL EXPOSED SURFACES TO BE TROWEL FINISHED EXCEPT AS SHOWN. SEE SECT. 340.
2. H=6" OR AS SPECIFIED ON PLANS.
3. CONTRACTION JOINT SPACING 10' MAXIMUM.
4. EXPANSION JOINTS AS PER SECT. 340.
5. CLASS 'B' CONCRETE PER 725.
6. WHEN THE ADJACENT PAVEMENT SECTION SLOPES AWAY FROM THE GUTTER, THE SLOPE OF THE GUTTER PAN SHALL MATCH PAVEMENT CROSS SLOPE.

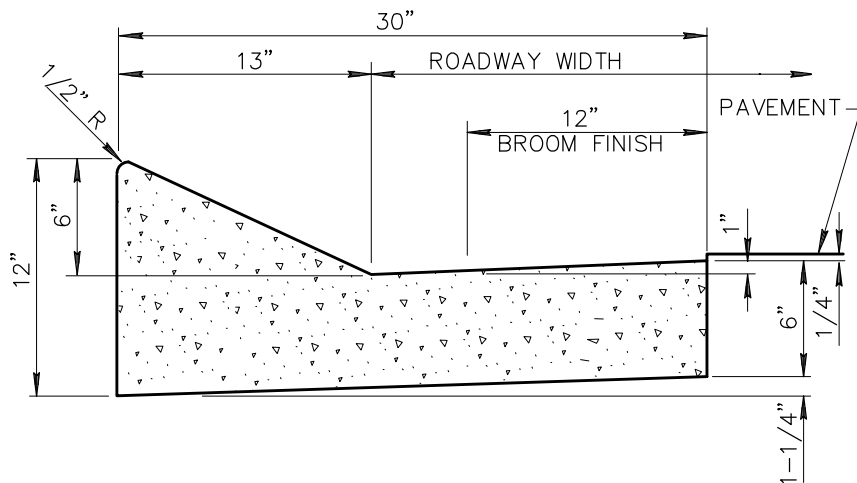
1. CONSTRUCT CURB AND INSTALL 1/2" MASTIC EXPANSION JOINTS, A.S.T.M. D-1751. SECT. 340.
2. BROOM FINISH ALL SURFACES.
3. RIBBON CURB MAY SLOPE TOWARDS PAVEMENT OR PARKWAY AS INDICATED ON PLANS.
4. CONTRACTION JOINT SPACING 10' MAXIMUM.
5. CONCRETE SHALL BE CLASS 'B' PER SECT. 725 AND INSTALLED PER SECT. 505.



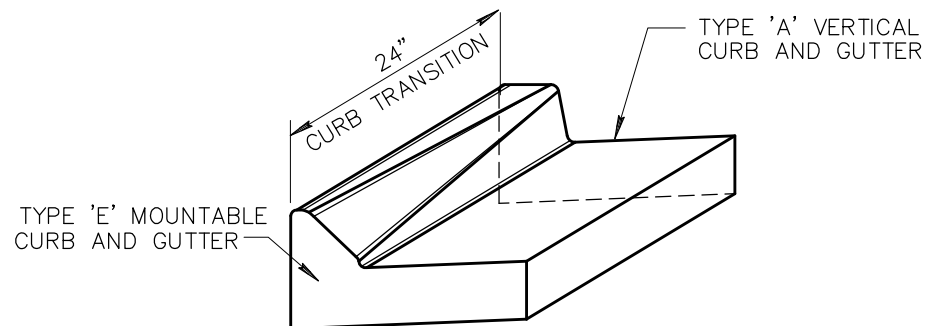
1. ALL WORK AND MATERIALS SHALL CONFORM TO SECT. 304, 505 AND 725. BROOM FINISH TO EXPOSED SURFACE.
2. CONTRACTION JOINT SPACING 10' MAXIMUM.
3. EXPANSION JOINTS AS PER SECT. 340.
4. CLASS 'B' CONCRETE PER 725.



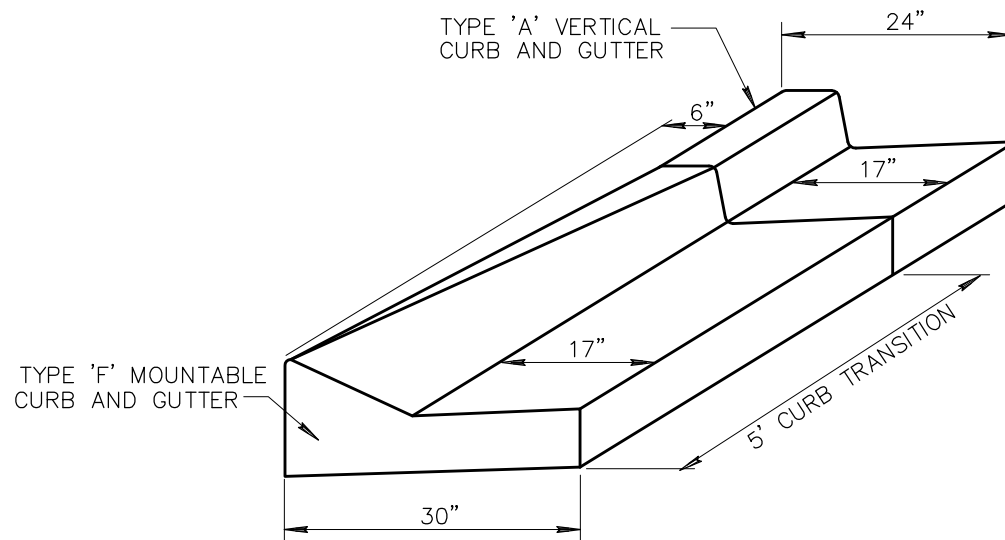
MOUNTABLE CURB AND GUTTER (TYPE E)



MOUNTABLE CURB AND GUTTER (TYPE F)



CURB TRANSITION TYPE 'E' TO TYPE 'A'



CURB TRANSITION TYPE 'F' TO TYPE 'A'

NOTES: (E & F)

1. ALL EXPOSED SURFACES TO BE TROWEL FINISHED EXCEPT AS SHOWN. SEE SECT. 340.
2. CONTRACTION JOINT SPACING 10' MAXIMUM.
3. EXPANSION JOINTS PER SECT. 340.
4. CLASS 'B' CONCRETE PER SECT. 725.
5. WHEN THE ADJACENT PAVEMENT SECTION SLOPES AWAY FROM THE GUTTER, THE SLOPE OF THE GUTTER PAN SHALL MATCH THE PAVEMENT CROSS SLOPE.

DETAIL NO.

220-2



STANDARD DETAIL
ENGLISH

CURB AND GUTTER
TYPES E AND F

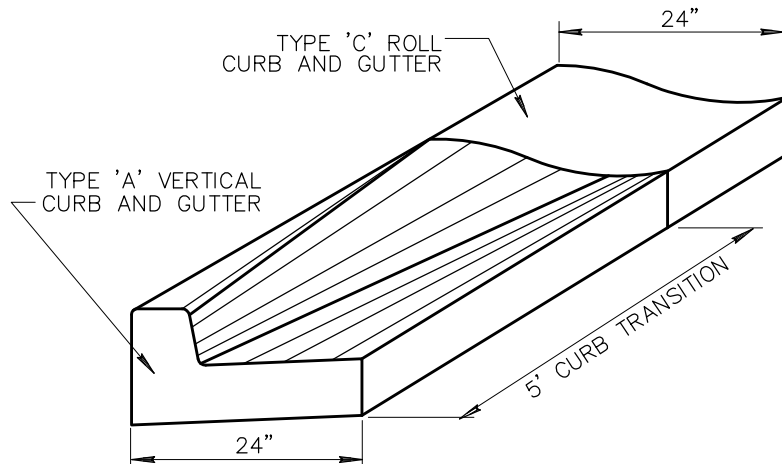
REVISED

01-01-2007

DETAIL NO.

220-2

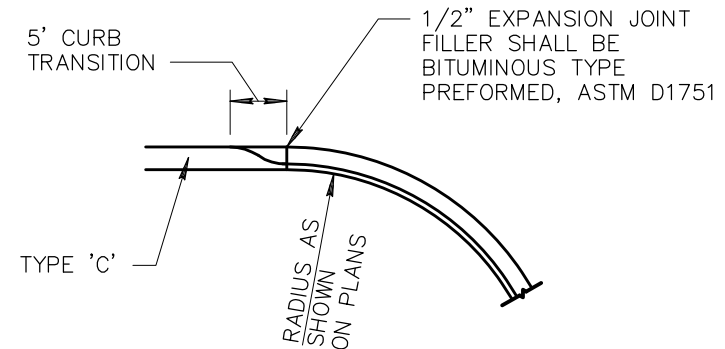
CURB TRANSITION TYPE 'A' TO TYPE 'C'



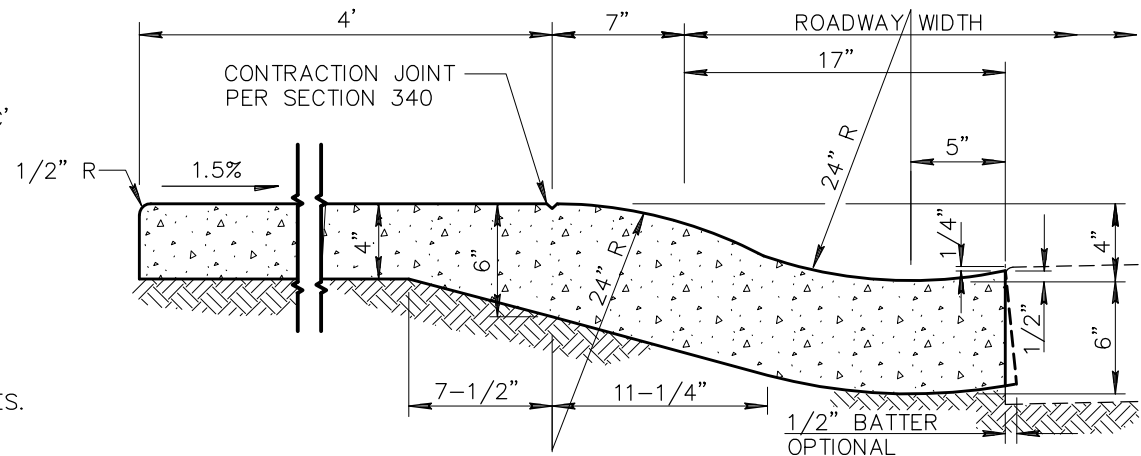
NOTES: (CURB AND GUTTER TRANSITIONS)

1. TRANSITIONS WILL BE PAID FOR AS THE PREDOMINANT TYPE OF CURB AND GUTTER BEING TRANSITIONED. WHEN TYPE 'A' CURB AND GUTTER ARE USED AT CURB RETURNS AND TYPE 'C' CURB AND GUTTER IS PREDOMINANTLY USED ELSEWHERE, THE TYPE 'A' TO TYPE 'C' TRANSITIONS SHALL BE MEASURED AND PAID FOR AS TYPE 'C' CURB AND GUTTER.
2. WHERE PROPOSED CONSTRUCTION IS TO BE CONNECTED TO EXISTING CURB AND GUTTER, THE TRANSITION SHALL BE INDICATED ON PLANS.
3. CLASS 'B' CONCRETE PER SECTION 725.
4. TRANSITION BETWEEN TYPICAL SECTIONS SHALL BE ACCOMPLISHED BY THE USE OF DIRECT STRAIGHT LINE TRANSITIONS OF THE FLOW LINE AND OTHER SURFACE FEATURES.

CURB AND GUTTER TRANSITION



INTEGRAL ROLL CURB, GUTTER AND SIDEWALK



NOTES: (INTEGRAL ROLL CURB, GUTTER AND SIDEWALK)

1. CONCRETE TO BE MONOLITHIC POUR. EXPOSED SURFACE FINISH AS PER SIDEWALK AND GUTTER DETAIL.
2. CONTRACTION JOINT SPACING 5' MAXIMUM.
3. EXPANSION JOINTS PER SECTION 340.
4. CLASS 'B' CONCRETE PER SECTION 725.

DETAIL NO.

221



STANDARD DETAIL
ENGLISH

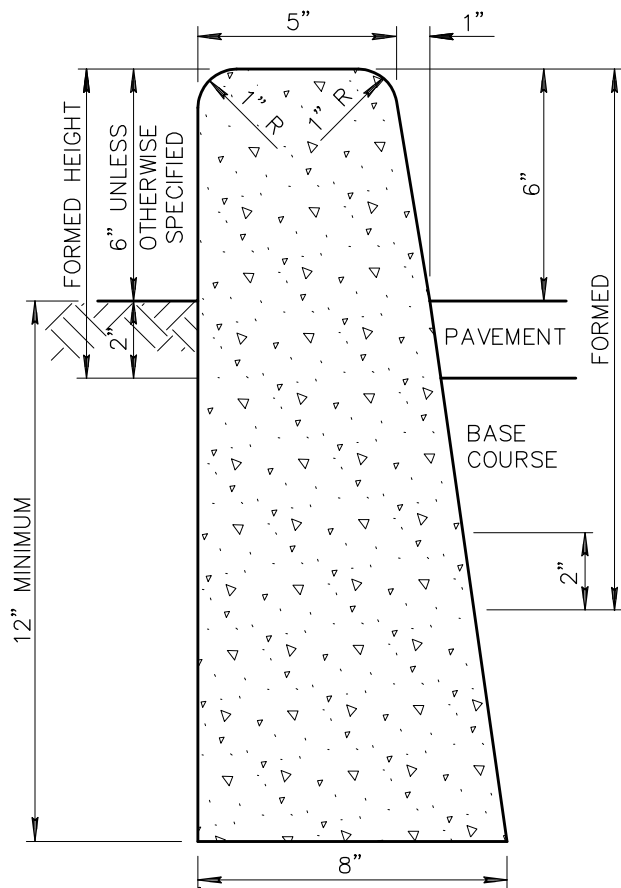
CURB AND GUTTER TRANSITION TYPE A TO TYPE C
INTEGRAL ROLL CURB, GUTTER AND SIDEWALK

REVISED

01-01-2014

DETAIL NO.

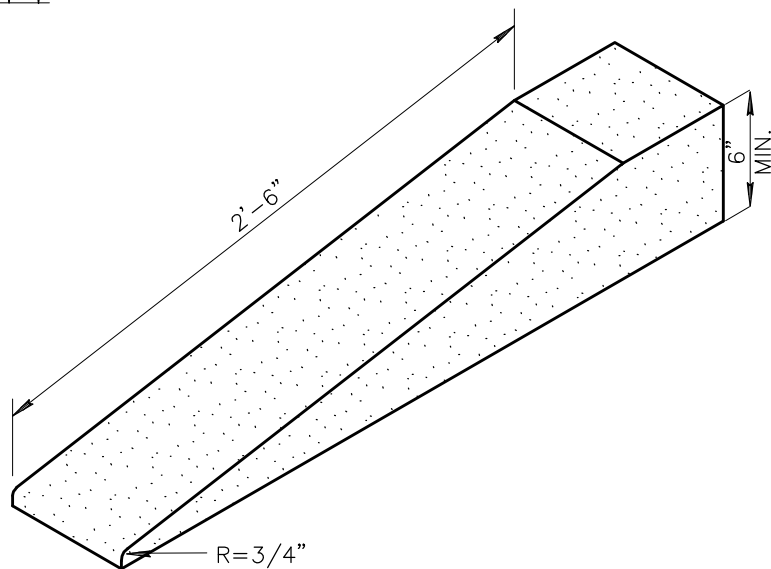
221



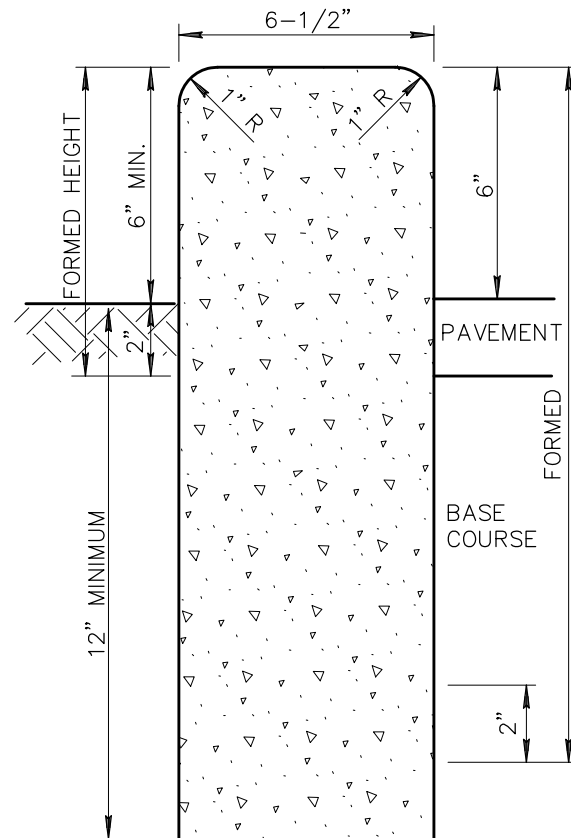
TYPE 'A'

NOTES:

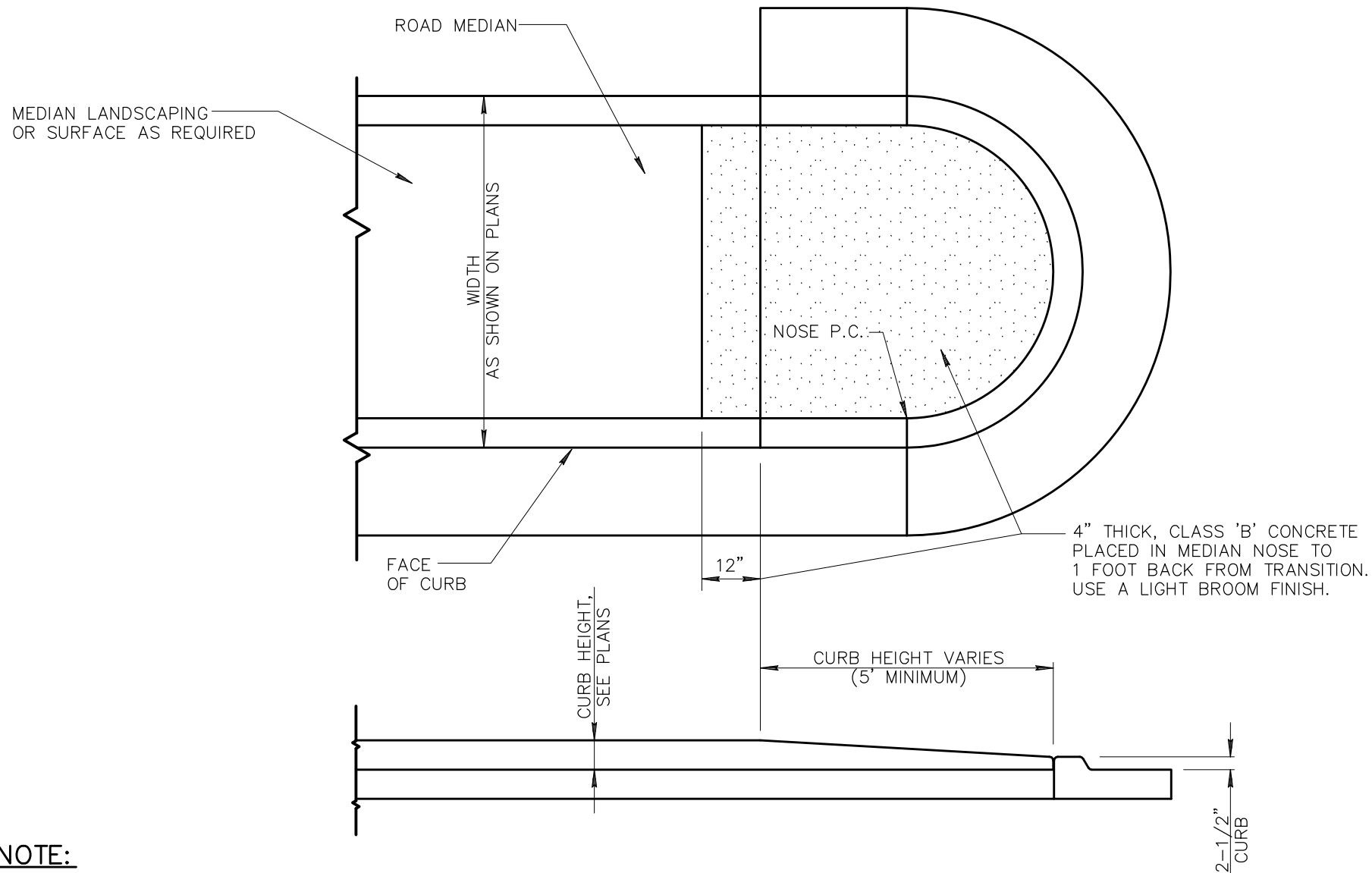
1. ALL VERTICAL SURFACES TO BE FORMED.
2. VERTICAL SURFACES DOWN FROM 2" BELOW UNDISTURBED SOIL MAY BE PLACED AGAINST NEAT CUT IF APPROVED BY THE ENGINEER AND CONCRETE WILL NOT EXTEND MORE THAN 1" BEYOND THEORETICAL FACE.
3. ALL EXPOSED SURFACES TO BE STRIPPED GREEN AND TROWEL FINISHED.
4. CONCRETE CURBS CONFORM TO SECT. 340.
5. MAXIMUM SPACING OF CONTRACTION JOINTS IS 10'.
6. CONCRETE TO BE CLASS 'B' PER SECT. 725.
7. WHEN PAVEMENT AND BASE COURSE EQUALS OR EXCEEDS 10" IN DEPTH, THE ENTIRE ROADWAY SIDE OF THE CURB SHALL BE FORMED. THE TOTAL CURB HEIGHT REMAINS 18" UNLESS NOTED OTHERWISE.



TYPICAL CURB TERMINATION



TYPE 'B'



NOTE:

LENGTH OF TRANSITION SHALL BE
EQUAL TO RADIUS OF MEDIAN NOSE,
(5' MINIMUM). FOR LOCATION
SEE PLANS.

DETAIL NO.

223



STANDARD DETAIL
ENGLISH

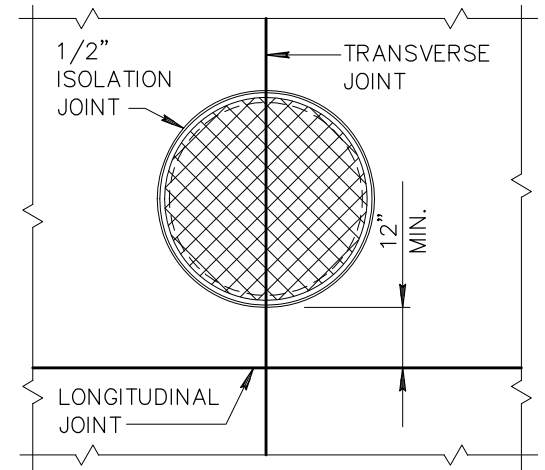
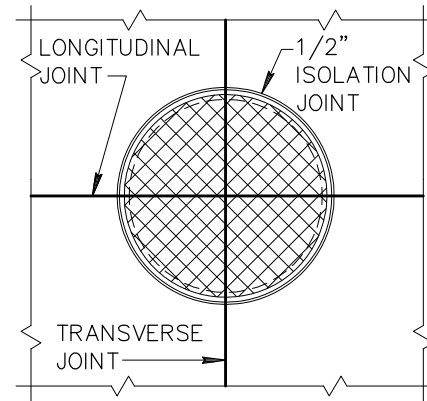
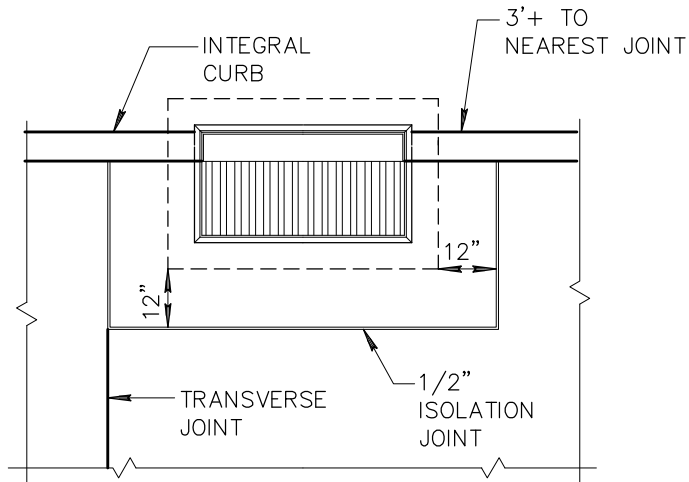
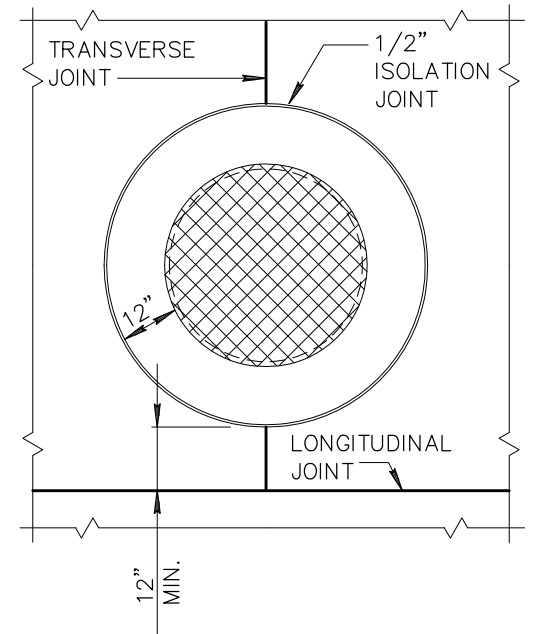
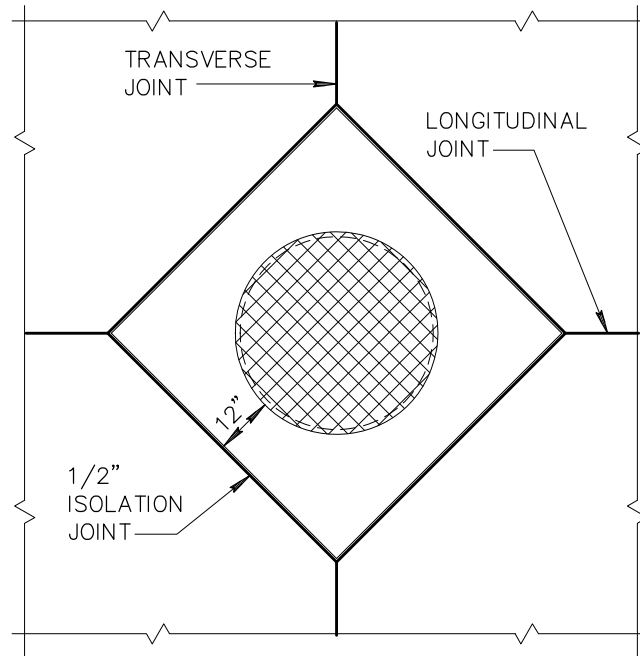
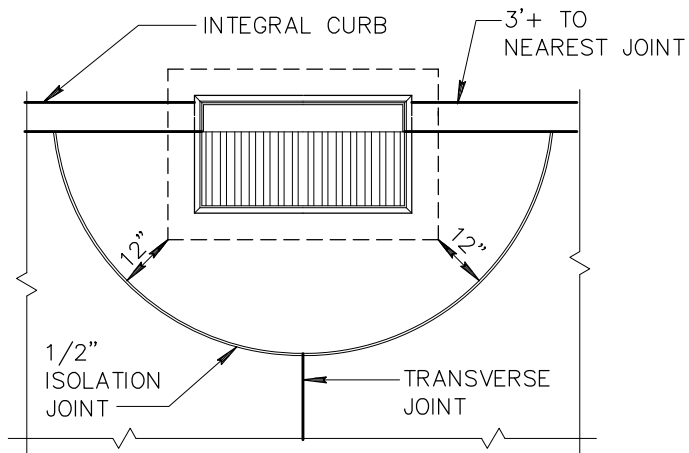
MEDIAN NOSE TRANSITION

REVISED

01-01-1998

DETAIL NO.

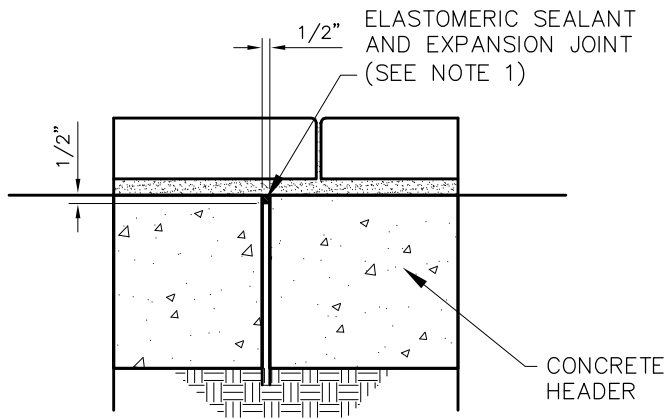
223



DRAINAGE INLET

MANHOLE COVERS

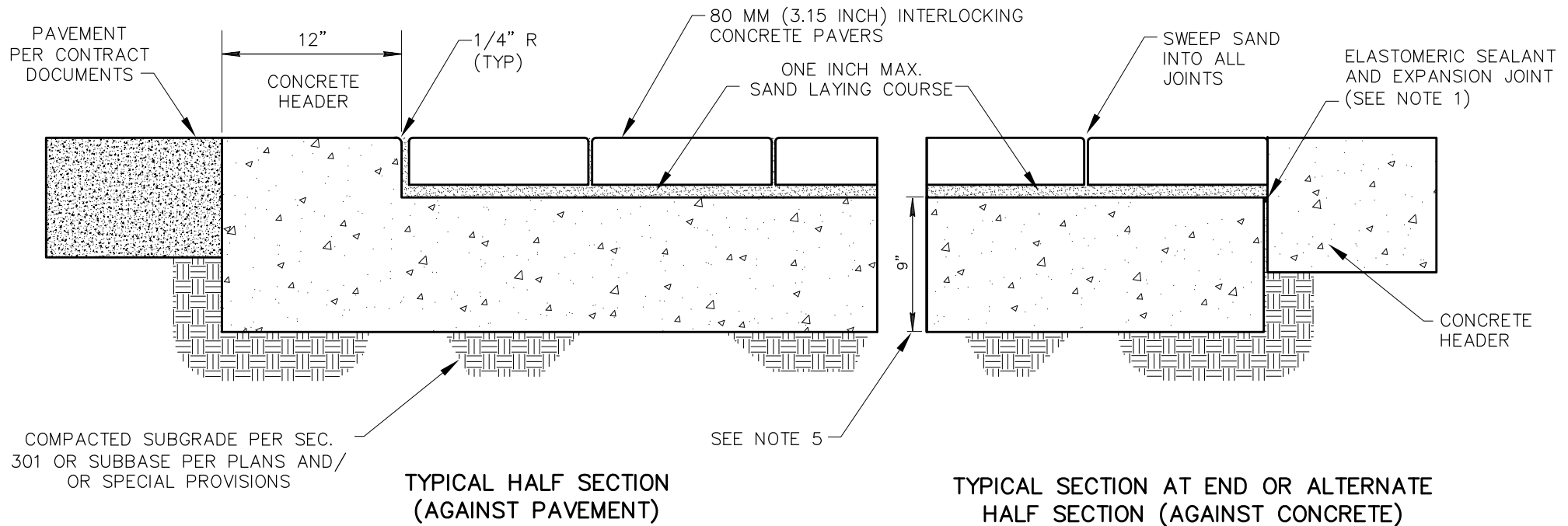
MANHOLE COVERS



EXPANSION JOINT DETAIL

NOTES:

1. 1/2 INCH EXPANSION JOINT, ASTM D-1751 PER SEC. 729 AND ELASTOMERIC SEALANT PER SEC. 342
2. CONTRACTION JOINTS PER SEC. 342
3. MATERIALS AND CONSTRUCTION PER SEC. 342
4. PORTLAND CEMENT CONCRETE SHALL BE CLASS A
5. DESIGN PARAMETERS FOR THE THICKNESS IS BASED ON:
ASSUMES MODULUS OF SUBGRADE REACTION (K) = 100 pci
CONCRETE WORKING STRESS $f = 300$ psi
TERMINAL SERVICABILITY INDEX I_p OF 2.5 OVER 20 YEARS
AND 1 MILLION TOTAL EQUIVALENT 18-KIP SINGLE-AXLE
LOAD APPLICATIONS



DETAIL NO.

225



STANDARD DETAIL
ENGLISH

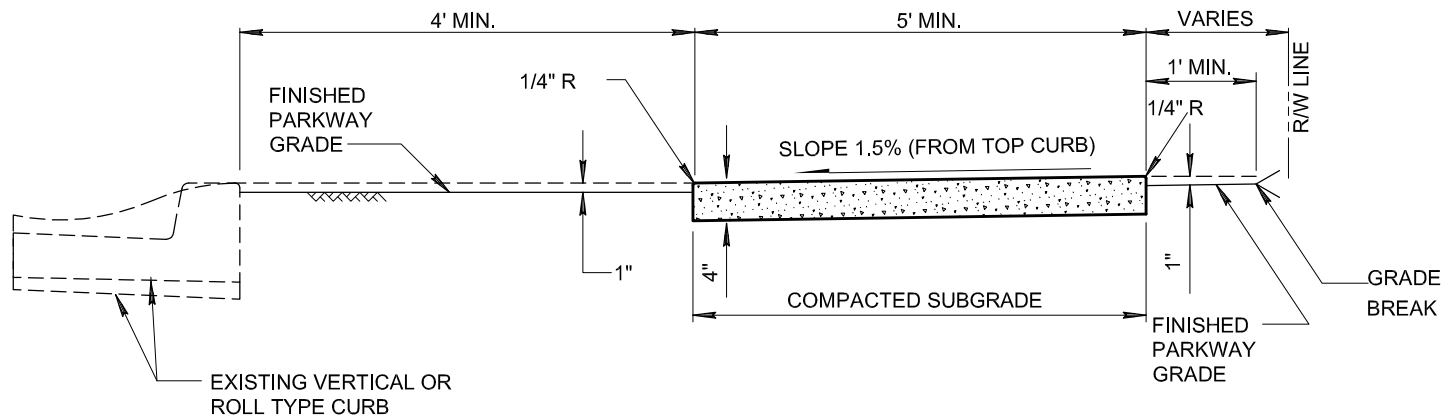
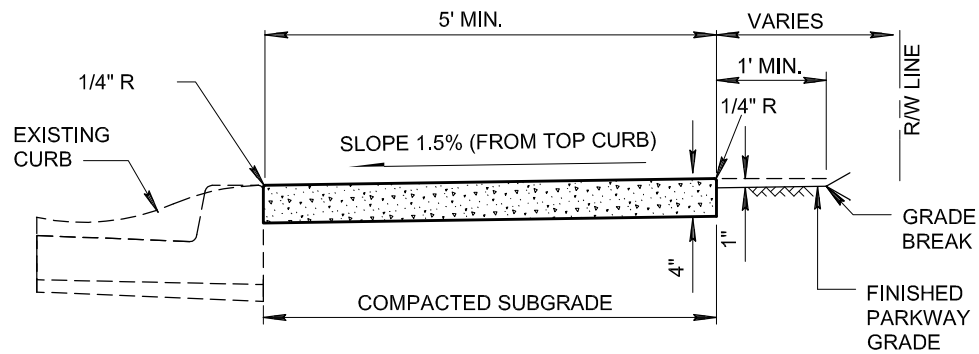
CONCRETE PAVERS

REVISED

01-01-2005

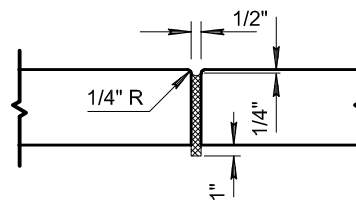
DETAIL NO.

225

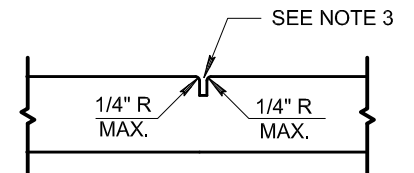


NOTES:

1. SIDEWALK CONSTRUCTION SHALL CONFORM TO SECTION 340.
2. EXPANSION JOINTS SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, PER SECTION 729.
3. LARGE AGGREGATE, IN CONTRACTION JOINT SHALL BE SEPARATED TO A DEPTH OF 1", FINISH DEPTH SHALL BE A MINIMUM OF 3/4".
4. EXPANSION JOINTS SHALL CONFORM TO SECTION 340, BE INSTALLED PRIOR TO CONCRETE PLACEMENT, AND AT A MAXIMUM SPACING OF 50'.
5. CONCRETE SHALL BE CLASS 'B' PER SECTION 725.
6. WHEN SIDEWALK AND ADJACENT CURB ARE CONSTRUCTED MONOLITHICALLY, ALL EXPANSION AND CONTRACTION JOINTS SHALL EXTEND ACROSS THE CURB.



EXPANSION JOINT



CONTRACTION JOINT

DETAIL NO.

230



STANDARD DETAIL
ENGLISH

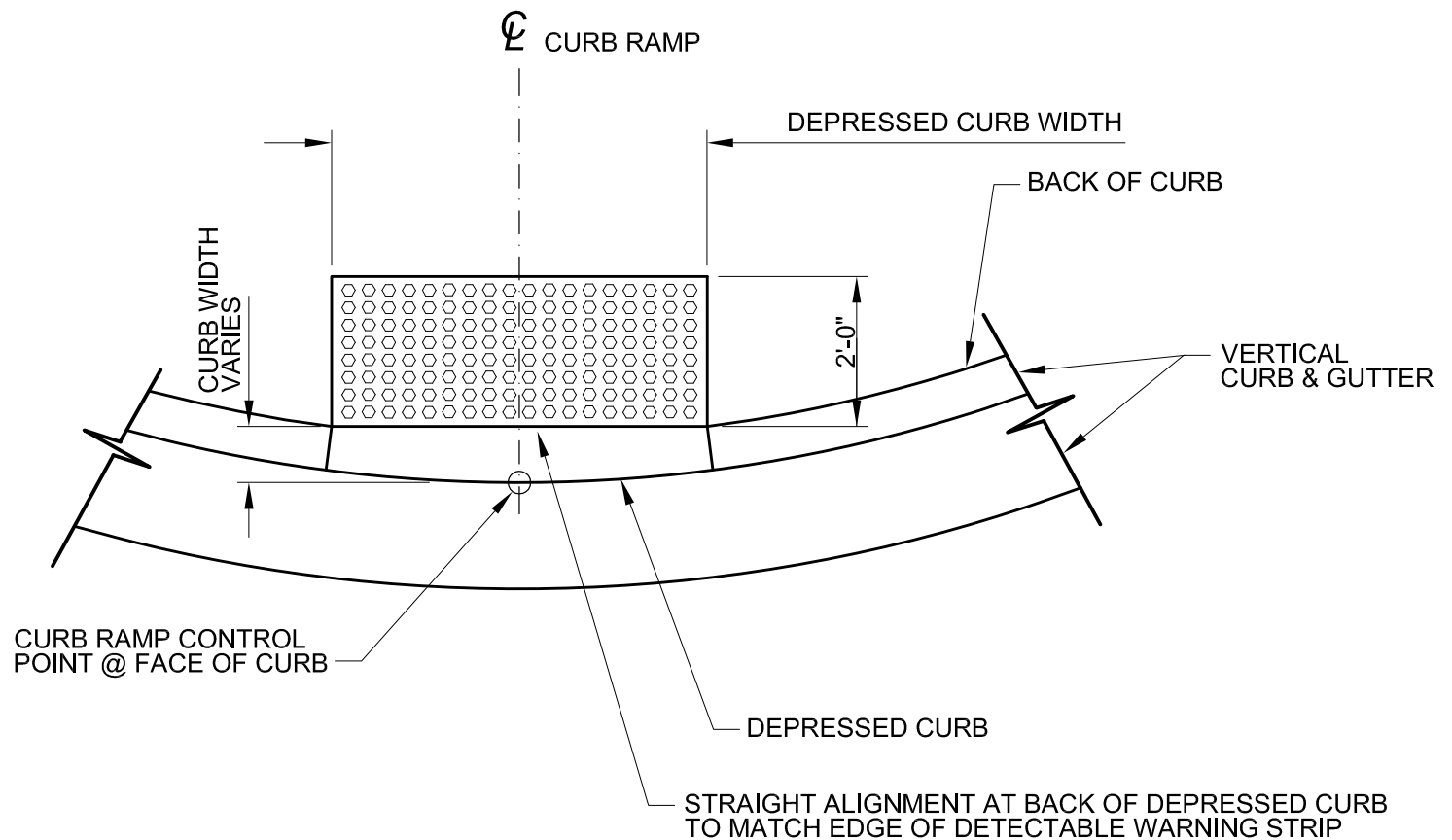
SIDEWALKS

REVISED

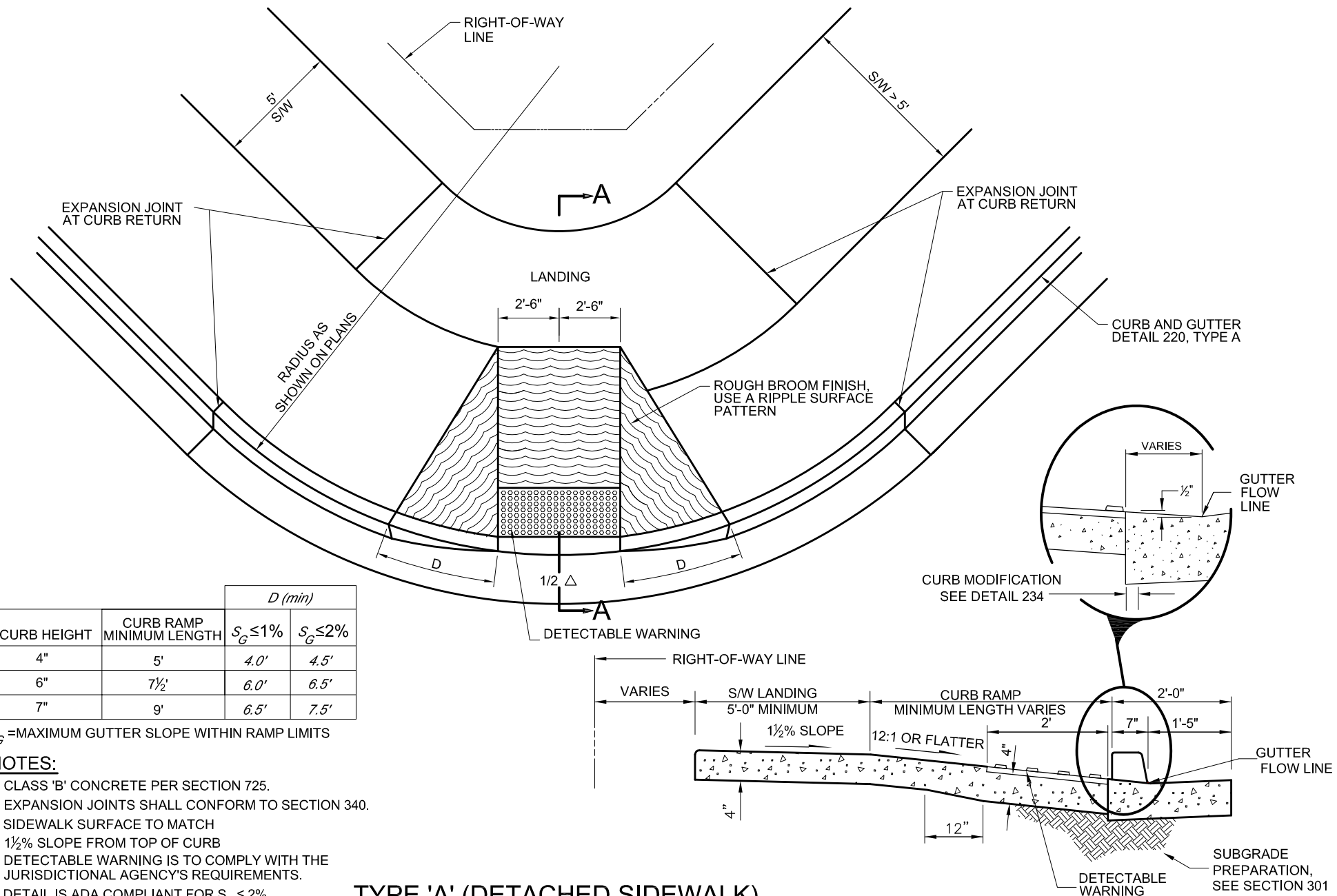
01-01-2014

DETAIL NO.

230



PLAN VIEW



TYPE 'A' (DETACHED SIDEWALK)

SECTION A-A

DETAIL NO.

235-1



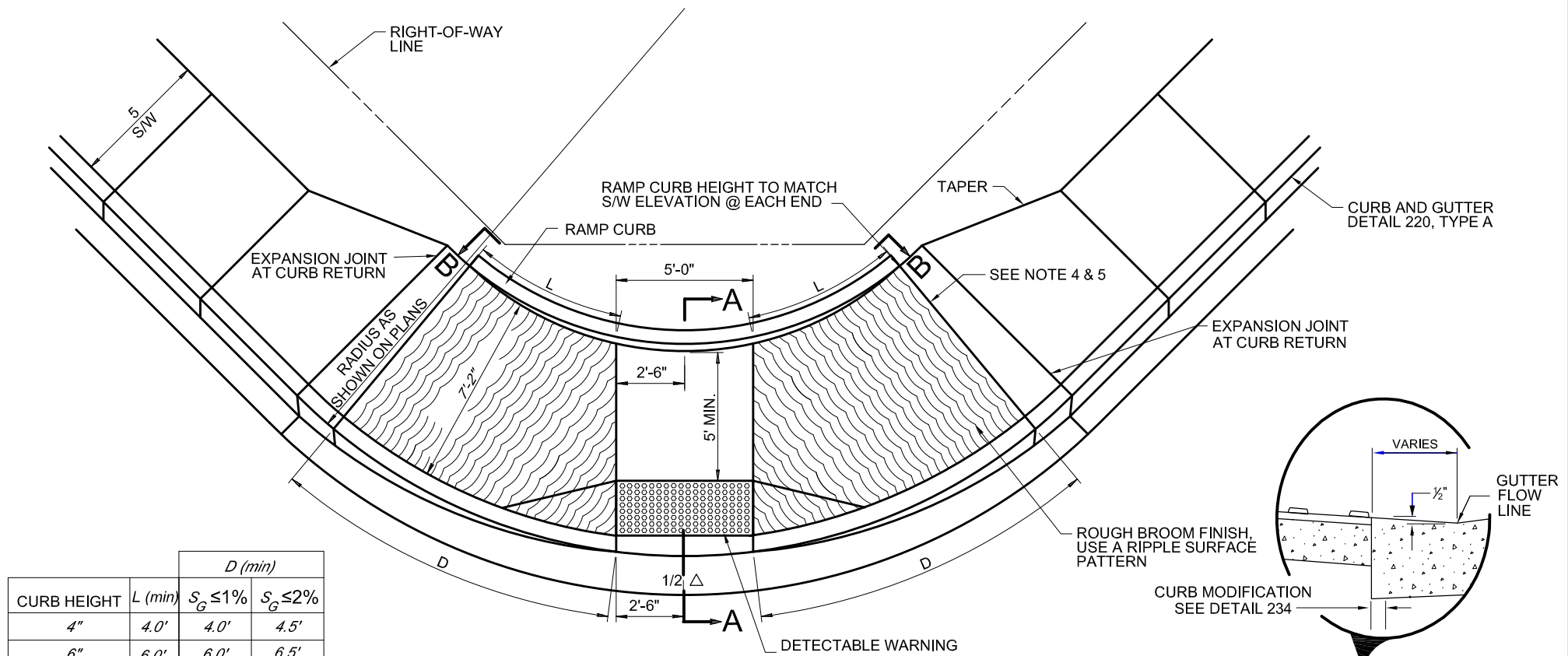
STANDARD DETAIL
ENGLISH

CURB RAMPS

REVISED
01-01-2012

DETAIL NO.

235-1

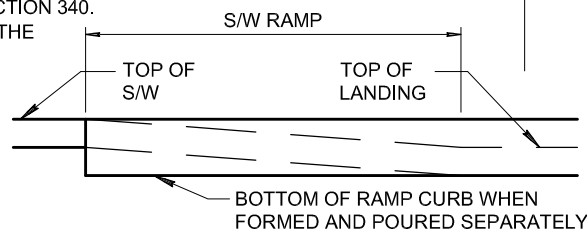


CURB HEIGHT	L (min)	D (min)	
		$S_G \leq 1\%$	$S_G \leq 2\%$
4"	4.0'	4.0'	4.5'
6"	6.0'	6.0'	6.5'
7"	7.0'	6.5'	7.5'

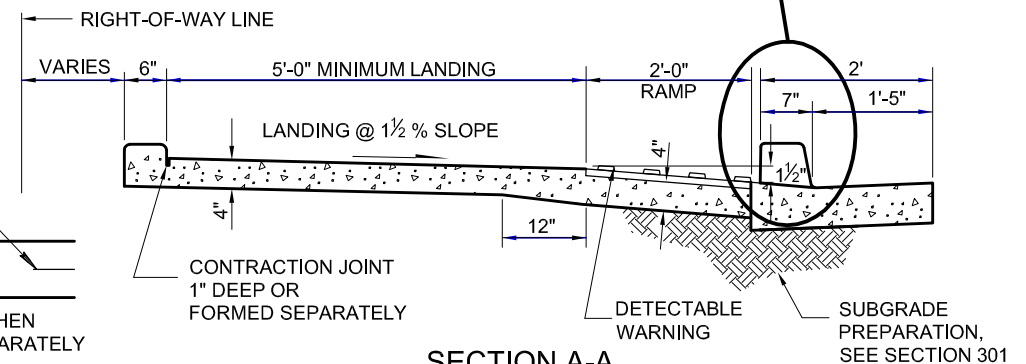
S_G = MAXIMUM GUTTER SLOPE WITHIN RAMP LIMITS

NOTES:

1. CLASS 'B' CONCRETE PER SECTION 725.
2. EXPANSION JOINTS SHALL CONFORM TO SECTION 340.
3. DETECTABLE WARNING IS TO COMPLY WITH THE JURISDICTIONAL AGENCY'S REQUIREMENTS.
4. INCREASE 'L' OR 'D' AS NEEDED TO HAVE THE TOP OF RAMP FORM A RADIAL LINE.
5. WHEN TOP OF RAMP IS LESS THAN 4' FROM CURB RETURN, EXTEND RAMP TO THE CURB RETURN.
6. DETAIL IS ADA COMPLIANT FOR $S_G \leq 2\%$.



SECTION B-B



TYPE 'B'

SECTION A-A

DETAIL NO.

235-2



STANDARD DETAIL
ENGLISH

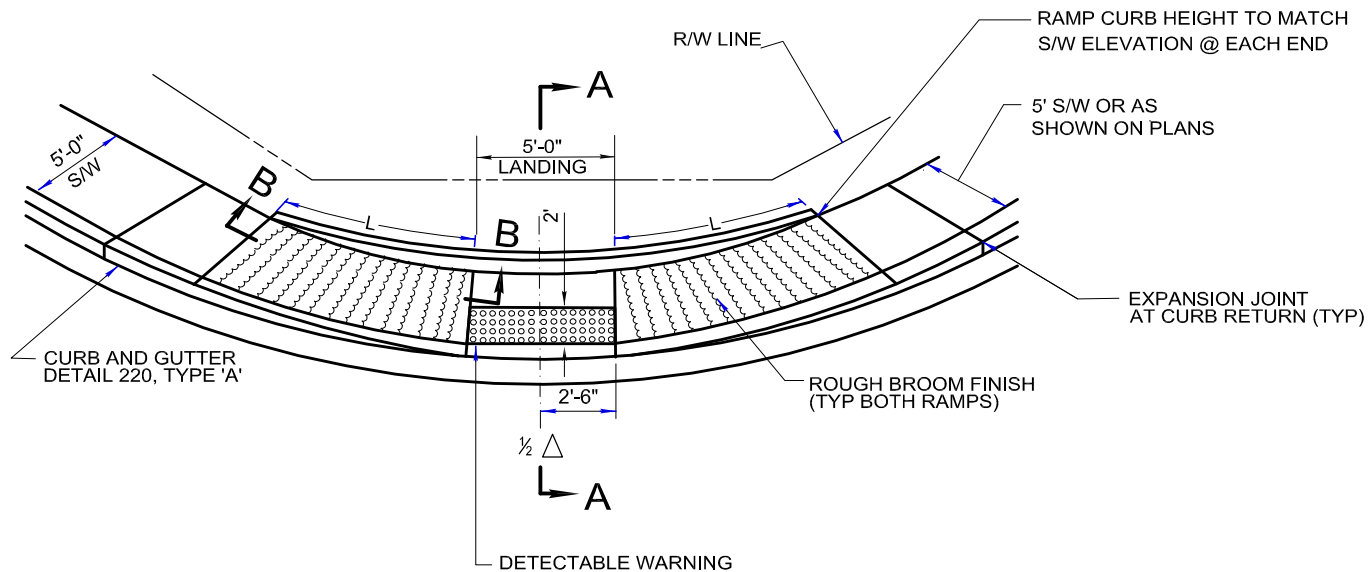
CURB RAMPS

REVISED

01-01-2012

DETAIL NO.

235-2

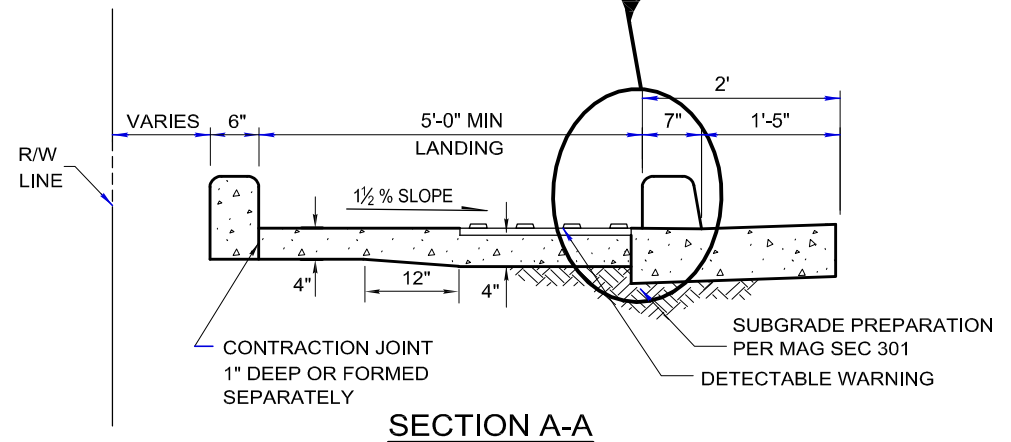
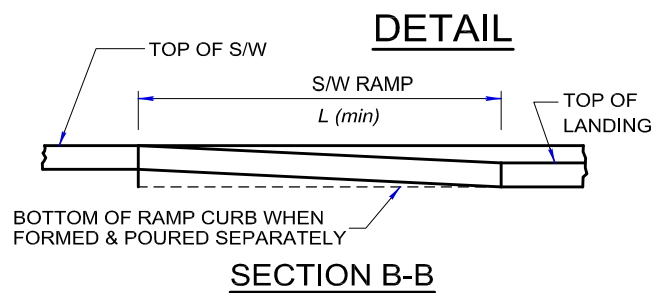


NOTES:

1. CLASS 'B' CONCRETE CONSTRUCTION PER SECTION 725.
2. DETECTABLE WARNING IS TO COMPLY WITH THE JURISDICTIONAL AGENCY'S REQUIREMENT.
3. RAMP LONGITUDINAL SLOPE SHALL BE 12:1 OR FLATTER.
4. RAMP CROSS SLOPE SHALL BE 1½%.
5. DETAIL IS ADA COMPLIANT FOR CURB RADII ≥ 20' AND GUTTER SLOPE ≤ 2.0%.

CURB HEIGHT	L (min)	
	$S_G \leq 1\%$	$S_G \leq 2\%$
4"	5.0'	6.0'
6"	7.0'	8.5'

S_G = MAXIMUM GUTTER SLOPE WITHIN RAMP LIMITS



TYPE 'C'

DETAIL NO.

235-3



STANDARD DETAIL
ENGLISH

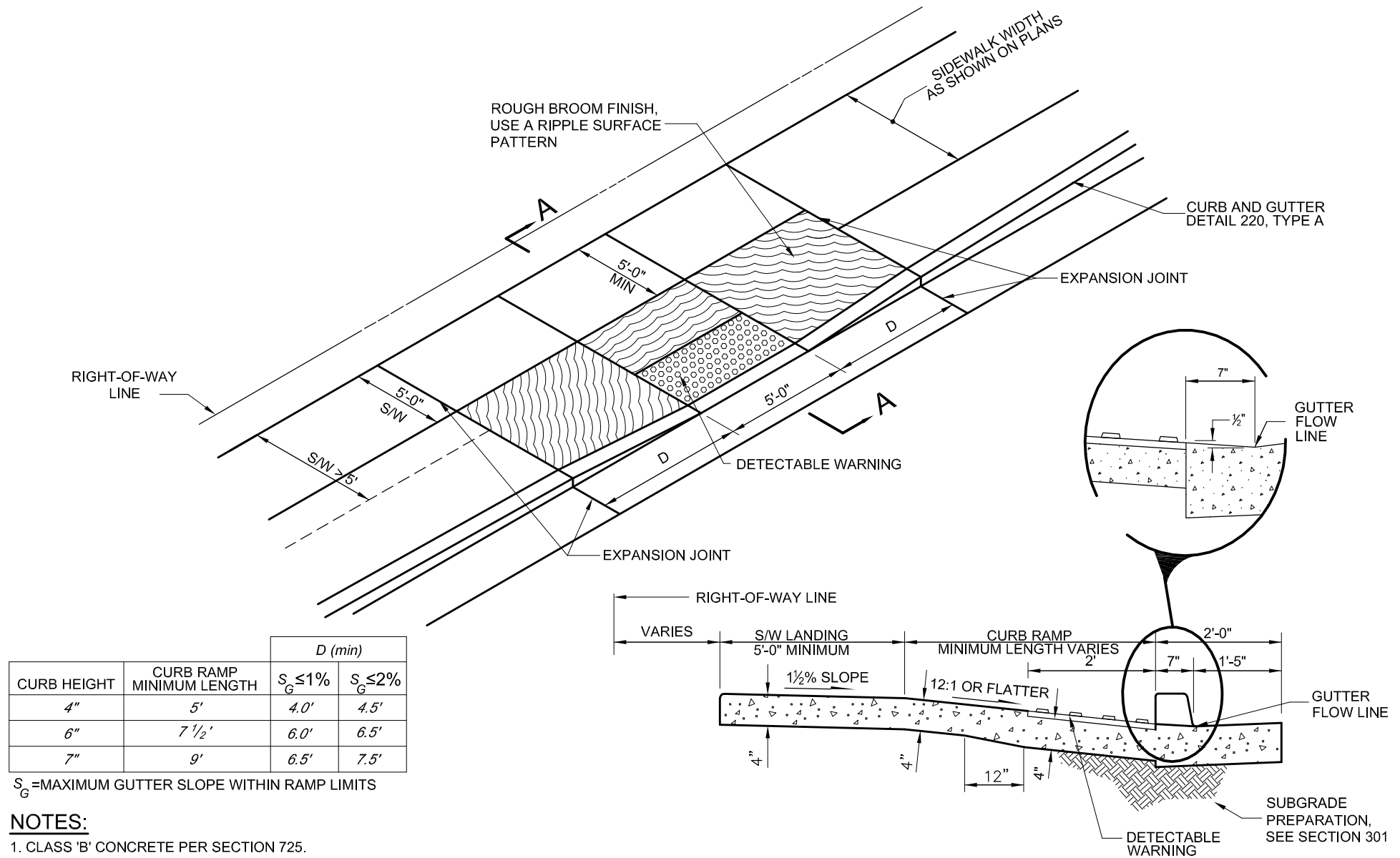
CURB RAMPS

REVISED

01-01-2012

DETAIL NO.

235-3



NOTES:

1. CLASS 'B' CONCRETE PER SECTION 725.
2. EXPANSION JOINTS SHALL CONFORM TO SECTION 340.
3. SIDEWALK SURFACE TO MATCH 1 1/2 % SLOPE FROM TOP OF CURB.
4. DETECTABLE WARNING IS TO COMPLY WITH THE JURISDICTIONAL AGENCY'S REQUIREMENTS.
5. DETAIL IS ADA COMPLIANT FOR $S_G \leq 2\%$.

SECTION A-A

TYPE 'D' DETACHED SIDEWALK

DETAIL NO.

235-4



STANDARD DETAIL
ENGLISH

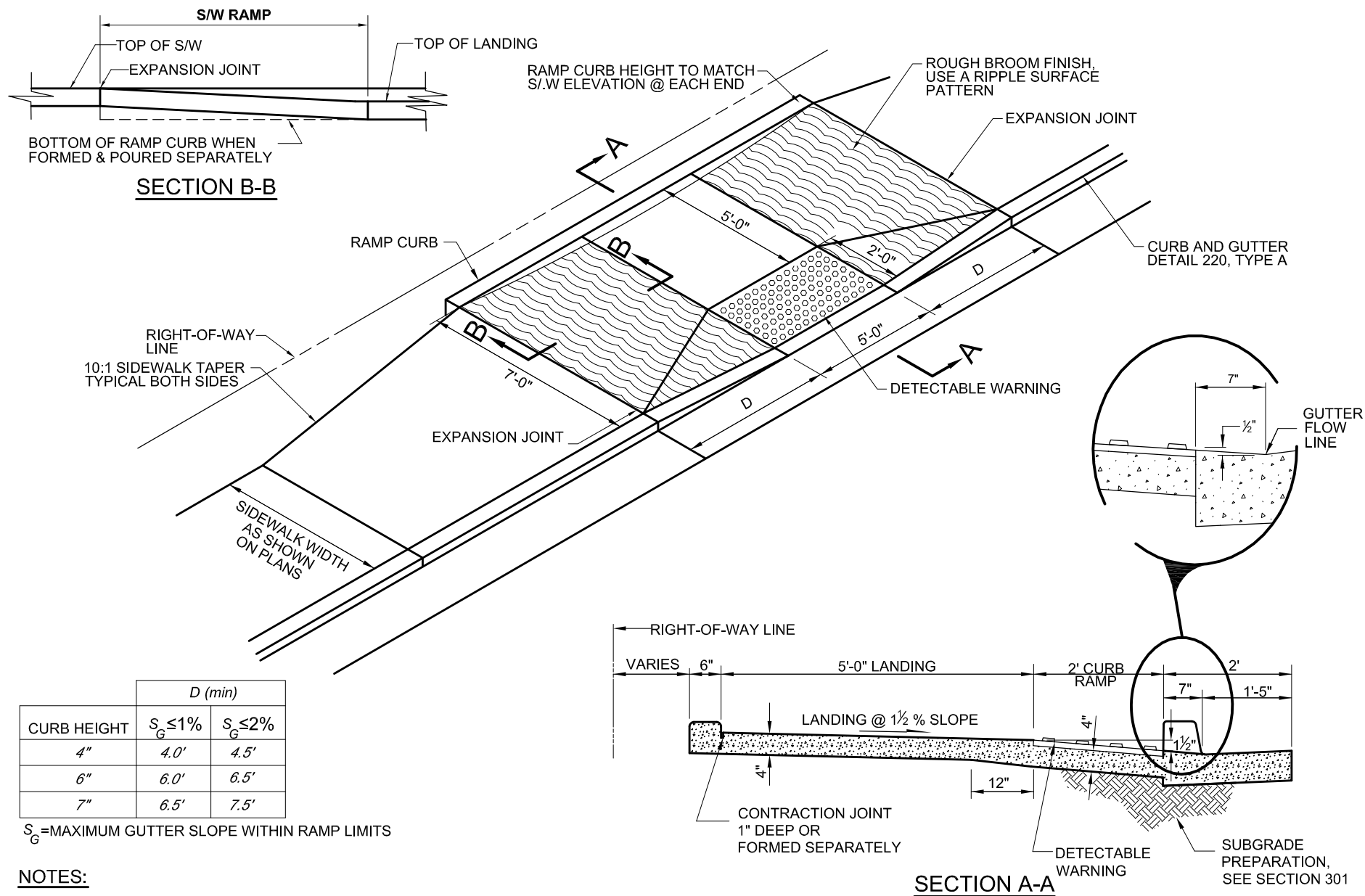
CURB RAMPS

REVISED

01-01-2011

DETAIL NO.

235-4



TYPE 'E'

DETAIL NO.

235-5



STANDARD DETAIL
ENGLISH

CURB RAMPS

REVISED

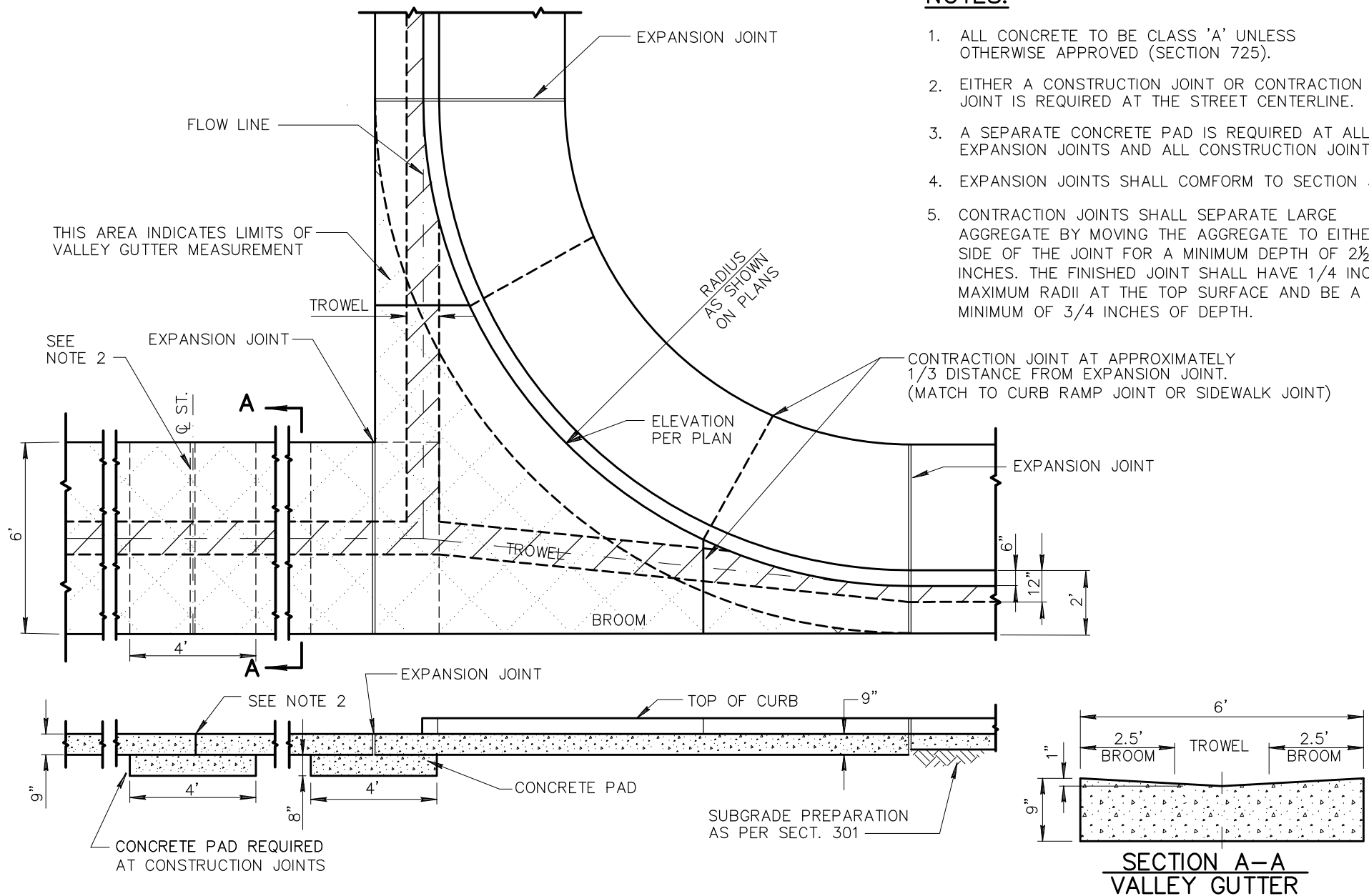
01-01-2011

DETAIL NO.

235-5

NOTES:

1. ALL CONCRETE TO BE CLASS 'A' UNLESS OTHERWISE APPROVED (SECTION 725).
2. EITHER A CONSTRUCTION JOINT OR CONTRACTION JOINT IS REQUIRED AT THE STREET CENTERLINE.
3. A SEPARATE CONCRETE PAD IS REQUIRED AT ALL EXPANSION JOINTS AND ALL CONSTRUCTION JOINTS.
4. EXPANSION JOINTS SHALL COMFORM TO SECTION 340.
5. CONTRACTION JOINTS SHALL SEPARATE LARGE AGGREGATE BY MOVING THE AGGREGATE TO EITHER SIDE OF THE JOINT FOR A MINIMUM DEPTH OF 2½ INCHES. THE FINISHED JOINT SHALL HAVE 1/4 INCH MAXIMUM RADII AT THE TOP SURFACE AND BE A MINIMUM OF 3/4 INCHES OF DEPTH.



DETAIL NO.

240



STANDARD DETAIL
ENGLISH

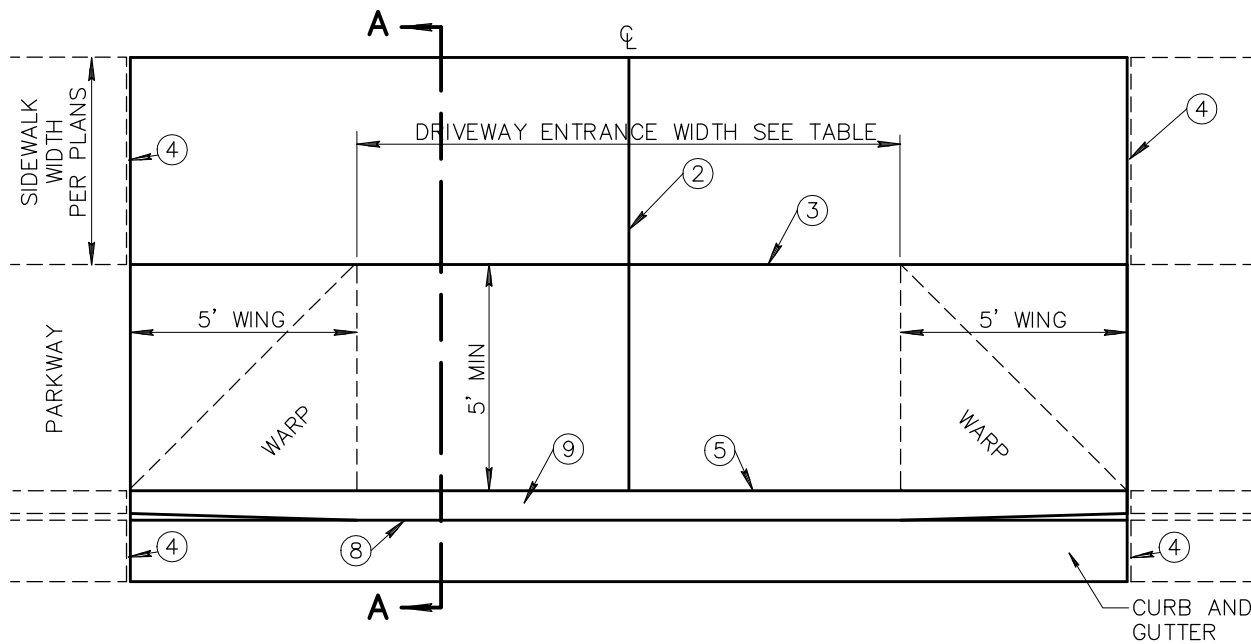
VALLEY GUTTER

REVISED

01-01-2010

DETAIL NO.

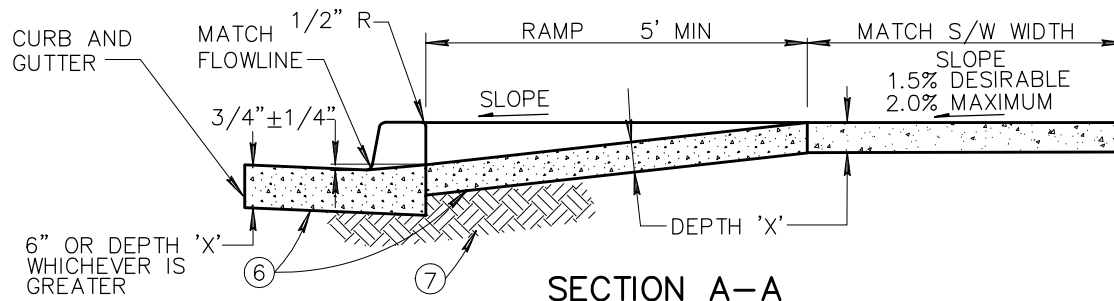
240



DRIVEWAY WITH DETACHED SIDEWALK

NOTES:

1. DEPRESSED CURB SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE FOR THE TYPE OF CURB USED AT THAT LOCATION.
2. CONTRACTION JOINT ON D/W CENTERLINE.
3. CONTRACTION JOINT.
4. 1/2-INCH EXPANSION JOINTS SHALL COMPLY WITH SECTION 340.
5. BACK OF CURB – CONSTRUCTION JOINT.
6. CONCRETE CLASS AS NOTED IN TABLE. CONCRETE PER SECTION 725.
7. SUBGRADE PREPARATION, SECT. 301.
8. FLOW LINE OF GUTTER.
9. DEPRESSED CURB.
10. SECT. A-A AND ELEVATION: D/W SHOWN WITH VERTICAL CURB AND GUTTER, ROLL TYPE CURB AND GUTTER TREATED SIMILARLY.
11. ROUGH BROOM FINISH FULL WIDTH OF RAMP AND WINGS.
12. TROWEL AND USE LIGHT HAIR BROOM FINISH FOR WALKWAY AREA.
13. 'DRIVEWAY ENTRANCE WIDTH' IS THE DRIVEWAY WIDTH PLUS ADDITIONAL WIDENING REQUIRED BY THE LOCAL JURISDICTION.
14. ELEVATION AT TOP OF DRIVEWAY RAMP SHALL BE EQUAL TO OR HIGHER THAN NORMAL CURB ELEVATION.



SECTION A-A

COMMERCIAL AND INDUSTRIAL

DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'
COMMERCIAL	* 16'	40'	A	9"
INDUSTRIAL	* 16'	40'	A	9"
* 24' MIN. FOR TWO WAY TRAFFIC				

RESIDENTIAL

DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'
MAJOR STREET	16'	30'	B	5"
COLLECTOR STREET	* 12'	30'	B	5"
LOCAL STREET	12'	30'	B	5"
* 16' DESIRABLE				

DETAIL NO.

250-1



STANDARD DETAIL
ENGLISH

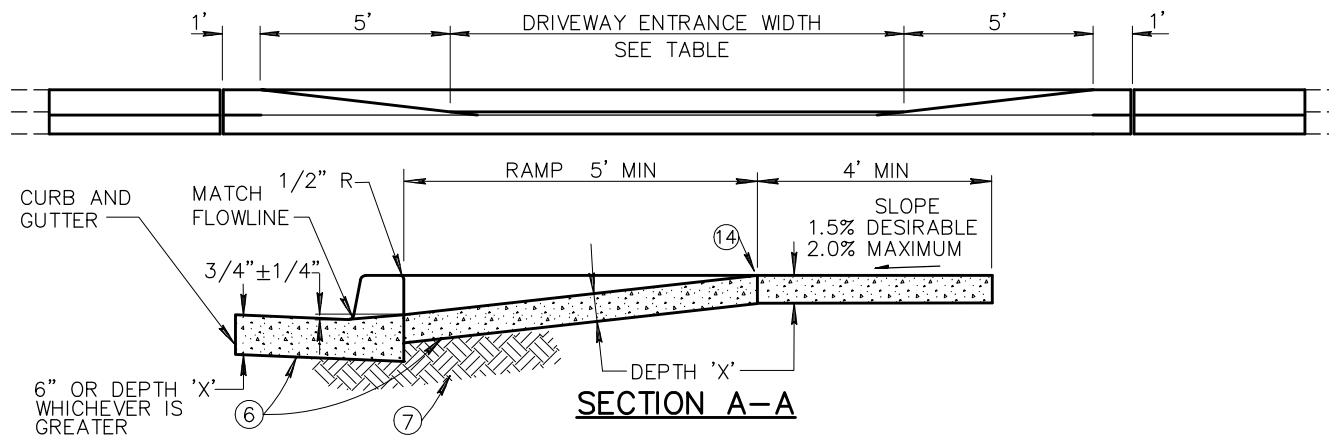
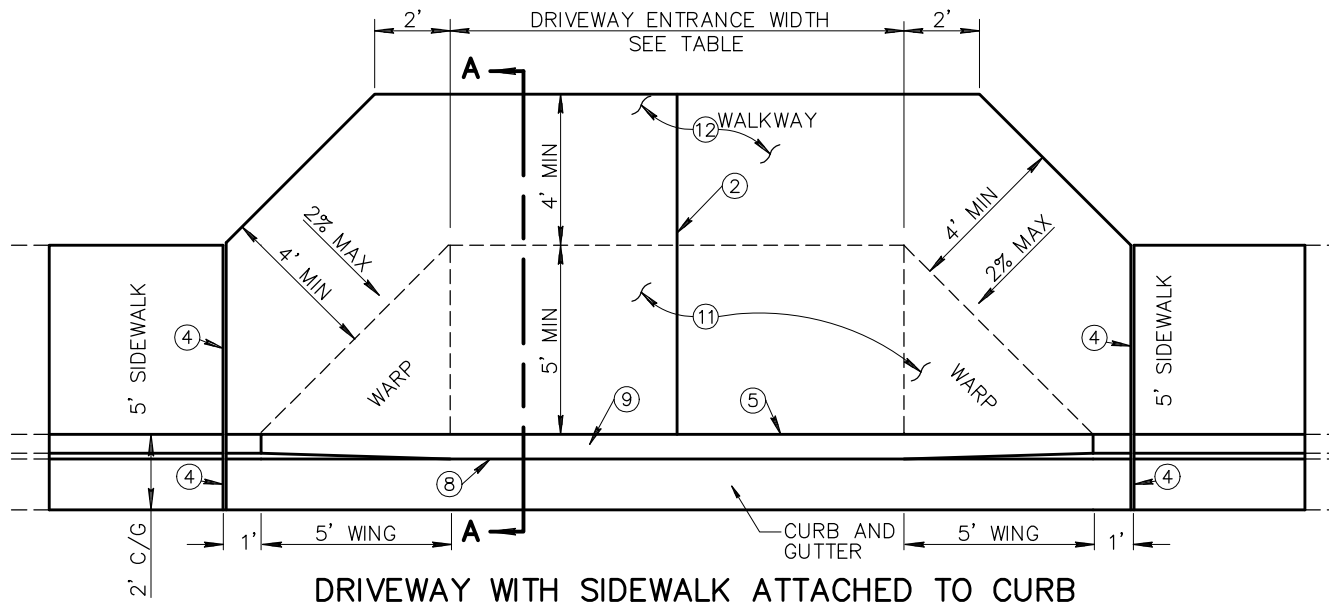
**DRIVEWAY ENTRANCES WITH
DETACHED SIDEWALK**

REVISED

01-01-2014

DETAIL NO.

250-1



COMMERCIAL AND INDUSTRIAL					RESIDENTIAL				
DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'	DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'
COMMERCIAL	* 16'	40'	A	9"	MAJOR STREET	16'	30'	B	5"
INDUSTRIAL	* 16'	40'	A	9"	COLLECTOR STREET	* 12'	30'	B	5"
* 24' MIN. FOR TWO WAY TRAFFIC					LOCAL STREET	12'	30'	B	5"
					* 16' DESIRABLE				

NOTES:

- DEPRESSED CURB SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE FOR THE TYPE OF CURB USED AT THAT LOCATION.
- CONTRACTION JOINT(S) FOR DRIVEWAY ENTRANCE: WIDTH LESS THAN 22' NONE REQUIRED; WIDTH GREATER THAN 22' AND LESS THAN 30' LOCATE SINGLE JOINT ON D/W CENTERLINE; WIDTH OF 30' OR GREATER LOCATE TWO JOINTS TO EQUALLY DIVIDE THE DRIVEWAY ENTRANCE WIDTH.
- DETAIL GEOMETRICS ARE BASED ON A CURB HEIGHT OF SIX INCHES (6"), AN ATTACHED SIDEWALK WIDTH OF FIVE FEET (5'), AND A DRIVEWAY RAMP LENGTH NOT EXCEEDING SIX FEET (6'). GEOMETRIC MODIFICATIONS MAY BE REQUIRED WHEN CONDITIONS ARE MODIFIED.
- 1/2-INCH EXPANSION JOINTS SHALL COMPLY WITH SECTION 340.
- BACK OF CURB - CONSTRUCTION JOINT.
- CONCRETE CLASS AS NOTED IN TABLE. CONCRETE PER SECTION 725.
- SUBGRADE PREPARATION, SECT. 301.
- FLOW LINE OF GUTTER.
- DEPRESSED CURB.
- SECT. A-A AND ELEVATION: D/W SHOWN WITH VERTICAL CURB AND GUTTER, ROLL TYPE CURB AND GUTTER TREATED SIMILARLY.
- ROUGH BROOM FINISH FULL WIDTH OF RAMP AND WINGS.
- TROWEL AND USE LIGHT HAIR BROOM FINISH FOR WALKWAY AREA.
- 'DRIVEWAY ENTRANCE WIDTH' IS THE DRIVEWAY WIDTH PLUS ADDITIONAL WIDENING REQUIRED BY THE LOCAL JURISDICTION.
- ELEVATION AT TOP OF DRIVEWAY RAMP SHALL BE EQUAL TO OR HIGHER THAN NORMAL CURB ELEVATION.

DETAIL NO.

250-2



STANDARD DETAIL
ENGLISH

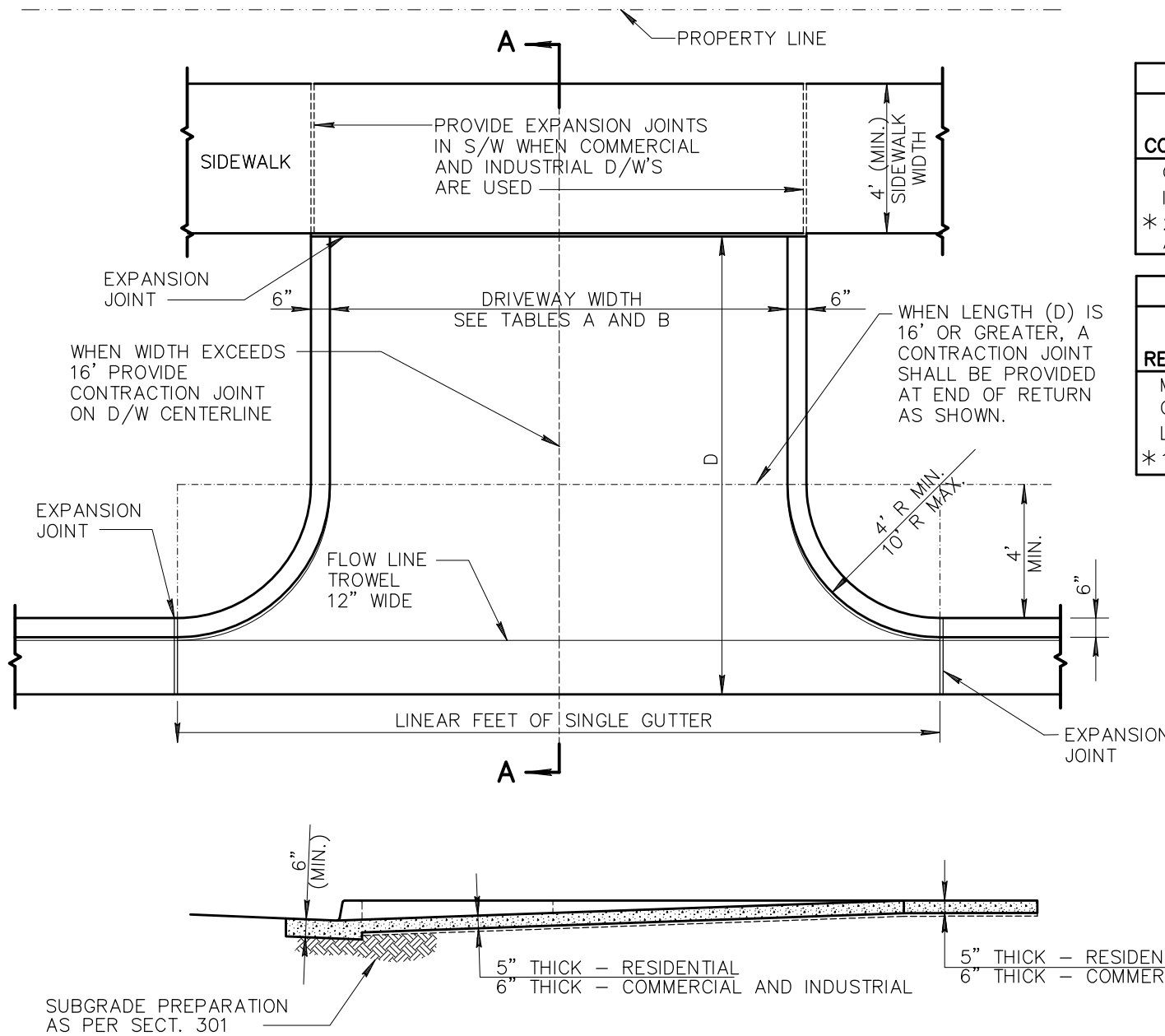
DRIVEWAY ENTRANCES WITH SIDEWALK ATTACHED TO CURB

REVISED

01-01-2013

DETAIL NO.

250-2



SECTION A-A

TABLE A		
ZONING	DRIVEWAY WIDTH	
	MIN.*	MAX.
COMMERCIAL AND INDUSTRIAL		
COMMERCIAL	16'	40'
INDUSTRIAL	16'	40'
* 24' WHERE 2-WAY TRAFFIC IS ANTICIPATED		

TABLE B		
ZONING	DRIVEWAY WIDTH	
	MIN.*	MAX.
RESIDENTIAL		
MAJOR STREET	16'	30'
COLLECTOR STREET	12'	30'
LOCAL STREET	12'	30'
* 16' WIDTH IS DESIRABLE		

NOTES:

1. EXPANSION JOINTS SHALL COMPLY TO SECTION 340.
2. THIS TYPE D/W TO BE USED ONLY UPON APPROVAL OF ENGINEER.
3. CLASS 'B' CONCRETE CONSTRUCTION AS PER SECT. 725

DETAIL NO.

251



STANDARD DETAIL
ENGLISH

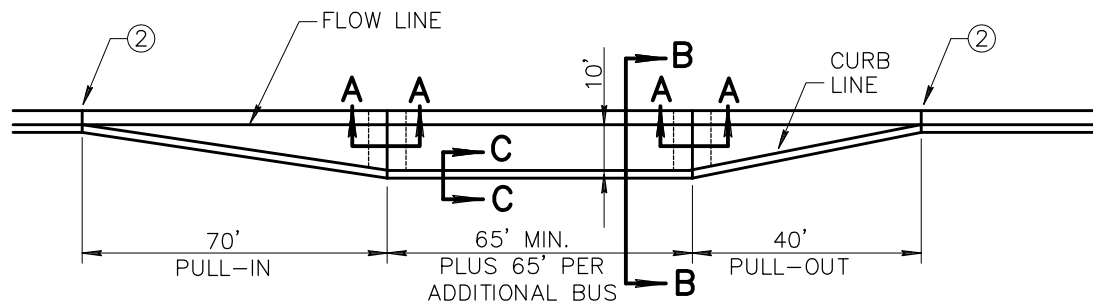
RETURN TYPE DRIVEWAYS

REVISED

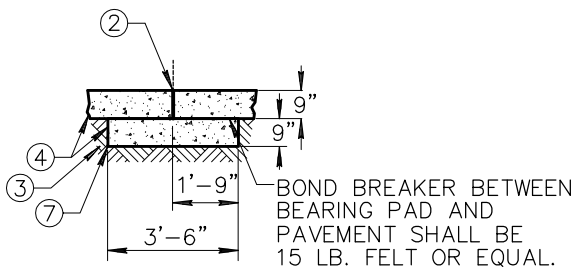
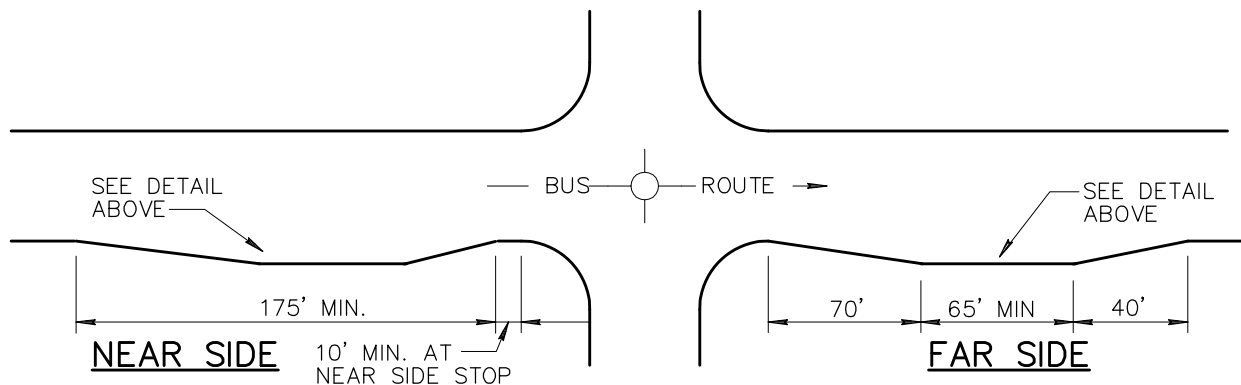
01-01-2003

DETAIL NO.

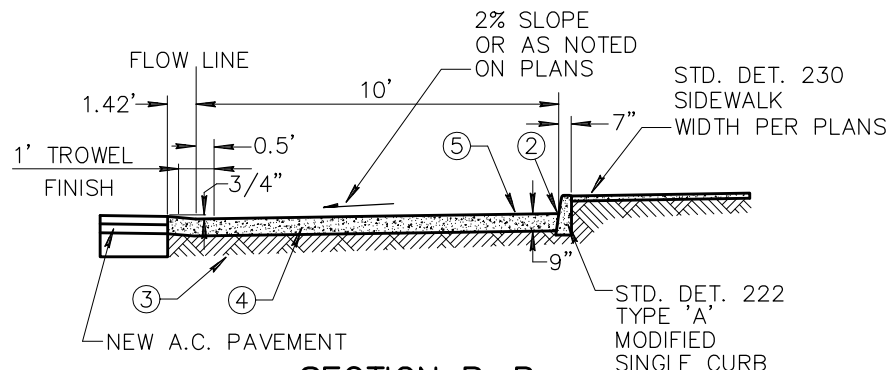
251



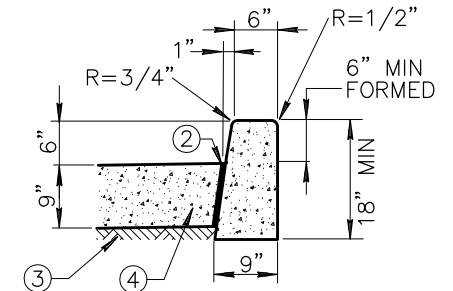
DETAIL



SECTION A-A



SECTION B-B



SECTION C-C

STD. DET. 222 TYPE 'A' MODIFIED SINGLE CURB

NOTES:

1. SUFFICIENT RIGHT-OF-WAY MUST BE AVAILABLE TO CONSTRUCT THE BUS BAY.
2. 1/2" BITUMINOUS PREFORMED EXPANSION JOINT FILLER ASTM D-1751 PER SPECIFICATION SECTION 729.
3. SUBGRADE PREPARATION PER SPECIFICATION SECTION 301 COMPACTED TO 95% MINIMUM DENSITY.
4. CONCRETE SHALL BE CLASS 'A' PER SPECIFICATION SECTION 725.
5. CONCRETE BUS BAY PAVEMENT SHALL BE BROOM FINISHED, EXCEPT WHERE OTHERWISE NOTED.
6. CONTRACTION JOINTS IN THE BUS BAY PAVEMENT SHALL MATCH THOSE IN THE CURB, 15 FT. MAXIMUM SPACING.
7. CONCRETE BEARING PAD (SECTION A-A) TO BE POURED SEPARATELY FROM CONCRETE BUS BAY PAVEMENT.

DETAIL NO.

252



STANDARD DETAIL
ENGLISH

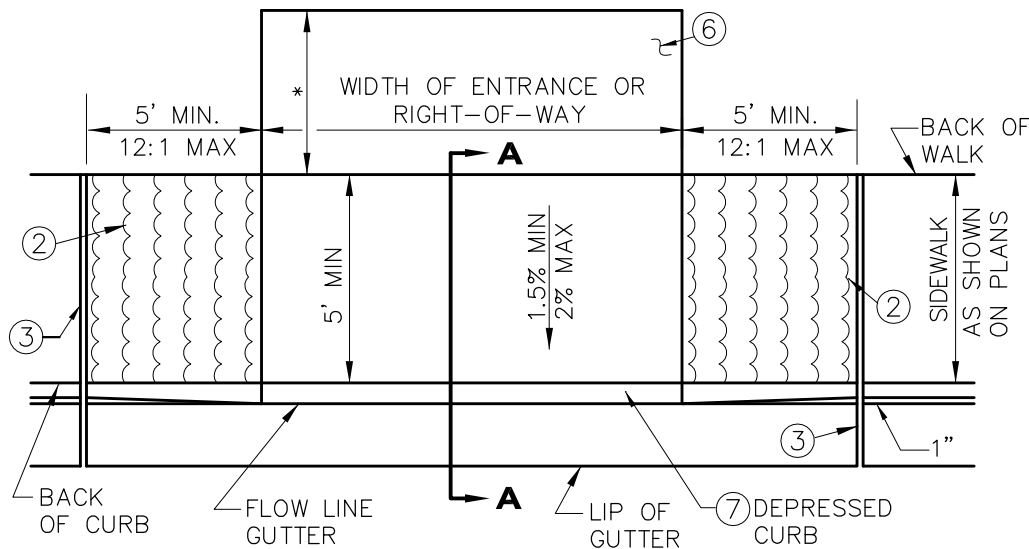
BUS BAYS

REVISED

01-01-2005

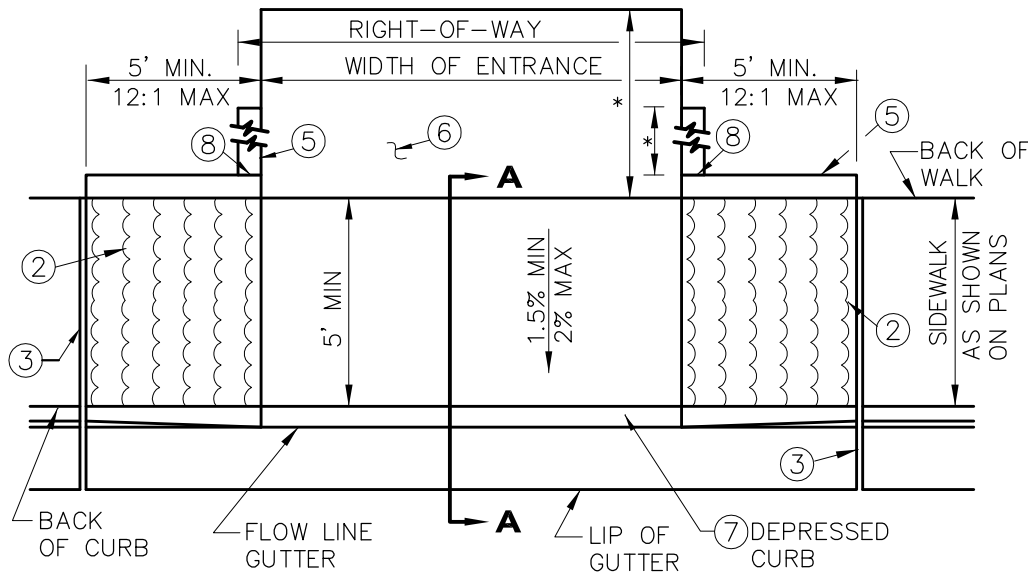
DETAIL NO.

252



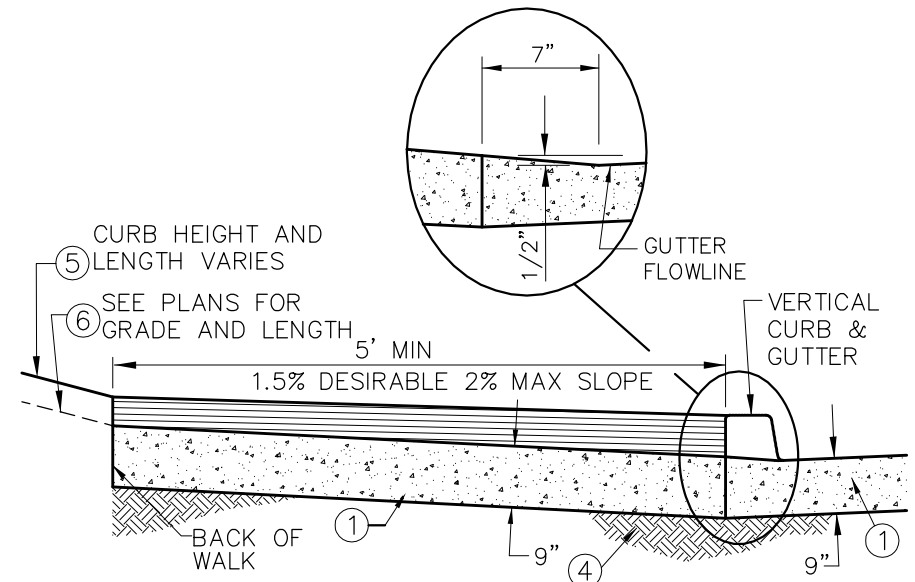
TYPE A - WITHOUT RETAINING CURB

* SEE PLANS FOR ALLEY SURFACING REQUIREMENTS



TYPE B - WITH RETAINING CURB

* SEE PLANS FOR RETAINING CURB LENGTHS, TOP OF CURB ELEVATIONS, AND ALLEY SURFACING REQUIREMENTS



SECTION A-A



ELEVATION

NOTES:

- (1). CLASS "A" CONCRETE PER SECTION 725.
- (2). LIMITS OF HEAVY ROUGH BROOM FINISH.
- (3). EXPANSION JOINTS PER SECTION 340.
- (4). SUBGRADE PREPARATION PER SECTION 301.
- (5). SINGLE CURB PER DETAIL 222, TYPE "B".
- (6). ALLEY SURFACING PER PLANS.
- (7). DEPRESSED CURB SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE FOR THE TYPE OF CURB USED AT THAT LOCATION.
- (8). CONTROL JOINT.

DETAIL NO.

260



STANDARD DETAIL
ENGLISH

ALLEY ENTRANCE (WITH VERTICAL CURB AND GUTTER)

REVISED

01-01-2013

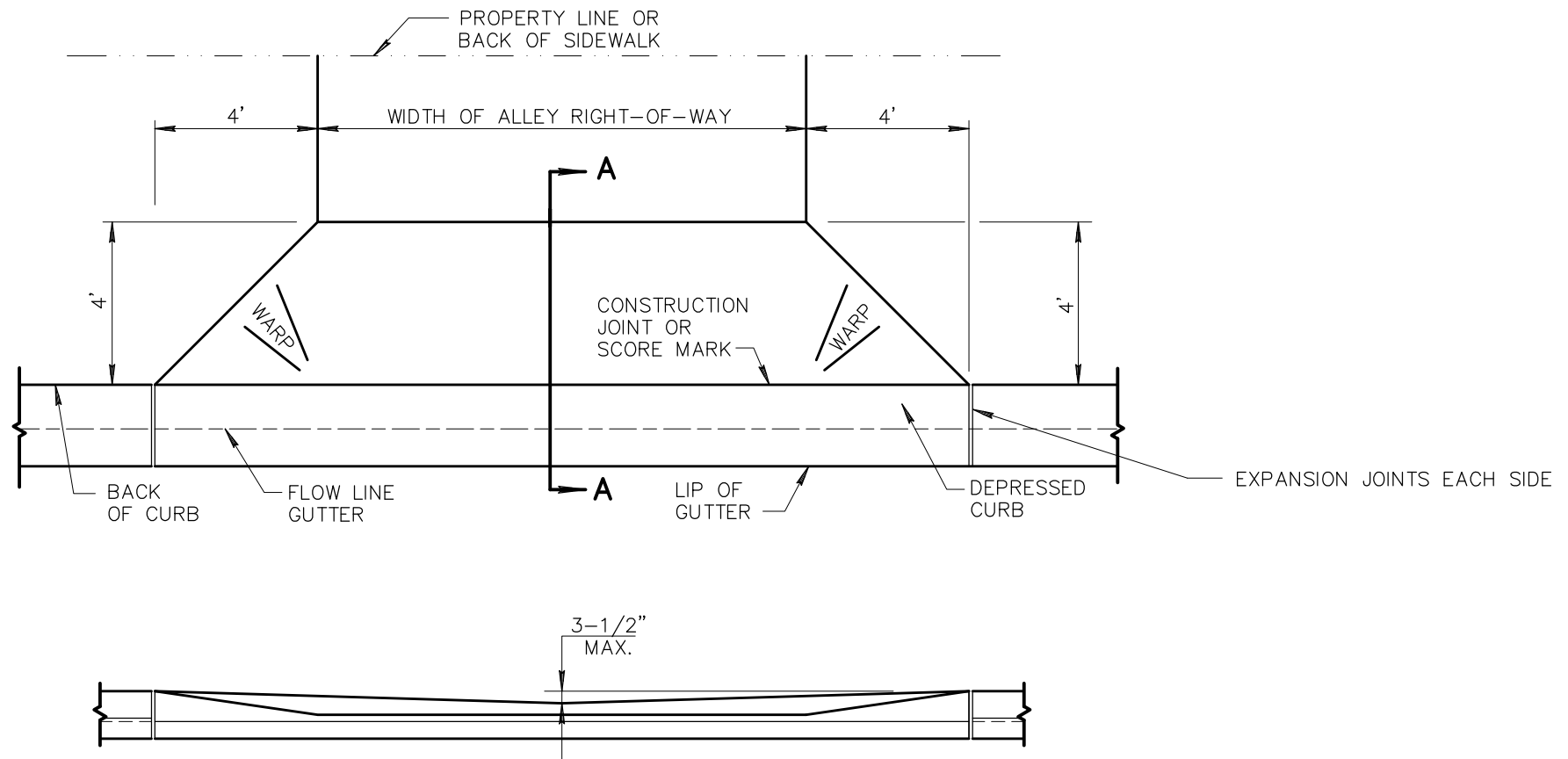
DETAIL NO.

260



-

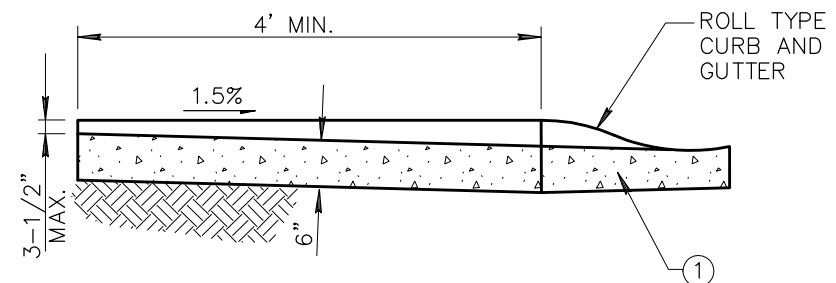
ELEVATION



ELEVATION

NOTES:

1. CLASS 'B' CONCRETE CONSTRUCTION PER SECT. 725.
2. EXPANSION JOINTS SHALL CONFORM TO SECT. 340.
3. SUBGRADE PREPARATION PER SECTION 301.



SECTION A-A

DETAIL NO.

263



STANDARD DETAIL
ENGLISH

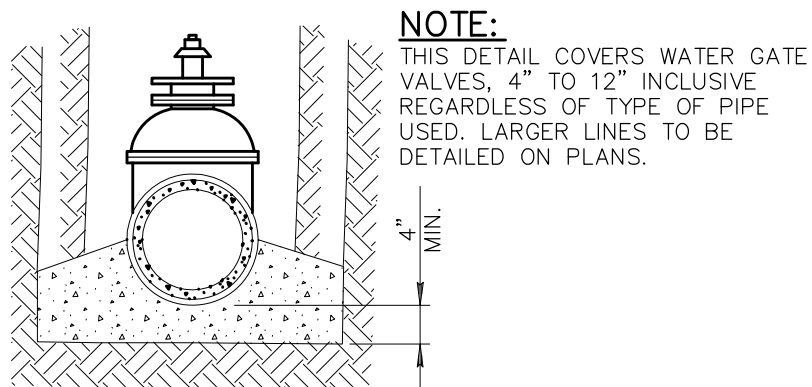
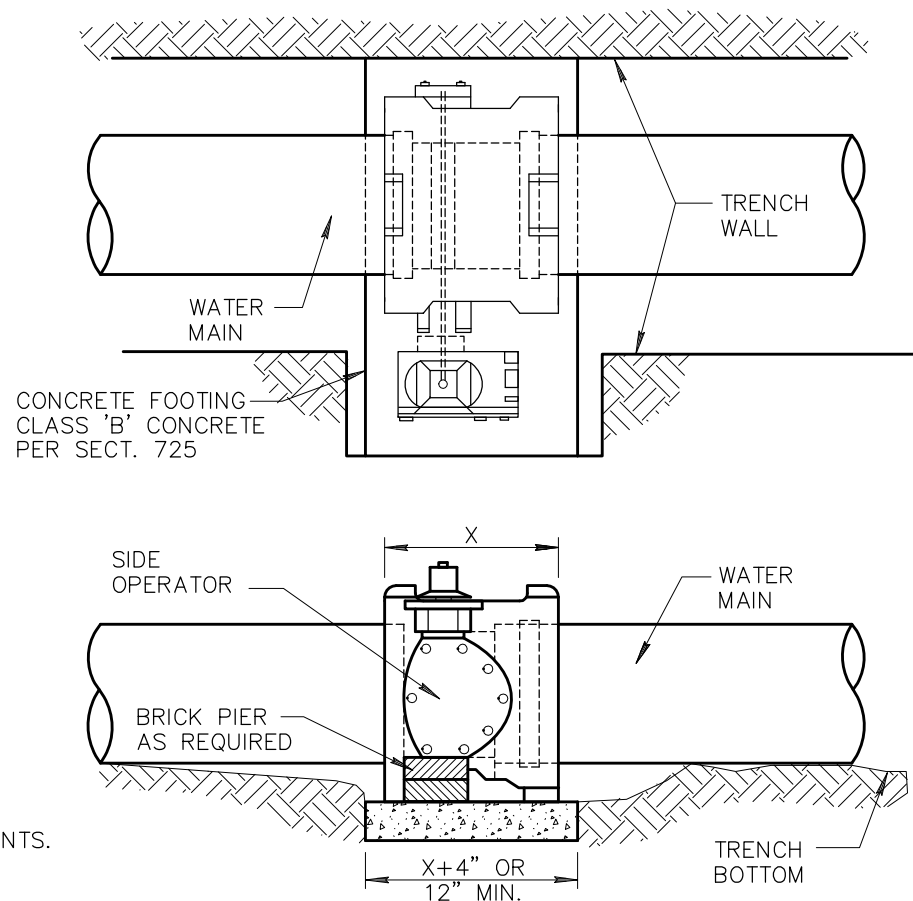
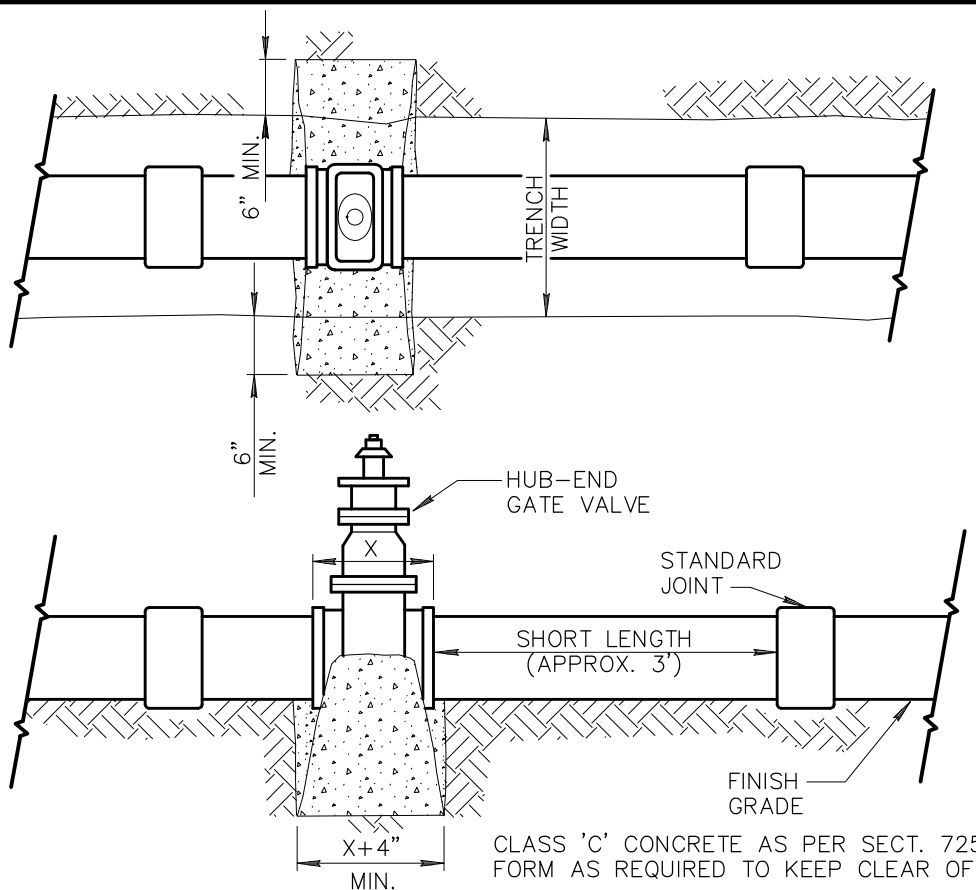
WING TYPE ALLEY ENTRANCE
(WITH ROLL TYPE CURB AND GUTTER)

REVISED

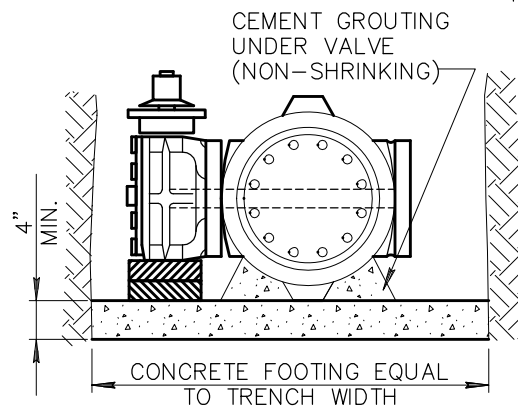
01-01-2002

DETAIL NO.

263



WATER GATE VALVE



BUTTERFLY VALVE

NOTES:

1. THIS DETAIL COVERS BUTTERFLY VALVE INSTALLATION, 3" TO 12" INCLUSIVE, REGARDLESS OF TYPE OF PIPE OR JOINT USED. LARGER LINES TO BE DETAILED ON PLANS.
2. VALVE BOX AND COVER REQUIRED PER DETAILS 270 AND 391.

DETAIL NO.

301



STANDARD DETAIL
ENGLISH

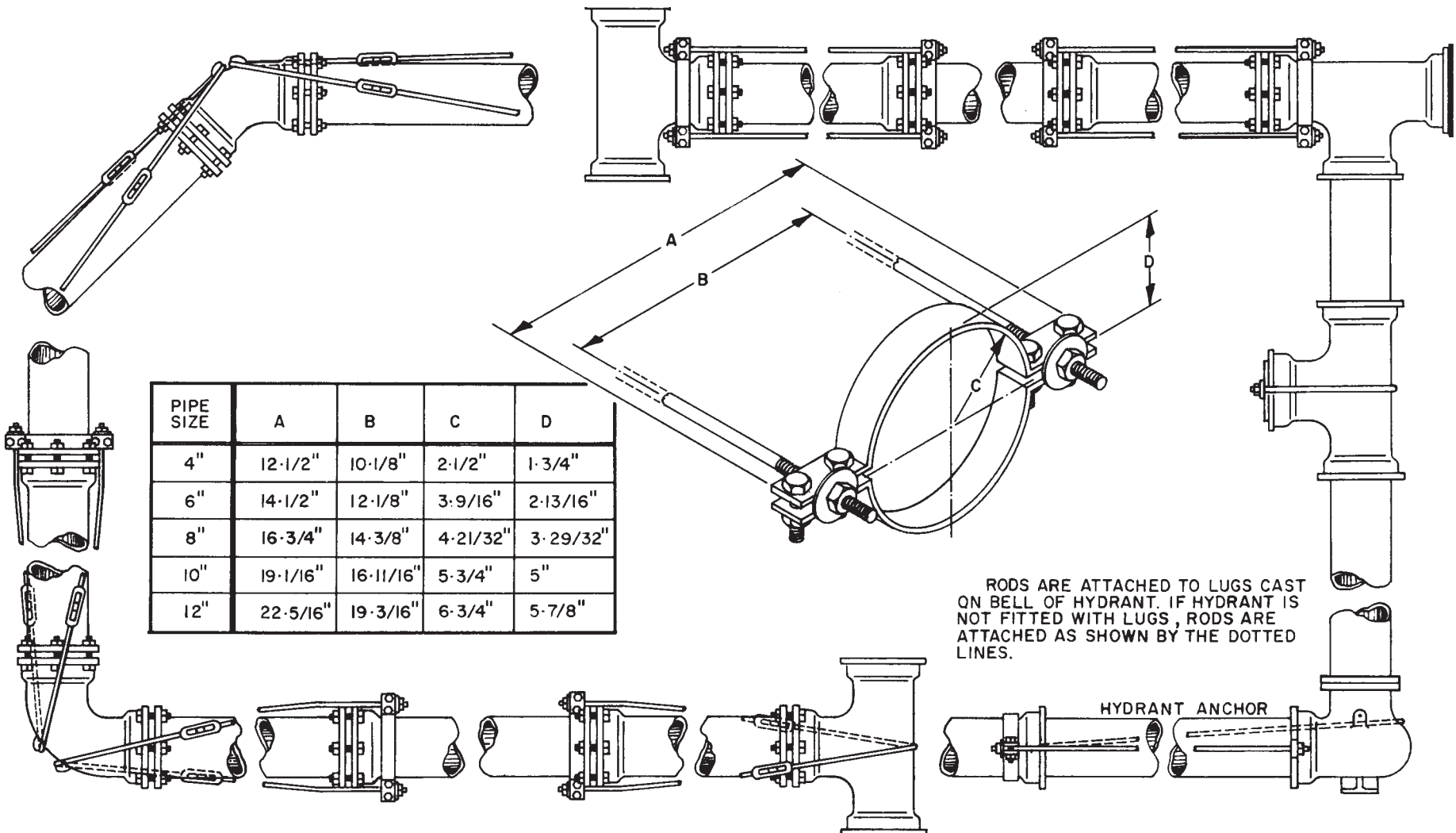
BLOCKING FOR
WATER GATE AND BUTTERFLY VALVES

REVISED

01-01-1998

DETAIL NO.

301



SHEET 1 OF 2

DETAIL NO.

302-1



STANDARD DETAIL
ENGLISH

JOINT RESTRAINT WITH TIE RODS

REVISED

01-01-1998

DETAIL NO.

302-1

THIS DETAIL IS FOR USE ONLY ON UNDERGROUND INSTALLATIONS WHERE THE USE OF CONCRETE THRUST BLOCKING PER DETAIL 380 CANNOT BE USED BECAUSE OF OBSTRUCTIONS, OR REQUIREMENTS OF THE SPECIFICATIONS...

- * CLAMPS SHALL BE 1/2 BY 2 INCHES FOR PIPE 4 AND 6 INCHES IN DIAMETER; 5/8 BY 2-1/2 INCHES FOR PIPE 8 AND 10 INCHES; 5/8 BY 3 INCHES FOR PIPE 12 INCHES. BOLT HOLES SHALL BE 1/16 INCH IN DIAMETER LARGER THAN BOLTS.
- * RODS SHALL BE 3/4 INCHES IN DIAMETER FOR PIPES 4, 6 AND 8 INCHES IN DIAMETER; 7/8 INCHES FOR PIPE 10 INCHES AND 1 INCH IN DIAMETER FOR PIPE 12 INCHES.
- * BOLTS SHALL BE 5/8 INCHES IN DIAMETER FOR PIPE 4, 6 AND 8 INCHES IN DIAMETER; 3/4 INCHES FOR PIPE 10 INCHES AND 7/8 INCHES IN DIAMETER FOR PIPE 12 INCHES
- * WASHERS MAY BE CAST IRON OR STEEL, ROUND OR SQUARE, DIMENSIONS FOR CAST IRON WASHERS ARE 5/8 BY 3 INCHES FOR PIPE 4, 6, 8 AND 10 INCHES IN DIAMETER AND 3/4 BY 3-1/2 INCHES FOR PIPE 12 INCHES. DIMENSIONS FOR STEEL WASHERS ARE 1/2 BY 3 INCHES FOR PIPE 4, 6, 8 AND 10 INCHES IN DIAMETER AND 1/2 BY 3-1/2 INCHES FOR PIPE 12 INCHES IN DIAMETER. HOLES SHALL BE 1/8 INCH LARGER THAN THE RODS.

FOR PIPE LARGER THAN 12 INCHES IN DIAMETER, RESTRAINT DETAILS SHALL BE SUBMITTED FOR APPROVAL PRIOR TO INSTALLATION.

1. ALL TIE RODS, ROD COUPLINGS, TURNBUCKLES, BOLTS AND NUTS FOR THESE JOINTS SHALL BE OF CARBON STEEL EQUIVALENT TO A.S.T.M. A-307, GRADE B, WITH CADMIUM PLATING IN ACCORDANCE WITH A.S.T.M. A-165. EXCEPT THAT THE MIN. THICKNESS OF THE PLATING SHALL BE .0002 OF AN INCH. CADMIUM PLATED BOLTS SHALL HAVE CLASS 2A THREADS AND THE NUTS, ROD COUPLINGS AND TURNBUCKLES SHALL HAVE 2B THREADS.
2. HIGH STRENGTH, HEAT TREATED CAST IRON TEE-HEAD BOLTS WITH HEXAGON NUTS, ALL IN ACCORDANCE WITH THE STRENGTH REQUIREMENTS OF A.W.W.A. C-111, MAY BE USED IN LIEU OF THE CADMIUM PLATED BOLTS AND NUTS.
3. THE SKETCHES IN THIS SERIES OF FIGURES SHOW ACCEPTABLE METHODS OF PROVIDING ANCHORAGE. THERE IS NO PARTICULAR SIGNIFICANCE TO BE ATTACHED TO WHETHER THE SKETCH SHOWS A BELL AND SPIGOT JOINT OR A STANDARD MECHANICAL JOINT. THE ANCHORING PROCEDURE ILLUSTRATED APPLIES IN MOST CASES TO EITHER TYPE OF JOINT. IN SOME CASES, DIMENSIONS OF THE PARTICULAR PIPE OR HUB AND SPACE AVAILABLE FOR WORKING AROUND THE PARTICULAR JOINT WILL INFLUENCE THE CHOICE OF METHODS USED.
4. IN CERTAIN ASSEMBLIES OF RODS AND CLAMPS SHOWN, RODS RUN FROM A LUG ON THE FITTING (OR A CLAMP BEHIND THE HUB OF A BELL) TO A CLAMP AGAINST A FACE OF A BELL. NOTE THAT THIS ARRANGEMENT ANCHORS ONLY ONE JOINT. THE STABILITY OF THE JOINT WHERE THE CLAMP IS AGAINST THE FACE OF THE BELL DEPENDS ON HAVING SOIL ABOVE A RELATIVELY LONG PIECE OF PIPE ON BOTH SIDES OF THE JOINT. CONSEQUENTLY, IF THE DISTANCE BETWEEN THE FIRST AND SECOND JOINTS IS LESS THAN 12 FEET, THE SECOND JOINT SHOWN SHALL BE ANCHORED BY A CLAMP BEHIND THE HUB OF THE BELL AND RODS TO A CLAMP AT THE FACE OF THE NEXT BELL.
5. COATING TYPE: A.H.D. ASPHALTIC PRIMER 719(A). - ALL EXPOSED METAL.

SHEET 2 OF 2

DETAIL NO.

302-2



STANDARD DETAIL
ENGLISH

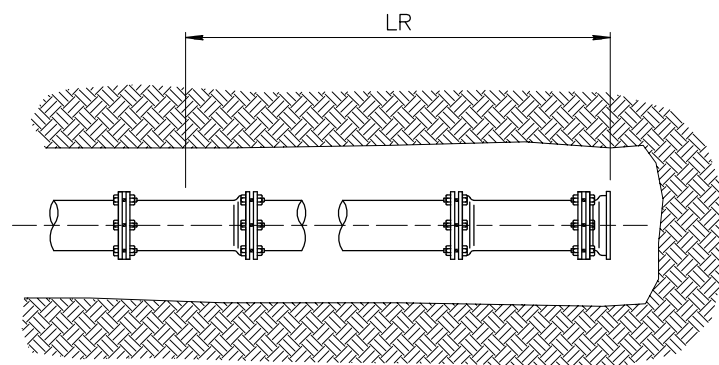
JOINT RESTRAINT WITH TIE RODS

REVISED

01-01-1998

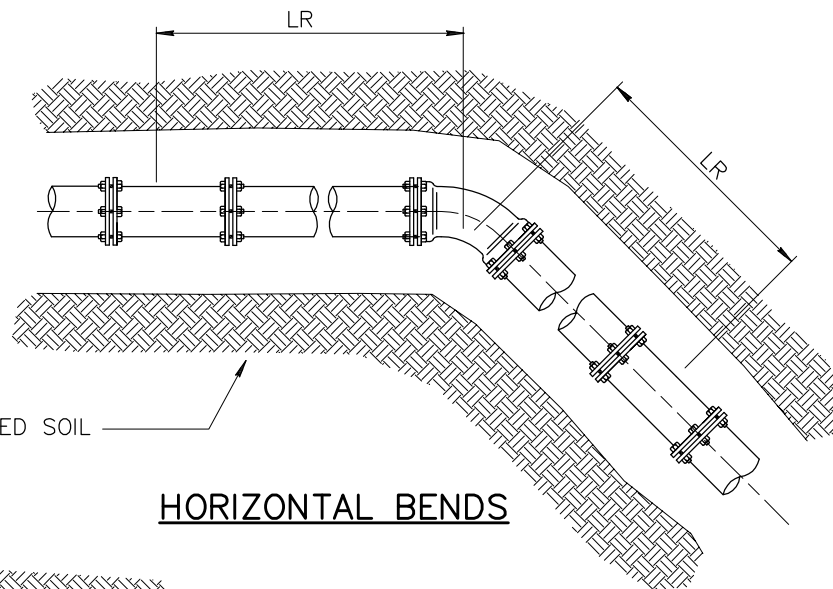
DETAIL NO.

302-2

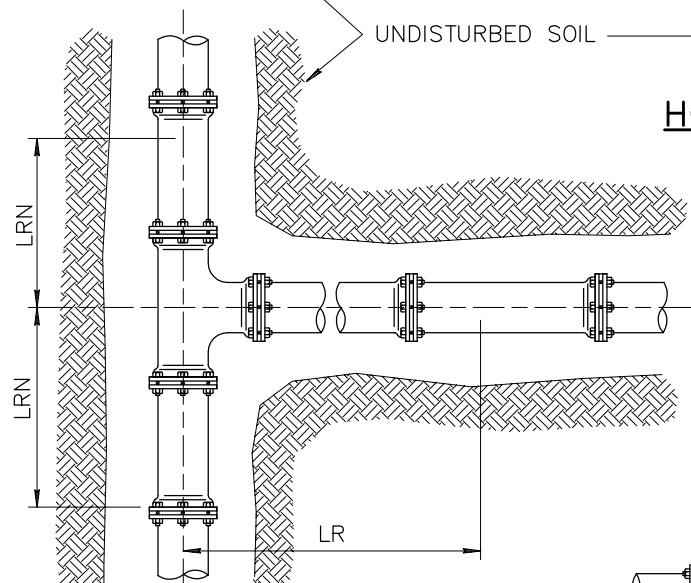


DEAD ENDS

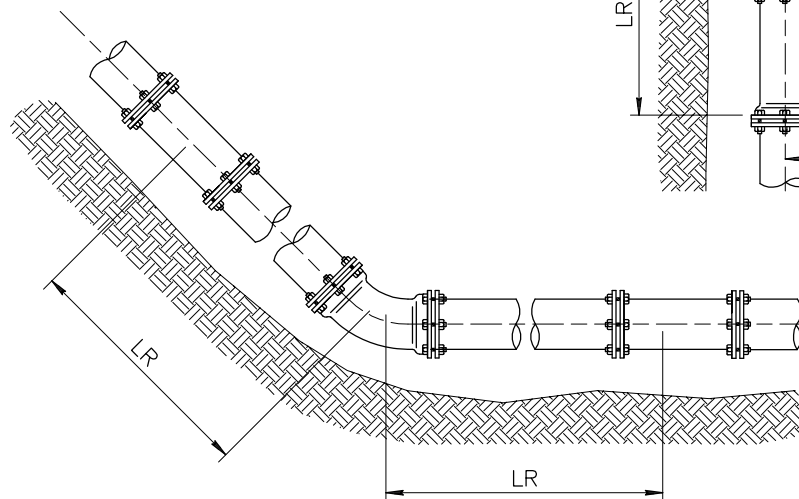
LRN = SHORTEST LENGTH
OF PIPE RESTRAINED TO
THE RUN OF THE TEE
FITTING (BOTH SIDES OF TEE).



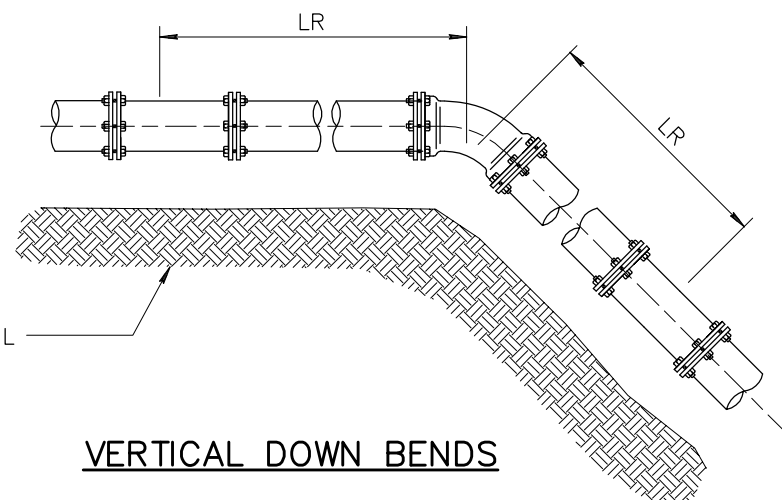
HORIZONTAL BENDS



TEES



VERTICAL UP BEND



VERTICAL DOWN BENDS

UNDISTURBED SOIL

UNDISTURBED SOIL

RESTRAINED LENGTHS, LR, FOR DUCTILE IRON PIPE												
NOMINAL PIPE SIZE INCHES	HORIZONTAL BENDS			TEES		VERTICAL OFFSETS						DEAD ENDS
						90° BEND FITTINGS		45° BEND FITTINGS		22-1/2° BEND FITTINGS		
	90°	45°	22-1/2°	LRN=0'	LRN=10'	DOWN BEND	UP BEND	DOWN BEND	UP BEND	DOWN BEND	UP BEND	
4	18	7	4	30	8	31	18	13	7	6	3	31
6	25	10	5	43	20	44	25	18	10	9	5	44
8	32	13	6	56	34	58	32	24	13	11	6	58
10	38	16	8	68	45	69	38	29	16	14	8	69
12	45	19	9	80	57	81	45	34	19	16	9	81
14	51	21	10	91	68	92	51	38	21	18	10	92
16	57	24	11	103	79	104	57	43	24	21	11	104
18	62	26	12	113	90	115	62	48	26	23	12	115
20	68	28	14	125	100	126	68	52	28	25	14	126
24	79	33	16	145	121	147	79	61	33	29	16	147

RESTRAINED LENGTHS, LR, FOR DUCTILE IRON PIPE WITH POLYETHYLENE WRAP												
NOMINAL PIPE SIZE INCHES	HORIZONTAL BENDS			TEES		VERTICAL OFFSETS						DEAD ENDS
						90° BEND FITTINGS		45° BEND FITTINGS		22-1/2° BEND FITTINGS		
	90°	45°	22-1/2°	LRN=0'	LRN=10'	DOWN BEND	UP BEND	DOWN BEND	UP BEND	DOWN BEND	UP BEND	
4	26	11	5	69	18	72	26	30	11	14	5	72
6	36	15	7	99	47	102	36	42	15	20	7	102
8	47	19	9	130	78	133	47	55	19	26	9	133
10	56	23	11	157	103	159	56	66	23	32	11	159
12	65	27	13	185	131	187	65	77	27	37	13	187
14	74	31	15	211	156	214	74	89	31	42	15	214
16	82	34	16	238	183	241	82	100	34	48	16	241
18	90	37	18	263	207	266	90	110	38	53	18	266
20	98	41	20	289	233	292	98	121	41	58	20	292
24	113	47	22	337	280	340	113	141	47	68	22	340

NOTES:

1. ALL JOINTS WITHIN THE SPECIFIED LENGTH LR MUST BE RESTRAINED.
ALL LENGTHS ARE GIVEN IN FEET.
2. THE MAXIMUM TEST PRESSURE SHALL NOT EXCEED 200 PSI
3. THE MINIMUM DEPTH OF BURY SHALL BE 3' TO TOP OF PIPE.
4. RESTRAINED LENGTHS MAY BE REDUCED WHEN SUPPORTED BY ENGINEERING CALCULATIONS.

DETAIL NO.

303-2



STANDARD DETAIL
ENGLISH

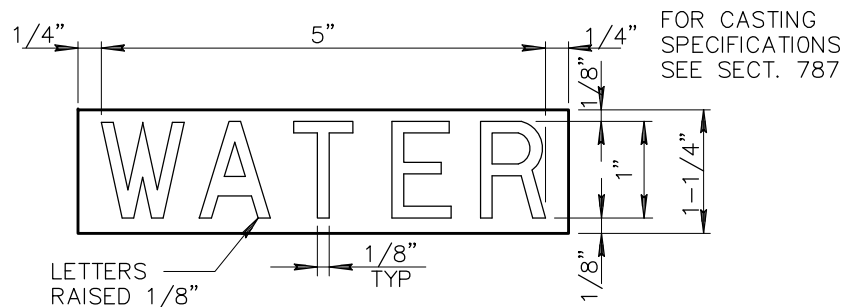
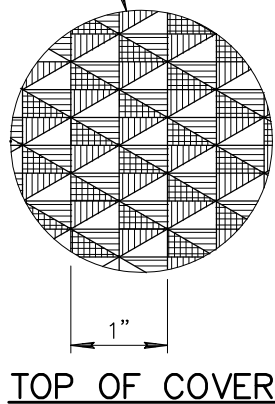
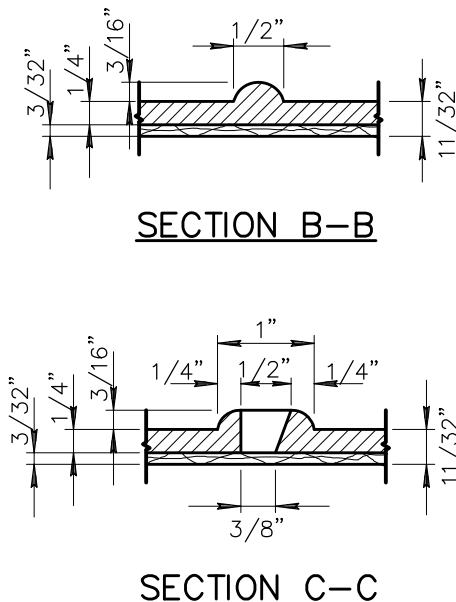
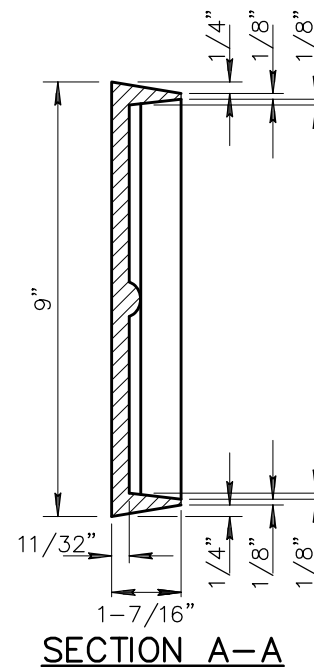
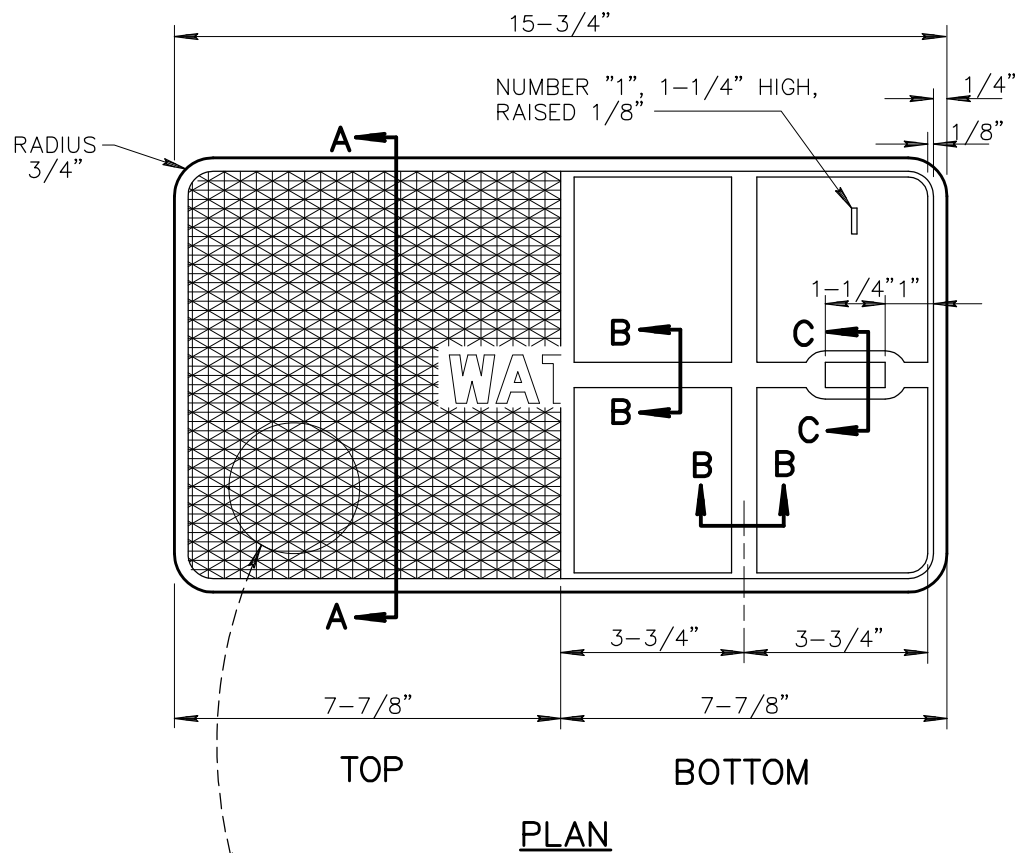
**JOINT RESTRAINT FOR DUCTILE IRON AND
POLYETHYLENE WRAPPED DUCTILE IRON WATER PIPES**

REVISED

01-01-1998

DETAIL NO.

303-2



DETAIL NO.

310



STANDARD DETAIL
ENGLISH

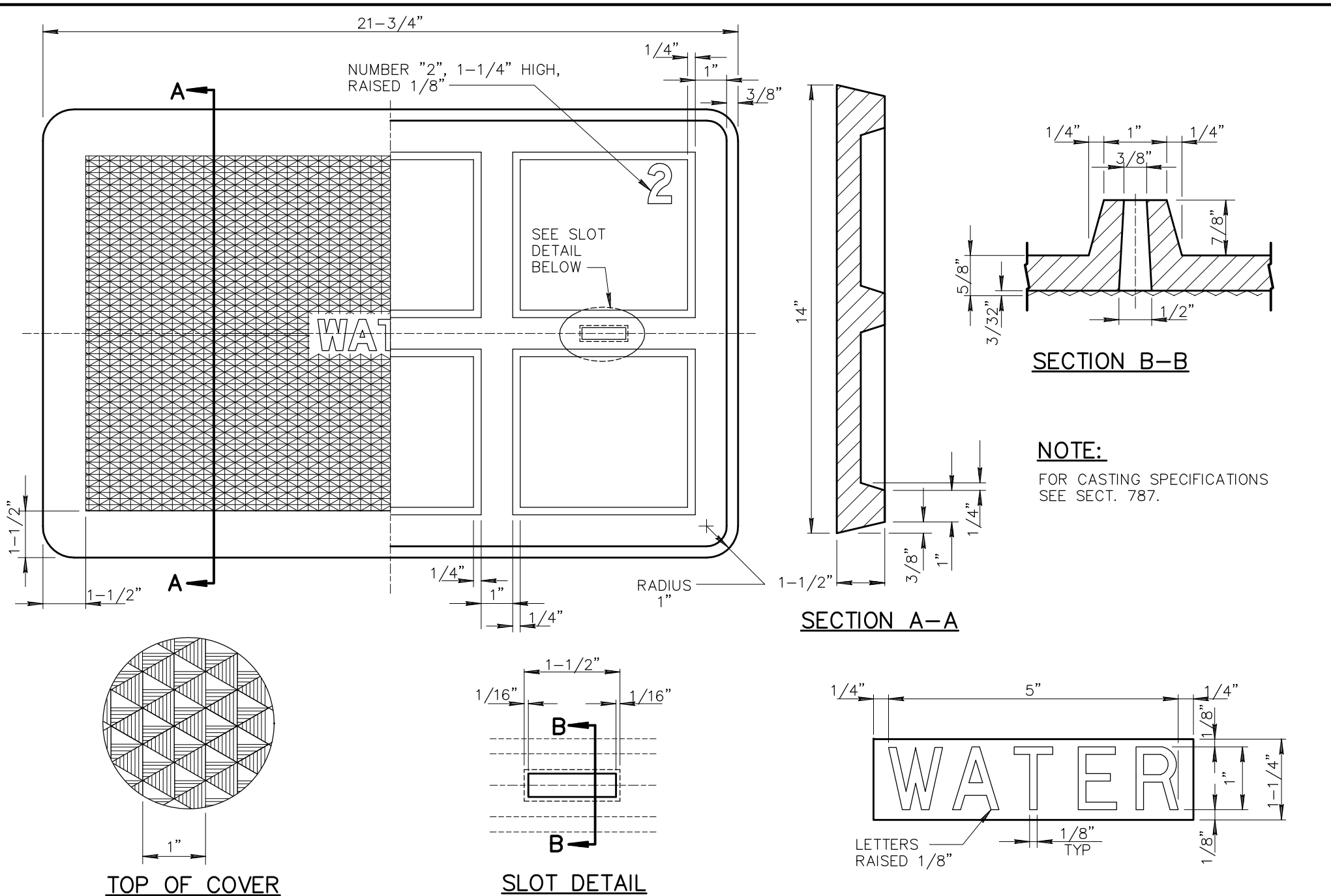
CAST IRON WATER METER BOX
COVER NO. 1

REVISED

01-01-1998

DETAIL NO.

310



DETAIL NO.

311



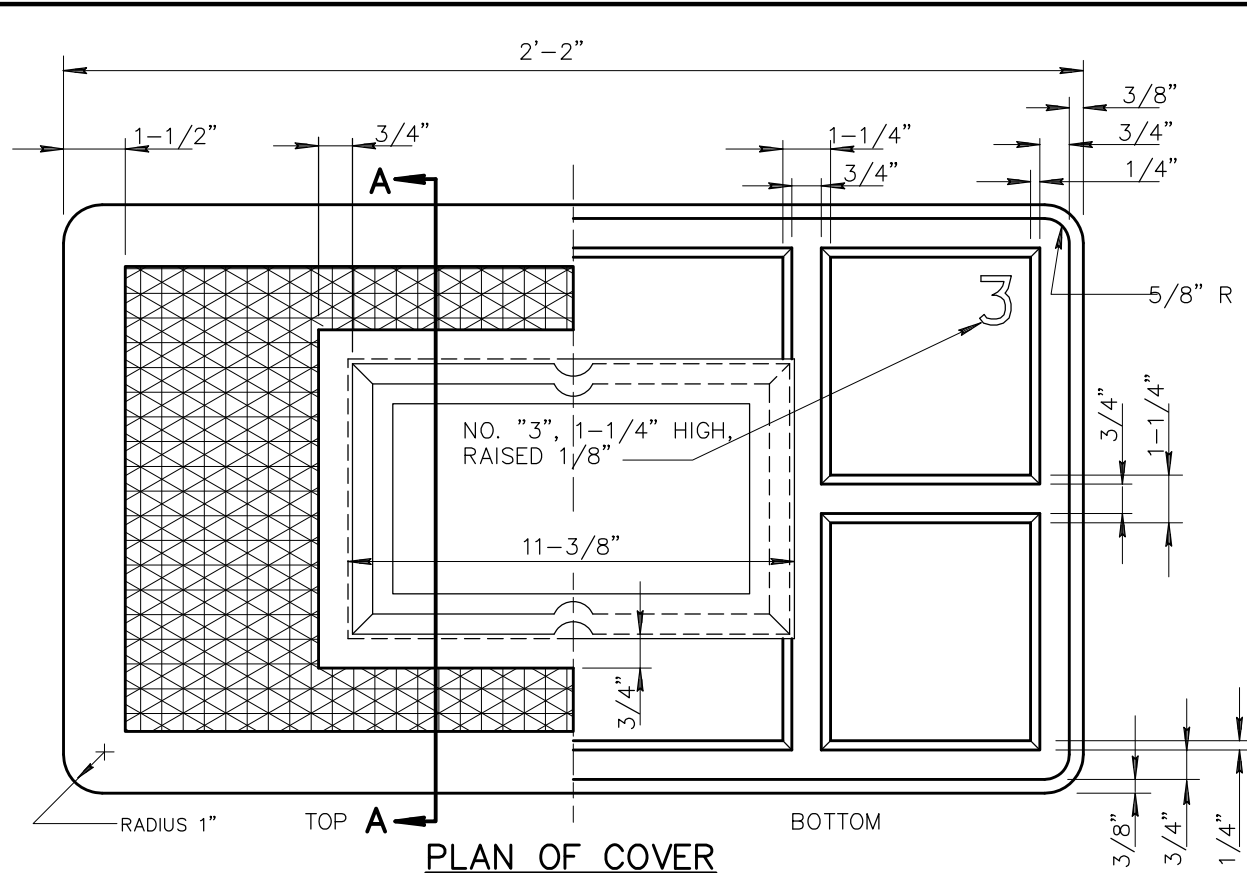
STANDARD DETAIL
ENGLISH

CAST IRON WATER METER BOX
COVER NO. 2

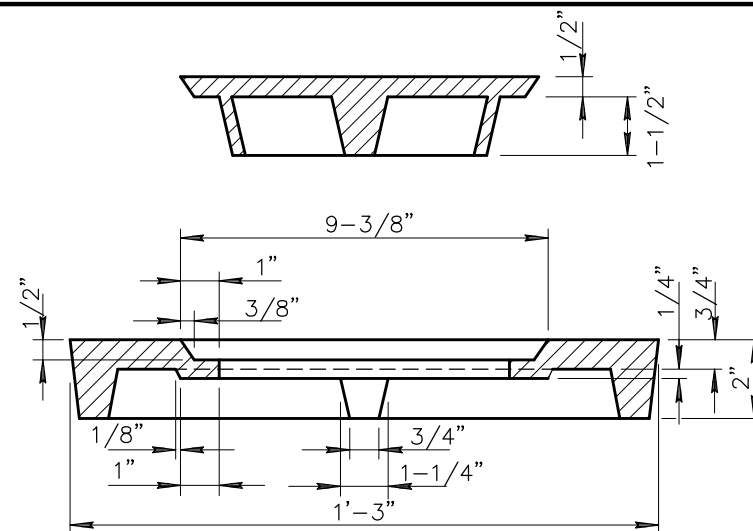
REVISED
01-01-1998

DETAIL NO.

311



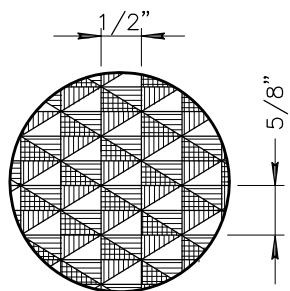
PLAN OF COVER



SECTION A-A

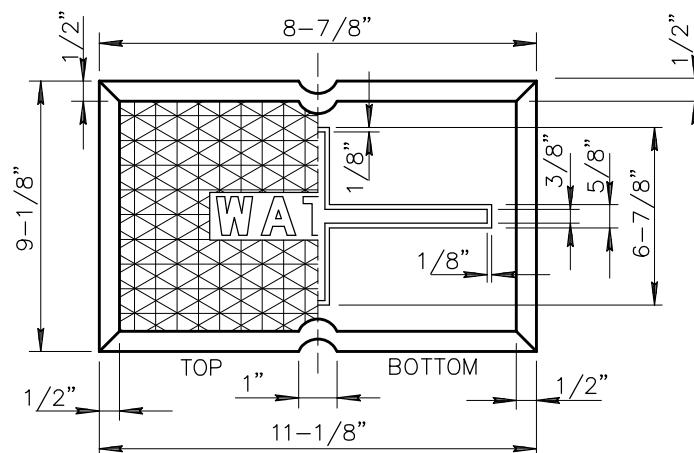
NOTES:

1. INSPECTION PLATE IS SAME AS USED WITH METER BOX COVER NO. 4.
2. FOR CASTING SPECIFICATIONS, SEE SECTION 787.
3. THE BEARING EDGES OF THESE CASTINGS SHALL BE MACHINED TO INSURE A FULL BEARING ON A FLAT SURFACE.

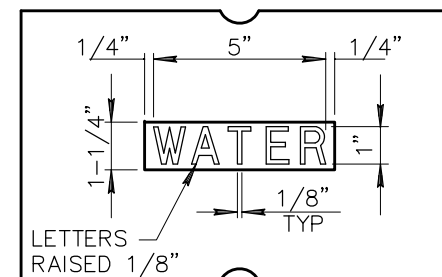


DETAIL

TOP OF COVER & PLATE



INSPECTION PLATE



LETTERING DETAIL

DETAIL NO.

312



STANDARD DETAIL
ENGLISH

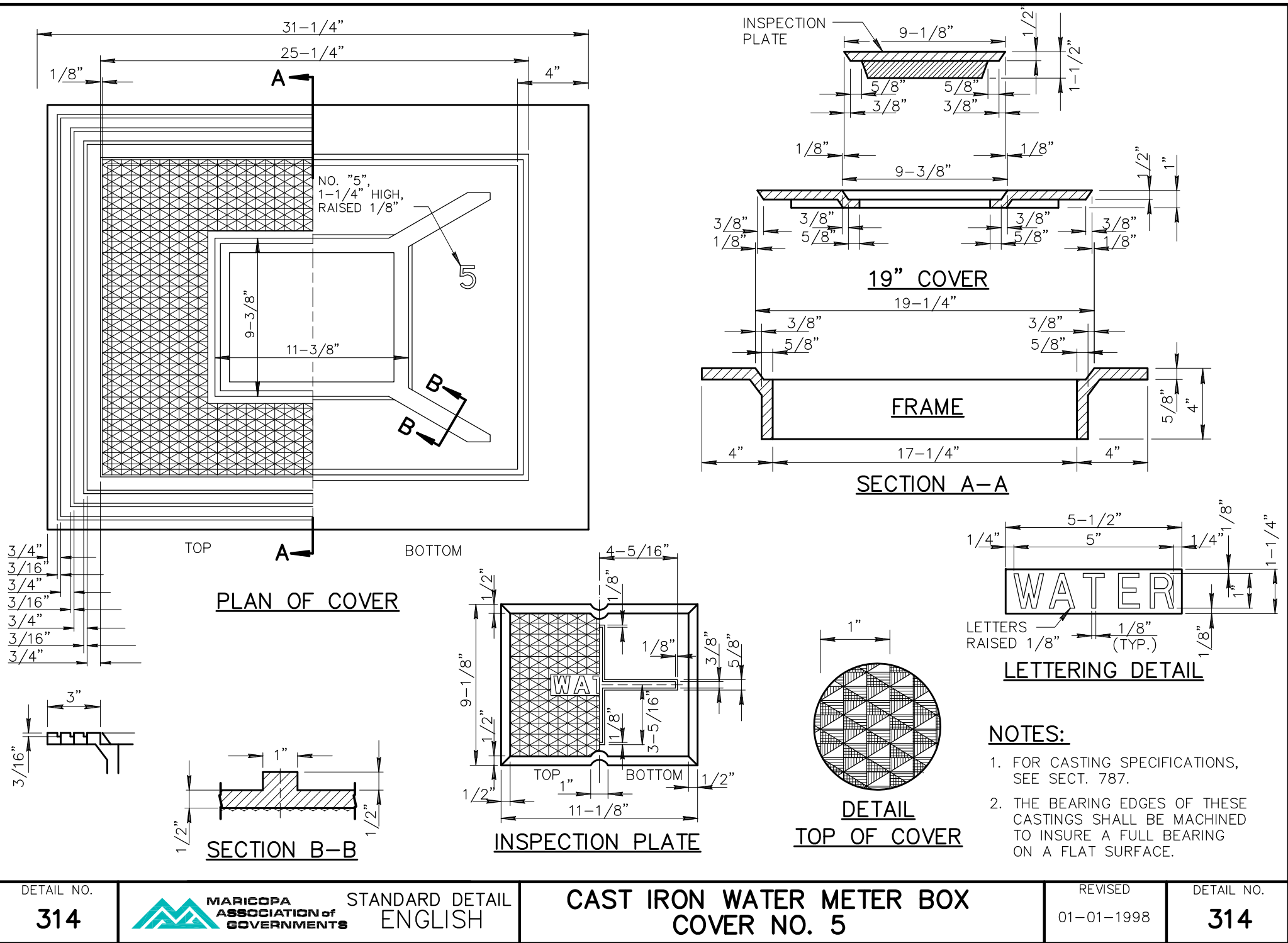
**CAST IRON WATER METER BOX
COVER NO. 3**

REVISED

01-01-1998

DETAIL NO.

312



DETAIL NO.

314



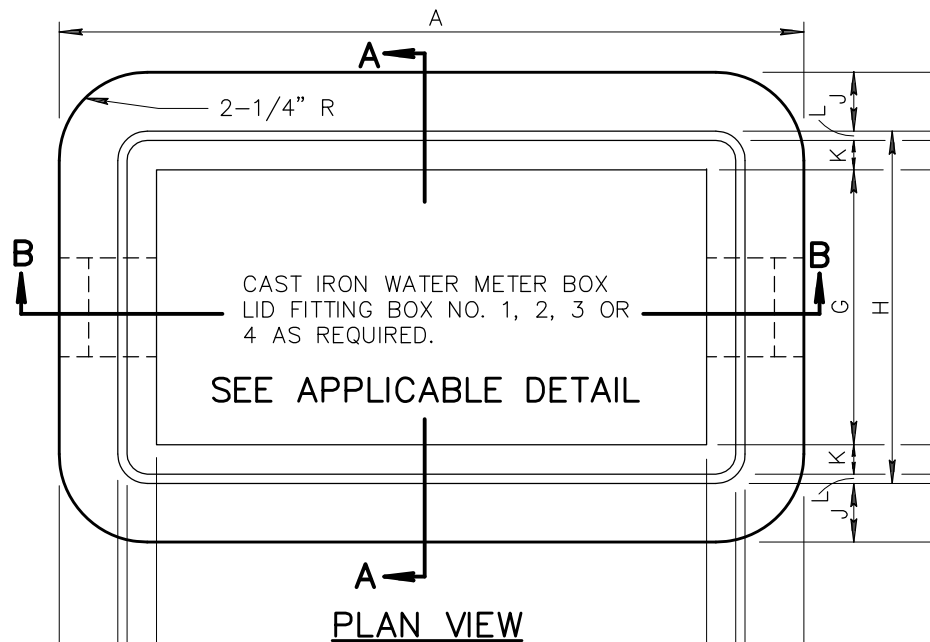
STANDARD DETAIL
ENGLISH

CAST IRON WATER METER BOX
COVER NO. 5

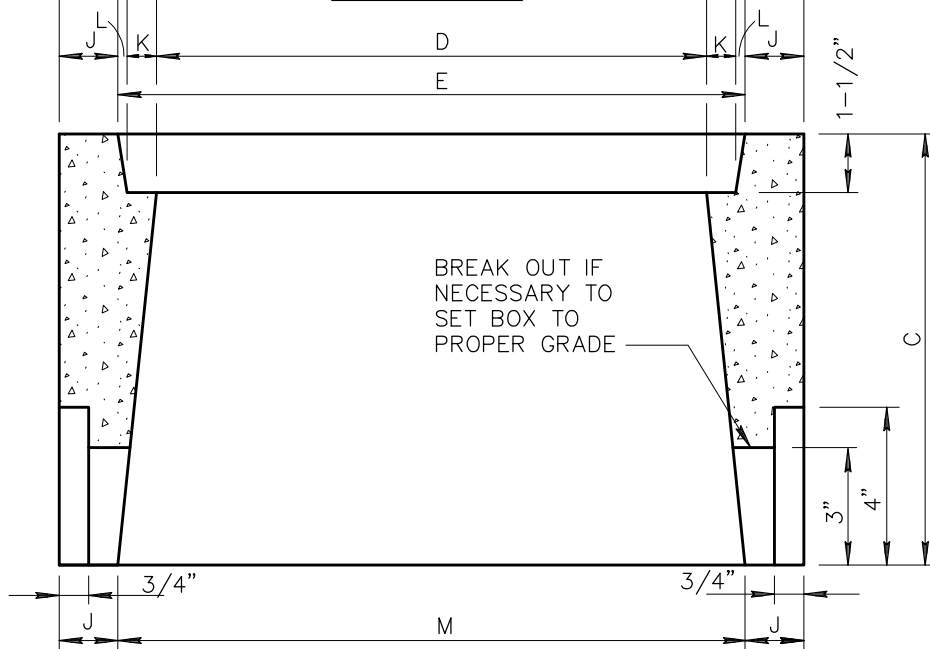
REVISED
01-01-1998

DETAIL NO.

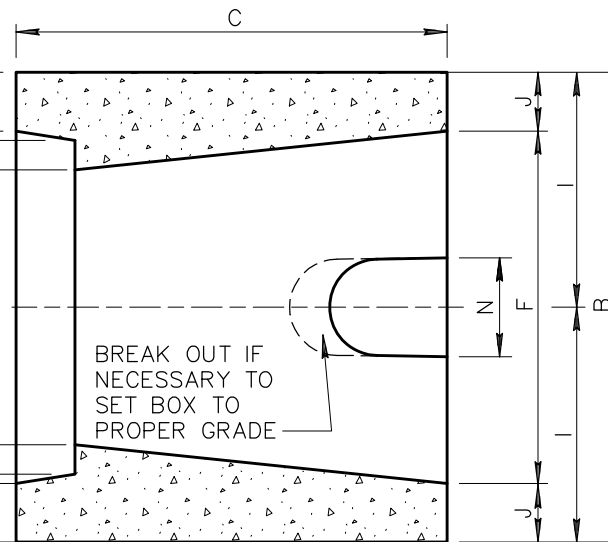
314



PLAN VIEW



SECTION B-B



SECTION A-A

NOTES:

1. THE METER BOXES SHALL CONFORM TO THE DIMENSIONS AS SHOWN AND SHALL BE MADE OF PORTLAND CEMENT CONCRETE POURED AND TAMPED (OR VIBRATED) IN TRUE FORMS.
2. USE CLASS 'AA' CONCRETE PER SECT. 725.

METER BOX DIMENSIONS				
DIMS	BOX NUMBER			
	1	2	3	4
A	19"	24-1/2"	29-1/2"	33-1/2"
B	12"	16-3/4"	18-1/2"	22-3/4"
C	11"	12"	13"	12"
D	14"	19"	23-3/4"	27-3/4"
E	16"	22"	26-1/2"	30-1/2"
F	9"	13-1/4"	15"	19-3/4"
G	7"	11-1/4"	12-3/4"	17"
H	9"	14-1/4"	15-1/2"	19-3/4"
I	6"	8-3/8"	9-1/4"	11-3/8"
J	1-1/2"	1-3/4"	1-3/4"	1-1/2"
K	3/4"	1-1/8"	1"	1"
L	1/4"	3/8"	3/8"	3/8"
M	16"	21"	25-1/2"	30-1/2"
N	2-1/2"	3-1/2"	4"	4"
	5/8" OR 3/4" METER	1" METER	1-1/2" METER	2" METER

DETAIL NO.

320



STANDARD DETAIL
ENGLISH

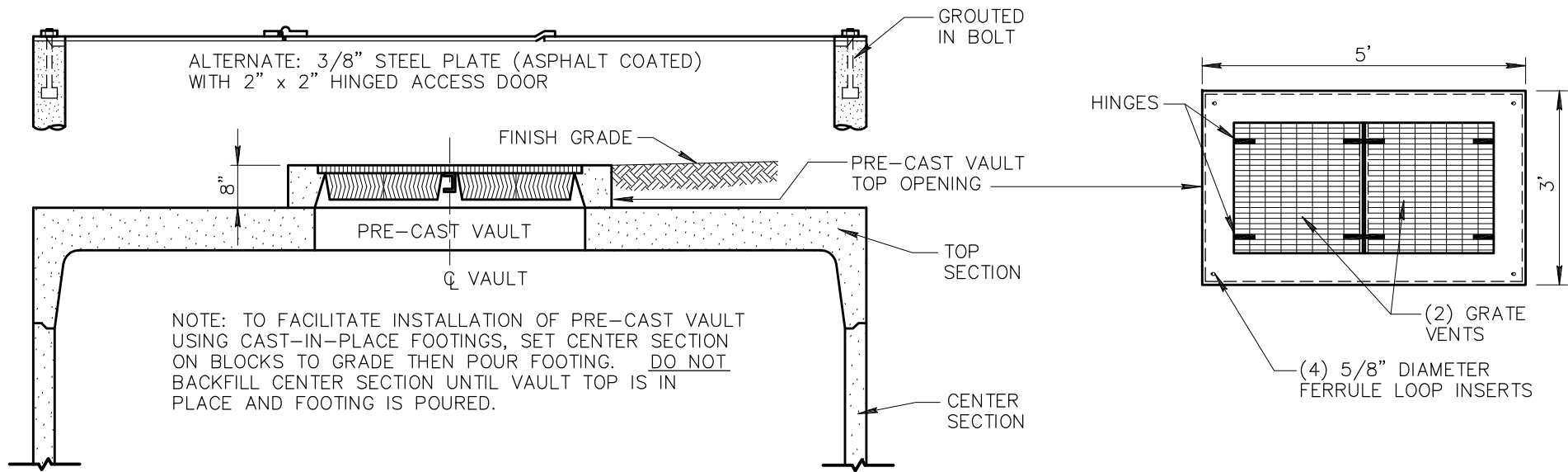
CONCRETE WATER METER BOXES

REVISED

01-01-1998

DETAIL NO.

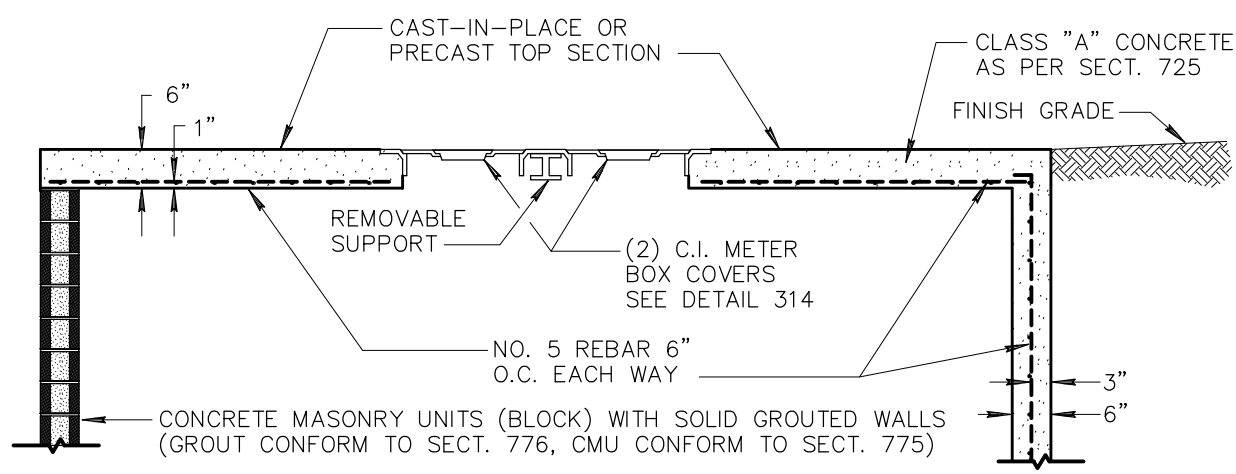
320



NOTE: TO FACILITATE INSTALLATION OF PRE-CAST VAULT USING CAST-IN-PLACE FOOTINGS, SET CENTER SECTION ON BLOCKS TO GRADE THEN POUR FOOTING. DO NOT BACKFILL CENTER SECTION UNTIL VAULT TOP IS IN PLACE AND FOOTING IS POURED.

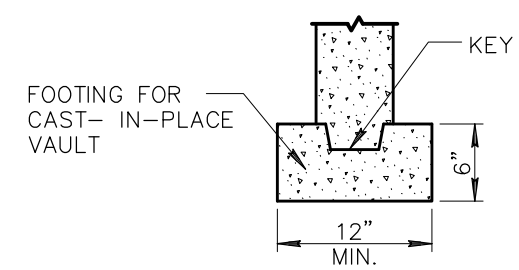
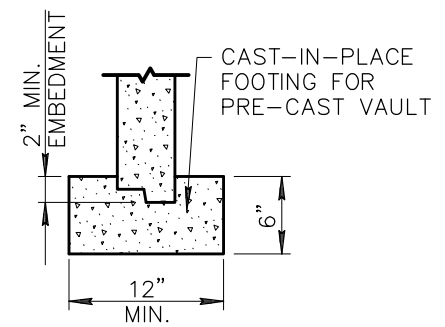
PRE-CAST VAULT SECTION

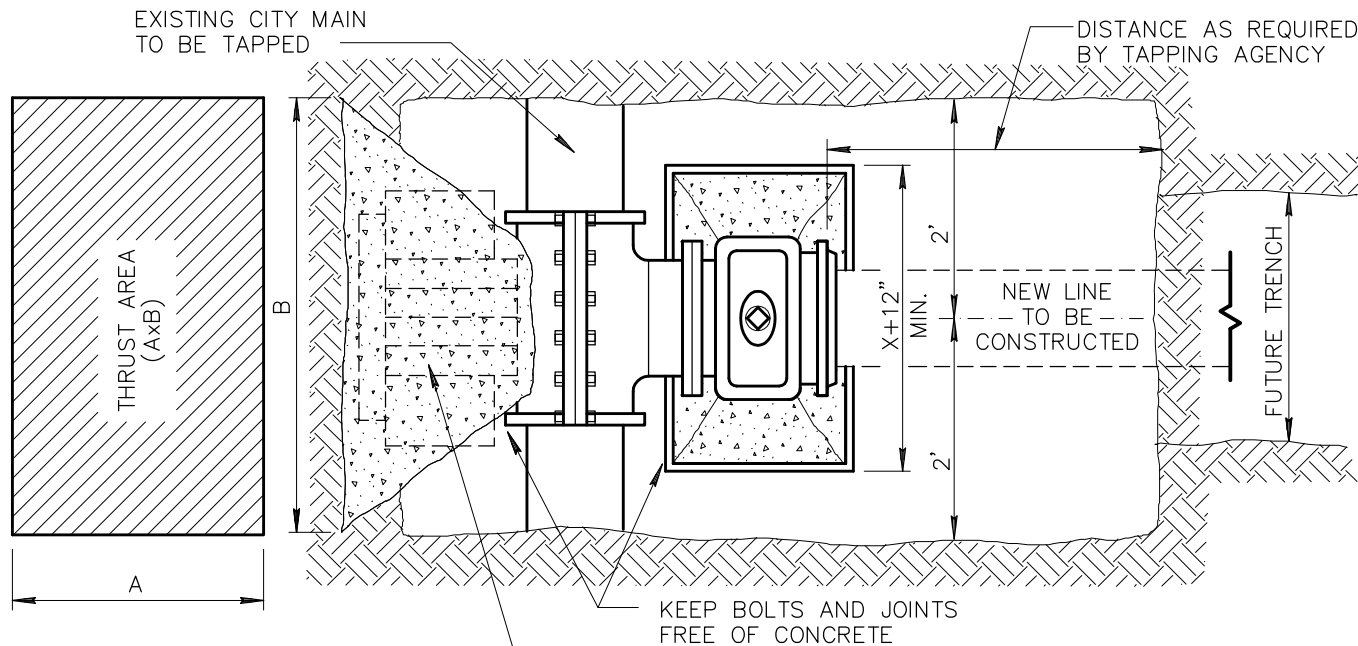
NOTE: PRECAST REINFORCED VAULT SECTIONS SHALL BE CONSTRUCTED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND DETAILS AS APPROVED BY ENGINEER.



BLOCK MASONRY MAY BE USED IN LIEU OF CAST-IN-PLACE VAULT WALLS, NO. 4 REBAR IN EVERY OTHER CORE.

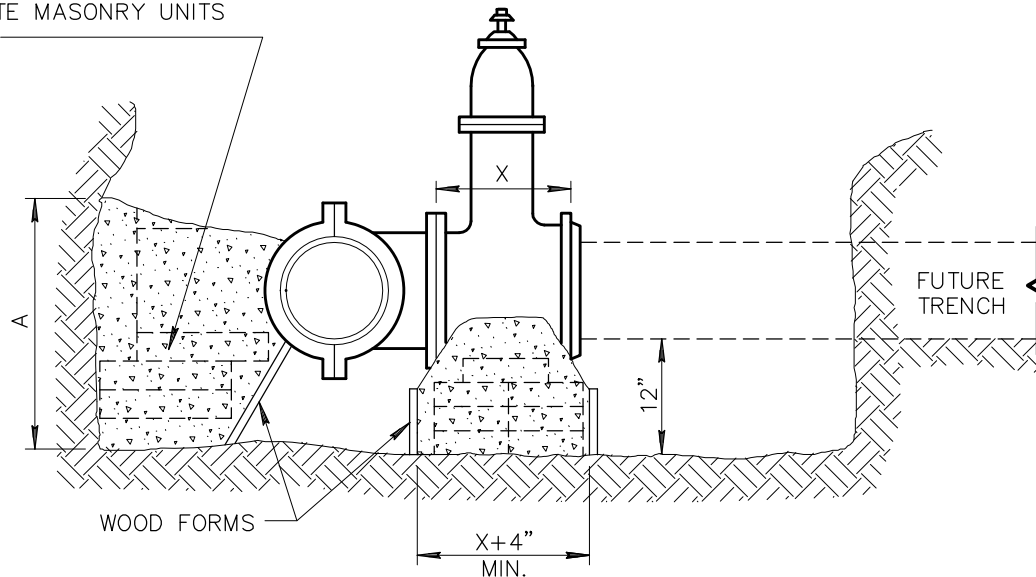
CAST-IN-PLACE VAULT SECTION





PLAN

OPTIONAL BLOCKING – 2" x 8" x 12"
SOLID CONCRETE MASONRY UNITS
AS INDICATED.



ELEVATION

NOTES:

1. TAPPING SLEEVE TO BE PLACED A MINIMUM OF 18" FROM ANY BELL COUPLING, VALVE, FITTING OR OTHER OBSTRUCTION
2. CONTRACTOR SHALL EXCAVATE AS SHOWN AND SHALL SET TAPPING SLEEVE AND VALVE AND TIGHTEN ALL BOLTS PRIOR TO THE PRESSURE TEST.
3. ALL TAPPING SLEEVES AND VALVES MUST BE PRESSURE TESTED PRIOR TO BLOCKING OR TAPPING. THE TEST MUST BE WITNESSED AND APPROVED BY THE INSPECTOR.
4. BLOCKS ARE TO EXTEND TO UNDISTURBED GROUND AND BE INSTALLED BEFORE THE TAP IS MADE. ALL FLANGE BOLTS SHALL BE FREE AND CLEAR OF CONCRETE.
5. CONCRETE THRUST BLOCKS SHALL BE CLASS 'B' PER SECT. 725. NORMALLY, CURE TIME FOR CONCRETE IS 24 HOURS BEFORE BACKFILLING.
6. TAPS SHALL BE MADE BY CITY CREWS AT PREVAILING RATES OR BY APPROVED CONTRACTORS WHEN ALLOWED BY AGENCY.
7. THIS DETAIL COVERS TAPPING SLEEVES 4" THROUGH 16" IN SIZE ON DUCTILE IRON, CAST IRON AND ASBESTOS CEMENT PIPE. ANY OTHER SIZE OR TYPE OF PIPE WILL REQUIRE A SEPARATE SUBMITTAL AND APPROVAL BY THE ENGINEER.

SIZE OF PIPE BEING CONNECTED	MINIMUM THRUST AREA REQUIRED EQUALS (AxB) (SQUARE FEET)
4" AND LESS	3
6"	4
8"	6
10"	9
12"	13
16"	23

DETAIL NO.

340



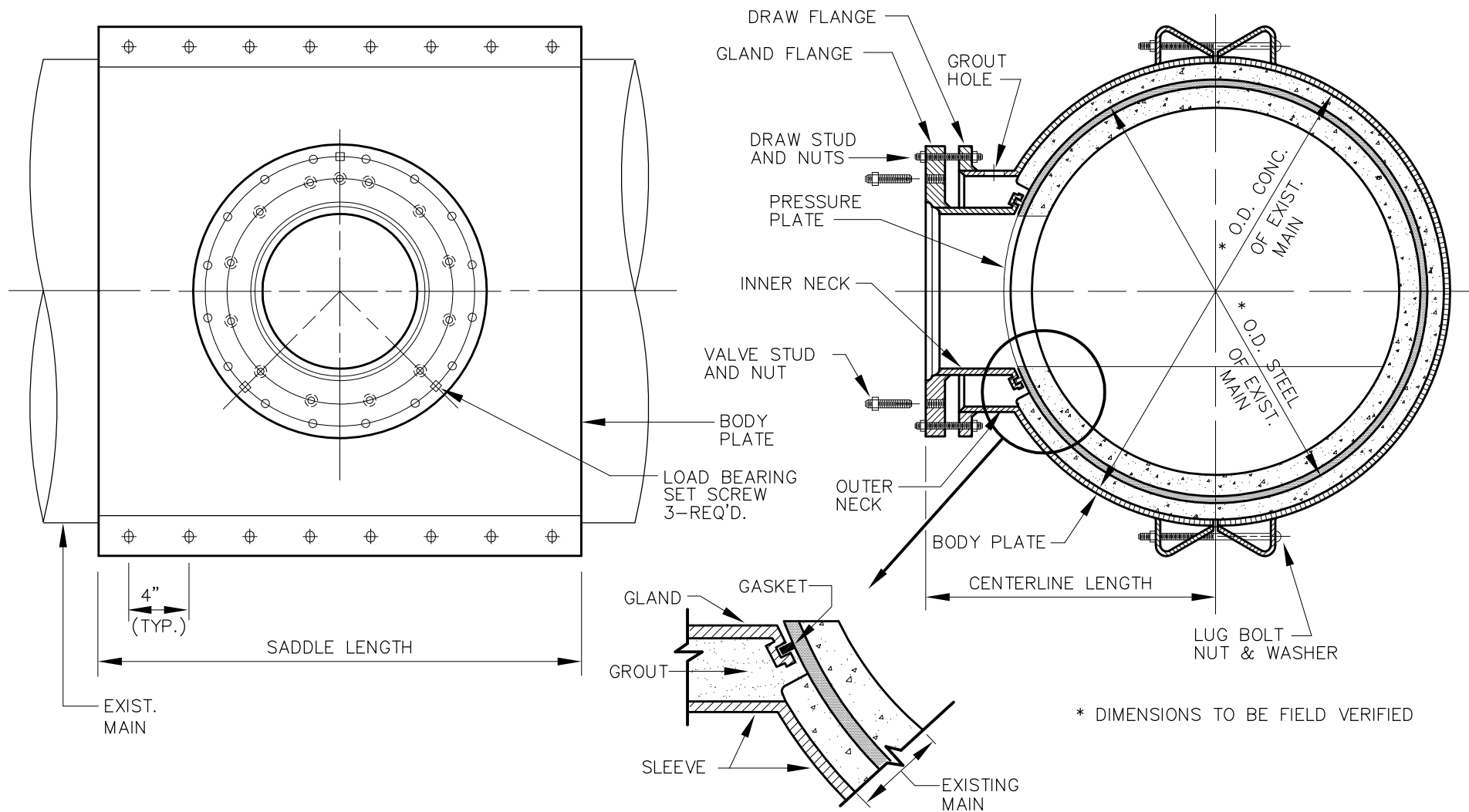
STANDARD DETAIL
ENGLISH

**INSTALLING TAPPING
SLEEVES AND VALVES**

REVISED
01-03-2002

DETAIL NO.

340



DETAIL NO.

342



STANDARD DETAIL
ENGLISH

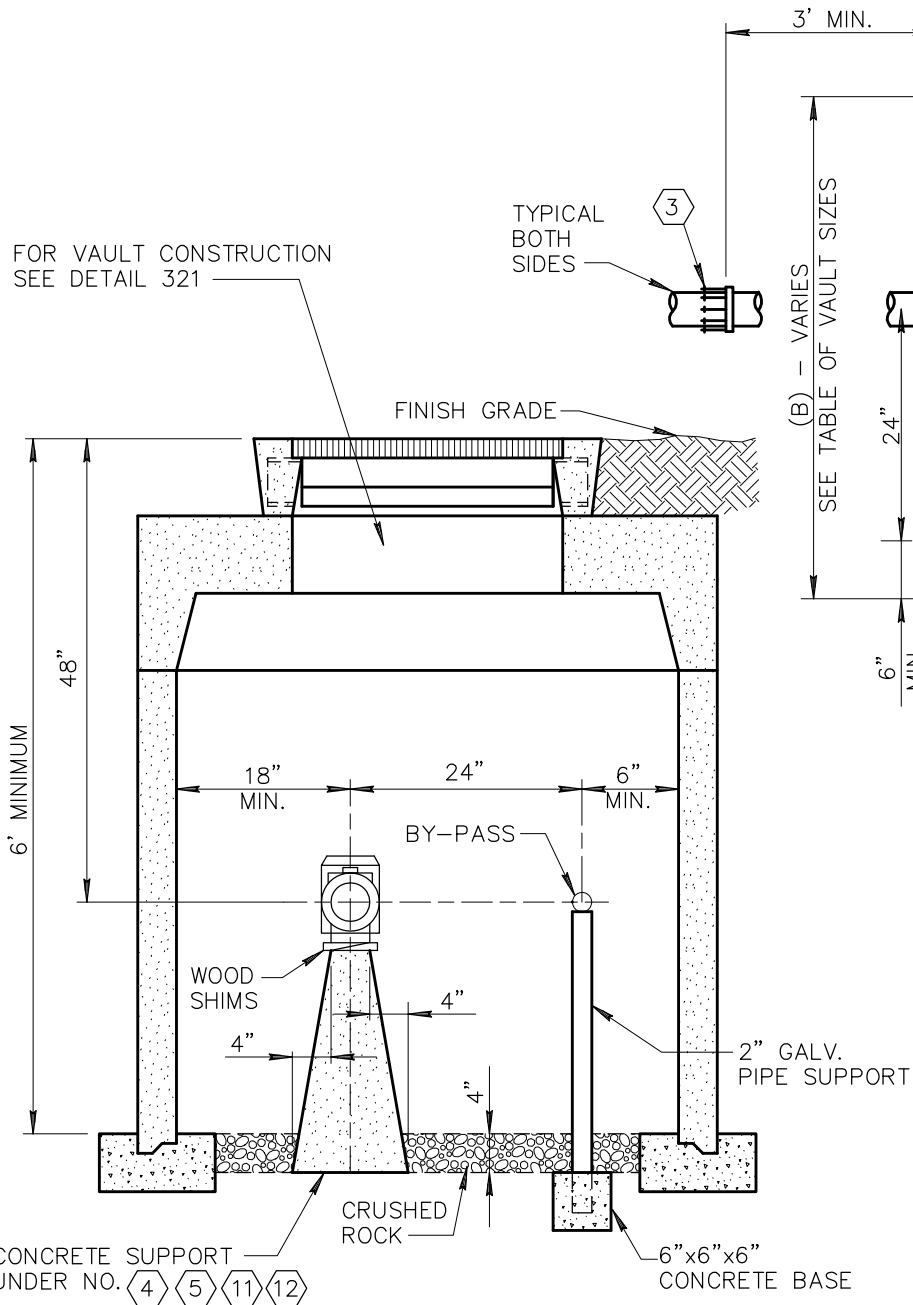
CONCRETE PRESSURE PIPE TAPPING SLEEVE

REVISED

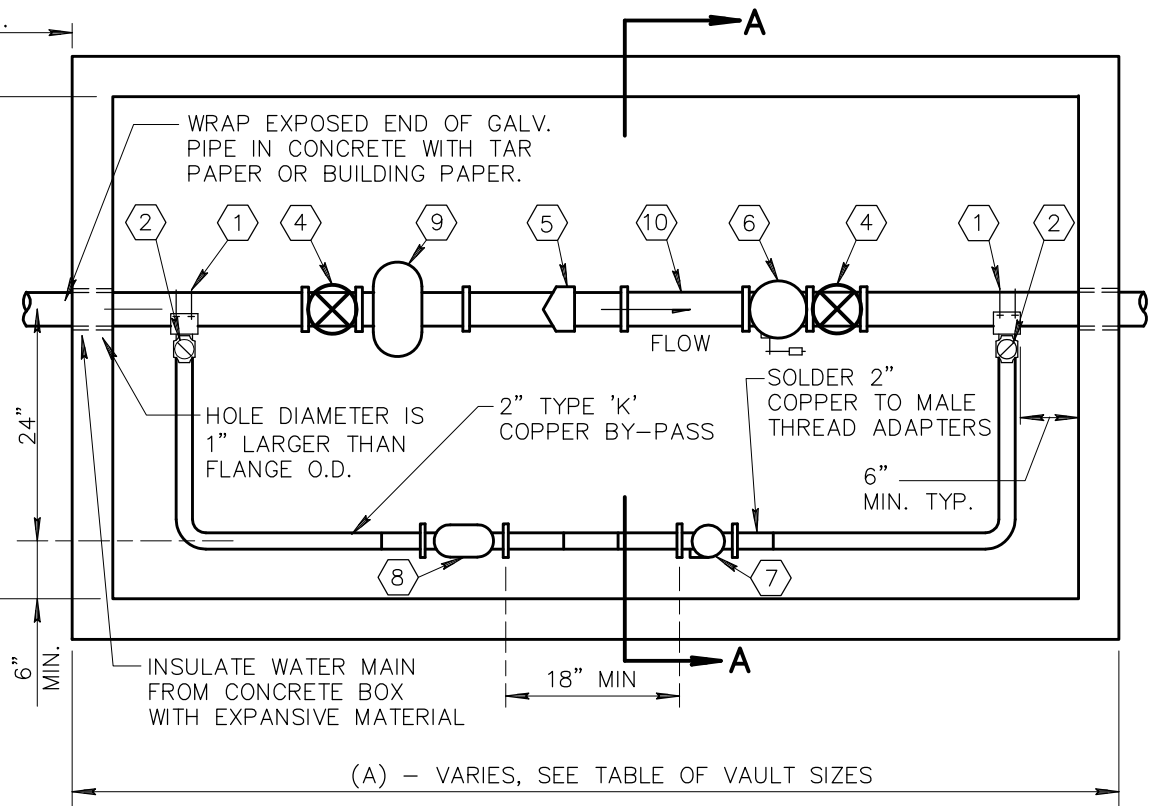
01-01-1998

DETAIL NO.

342



SECTION A-A

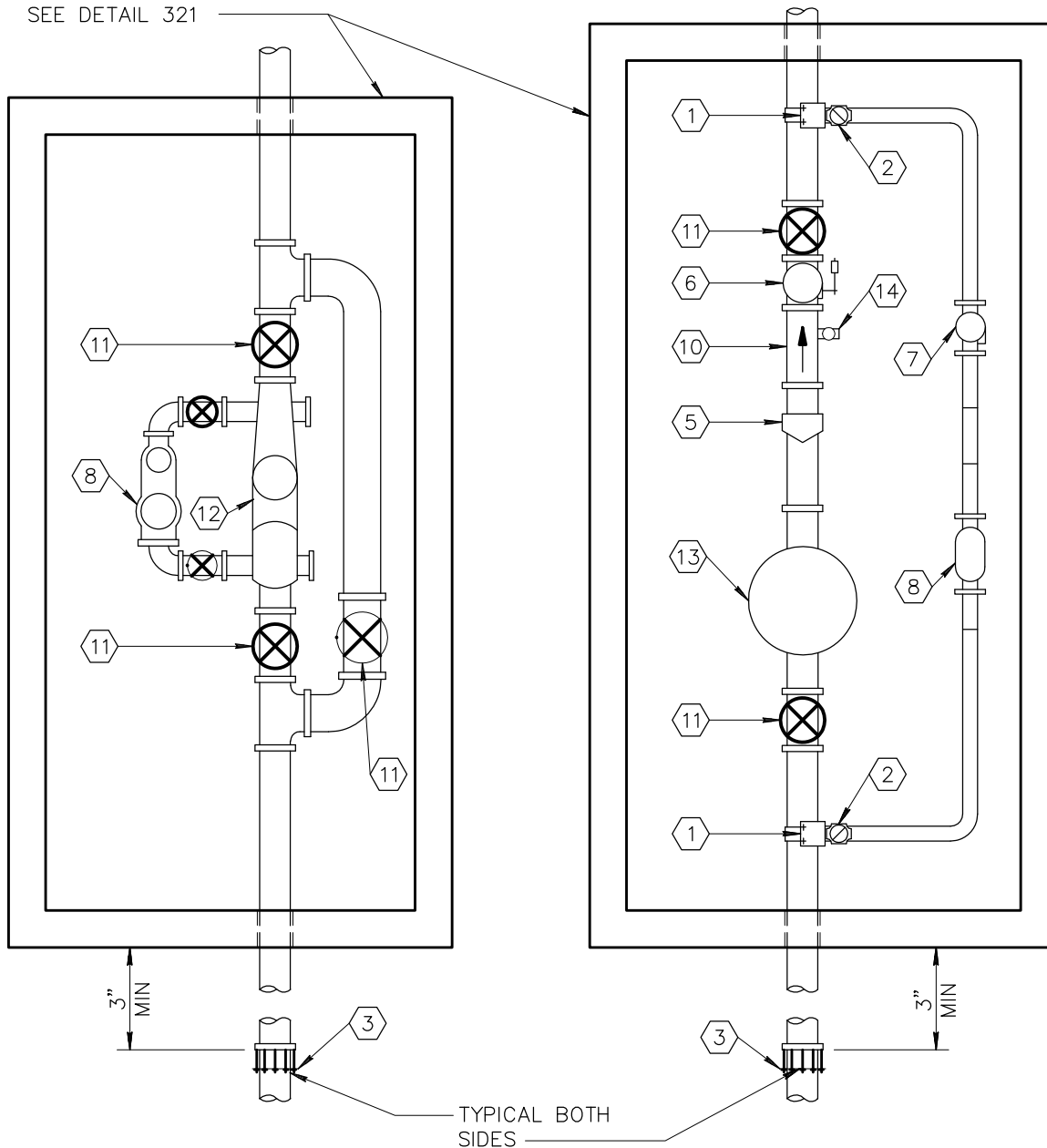


VAULT DIMENSION DETAILS

A.C.P. SIZE	3"	4"	6"
(A)	8'-4"	10'-6"	12'-0"
(B)	4'-4"	5'-0"	5'-0"

NOTE: METER VAULTS MAY BE EITHER CONCRETE MASONRY UNITS OR CAST-IN-PLACE OR PRE-CAST CONCRETE, SEE DETAIL 321 FOR VAULT CONSTRUCTION.

FOR VAULT CONSTRUCTION
SEE DETAIL 321



LEGEND

- ① DOUBLE STRAP ALL BRONZE SERVICE SADDLES.
- ② CORP. STOP, 2" (BALL TYPE).
- ③ ADAPTER, FLANGED, TO MECH. JOINT FOR A.C.P.
- ④ GATE VALVE, FLANGED, WITH HAND WHEEL, OPEN LEFT.
- ⑤ TURBOMETER: ROCKWELL SERIES 'W' OR HERSEY SERIES 'M.H.R.' OR NEPTUNE TRIDENT TURBINE.
- ⑥ FLANGED SWING CHECK VALVE WITH EXTERNAL LEVER AND WEIGHT.
- ⑦ 2" BRONZE CHECK VALVE.
- ⑧ 2" TURBOMETER: ROCKWELL 'W-160' OR HERSEY 'M.H.R.' OR NEPTUNE TRIDENT TURBINE.
- ⑨ STRAINER (3", 4", 6") AVAILABLE FROM METER MANUFACTURER, INSTALL ONLY WHEN 'TURBO' IS USED.
- ⑩ FLANGED SPOOL (3 PIPE DIAMETERS IN LENGTH).
- ⑪ O.S.&Y. GATE VALVE, FLANGED WITH HAND WHEEL OPEN LEFT, AND RISING STEM.
- ⑫ TURBOMETER U.L. APPROVED: ROCKWELL W-5000 DR. OR W-2000 DR. OR HERSEY F.M.-C.T. OR NEPTUNE TURBINE-F.S.-U.L.
- ⑬ 6" OR 10" STRAINER, U.L. APPROVED.
- ⑭ 2" THREADED OUTLET AND GATE VALVE.

NOTES

1. FOR LARGER METERS, SPECIAL VAULT DESIGN IS REQUIRED.
2. USE OF REMOTE READING DEVICE AT OPTION OF UTILTY.
3. CERTAIN AGENCIES AND/OR UTILITIES PREFER TO CONSTRUCT VAULT, CONTACT AGENCY INVOLVED PRIOR TO VAULT CONSTRUCTION.

DETAIL NO.

345-2



STANDARD DETAIL
ENGLISH

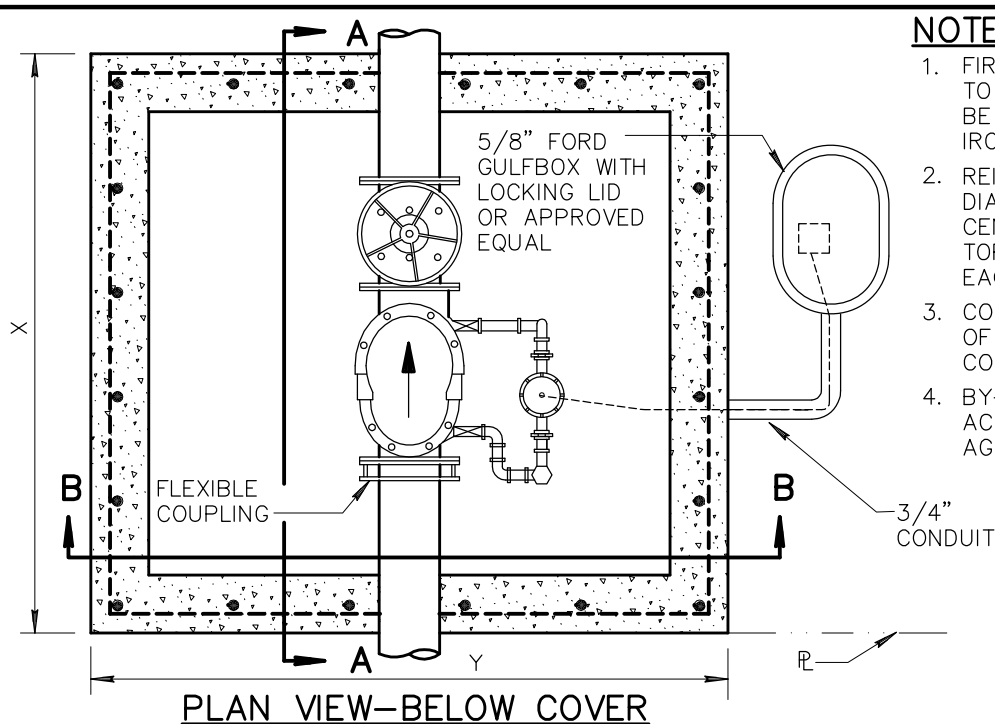
4", 6" WATER METER
WITH ON-SITE FIRE HYDRANTS

REVISED

01-01-1998

DETAIL NO.

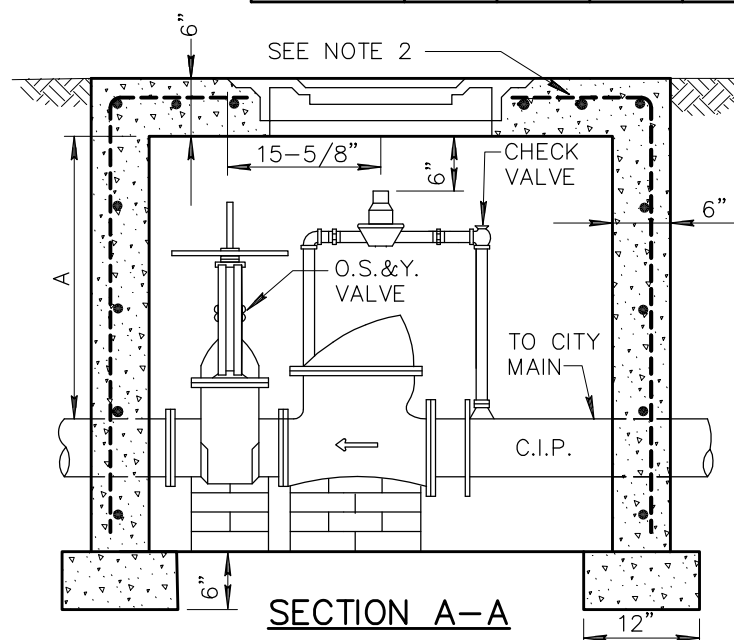
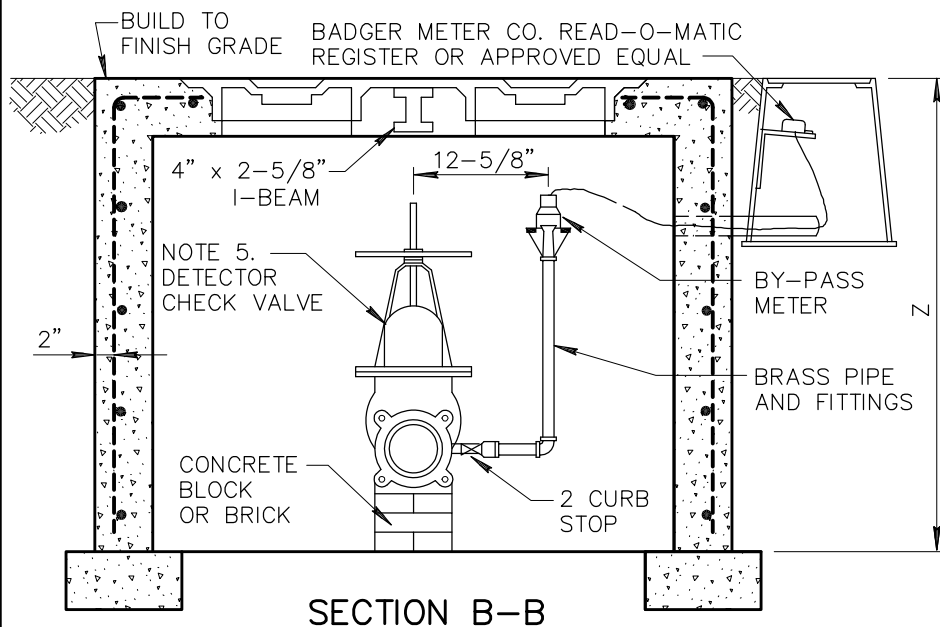
345-2



NOTES:

1. FIRELINE FROM CITY MAIN TO PROPERTY LINE SHALL BE CONSTRUCTED OF CAST IRON PIPE.
2. REINFORCING TO BE 1/2" DIAMETER REBAR ON 6" CENTERS EACH WAY ON TOP AND 12" CENTERS EACH WAY ON THE SIDES.
3. COVERS TO CONSIST OF TWO METER BOX COVERS DET. 314.
4. BY-PASS METER TO BE ACCORDING TO GOVERNING AGENCY.
5. CHECK VALVE TO BE GLOBE MODEL "A" GRINNEL, HERSEY MODEL D.C., VIKING MODEL "A" OR APPROVED EQUAL.
6. VAULT SHALL BE CONSTRUCTED IN OWNERS PROPERTY AGAINST THE FRONT PROPERTY LINE OR ANOTHER APPROVED LOCATION. WALLS AND FENCES SHALL NOT OBSTRUCT ACCESS.
7. CITY CONTROL VALVE TO BE REQUIRED AT MAIN.
8. PARTS OF PIPE TO BE EMBEDDED IN CONC. SHALL BE WRAPPED WITH 30 LB ASPHALT ROOFING FELT.
9. REMOTE READING DEVICE SHALL BE OF SELF GENERATING ELECTRICAL TYPE. HYDRAULIC OR MECHANICAL DRIVE REGISTERS WILL NOT BE ACCEPTABLE.
10. CONCRETE TO BE CLASS 'B' PER SECT. 725.

DIA. OF PIPE	X	Y	Z	BY-PASS METER SIZE	A
4"	60"	66"	49"	5/8" x 3/4"	30"
6"	66"	72"	49"	5/8" x 3/4"	30"
8"	72"	72"	58"	1"	36"
10"	78"	72"	69"	1-1/2"	36"



DETAIL NO.

346



STANDARD DETAIL
ENGLISH

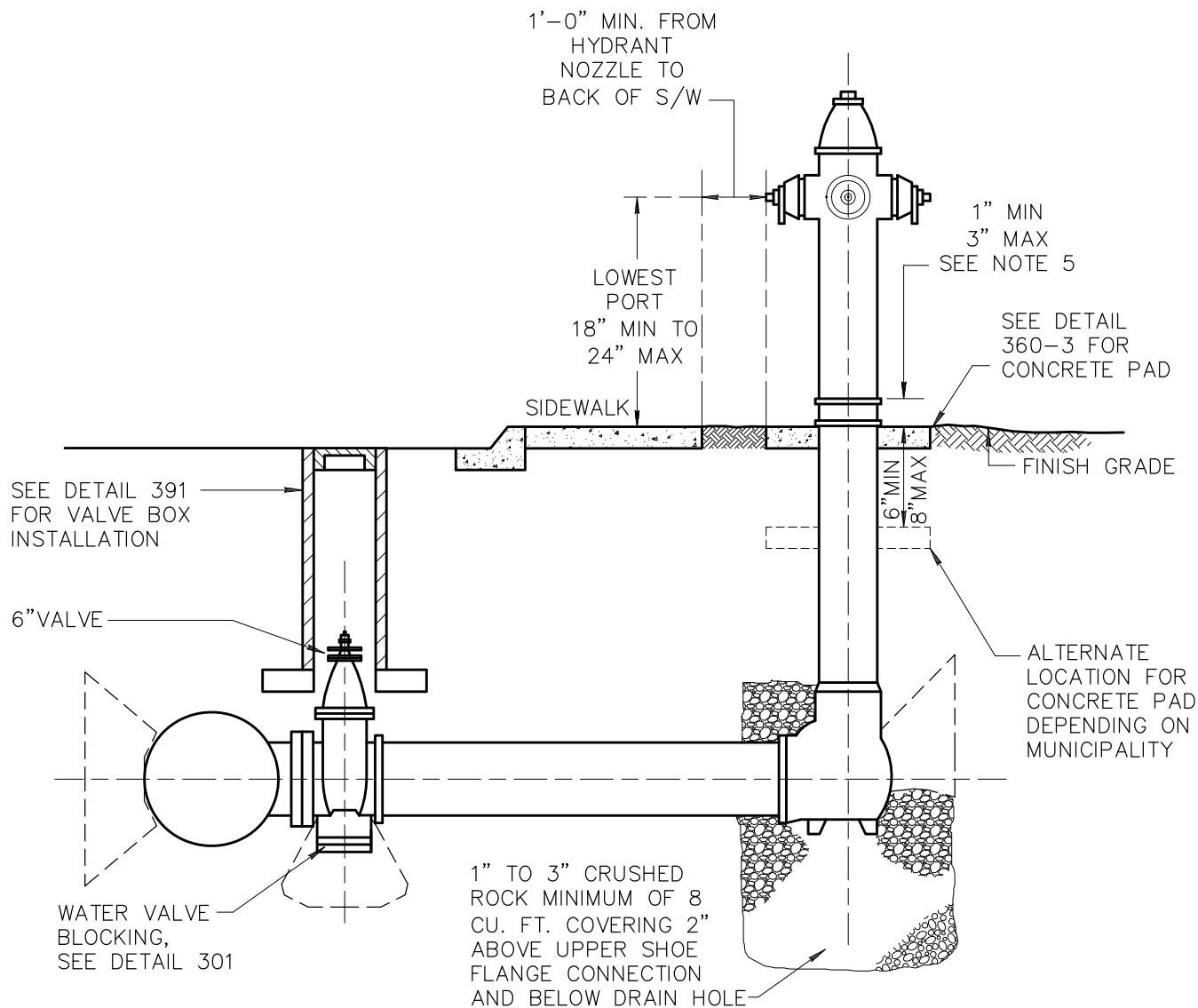
FIRE LINE DETECTOR CHECK VAULT

REVISED

01-01-1998

DETAIL NO.

346



NOTES:

1. JOINTS BETWEEN THE VALVE AND THE MAIN SHALL BE FLANGED TYPE. JOINTS BETWEEN THE VALVE AND HYDRANT SHALL BE RESTRAINT OR MECHANICAL TYPE.
2. RESTRAINTS SHALL BE MECHANICAL RESTRAINT OR THRUST BLOCK PER DETAIL 380.
3. A FLANGE JOINT BY MECHANICAL JOINT VALVE SHALL BE USED AS THE TRANSITION BETWEEN THE JOINT TYPES.
4. PIPING BETWEEN WATER VALVE AND HYDRANT SHALL BE DUCTILE IRON.
5. SEE DETAIL 362 FOR LOCATION OF HYDRANT.
6. PUMPER CONNECTION SHALL FACE THE STREET.
7. NO VALVES ARE TO BE LOCATED IN CURB.
8. NATIONAL STANDARD THREADS REQUIRED ON ALL CONNECTIONS UNLESS OTHERWISE DIRECTED.
9. SEE DETAIL 360-3 FOR CONCRETE PAD.
10. FIRE HYDRANT SHALL BE FRESHLY PAINTED PRIOR TO FINAL ACCEPTANCE.
11. SEE SECTION 756 FOR HYDRANT MATERIAL.

DETAIL NO.

360-1



STANDARD DETAIL
ENGLISH

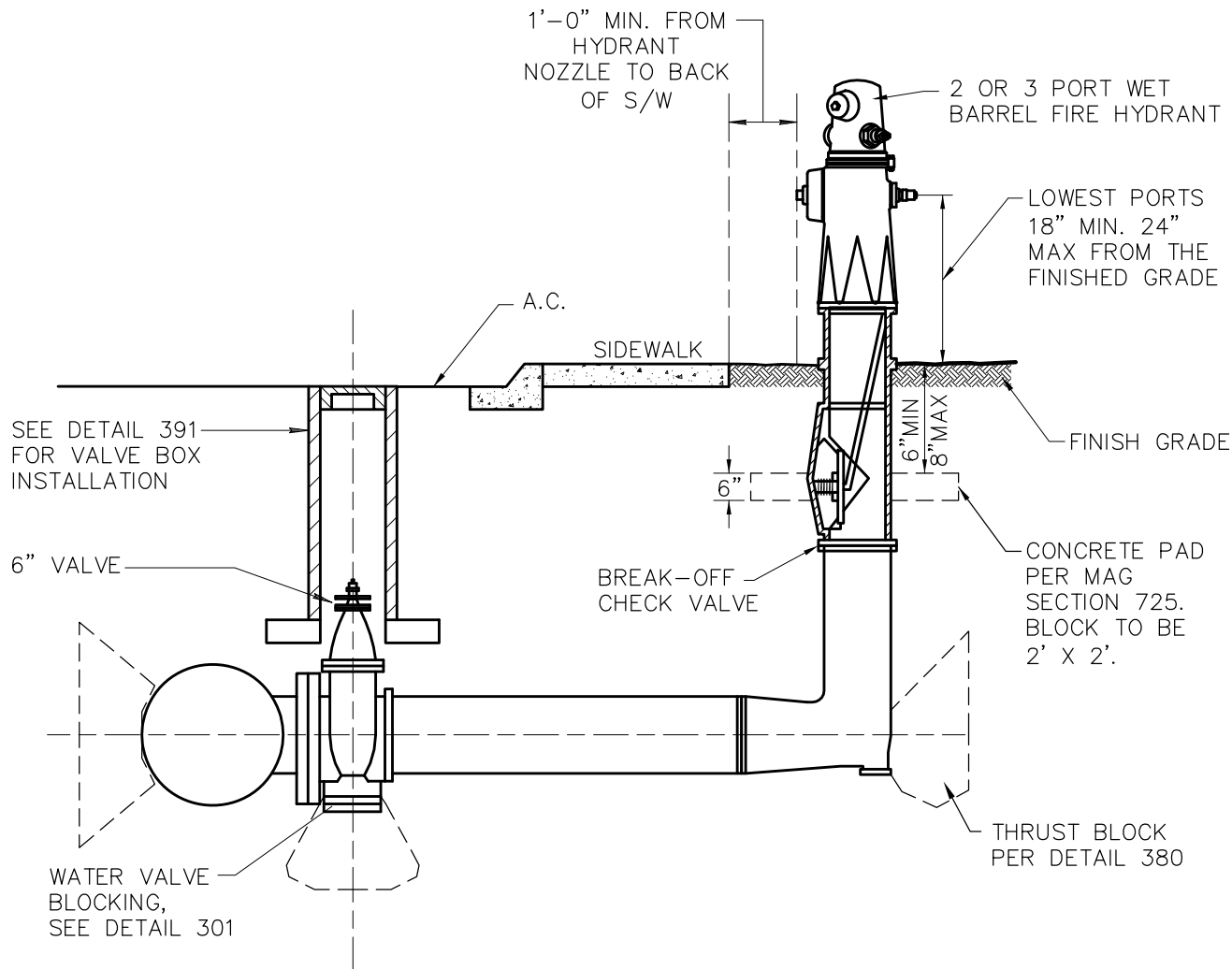
DRY BARREL FIRE HYDRANT INSTALLATION

REVISED

01-01-2013

DETAIL NO.

360-1



NOTES:

1. JOINTS BETWEEN THE VALVE AND THE MAIN SHALL BE FLANGED TYPE. JOINTS BETWEEN THE VALVE AND HYDRANT SHALL BE MECHANICAL RESTRAINT MECHANICAL TYPE.
2. RESTRAINTS SHALL BE MECHANICAL RESTRAINT OR THRUST BLOCK PER DETAIL 380.
3. A FLANGE JOINT BY MECHANICAL JOINT VALVE SHALL BE USED AS THE TRANSITION BETWEEN THE JOINT TYPES.
4. PIPING BETWEEN WATER VALVE AND HYDRANT SHALL BE DUCTILE IRON.
5. SEE DETAIL 362 FOR LOCATION OF HYDRANT.
6. PUMPER CONNECTION SHALL FACE THE STREET.
7. NO VALVES ARE TO BE LOCATED IN CURB.
8. NATIONAL STANDARD THREADS REQUIRED ON ALL CONNECTIONS UNLESS OTHERWISE DIRECTED.
9. SEE DETAIL 360-3 FOR CONCRETE PAD.
10. FIRE HYDRANT SHALL BE FRESHLY PAINTED PRIOR TO FINAL ACCEPTANCE.
11. THE HYDRANT SHALL HAVE 2- 2½" PORT AND 1- 4½" PORT (INDUSTRIAL OR COMMERCIAL).
12. THE HYDRANT SHALL HAVE 1- 2½" PORT AND 1- 4½" PORT (RESIDENTIAL).

DETAIL NO.

360-2



STANDARD DETAIL
ENGLISH

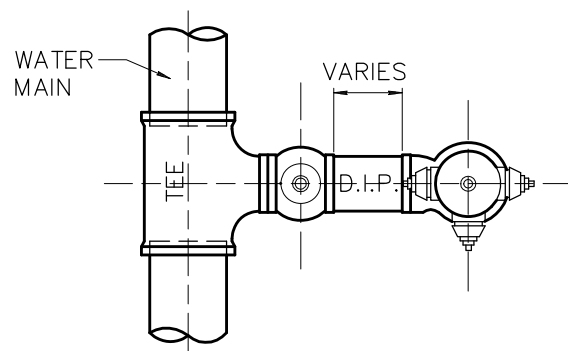
WET BARREL FIRE HYDRANT INSTALLATION

REVISED

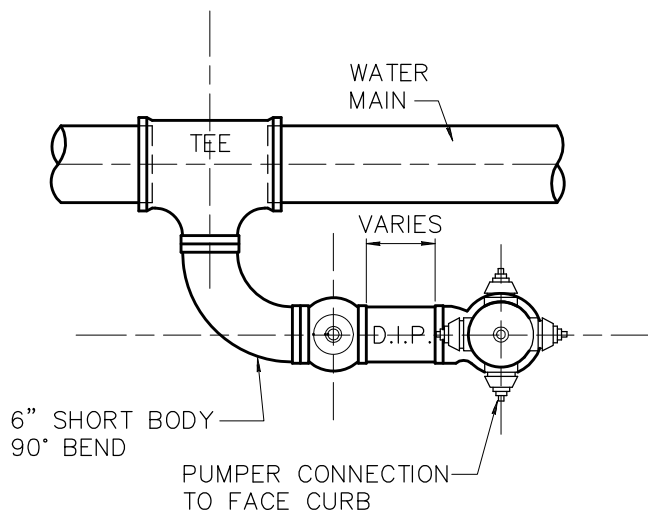
01-01-2013

DETAIL NO.

360-2

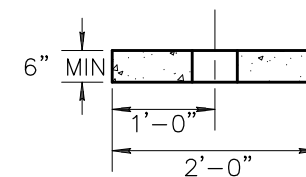
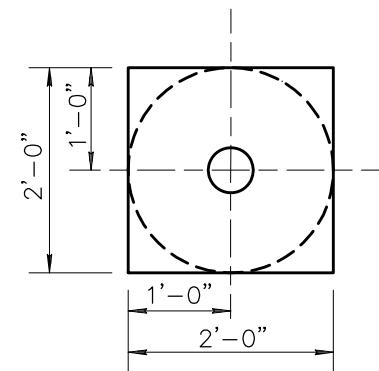


**TYP MAIN CONNECTION
(PREFERRED)**

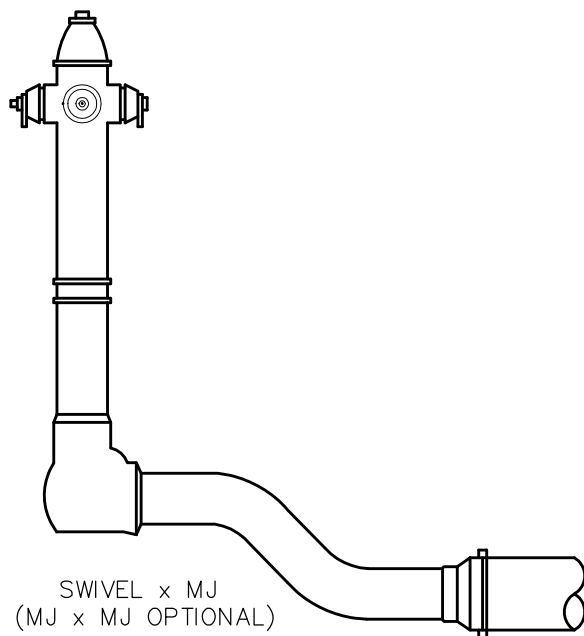


**ALT MAIN
CONNECTION**

SQUARE OR ROUND IS ACCEPTABLE
IF ROUND: 24" DIAMETER MIN. REQUIRED



**CONCRETE PAD
LOCATION DETAIL**



OFFSET FITTINGS

NOTES:

1. CONCRETE FOR PAD SHALL BE CLASS "A".
2. SCORE LINE SHALL BISECT CONCRETE PAD AT MID POINT OF ALL SIDES.
3. CONCRETE COLOR SHALL MATCH ADJACENT CONCRETE. THE FINISHED CONCRETE SURFACE SHALL HAVE A ROUGH BROOM FINISH (SURFACE ONLY).
4. MULTIPLE OFFSET FITTINGS SHALL NOT BE ALLOWED.
5. MINIMUM 36" CLEARANCE PER NFPA-24 AROUND FIRE HYDRANT.
6. 1/2" BITUMINOUS EXPANSION SHALL BE PLACED AROUND THE BARREL OF THE FIRE HYDRANT AT THE CONCRETE PAD.

DETAIL NO.

360-3



STANDARD DETAIL
ENGLISH

FIRE HYDRANT INSTALLATION DETAILS

REVISED

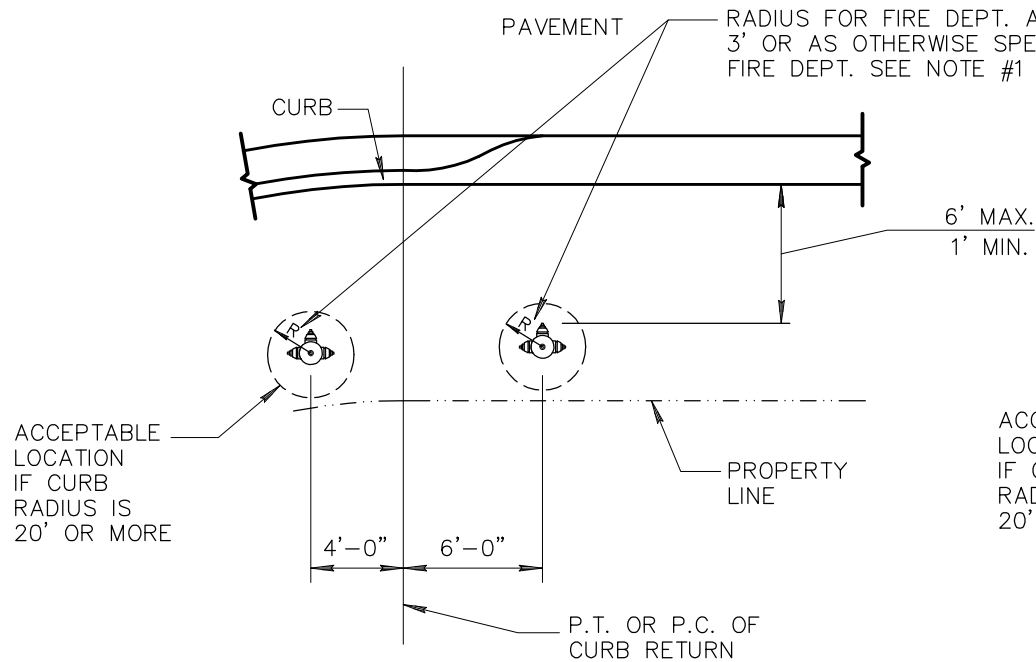
01-01-2013

DETAIL NO.

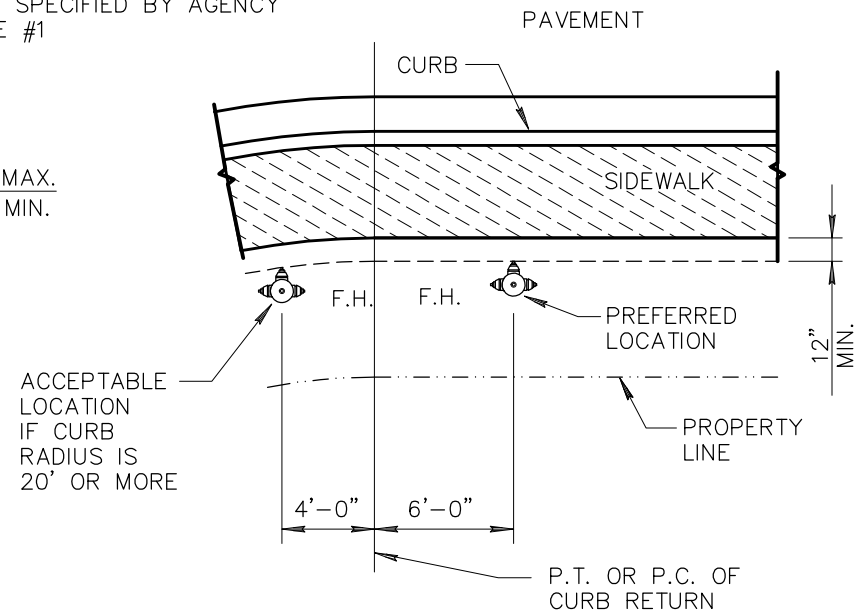
360-3

NOTES:

1. OBSTRUCTIONS SUCH AS UTILITY POLES, STREET SIGNS, IRRIGATION BOXES, FENCES, ETC., MUST NOT BE PLACED BETWEEN CURB AND HYDRANT AND WITHIN THE RADIUS FOR FIRE DEPT. ACCESS.
2. DIMENSIONS SHOWN ON CONSTRUCTION DRAWINGS SUPERSEDE LOCATIONS SHOWN HERE.
3. ON LOCATIONS IN MIDBLOCK, THE FIRE HYDRANT WILL BE ALIGNED WITH A PROPERTY LINE.



PARKWAY AREA OR NO SIDEWALK



AREA WITH SIDEWALK

DETAIL NO.

362



STANDARD DETAIL
ENGLISH

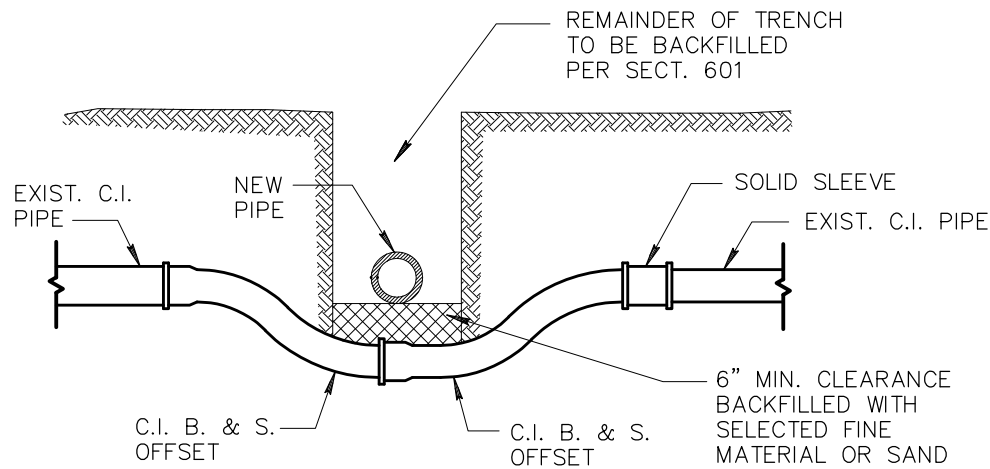
LOCATIONS FOR NEW FIRE HYDRANTS

REVISED

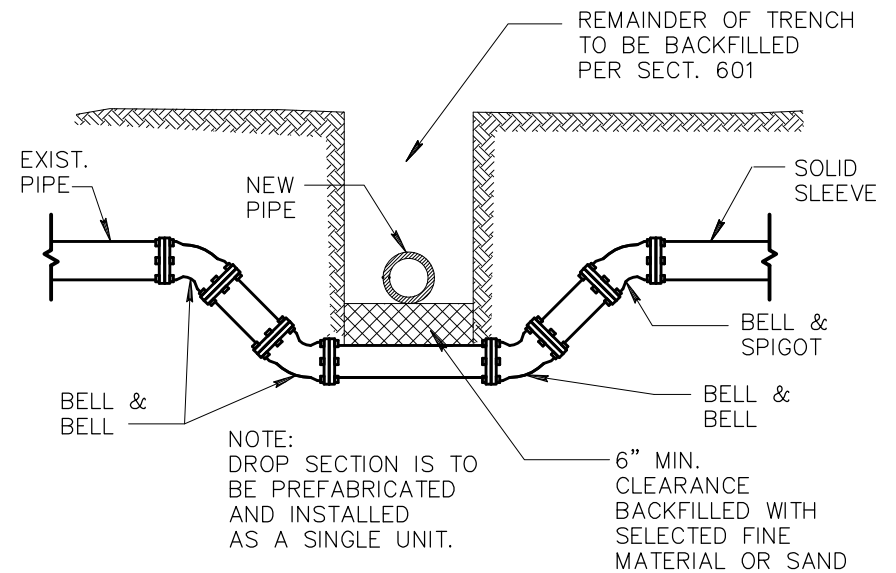
01-01-1999

DETAIL NO.

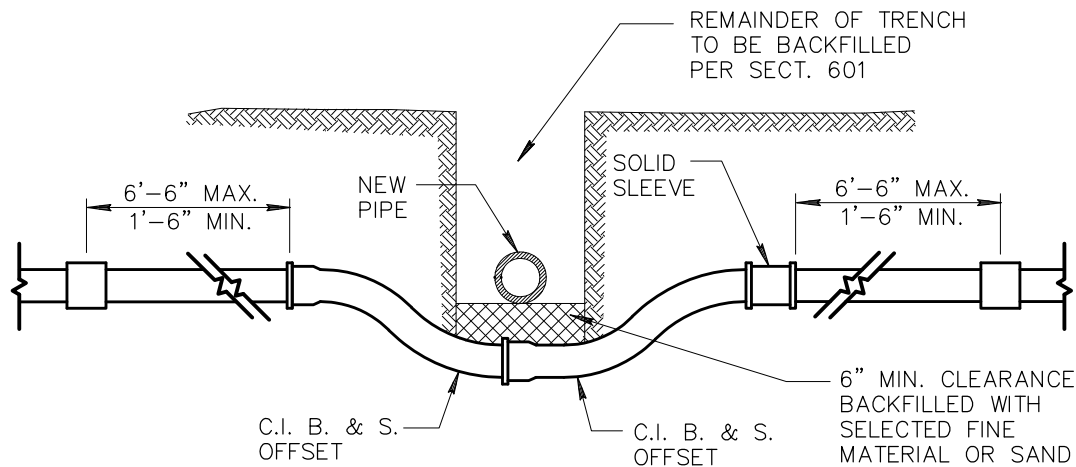
362



CAST IRON



CAST IRON MECHANICAL JOINT



ASBESTOS CEMENT

NOTES:

1. THIS DETAIL COVERS MOVING OF WATER MAINS 2" TO 12" ONLY.
2. THRUST BLOCKING AS PER DET. 380 & 381.
3. IF OFFSET IS TO GO OVER OBSTRUCTION, JOINT RESTRAINTS MUST BE USED.
4. PIPE IS TO BE CAST IRON OR DUCTILE IRON.

DETAIL NO.

370



STANDARD DETAIL
ENGLISH

VERTICAL REALIGNMENT OF WATER MAINS

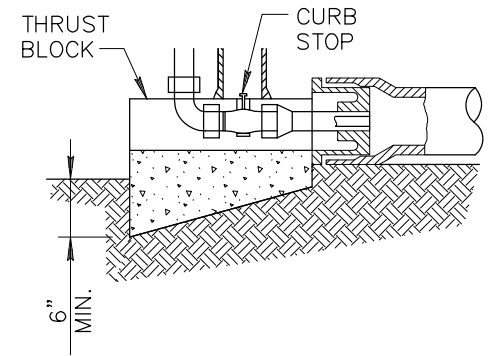
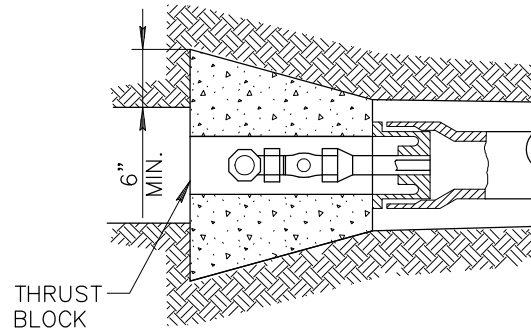
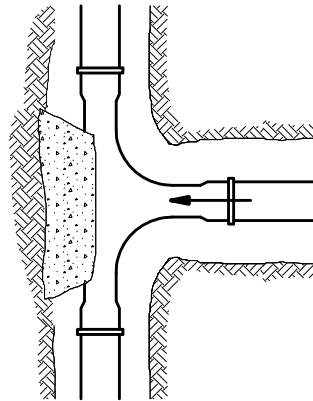
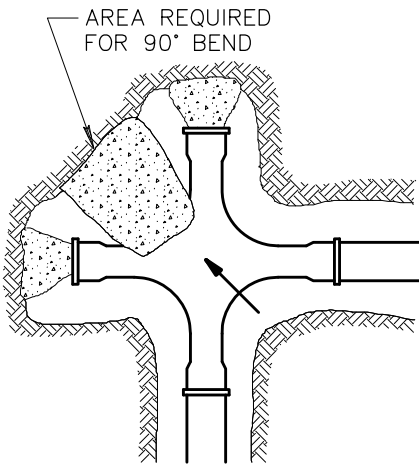
REVISED

01-01-1998

DETAIL NO.

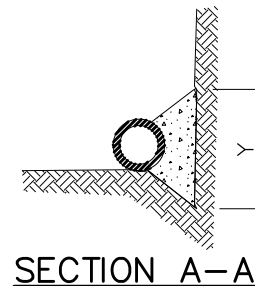
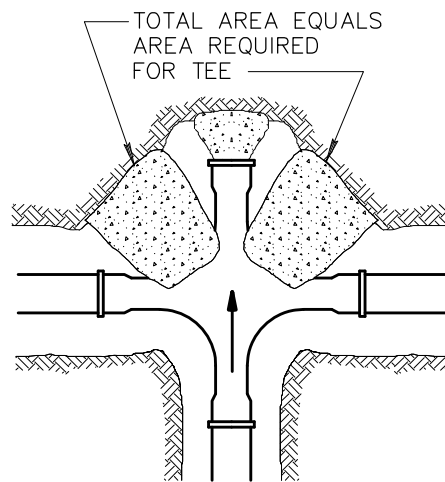
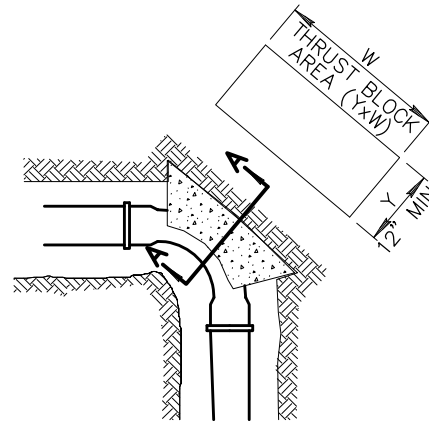
370

TYPICAL LOCATIONS OF THRUST BLOCKS



NOTES:

1. TABLE IS BASED ON 200 P.S.I. TEST PRESSURE AND 3,000 LBS/SQ. FT. SOIL. IF CONDITIONS ARE FOUND TO INDICATE SOIL BEARING IS LESS, THE AREAS SHALL BE INCREASED ACCORDINGLY.
2. AREAS FOR PIPES LARGER THAN 16" SHALL BE CALCULATED FOR EACH PROJECT.
3. FORM ALL NON-BEARING VERTICAL SURFACES.
4. THRUST BLOCKS ARE TO EXTEND TO UNDISTURBED GROUND. CONCRETE TO BE CLASS 'C', SECT. 725.



MINIMUM THRUST BLOCK AREA REQUIRED (YxW) (SQ. FT.)

PIPE SIZE	WATER PIPE	
	TEE, DEAD END, 90° BEND	45° & 22 1/2° BENDS
4" OR LESS	3	3
6"	4	3
8"	6	3
10"	10	5
12"	14	7
16"	24	12

DETAIL NO.

380



STANDARD DETAIL
ENGLISH

THRUST BLOCKS FOR WATER LINES

REVISED

01-01-1998

DETAIL NO.

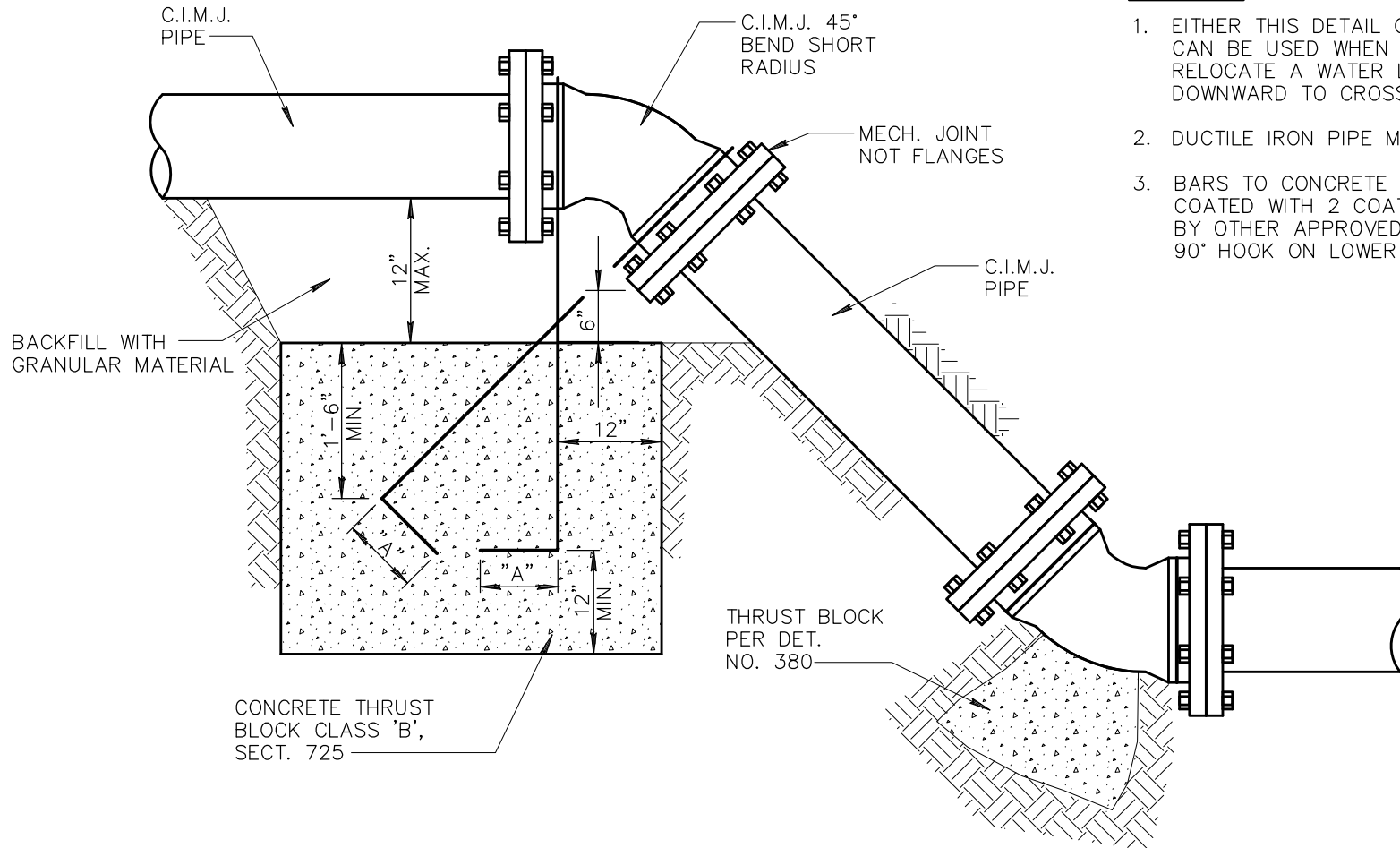
380

PIPE SIZE	MIN BAR SIZE	"A"—DIMENSION HOOK	MIN. * BLOCK DIM.
6"	#6	6"	3' x 3' x 3'
8"	#6	9"	4' x 4' x 2.5'
12"	#8	9"	4' x 4' x 5'

* FOR 125 P.S.I. WORKING PRESSURE.

NOTES:

1. EITHER THIS DETAIL OR RESTRAINT RODS CAN BE USED WHEN IT IS ALLOWED TO RELOCATE A WATER LINE UPWARD OR DOWNWARD TO CROSS A CONFLICT.
2. DUCTILE IRON PIPE MAY BE USED.
3. BARS TO CONCRETE THRUST BLOCK TO BE COATED WITH 2 COATS COAL TAR, EPOXY OR BY OTHER APPROVED METHOD. BARS TO HAVE 90° HOOK ON LOWER END, AS PER TABLE.



DETAIL NO.

381



STANDARD DETAIL
ENGLISH

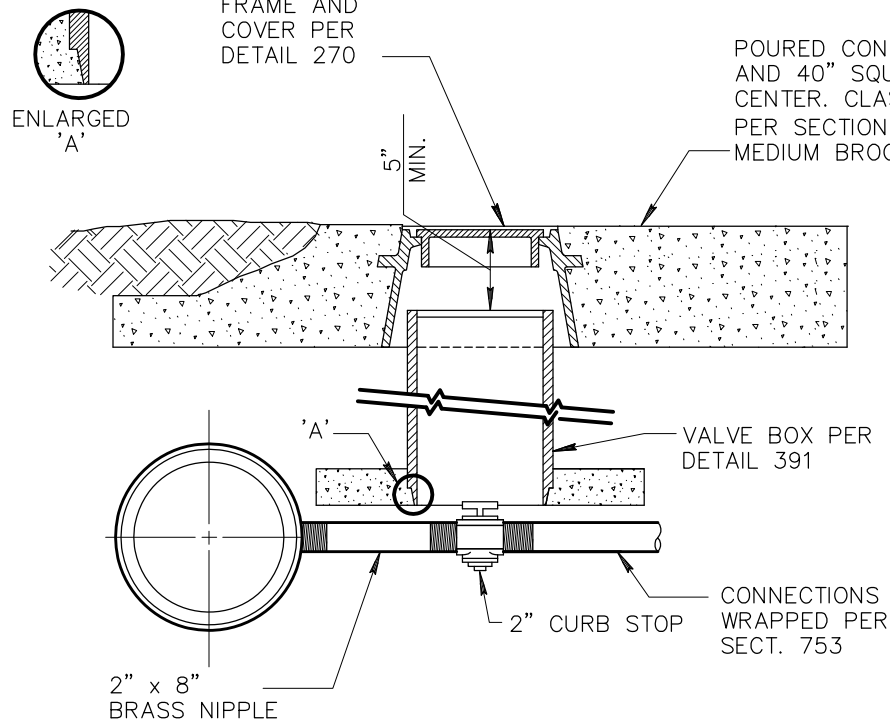
ANCHOR BLOCKS FOR VERTICAL BENDS

REVISED

01-01-1998

DETAIL NO.

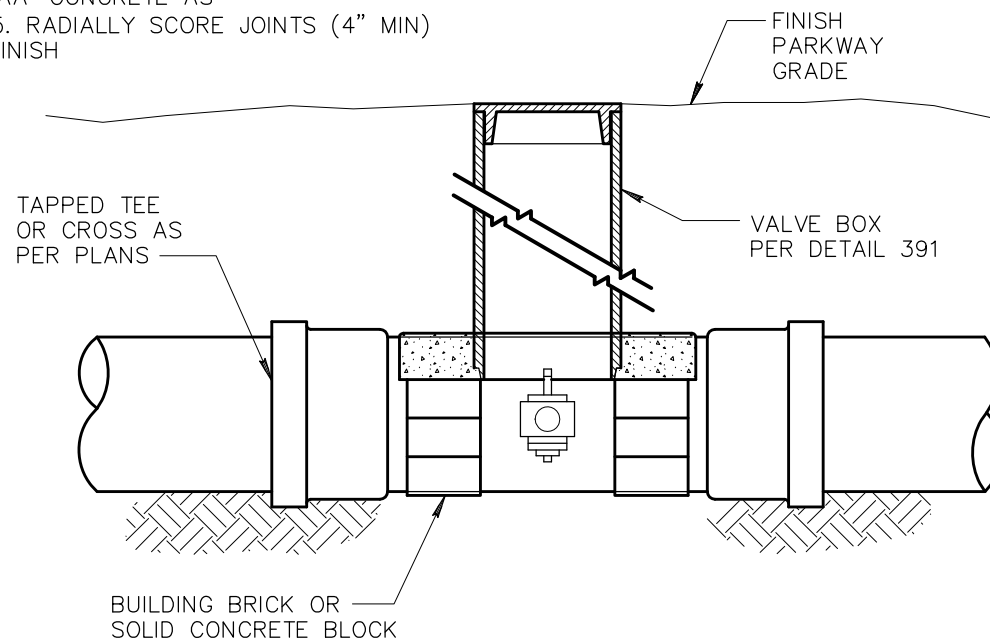
381



TYPE 'A'

NOTES:

1. CURB STOP TO BE MUELLER ORISEAL (H-10283), FORD BALL VALVE B11-777, HAYES BULLETIN 400, J. JONES (J-1900) OR APPROVED EQUAL.
2. REDUCER MAY BE USED WHEN CONNECTING TO SMALLER GALVANIZED PIPE.
3. THIS DETAIL IS TO BE USED WHEN CONNECTING EXISTING GALVANIZED PIPE TO ASBESTOS CEMENT PIPE OR CAST IRON PIPE.



TYPE 'B'

NOTE:

1. VALVE BOX TO BE SUPPORTED ON BRICKS TO PREVENT VERTICAL LOADS FROM BEING TRANSMITTED TO THE SMALL PIPE.

DETAIL NO.

389



STANDARD DETAIL
ENGLISH

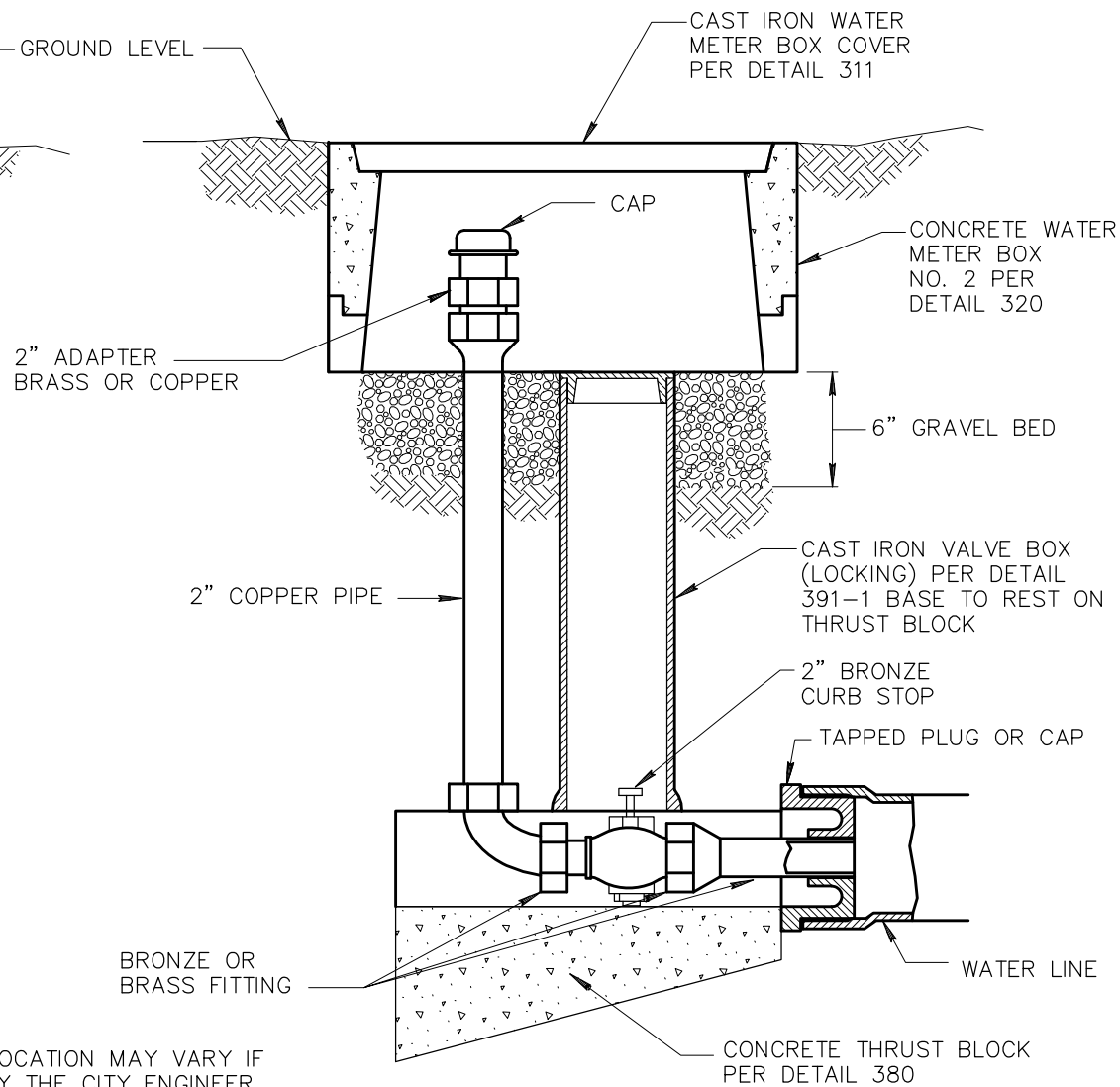
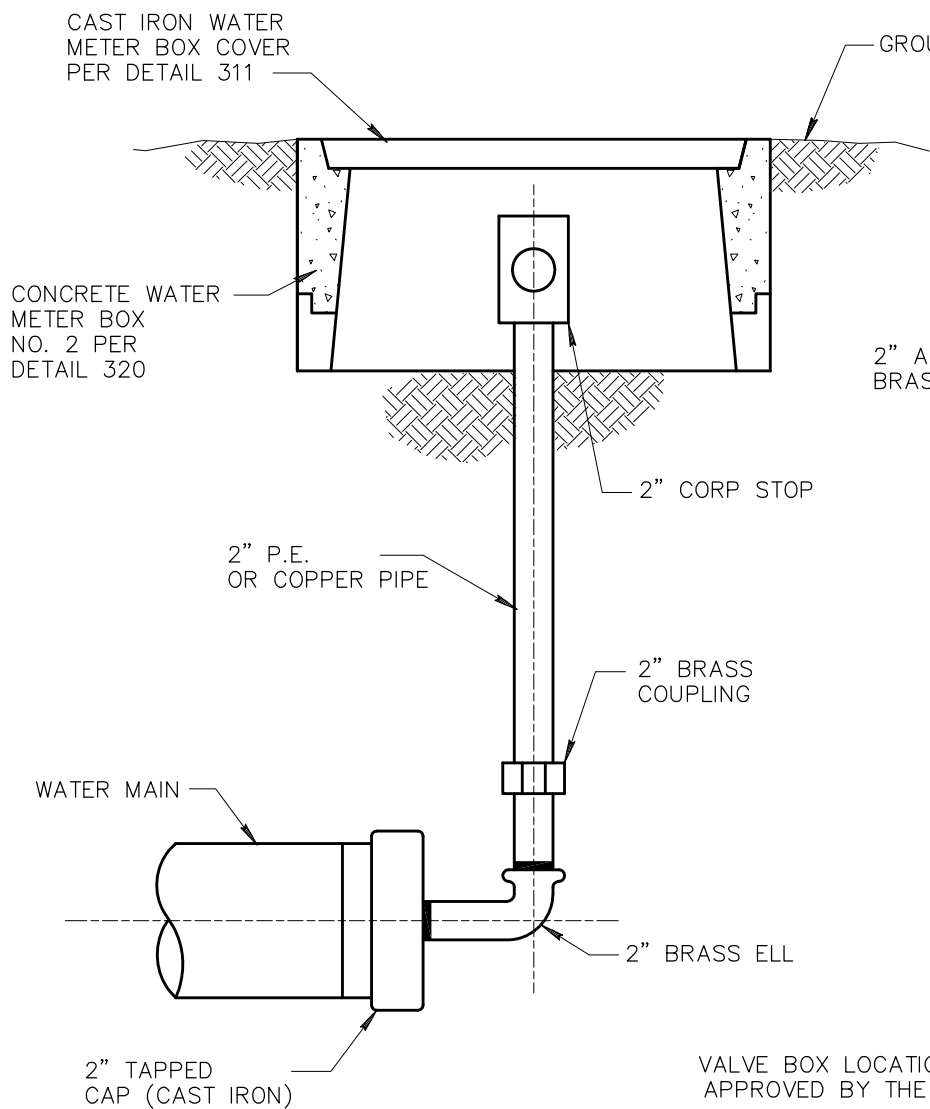
**CURB STOP WITH VALVE BOX
AND COVER**

REVISED

01-01-2001

DETAIL NO.

389



DETAIL NO.

390



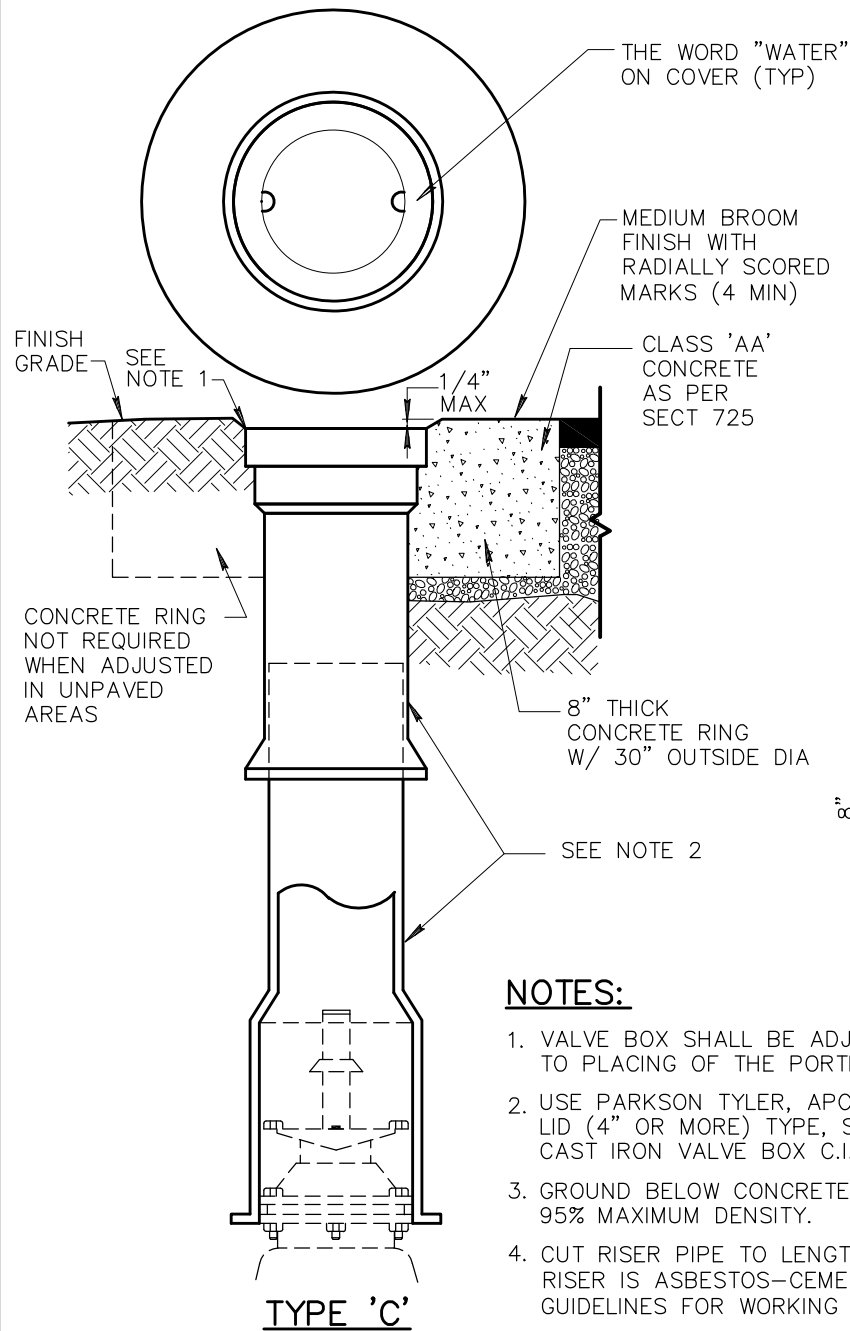
STANDARD DETAIL
ENGLISH

CURB STOP WITH FLUSHING PIPE

REVISED
01-01-1998

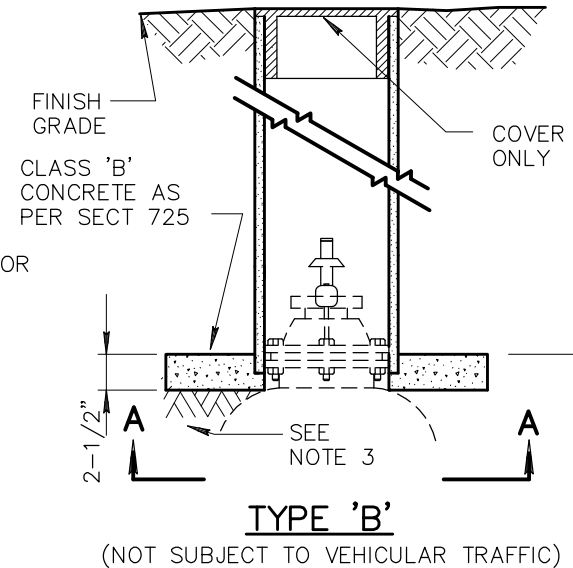
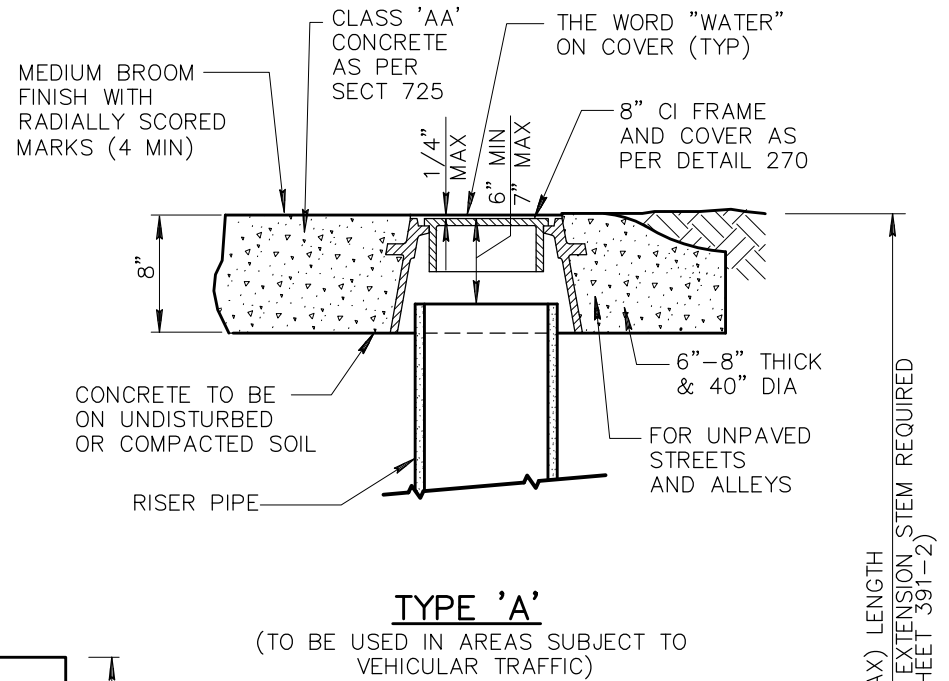
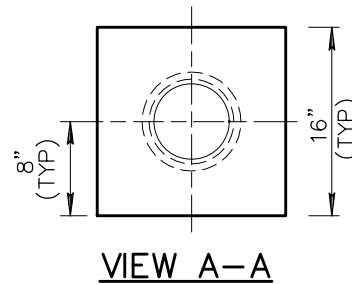
DETAIL NO.

390



NOTES:

1. VALVE BOX SHALL BE ADJUSTED TO THE FINISHED GRADE PRIOR TO PLACING OF THE PORTLAND CEMENT CONCRETE SURFACE.
2. USE PARKSON TYLER, APCO OR EQUAL DEEP SKIRTED LID (4" OR MORE) TYPE, SLIDING ADJUSTABLE CAST IRON VALVE BOX C.I. MIN. T.S. 30,000 P.S.I.
3. GROUND BELOW CONCRETE PAD TO BE COMPACTED 95% MAXIMUM DENSITY.
4. CUT RISER PIPE TO LENGTH IN FIELD. **CAUTION:** IF EXISTING RISER IS ASBESTOS-CEMENT PIPE (ACP) FOLLOW OSHA GUIDELINES FOR WORKING WITH ACP.



DETAIL NO.

391-1



STANDARD DETAIL
ENGLISH

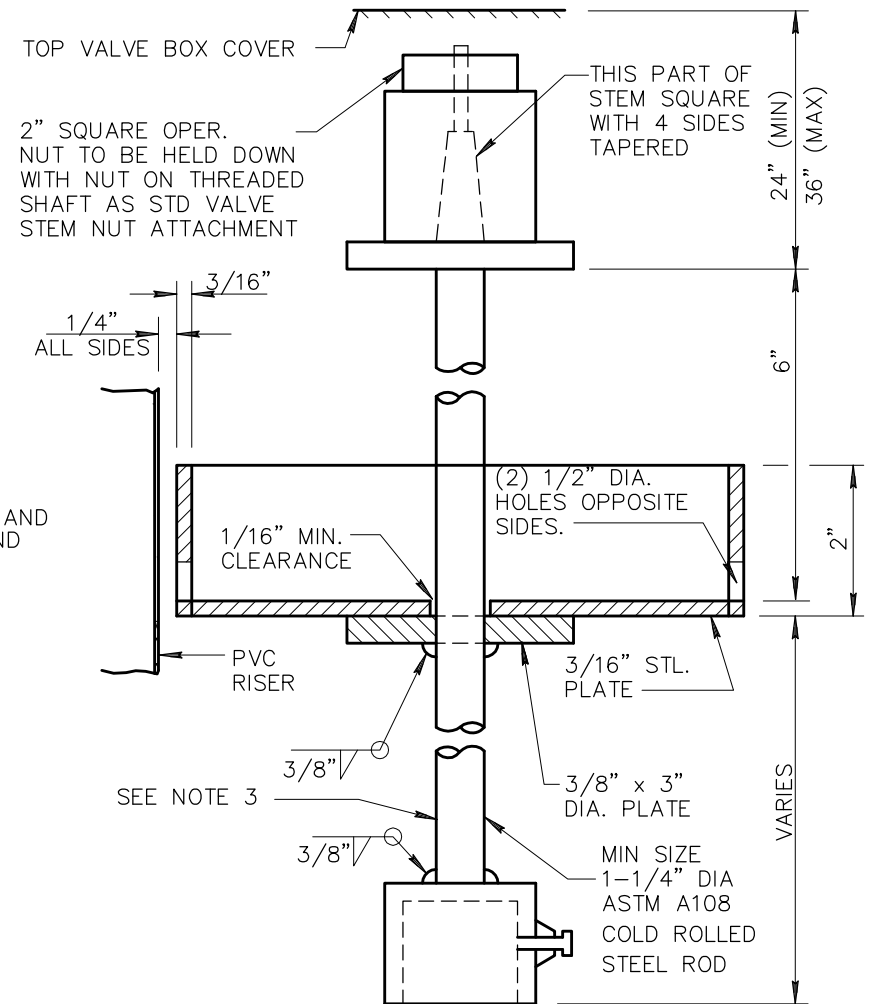
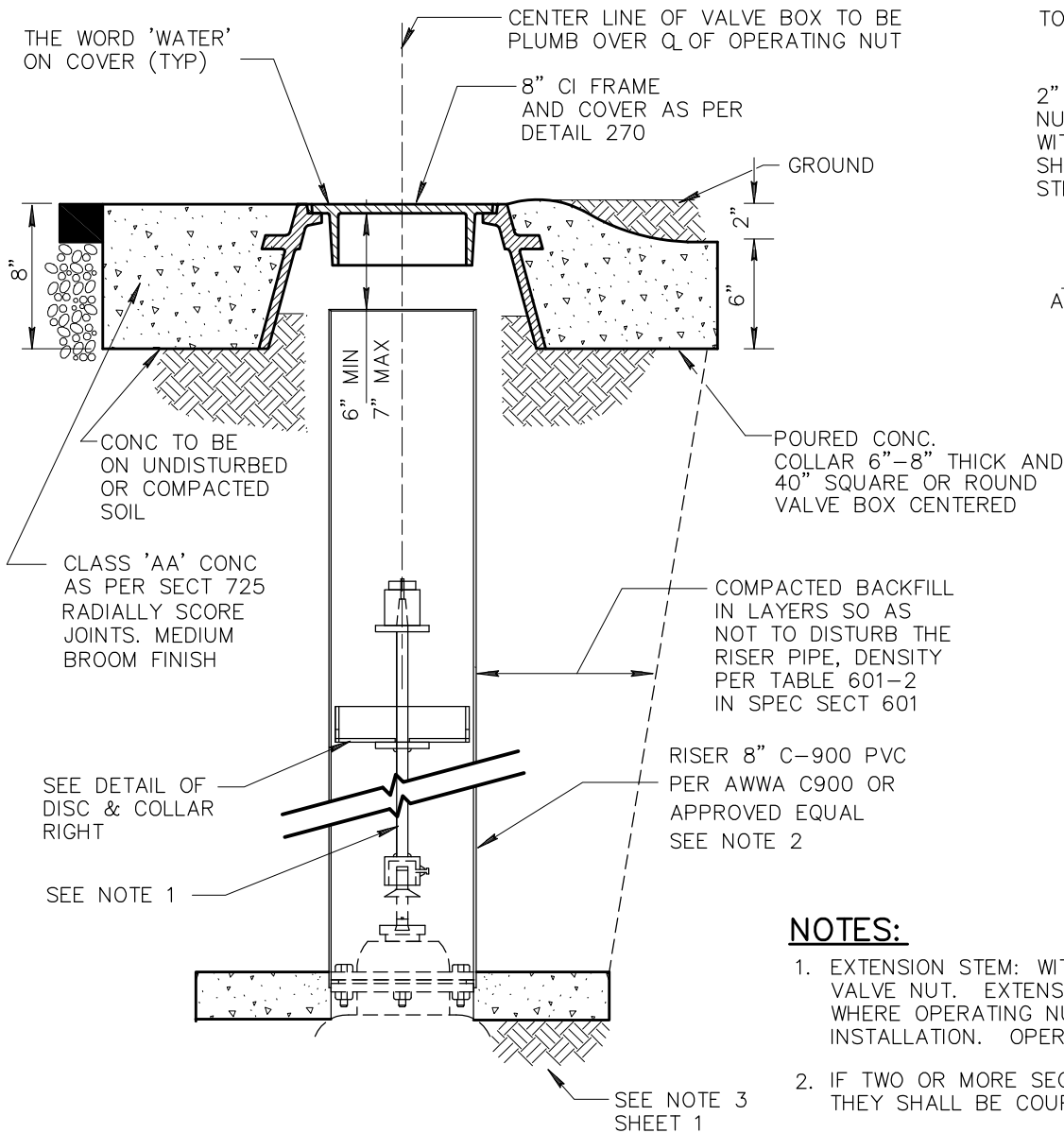
VALVE BOX INSTALLATION AND GRADE ADJUSTMENT

REVISED

01-01-2015

DETAIL NO.

391-1



NOTES:

1. EXTENSION STEM: WITH SQUARE SOCKET ON BOTTOM TO FIT 2" SQUARE VALVE NUT. EXTENSION TO VALVE STEMS REQUIRED ON ALL VALVES INSTALLED WHERE OPERATING NUT IS OVER 5' BELOW SURFACE. LENGTH TO FIT EACH INSTALLATION. OPERATING NUT TO BE HELD ON TOP OF EXTENSION WITH STOP NUT.
2. IF TWO OR MORE SECTIONS OF PIPE ARE USED TO MAKE THE VALVE BOX RISER, THEY SHALL BE COUPLED OR BONDED TO FORM DEBRIS-TIGHT JOINTS.
3. STEM PAINTING: ALL STEEL TO HAVE PRIME COAT OF PAINT NO. 1-D AND ONE HEAVY APPLICATION (FINISH COAT) OF PAINT NO. 9 AS PER SECT. 790.

DETAIL NO.
391-2

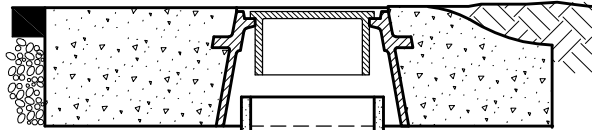


STANDARD DETAIL
ENGLISH

VALVE BOX INSTALLATION AND GRADE ADJUSTMENT

REVISED
01-01-2015

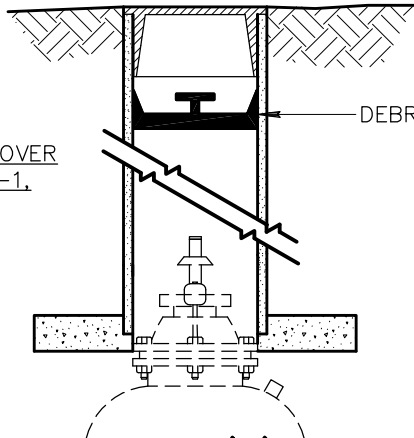
DETAIL NO.
391-2



VALVE BOX AND COVER
FOR DETAIL 391-1,
TYPE A

DEBRIS CAP

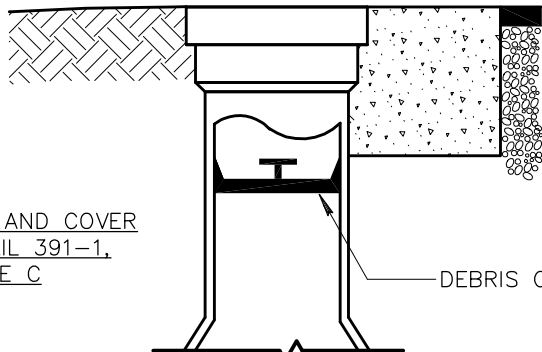
TYPE 'A'



VALVE BOX AND COVER
FOR DETAIL 391-1,
TYPE B

DEBRIS CAP

TYPE 'B'



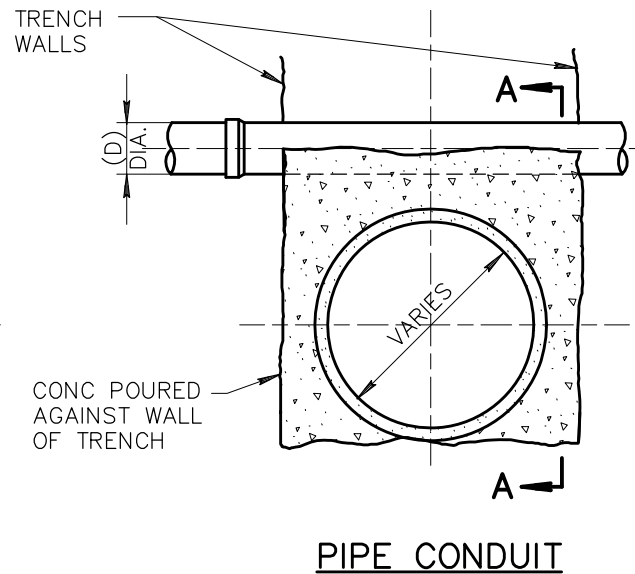
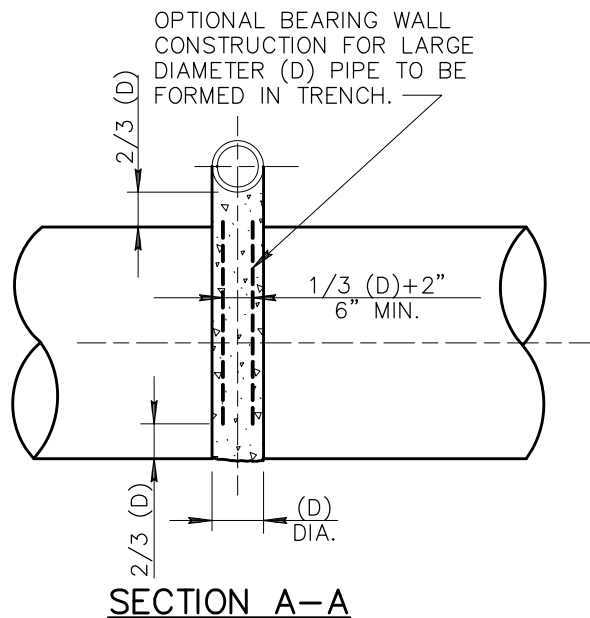
VALVE BOX AND COVER
FOR DETAIL 391-1,
TYPE C

DEBRIS CAP

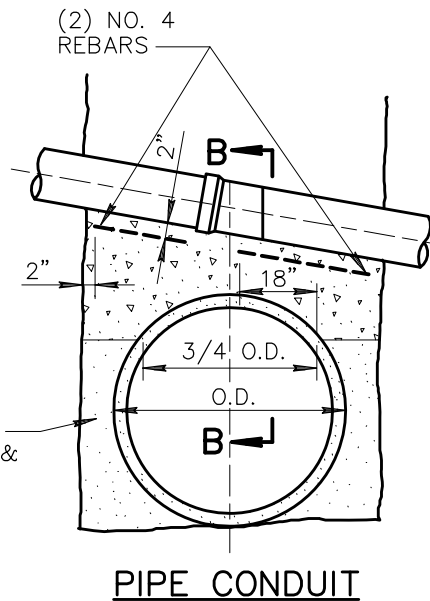
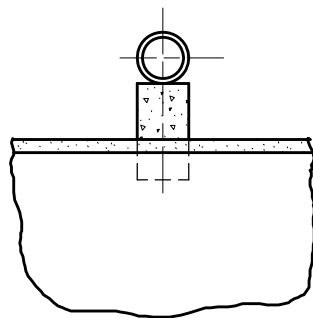
TYPE 'C'

NOTES:

1. THE DEBRIS CAP SHALL BE DESIGNED AND INSTALLED TO PREVENT DEBRIS SUCH AS DIRT, DUST SAND, ETC., FROM PASSING AROUND THE CAP AND DOWN INTO THE VALVE HOUSING. THE CAP SHALL BE HELD IN PLACE BY A MECHANISM WHICH WILL NOT DAMAGE THE VALVE HOUSING.
2. THE CAP SHALL BE MANUFACTURED OF CORROSIVE RESISTANT MATERIALS.
3. DEBRIS CAP SHALL BE INSTALLED AS CLOSE UNDER THE CAST IRON COVER WITHOUT INTERFERING WITH COVER OPERATION.
4. THE CAP SHALL BE CAPABLE OF SECURELY HOLDING A STANDARD LOCATING COIL, "SCOTCH MARK" 4 DISK MARKER BY 3M OR EQUAL.
5. THE CAP SHALL BE CONSTRUCTED TO ALLOW THE DEVICE TO BE SECURED BY A LOCK. THE LOCK (PAD, BARREL, ETC.) SHALL BE SUPPLIED BY THE AGENCY.
6. THE CAP SHALL BE INSTALLED IN ALL VALVE HOUSINGS AS REQUIRED BY THE CONTRACT DOCUMENTS OR BY THE AGENCY'S POLICIES.



TYPE 'A'



TYPE 'B'

NOTES:

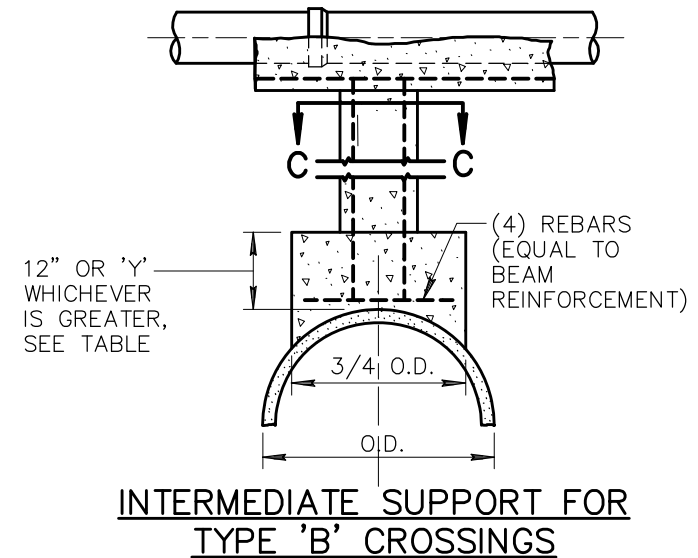
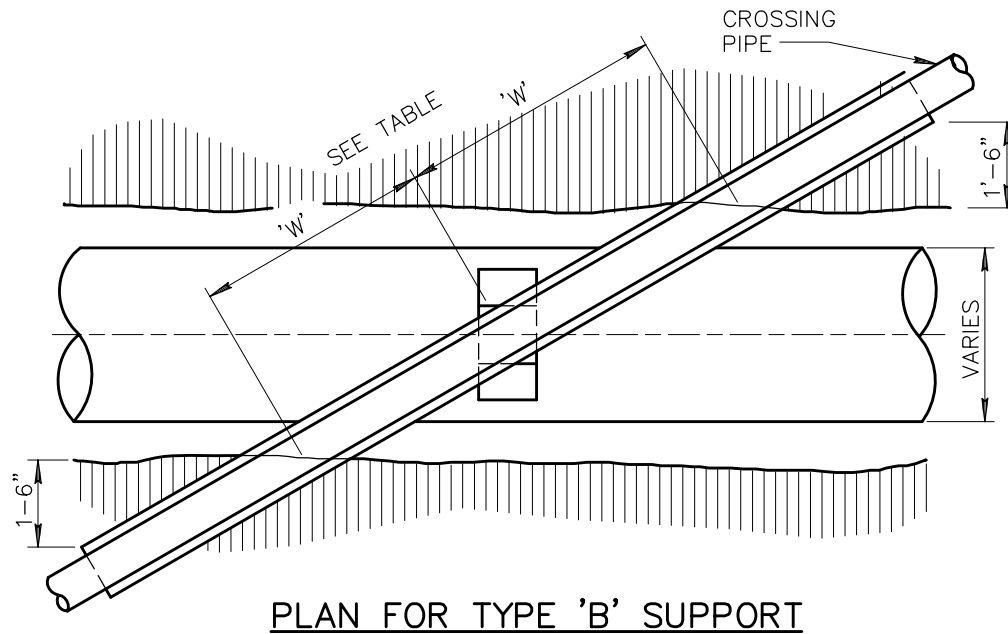
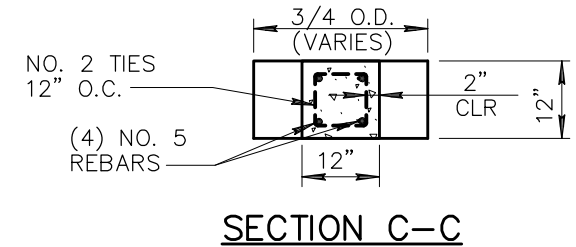
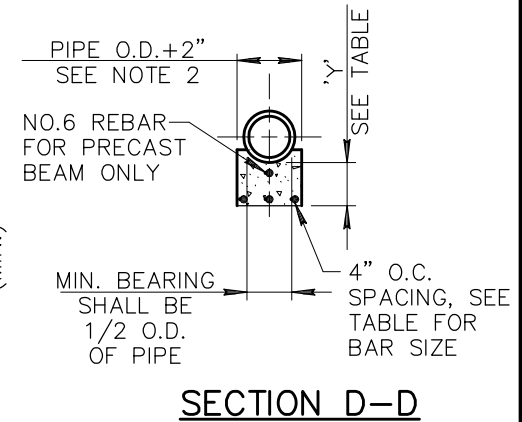
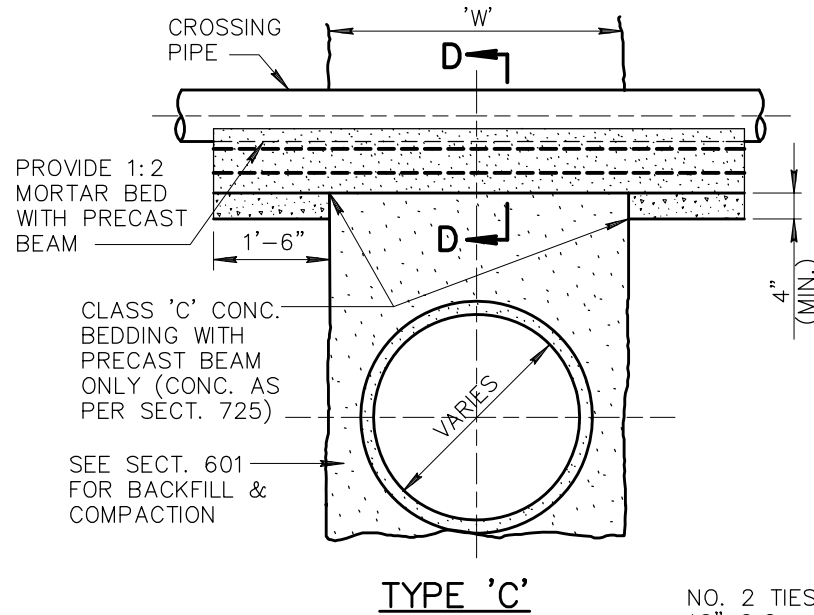
1. TYPE 'A' PIPE SUPPORT MAY BE USED FOR ANY TYPE CROSSING CONDITION.
2. TYPE 'C' PIPE SUPPORT MAY BE USED FOR CROSSING PIPES WITH A BELL DIAMETER OF 18" OR LESS IF SUFFICIENT CLEARANCE OVER STORM SEWER IS AVAILABLE AND TOTAL SPAN IS LESS THAN 34'.
3. INTERMEDIATE PIPE SUPPORT SHALL BE USED IN CONJUNCTION WITH TYPE 'C' PIPE SUPPORT IF TOTAL SPAN EXCEEDS MAX. 'W' IN TABLE.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING ALL SUPPORTS BOTH PERMANENT AND TEMPORARY. TEMPORARY SUPPORTS SHALL NOT BE A SEPARATE PAY ITEM.
5. PERMANENT PIPE SUPPORTS MAY BE DECREASED FROM PLAN QUANTITIES OR EXTENDED TO INCLUDE SOME LISTED BELOW AS TEMPORARY SUPPORTS IF CONDITIONS WARRANT THESE CHANGES AT THE TIME OF CONSTRUCTION. DECISION SHALL BE MADE BY THE ENGINEER.
6. WHEN TYPE 'A' PIPE SUPPORT IS USED AND WHENEVER SO DIRECTED BY THE ENGINEER, THE CONTRACTOR SHALL PIERCE THE WALL WITH SUITABLE OPENINGS TO PREVENT UNEQUAL PRESSURE RESULTING FROM FLOODING OF THE BACKFILL. THE VOLUME OF THE PIERCED OPENING SHALL NOT EXCEED 1/2 THE VOLUME OF THE SUPPORTING WALL.
7. USE TYPE 'B' PIPE SUPPORT INSTEAD OF TYPE 'C' WHEN CLEARANCE IS LESS THAN 'Y' IN TABLE, BETWEEN PIPES.
8. CLASS 'A' CONCRETE AS PER SECT. 725 UNLESS OTHERWISE NOTED.

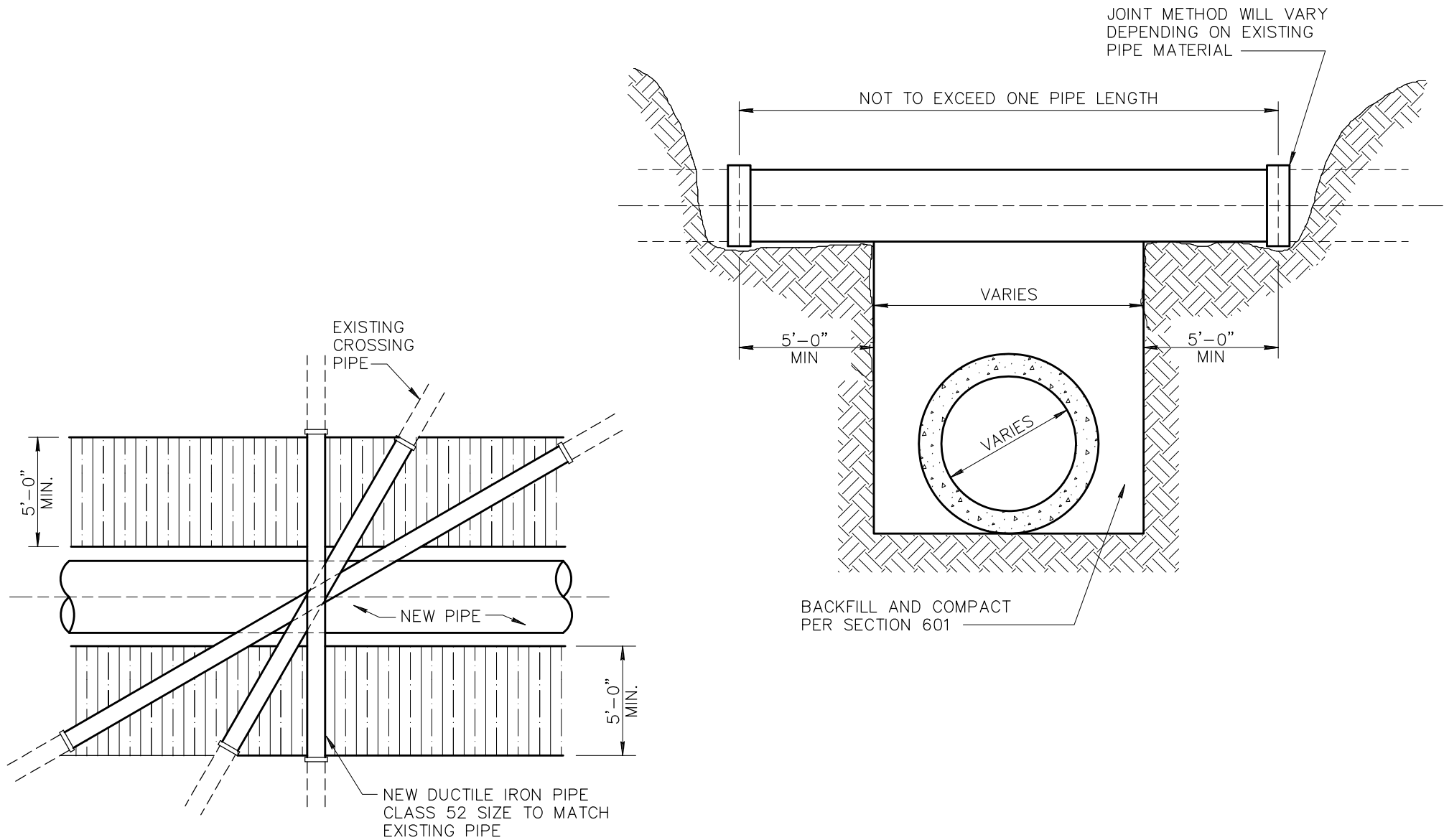
SCHEDULE OF REQUIRED SUPPORTS

PERMANENT	TEMPORARY
SEWER LINES	CAST IRON PIPE CONC. IRRIG. PIPE BURIED TELCO. GAS PIPES
OTHER UTILITIES AS NOTED ON THE PLANS OR AS REQUIRED BY THE ENGINEER AT TIME OF CONSTRUCTION.	CONC. STORM DRAIN CONC. BOX CULVERT TRAFFIC CONTROL CONDUIT WATER & SEWER LINES

TABLE

'W'	DEPTH OF COVER ON SUPPORTS			
	0' TO 8'		8' TO 16'	
	BAR NO.	Y	BAR NO.	Y
TO 6'	5	8"	6	11"
7'	5	9"	6	12"
8'	5	10"	6	13"
9'	6	11"	6	14"
10'	6	12"	7	15"
11'	6	13"	7	16"
12'	6	14"	7	17"
13'	7	15"	7	19"
14'	7	16"	8	20"
15'	7	17"	8	21"
16'	7	18"		
17'	8	19"		





DETAIL NO.
403-3



STANDARD DETAIL
ENGLISH

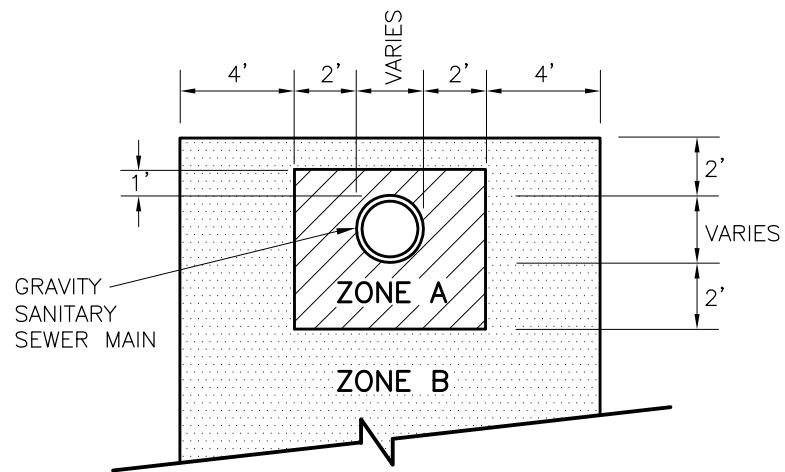
ALTERNATE TO PIPE SUPPORT

REVISED
01-01-1998

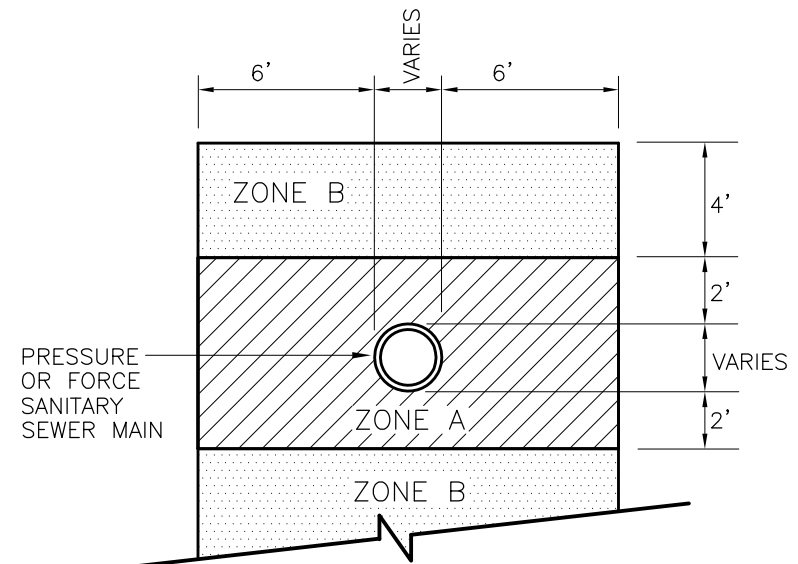
DETAIL NO.
403-3

WATER LINE EXCLUSION AND EXTRA PROTECTION ZONES*

GRAVITY SANITARY SEWER



PRESSURIZED SANITARY SEWER



NOTES:

ZONE A: NO WATER LINES ALLOWED/MINIMUM SEPARATION.

ZONE B: EXTRA PROTECTION REQUIRED FOR WATER LINES.

* REFER TO STANDARD 610, WATER LINE CONSTRUCTION.

DETAIL NO.

404-1



STANDARD DETAIL
ENGLISH

WATER AND SANITARY SEWER
SEPARATION/PROTECTION

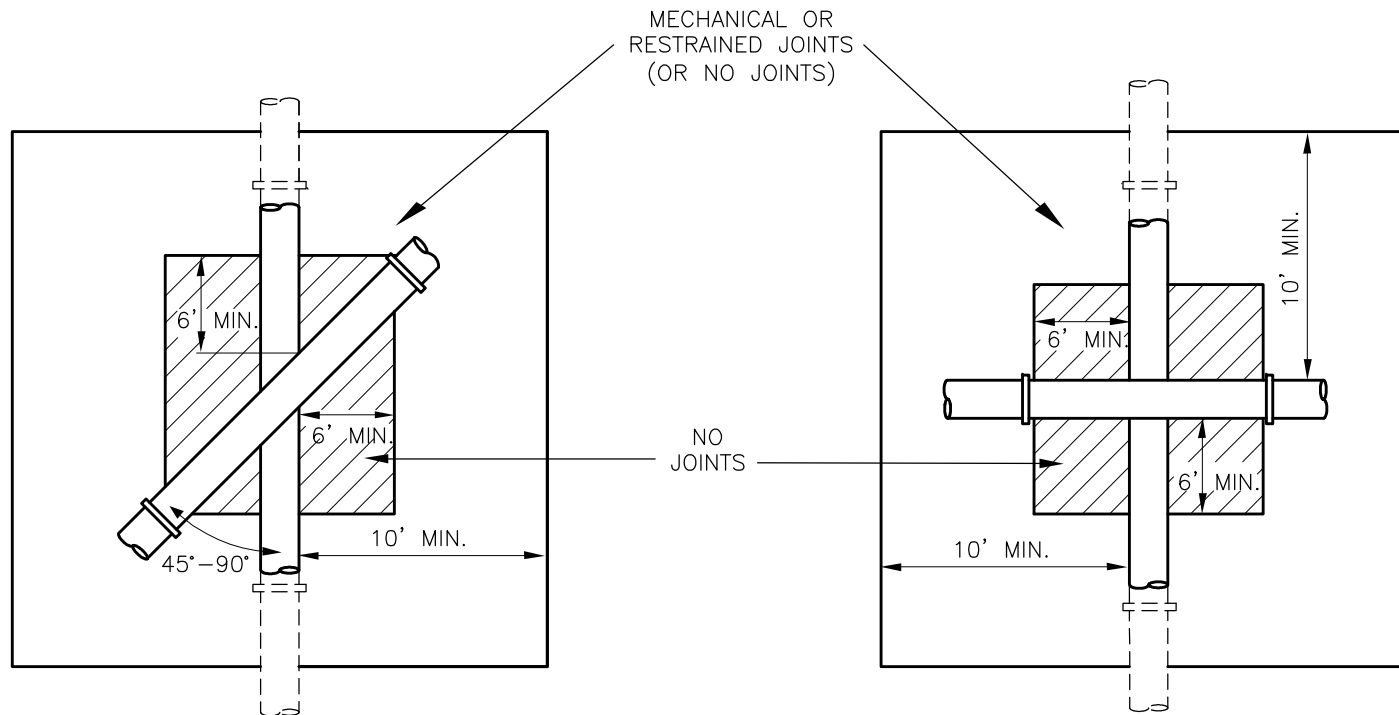
REVISED

01-01-2006

DETAIL NO.

404-1

WATER LINE EXTRA PROTECTION DUCTILE IRON PIPE WITH RESTRAINED OR MECHANICAL JOINTS*



EXTRA PROTECTION DUCTILE IRON PIPE
(GRAVITY OR PRESSURIZED) SEWER LINE

NOTES:

* REFER TO MAG STANDARD SPECIFICATION SECTION 610.

DETAIL NO.
404-2



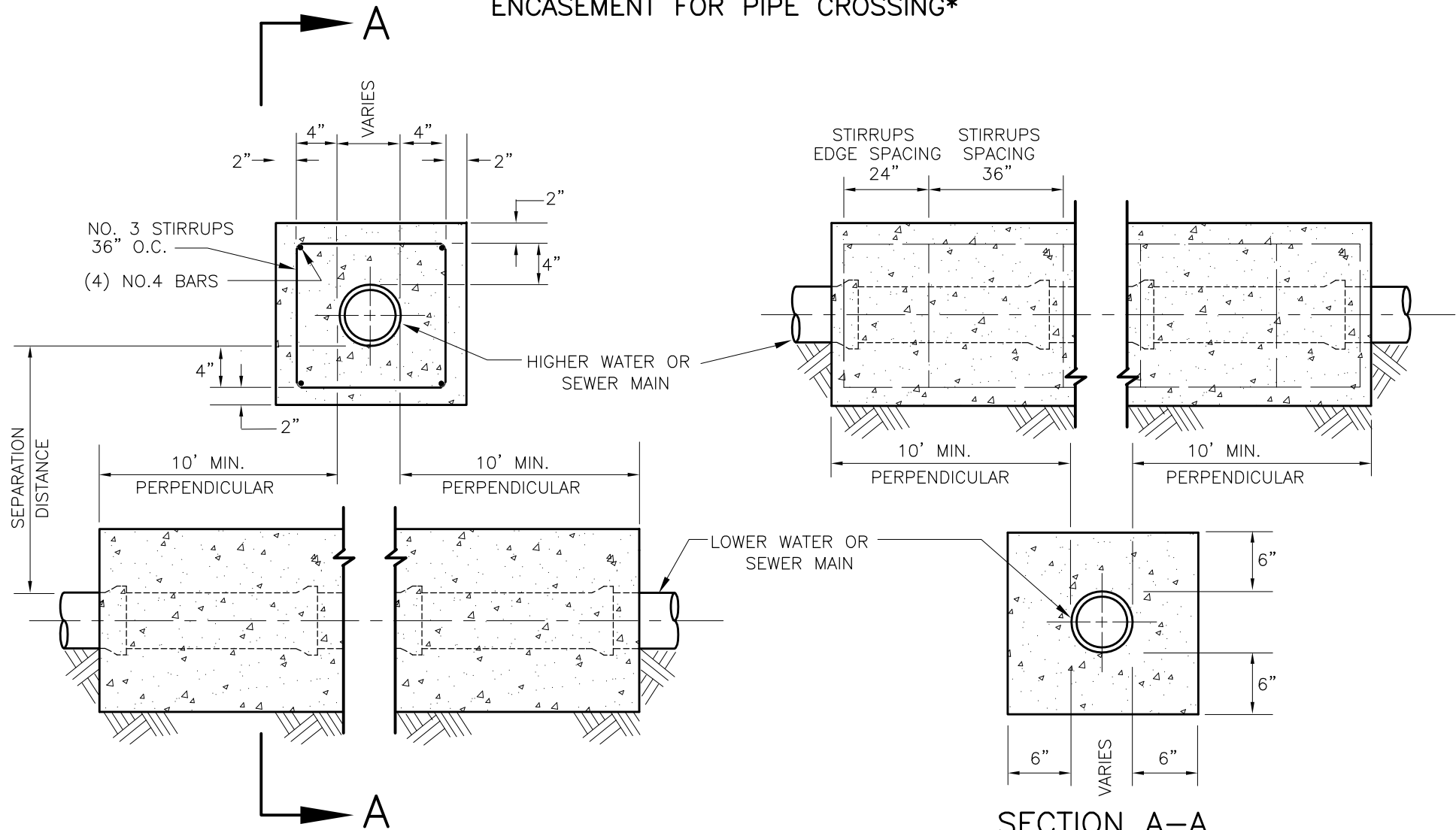
STANDARD DETAIL
ENGLISH

**WATER AND SANITARY SEWER
SEPARATION/PROTECTION**

REVISED
01-01-2006

DETAIL NO.
404-2

ENCASEMENT FOR PIPE CROSSING*



SECTION A-A

NOTES:

1. CLASS 'C' CONCRETE AS PER SECTION 725.
- *REFER TO MAG STANDARD SPECIFICATION SECTION 610.

DETAIL NO.
404-3

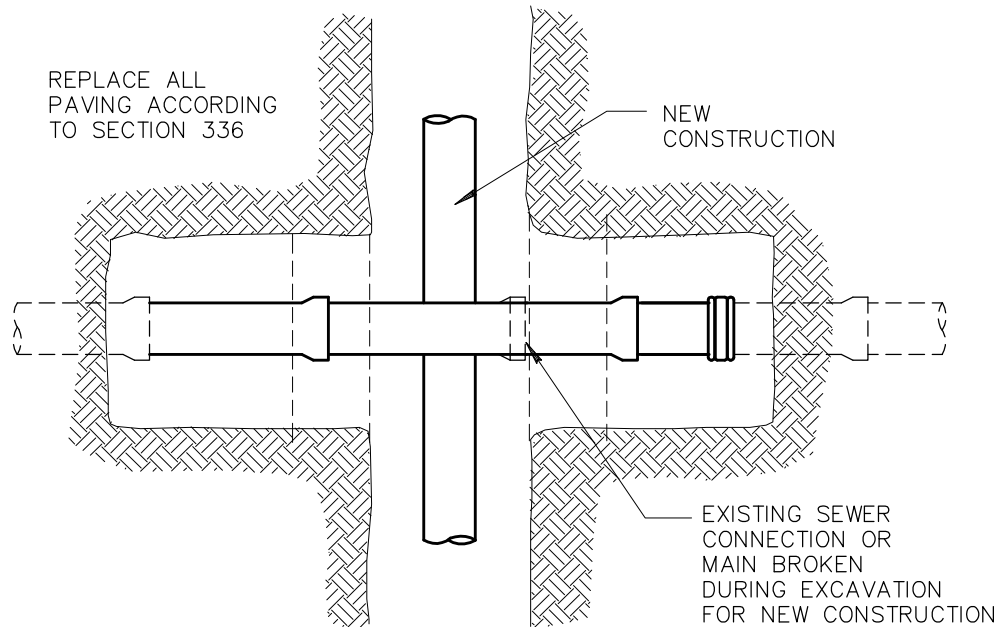


STANDARD DETAIL
ENGLISH

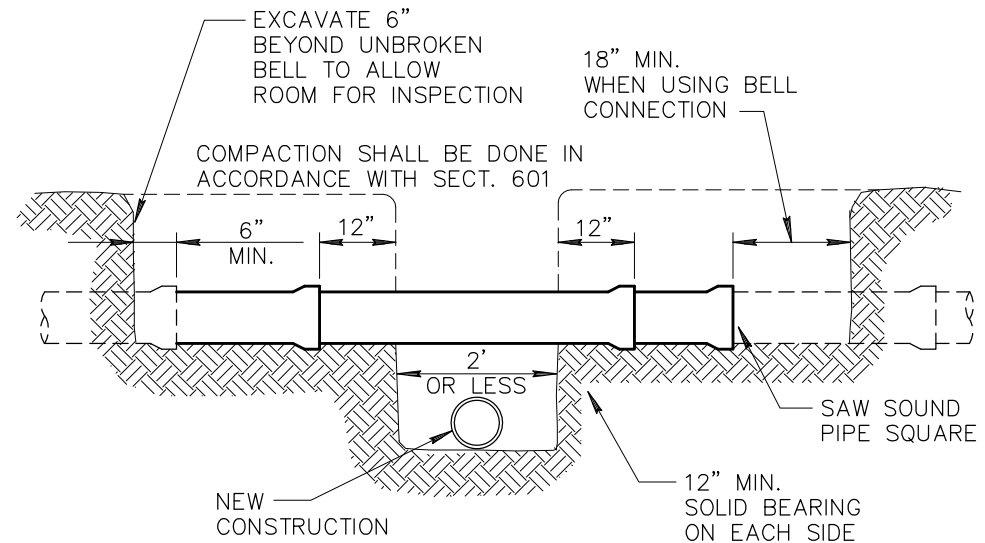
WATER AND SANITARY SEWER
SEPARATION/PROTECTION

REVISED
01-01-2006

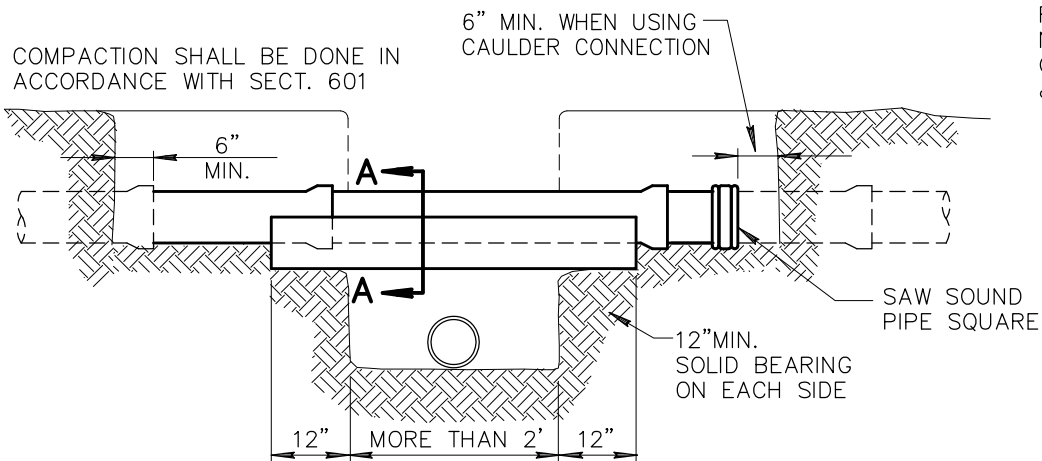
DETAIL NO.
404-3



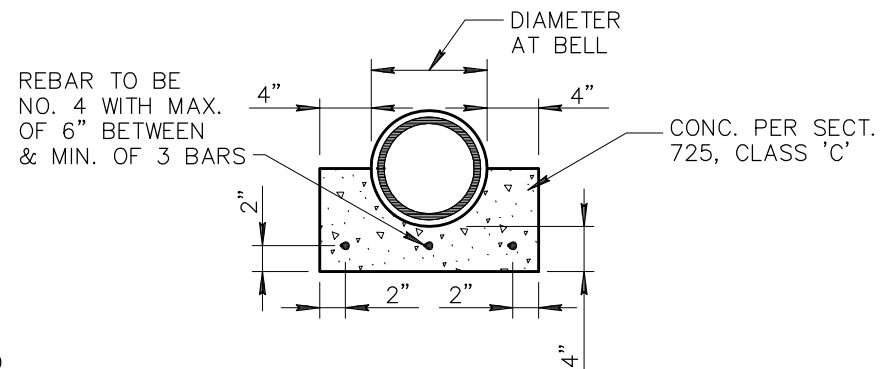
PLAN VIEW OF REPLACEMENT



REPLACEMENT WHEN NEW TRENCH 2' WIDE OR LESS



REPLACEMENT WHEN NEW TRENCH MORE THAN 2' WIDE



SECTION 'A-A'

NOTES:

1. BROKEN PIPE SHALL BE REPLACED WITH A MINIMUM OF ONE FULL JOINT AND TWO SHORT LENGTHS WITH UNBROKEN BELLS. CONSTRUCTION AND JOINTS TO BE MADE AS PER SECTION 615.

DETAIL NO.

405



STANDARD DETAIL
ENGLISH

BROKEN SEWER LINE REPLACEMENT

REVISED

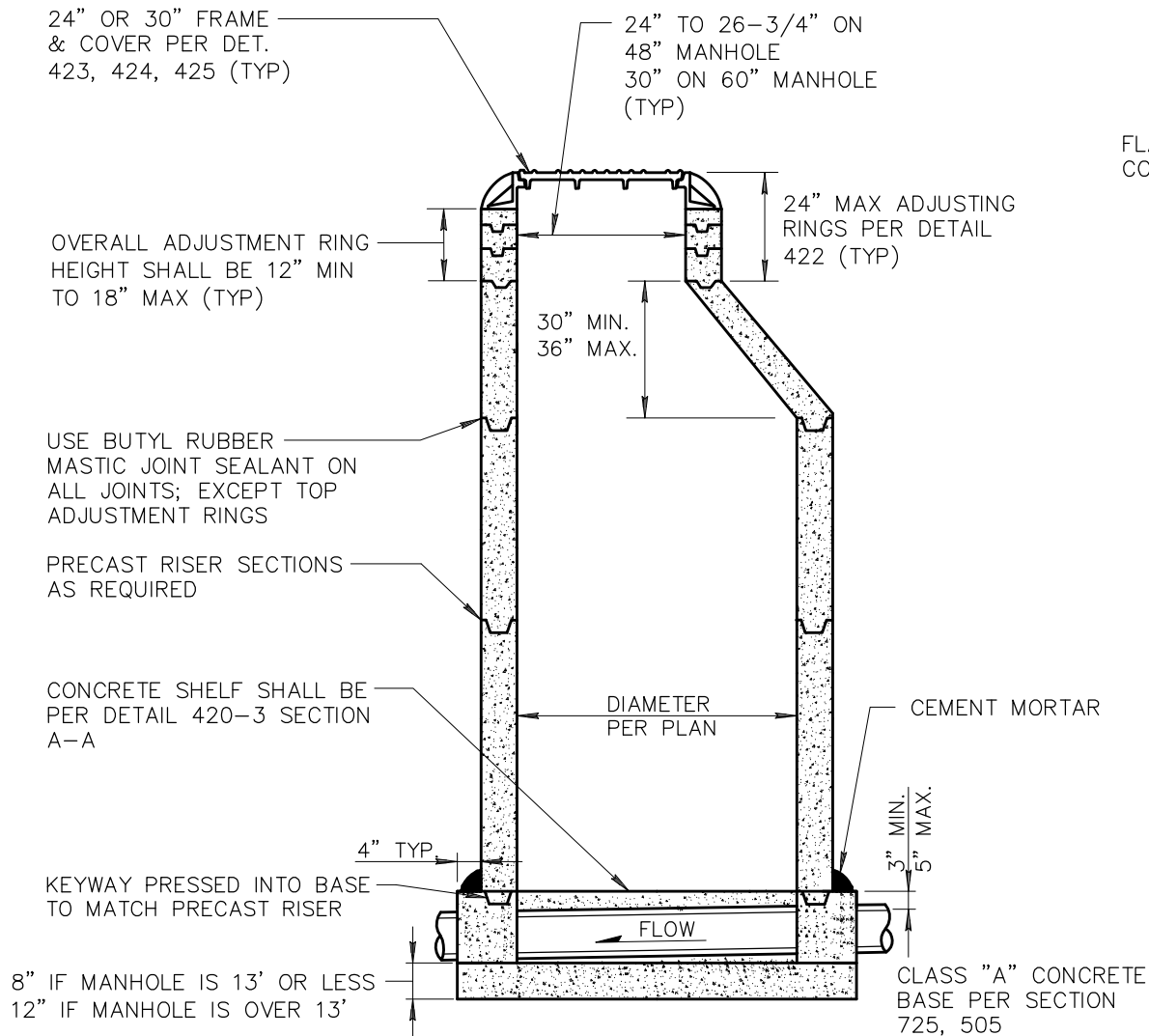
01-01-1998

DETAIL NO.

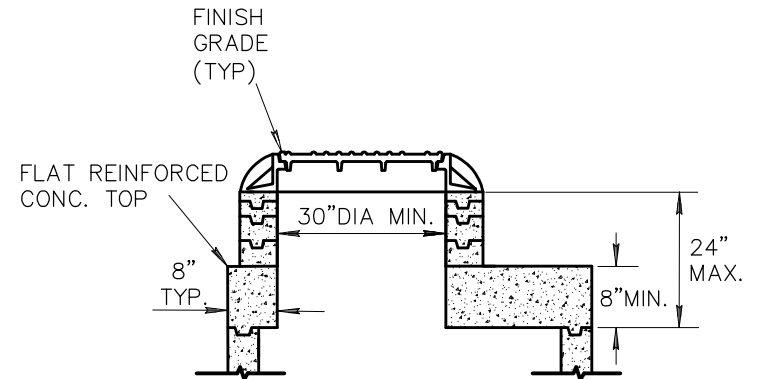
405

TYPE 'A' TOP

(PRECAST ECCENTRIC CONICAL TOP MANHOLE)



(PRECAST FLAT TOP M.H.)



NOTES:

1. PRECAST STEEL REINFORCED MANHOLE SECTIONS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C 478 EXCEPT AS MODIFIED HEREIN.
2. CAST-IN-PLACE MANHOLE BASE TO BE CONSTRUCTED IN ONE PLACEMENT.
3. CAST-IN-PLACE MANHOLE BASE SHELF AND CHANNEL TO RECEIVE SMOOTH TROWEL FINISH.
4. MANHOLE COATINGS PER AGENCY.
5. SEE MAG DETAIL 422 FOR FINAL ADJUSTMENT TO GRADE.
6. ANY MANHOLE OVER 20' SHALL REQUIRE ENGINEER (STRUCTURAL) CALCS.
7. THE MANHOLE ACCESS POINT SHALL BE ORIENTED IN SUCH A WAY THAT THE OPENING IS DIRECTLY ABOVE THE LOWEST INVERT, OR AS OTHERWISE DIRECTED BY THE PLANS OR ENG.
8. FOR PRECAST BASE SEE DETAIL 420-2.
9. FLAT TOPS SHALL ONLY BE USED WITH APPROVAL FROM THE ENGINEER.

DETAIL NO.

420-1



STANDARD DETAIL
ENGLISH

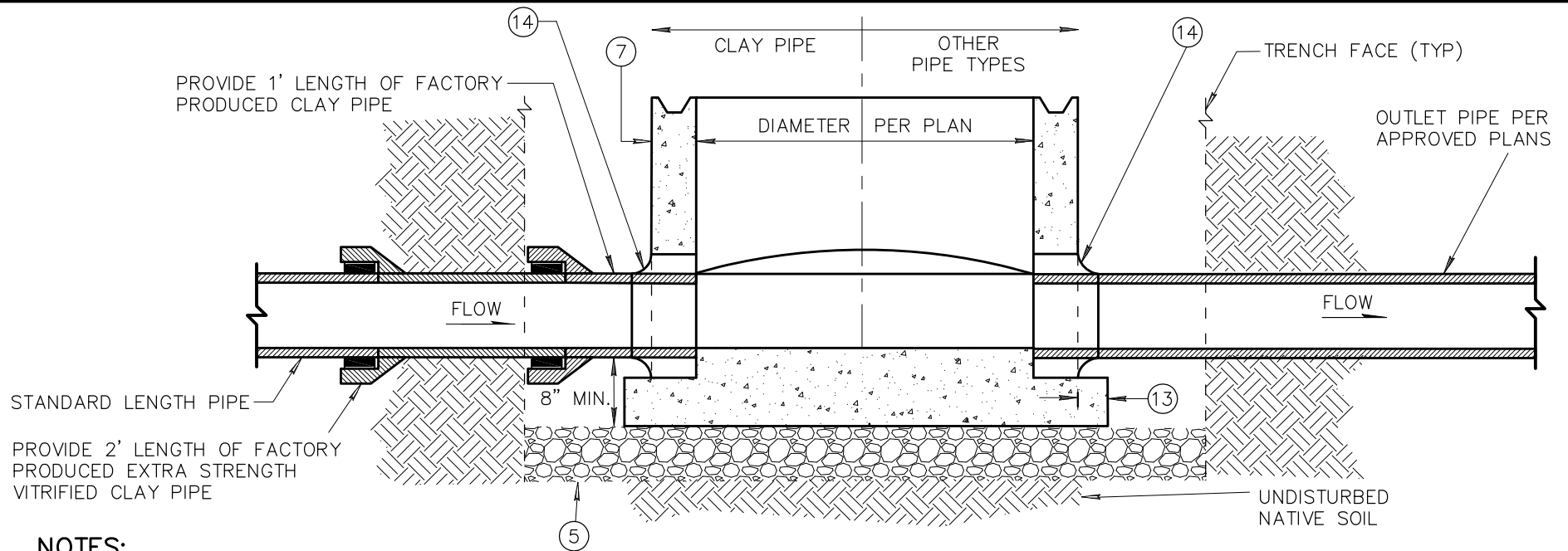
CONCRETE SANITARY SEWER MANHOLE

REVISED

01-01-2015

DETAIL NO.

420-1



NOTES:

- ① PRECAST, MANUFACTURER SHALL BE AN NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA) CERTIFIED PLANT. ENTIRE PRECAST BASE SHALL BE MANUFACTURED AT THE PLANT PER ASTM C478.
- ② MAG "AA" 4000 PSI CONCRETE SHALL BE USED FOR PRECAST MANHOLE BASES.
- ③ SPRING LINE OF CAST-IN-PLACE BELL SHALL STOP AT INSIDE FACE OF MANHOLE.
- ④ JOINTS FOR BARREL SECTION SHALL BE TONGUE AND GROOVE TYPE. ALL LIFTING HOLES SHALL BE SEALED WITH GROUT.
- ⑤ ALL PRECAST MANHOLE BASES SHALL BE PLACED ON 8" MINIMUM OF ABC PER SECTION 702 COMPACTED TO 100% MAXIMUM DENSITY.
- ⑥ ALL MODIFICATIONS SHALL BE APPROVED BY THE ENGINEER.
- ⑦ MINIMUM WALL THICKNESS SHALL BE PER ASTM C478 (MIN 5").
- ⑧ REINFORCEMENT SHALL BE DESIGNED BY AN ARIZONA REGISTERED PROFESSIONAL ENGINEER.
- ⑨ CHANNEL TRANSITION SHALL BE CONSTANT FROM INLET TO OUTLET OF MANHOLE TO FACILITATE SMOOTH TRANSITIONS AND ACCOMMODATE CORRESPONDING MANDREL.
- ⑩ THERE SHALL BE NO HARD CONNECTIONS (GROUTED) INTO THE MANHOLE BASE UNLESS APPROVED BY THE ENGINEER.
- ⑪ ALL SEWER SERVICE CONNECTIONS SHALL HAVE THE SAME CONNECTION TYPES IN THE PRECAST MANHOLE BASE.
- ⑫ ALL CORE HOLES INTO THIS STRUCTURAL PRECAST BASE SHALL BE COATED WITH AN APPROVED COATING MATERIAL.
- ⑬ THE MANHOLE BOTTOM SHALL EXTEND OUTSIDE THE MANHOLE WALL A MINIMUM 6" WIDE ON 48" BASES, 7" WIDE ON 60" BASES, AND 8" WIDE ON 72" BASES. EXTENDED BOTTOM SHALL BE A MINIMUM OF 5" THICK.
- ⑭ ALL PIPE CONNECTIONS SHALL BE IN COMPLIANCE WITH ASTM F477 OR ASTM C425. AN EXTRA STRENGTH VCP BELL WITH A POLYURETHANE JOINT THAT MEETS ASTM C425 MAY BE USED WITH VCP.

DETAIL NO.
420-2

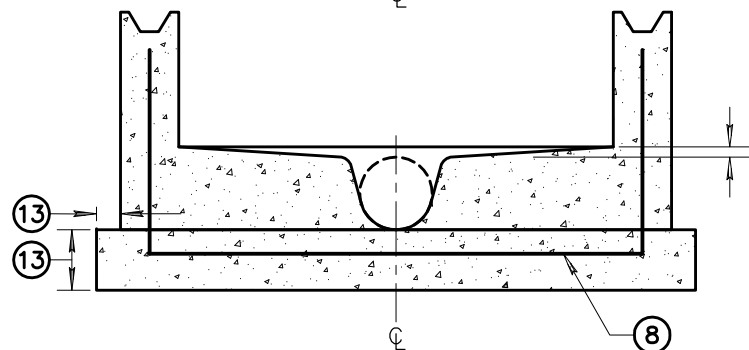
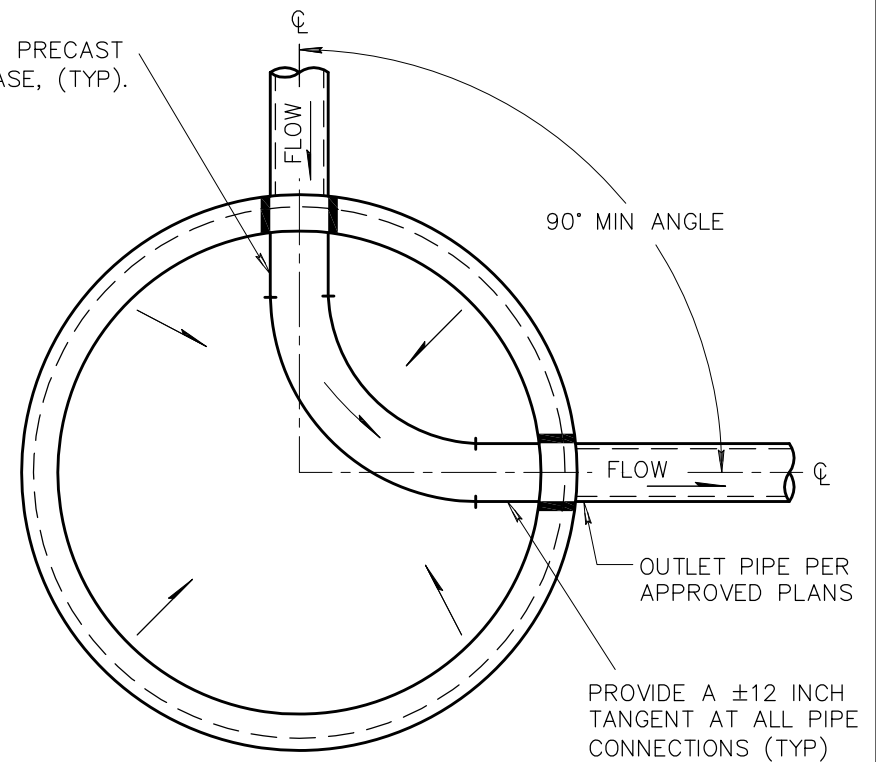
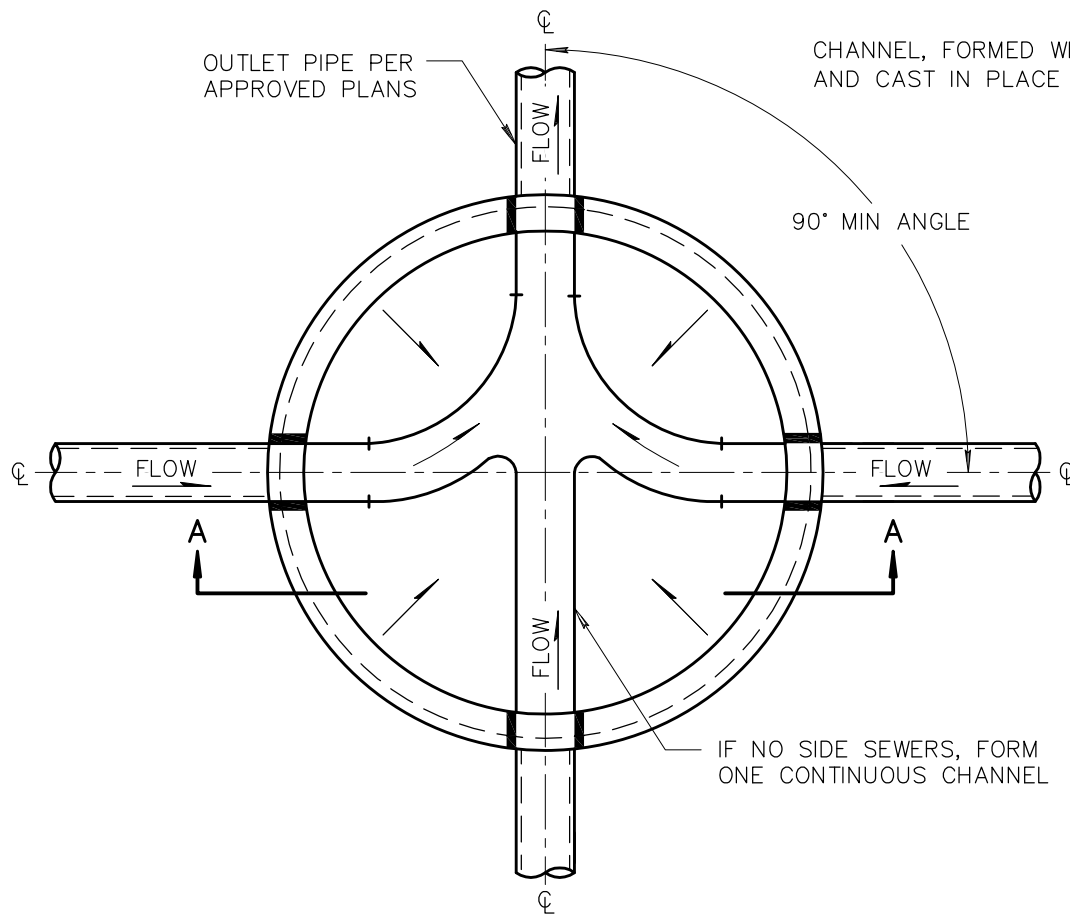


STANDARD DETAIL
ENGLISH

PRECAST CONCRETE MANHOLE BASE

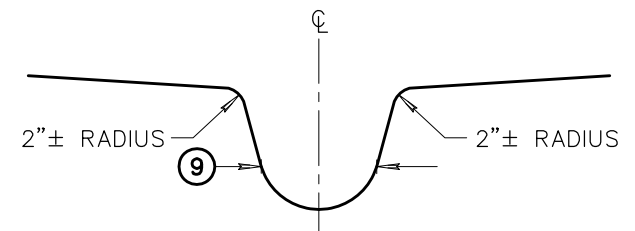
REVISED
01-01-2015

DETAIL NO.
420-2



SECTION A-A

TOP OF SHELF TO
TOP OF PIPE
(MIN 2% SLOPE)
NOT
TO EXCEED 3"



CHANNEL TRANSITION SHALL BE CONSISTENT
FROM INLET TO OUTLET OF MANHOLE TO
FACILITATE SMOOTH TRANSITIONS AND
ACCOMMODATE CORRESPONDING MANDREL.

TYPICAL CHANNEL

SEE DETAIL 420-2 FOR NOTES

DETAIL NO.

420-3



STANDARD DETAIL
ENGLISH

CONCRETE MANHOLE BASE

REVISED

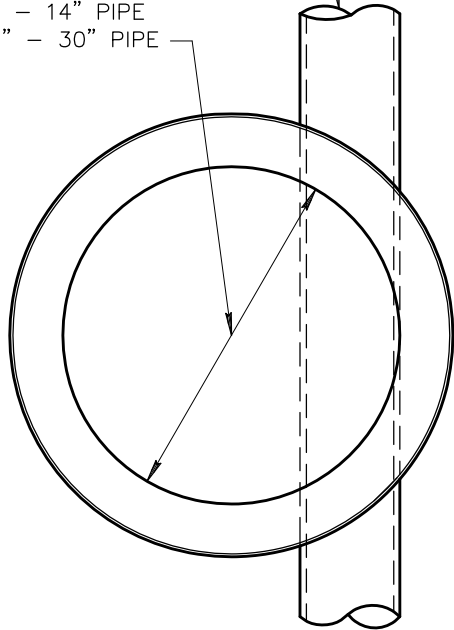
01-01-2015

DETAIL NO.

420-3

PIPE SIZE & ELEVATION
AS SHOWN ON PLANS

48" I.D. FOR 8" - 14" PIPE
60" I.D. FOR 15" - 30" PIPE



MANHOLE ADJUSTMENT
PER DETAIL 422

COMBINED CURB
AND GUTTER

SEE DETAIL
420-1 FOR
ADJUSTMENT
REQUIREMENTS

MANHOLE TO BE
PRECAST PER
SECT. 625

PRECAST RISER PER
ASTM C-478

4"
TYP

2% MIN NOT TO
EXCEED 3"

CEMENT
MORTAR
(TYP)

30" MIN.
36" MAX.

CLASS A CONCRETE
PER SECT. 725, 505

TROWEL
FINISH
SMOOTH

8" IF MANHOLE
IS 13' OR LESS
12" IF MANHOLE
IS OVER 13'

DETAIL NO.

421



STANDARD DETAIL
ENGLISH

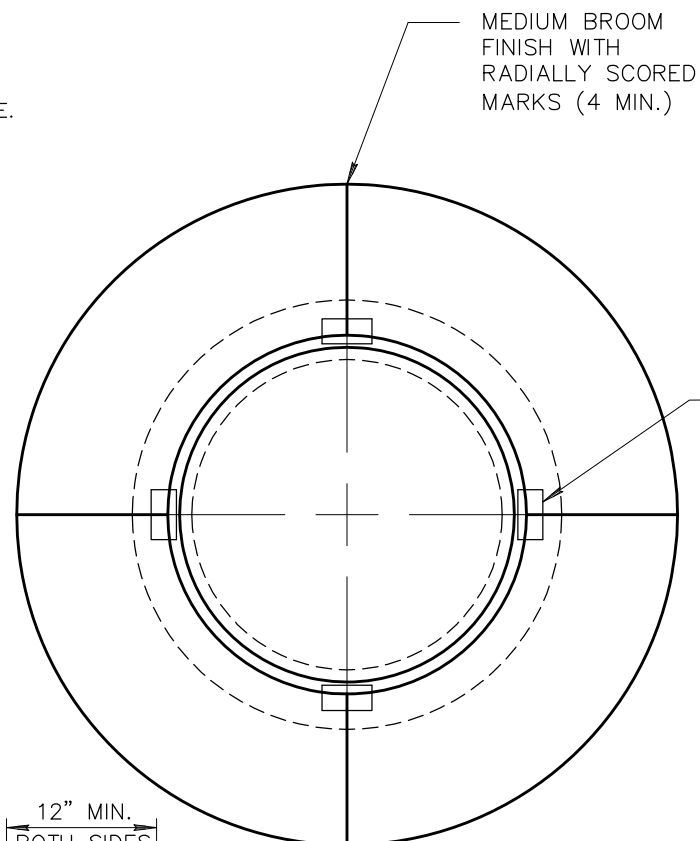
OFFSET MANHOLE 8" TO 30" PIPE

REVISED

01-01-2015

DETAIL NO.

421

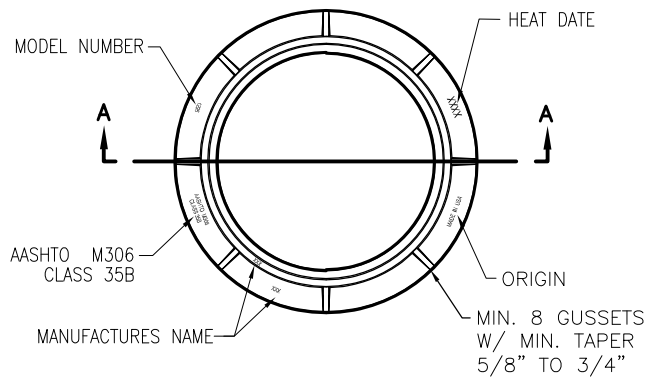


1. CONTRACTORS SHALL ADJUST ALL MANHOLE RINGS AND COVERS, INCLUDING MANHOLES OUTSIDE OF THE PAVEMENT.
2. ADJUSTMENT SHALL BE CONSTRUCTED PER MAG SECTION 345.
3. MANHOLE COATINGS PER AGENCY
4. GROUT SHALL BE USED BETWEEN FRAME AND ADJUSTING RING TO ACHIEVE WATER TIGHTNESS.

SPACER TYPE	REQUIRED THICKNESS
BRICK	GREATER THAN 2"
4"x2" STEEL SPACER	½" TO 2"
GROUT	LESS THAN ½"

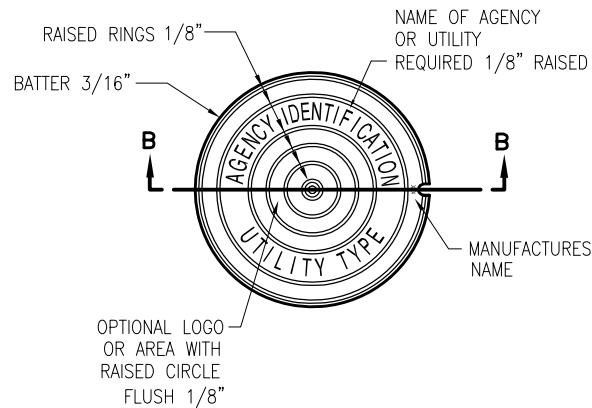


FRAME TOP VIEW

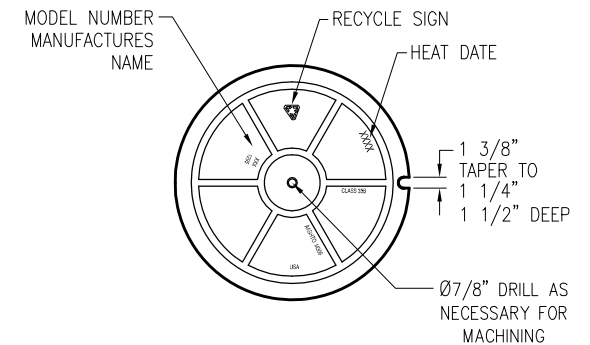


FRAME WT. (CL. 35) – 180 LBS

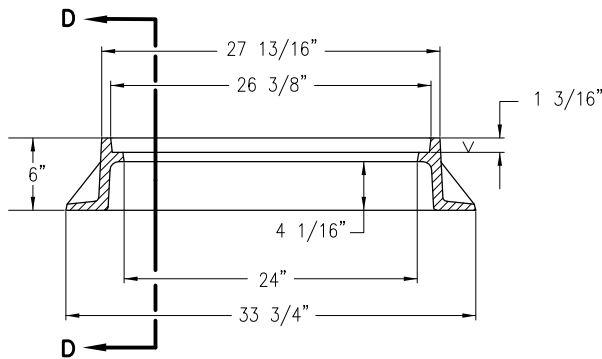
COVER TOP VIEW



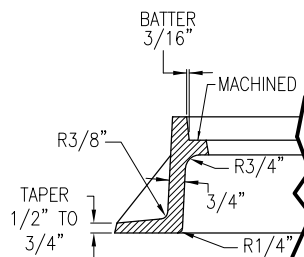
COVER BOTTOM VIEW



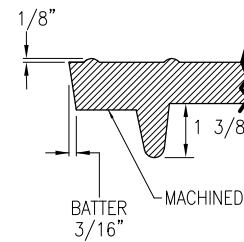
COVER WT. (CL. 35) – 188 LBS



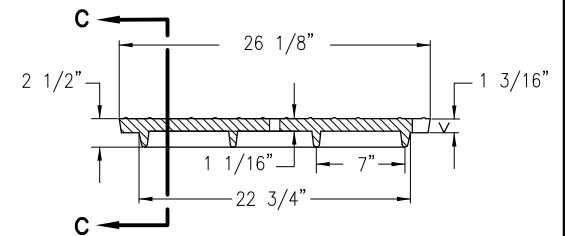
SECTION A



SECTION D



SECTION C



SECTION B

NOTE:

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF RINGS. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.
423-1



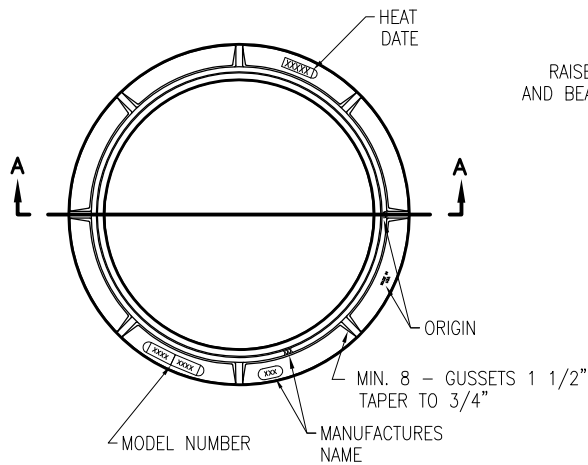
STANDARD DETAIL
ENGLISH

**24" CAST IRON
MANHOLE FRAME AND COVER**

REVISED
01-01-2012

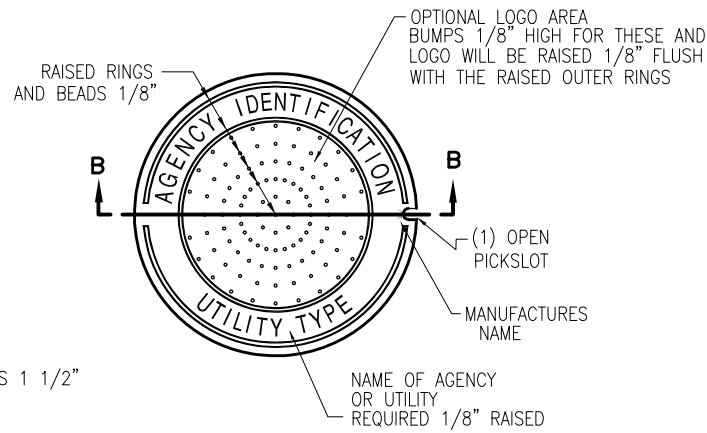
DETAIL NO.
423-1

FRAME TOP VIEW

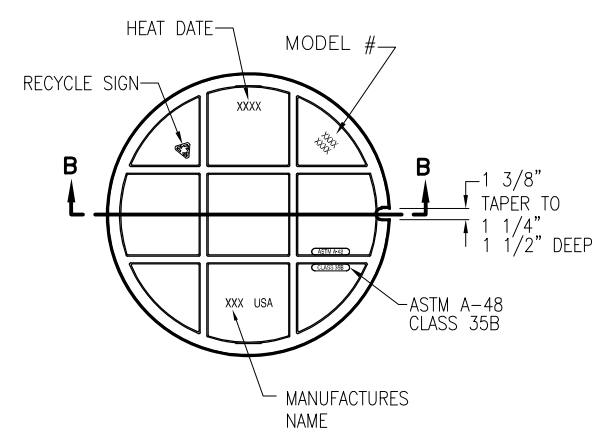


FRAME WT. (CL. 35) - 227 LBS

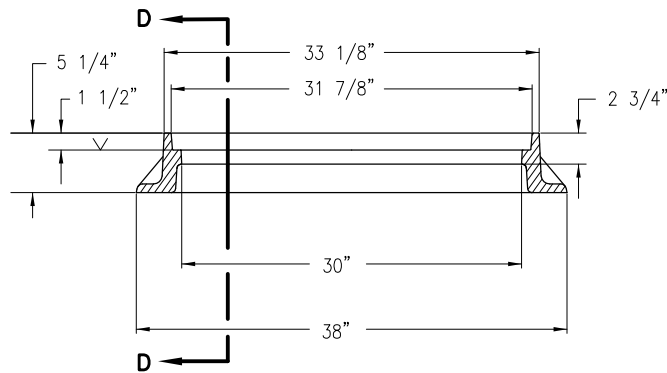
COVER TOP VIEW



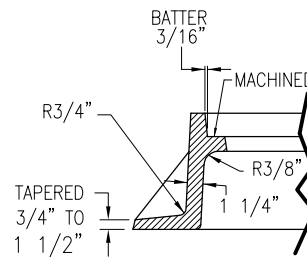
COVER BOTTOM VIEW



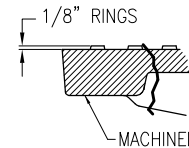
COVER WT. (CL. 35) - 210 LBS



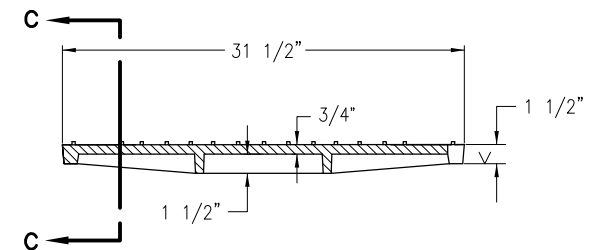
SECTION A



SECTION D



SECTION C



SECTION B

NOTE:

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.

423-2



STANDARD DETAIL
ENGLISH

30" CAST IRON
MANHOLE FRAME AND COVER

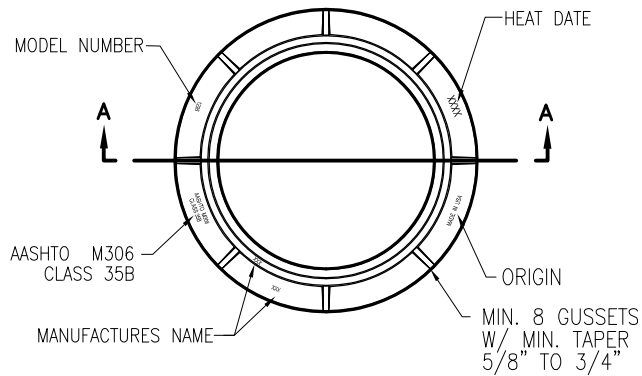
REVISED

01-01-2012

DETAIL NO.

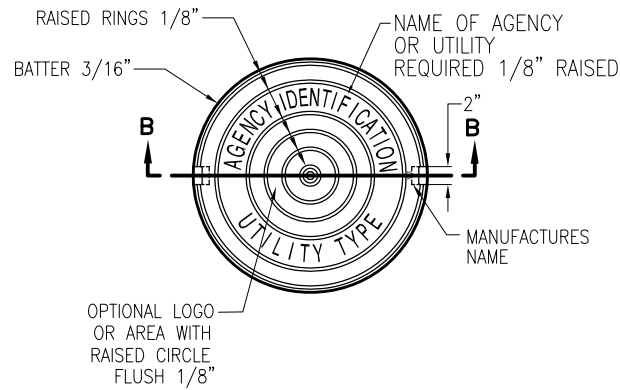
423-2

FRAME TOP VIEW

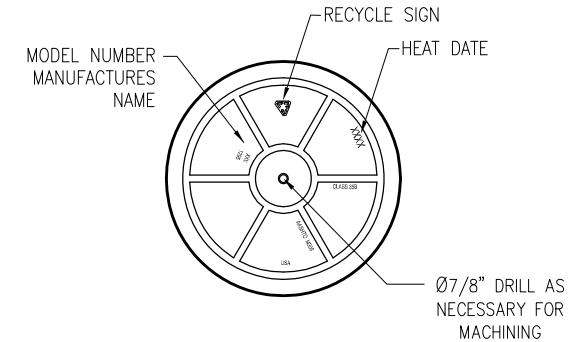


FRAME WT. (CL. 35) – 180 LBS

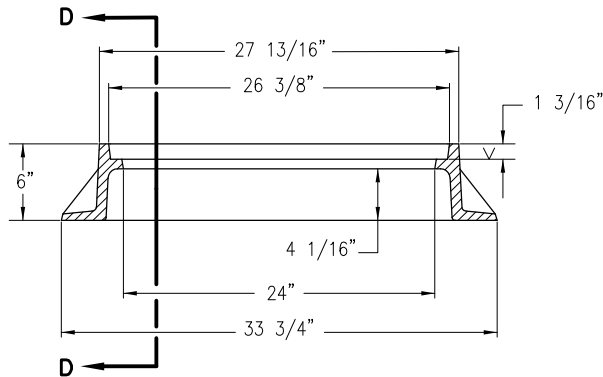
COVER TOP VIEW



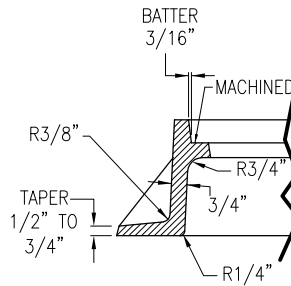
COVER BOTTOM VIEW



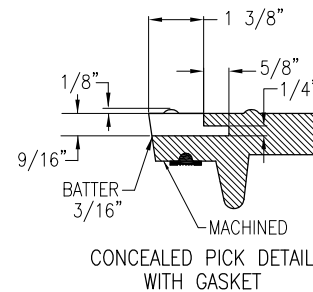
COVER WT. (CL. 35) – 188 LBS



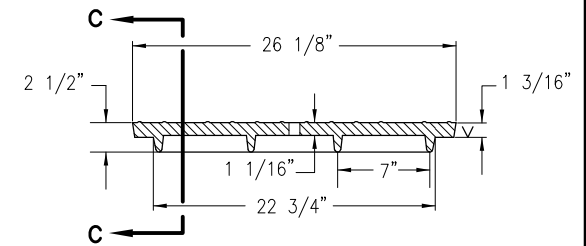
SECTION A



SECTION D



SECTION C



SECTION B

NOTE:

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.
424-1



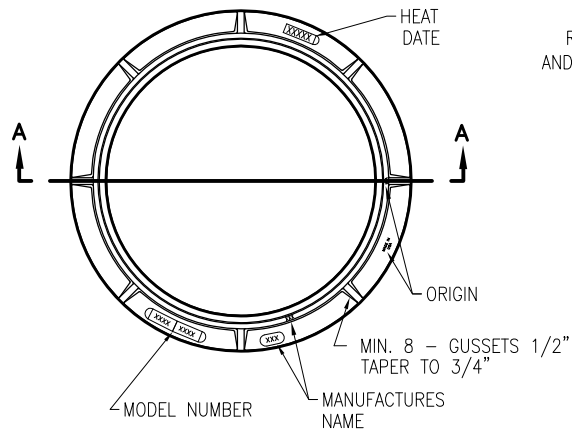
STANDARD DETAIL
ENGLISH

**24" CAST IRON WATERTIGHT
MANHOLE FRAME AND COVER**

REVISED
01-01-2012

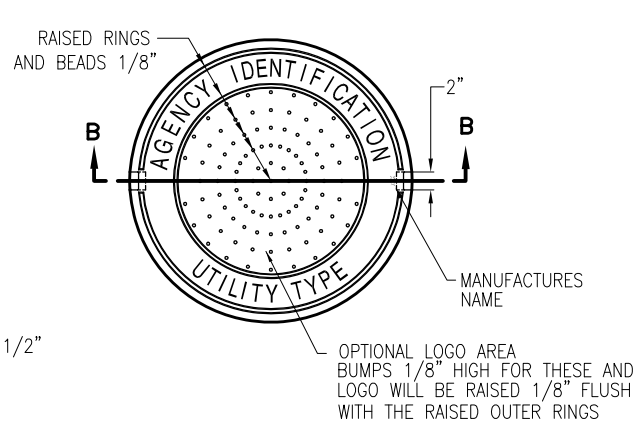
DETAIL NO.
424-1

FRAME TOP VIEW

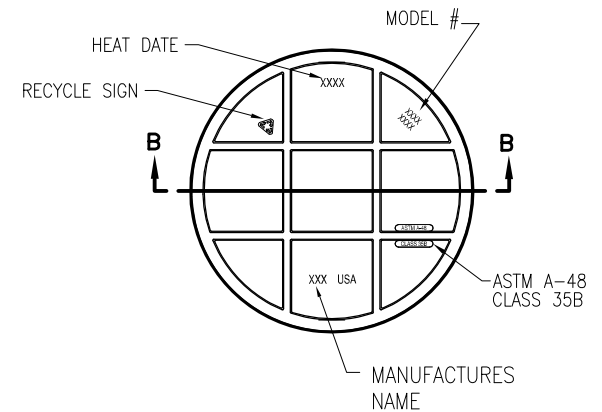


FRAME WT. (CL. 35) - 227 LBS

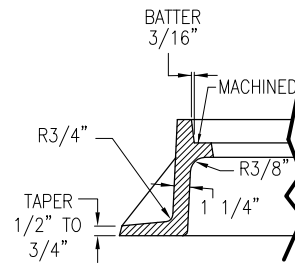
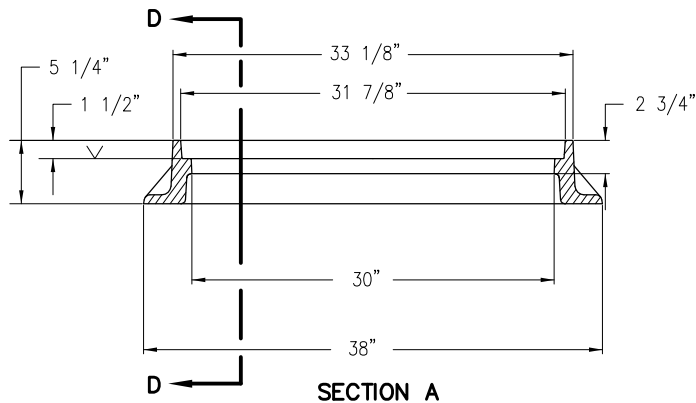
COVER TOP VIEW



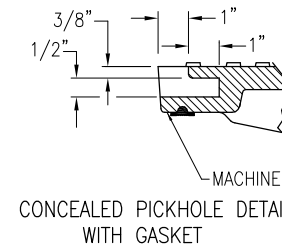
COVER BOTTOM VIEW



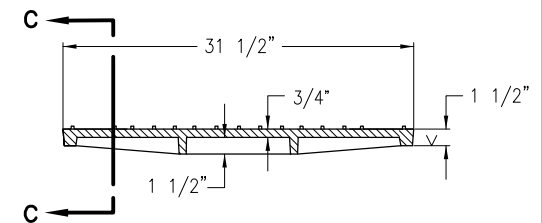
COVER WT. (CL. 35) - 210 LBS



SECTION D



SECTION C



SECTION B

NOTE:

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.

424-2



STANDARD DETAIL
ENGLISH

30" CAST IRON WATERTIGHT
MANHOLE FRAME AND COVER

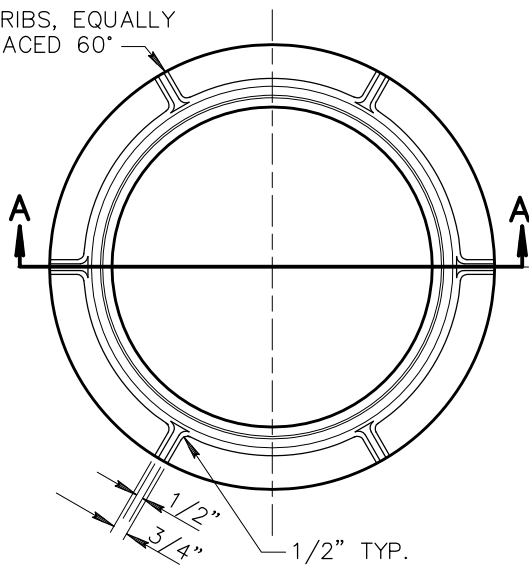
REVISED

01-01-2012

DETAIL NO.

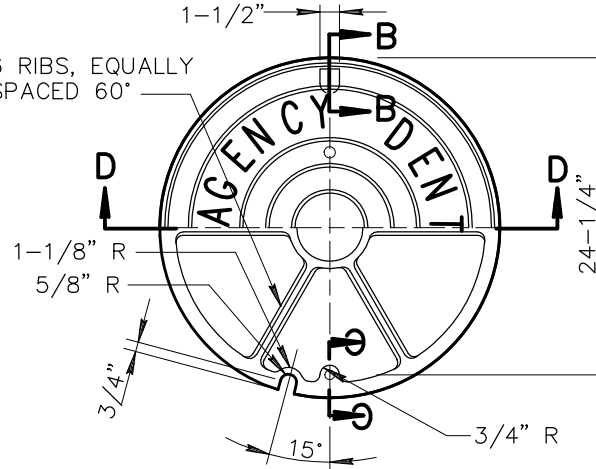
424-2

6 RIBS, EQUALLY
SPACED 60°

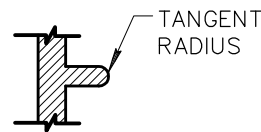


TOP VIEW

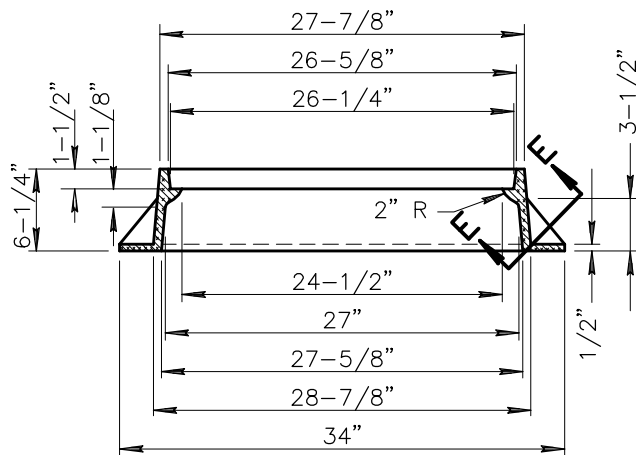
6 RIBS, EQUALLY
SPACED 60°



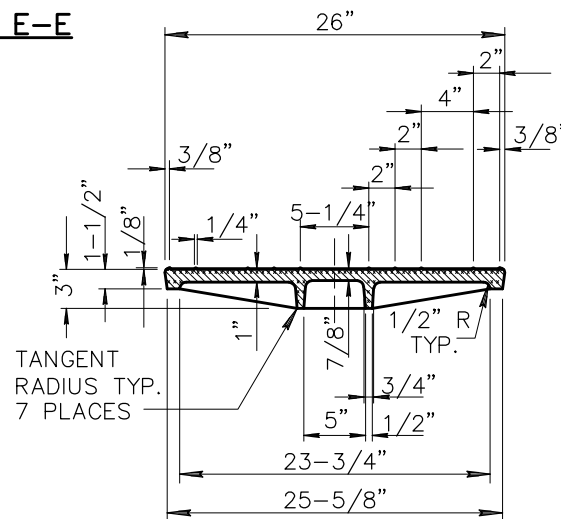
BOTTOM VIEW



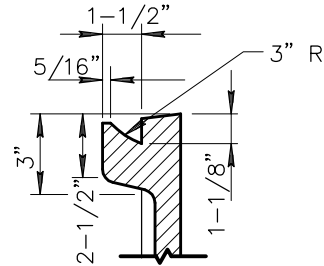
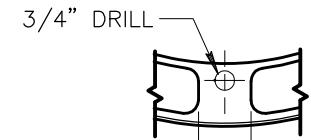
SECTION E-E



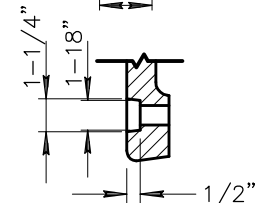
SECTION 'A-A'



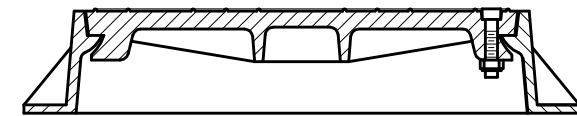
SECTION 'D-D'



SECTION 'B-B'



SECTION 'C-C'



**SECTION VIEW OF FRAME AND COVER
WITH CAM LOCKING DEVICE**

NOTES:

1. MATERIAL SHALL CONFORM TO A.S.T.M. STANDARDS
B 179-65 ALLOY SN122A
B 179-65 ALLOY CN42A
B 108-65 ALLOY SC103A
(ALL 3 ACCEPTABLE)
2. LETTERING ON MANHOLE COVER TO CONTAIN NAME
OF AGENCY AND UTILITY FOR WHICH MANHOLE IS
NEEDED. (I.E. "PHOENIX SANITARY SEWER"), OR AS
DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS
TO BE SUCH THAT LETTERS AND WORDS ARE
EQUALLY SPACED AND BALANCED TO FORM A
COMPLETE CIRCLE WITH SPACERS BEFORE AND
AFTER THE WORD IDENTIFYING THE AGENCY
INVOLVED. LETTERS TO BE 2" RAISED 1/8"
ABOVE LEVEL OF COVER. TYPE OF LETTERS TO BE
SUBMITTED FOR APPROVAL.
3. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2%
LESS THAN THE APPROXIMATE WEIGHT SPECIFIED.
4. CASTINGS SHALL CONFORM TO SECT. 787.
5. SHALL CONFORM TO SECT. 625.3.1 - (FRAME
AND COVER).

DETAIL NO.

425



STANDARD DETAIL
ENGLISH

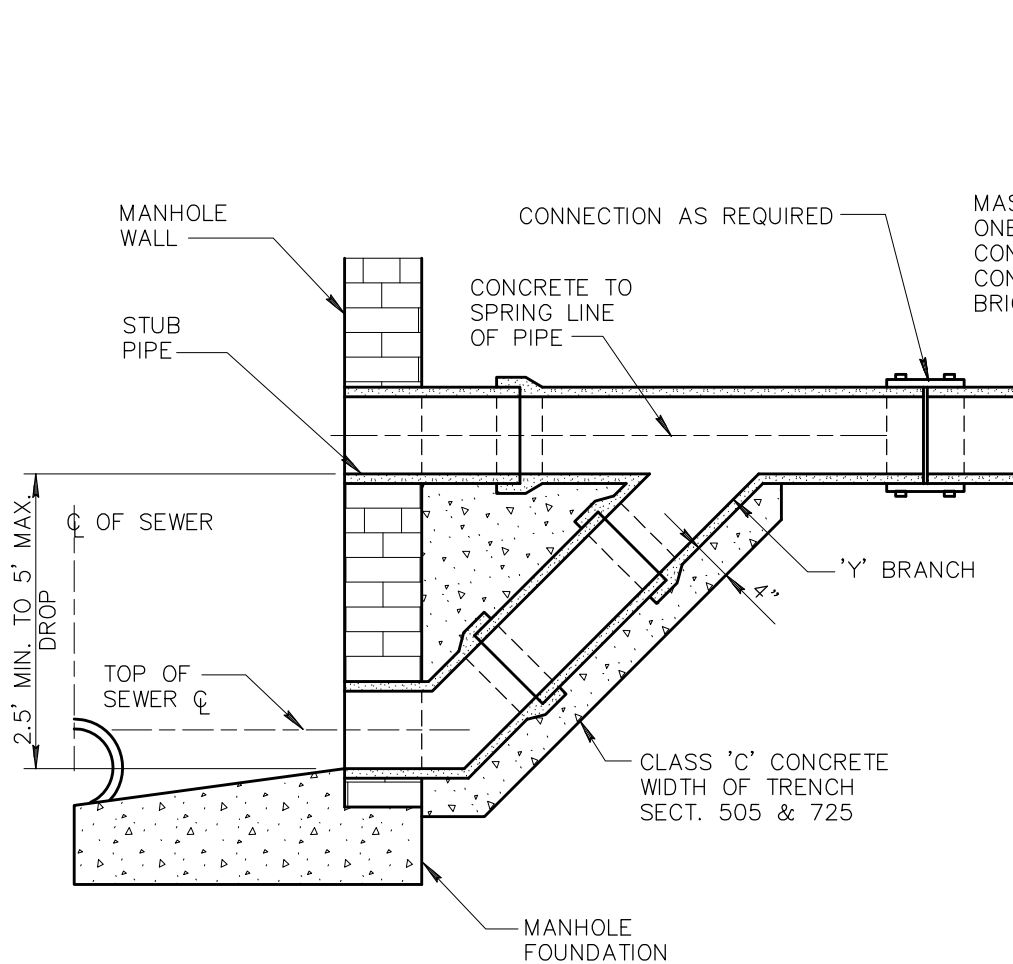
**24" ALUMINUM
MANHOLE FRAME AND COVER**

REVISED

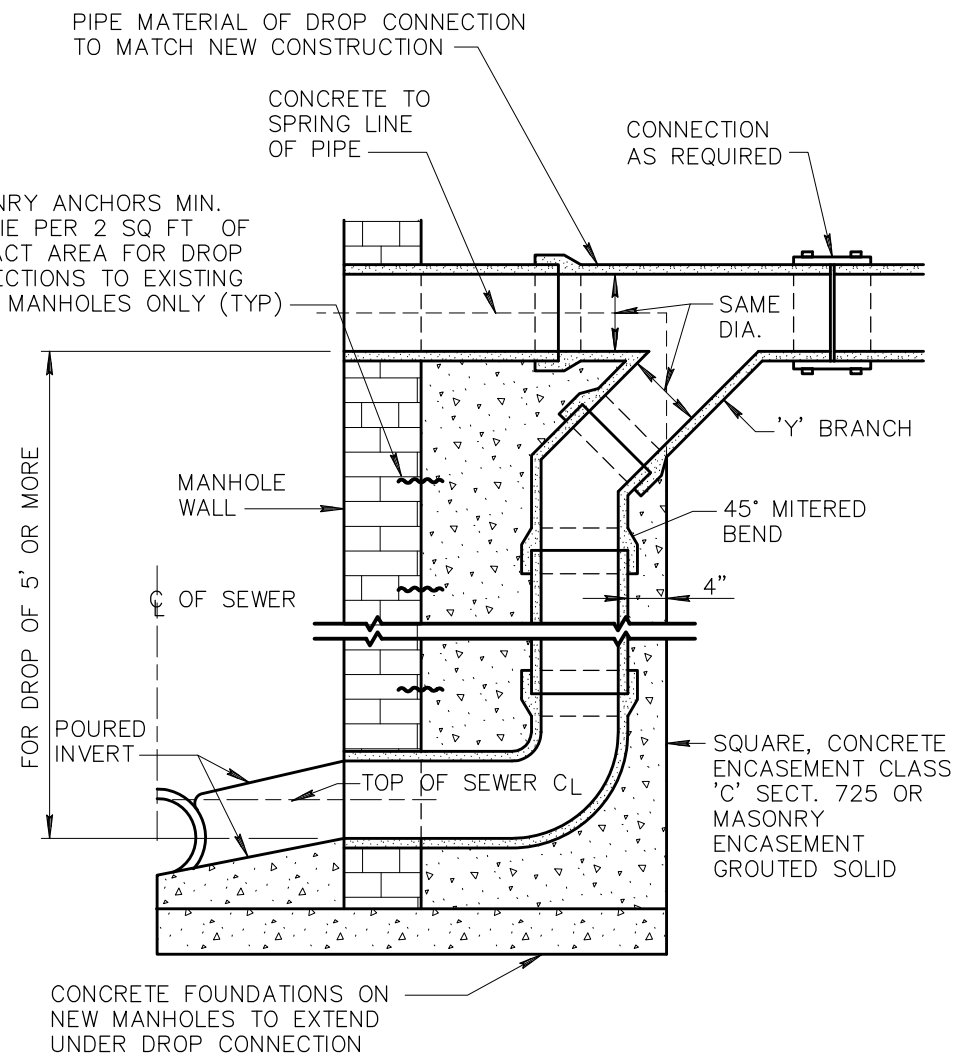
01-01-1998

DETAIL NO.

425



TYPE A
2.5' TO 5' DROP



TYPE B
5' OR MORE

DETAIL NO.

426



STANDARD DETAIL
ENGLISH

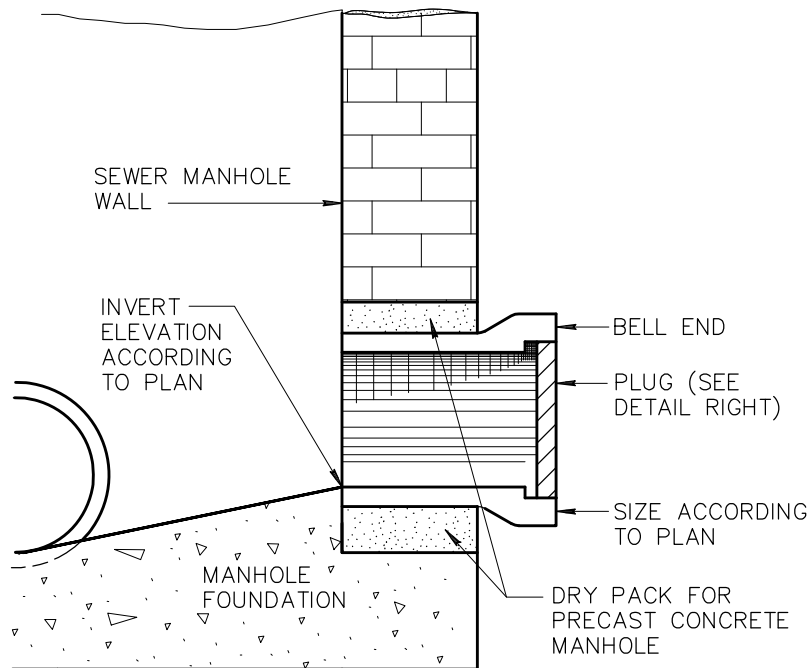
DROP SEWER CONNECTIONS

REVISED

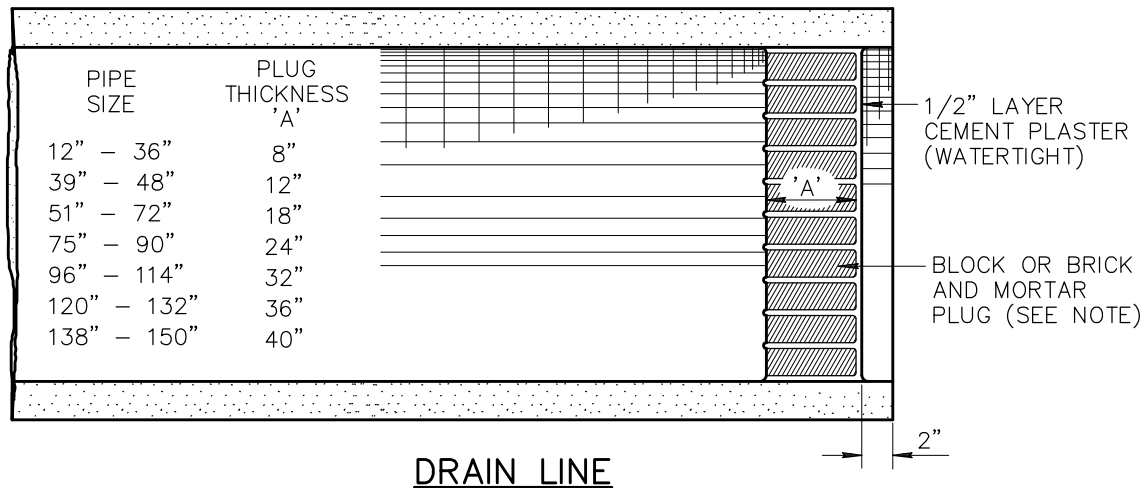
01-01-2007

DETAIL NO.

426

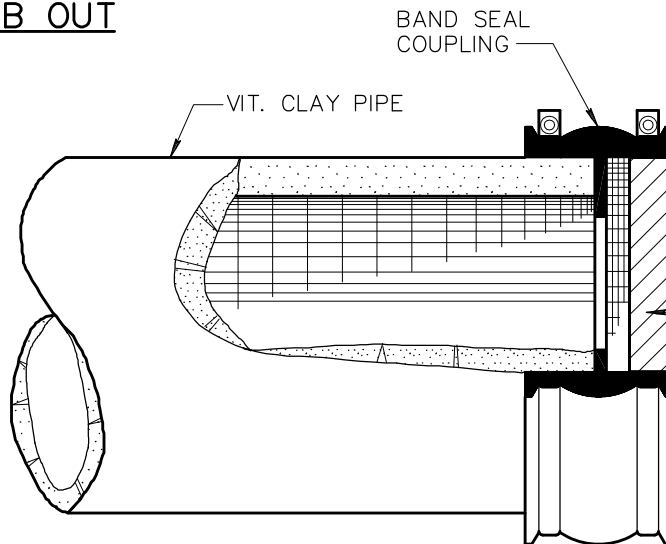


TYPICAL STUB OUT

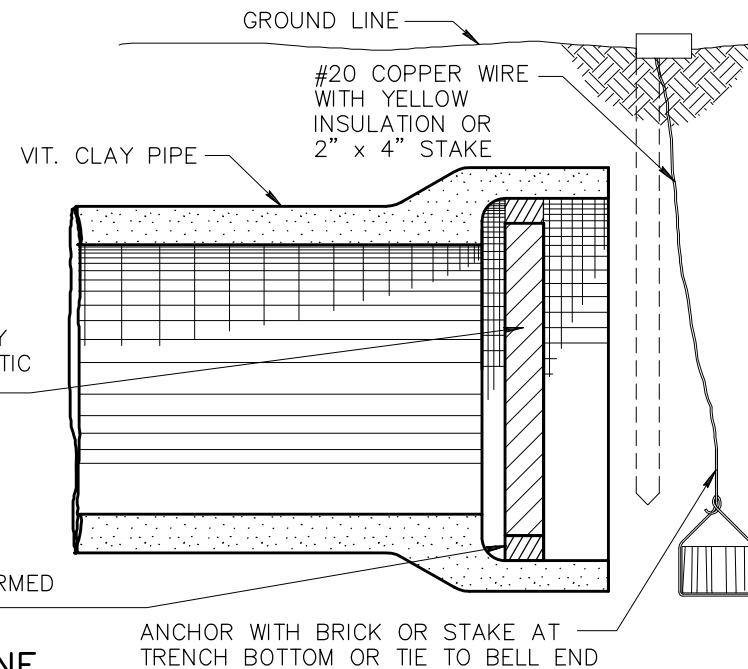


NOTES:

1. NOTE: COMPACT SOIL AT END OF PIPE TO 95% OF MAXIMUM DENSITY.
2. IF DEPTH OF COVER IS LESS THAN 5' OR GREATER THAN 10' INCREASE PLUG THICKNESS A MIN. OF 4".



SEWER LINE



DETAIL NO.

427



STANDARD DETAIL
ENGLISH

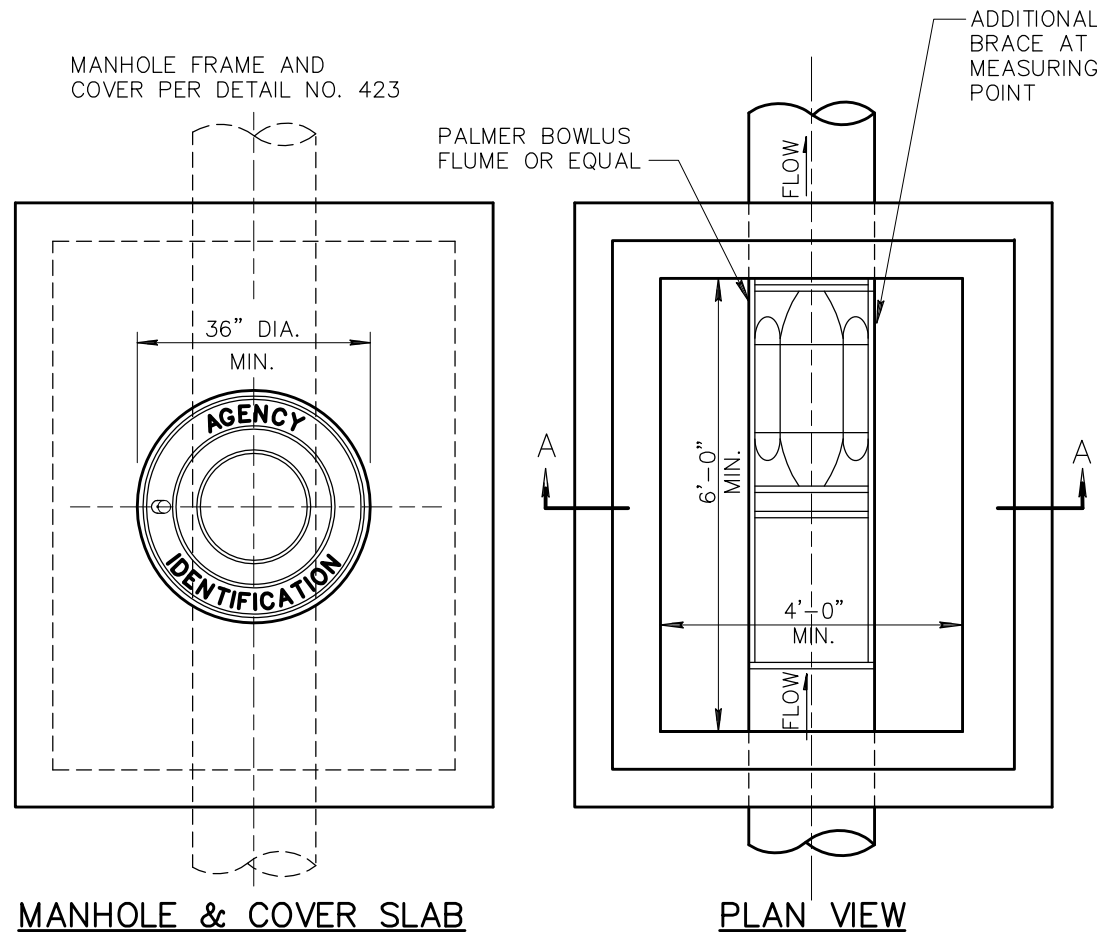
STUB OUT AND PLUGS

REVISED

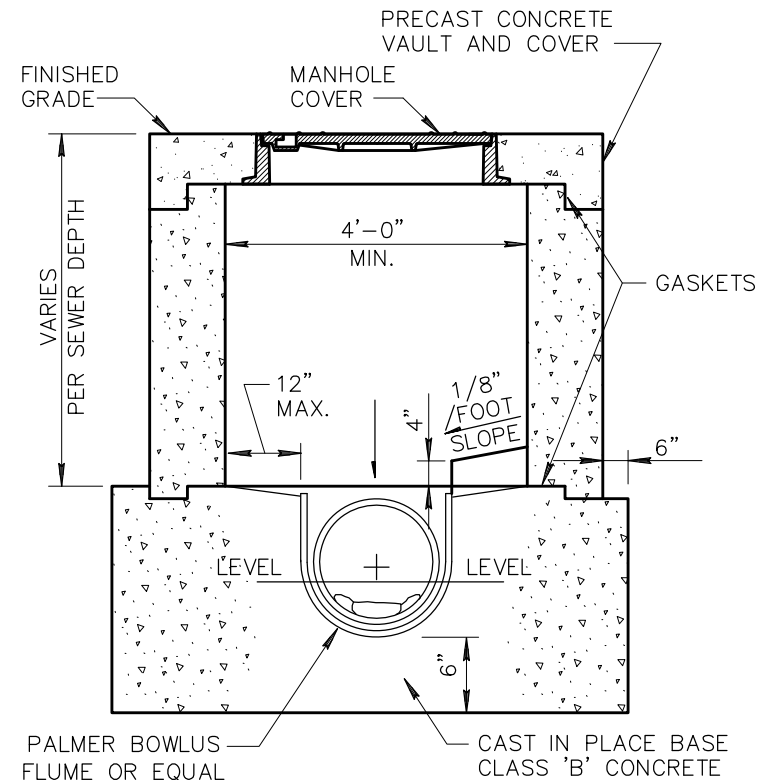
01-01-1998

DETAIL NO.

427



NOTE: WITH COVER REMOVED.



NOTE: LADDER NOT SHOWN IN SECTION VIEW. SECTION SHOWN WITH COVER IN PLACE.

NOTES:

1. THIS CONTROL VAULT WITH MANHOLE AND COVER SHALL BE USED ON 6" AND 8" DIAMETER SEWER WITH FLOWS IN THE RANGE OF 40 TO 340 GPM.
2. VAULT TO BE CONSTRUCTED ON STRAIGHT RUN OF BUILDING SEWER. ACCESSIBLE AND SAFELY LOCATED ON THE OWNERS PROPERTY ADJACENT TO A PUBLIC RIGHT-OF-WAY.
3. THE PALMER BOWLUS FLUME SHALL BE INSTALLED PER THE MANUFACTURERS RECOMMENDATIONS.
4. THE PRE-CAST CONCRETE VAULT SHALL BE RECTANGULAR WITH MINIMUM INSIDE DIMENSIONS OF 4' WIDE AND 6' LONG AND AT A DEPTH OF THE DESIGN OF THE BUILDING SEWER.
5. A SHOP DRAWING SHALL BE SUBMITTED TO THE CONTRACTING AGENCY FOR APPROVAL BEFORE INSTALLATION OF THE VAULT AND THE PALMER BOWLUS FLUME WILL BE ALLOWED.

DETAIL NO.

429



STANDARD DETAIL
ENGLISH

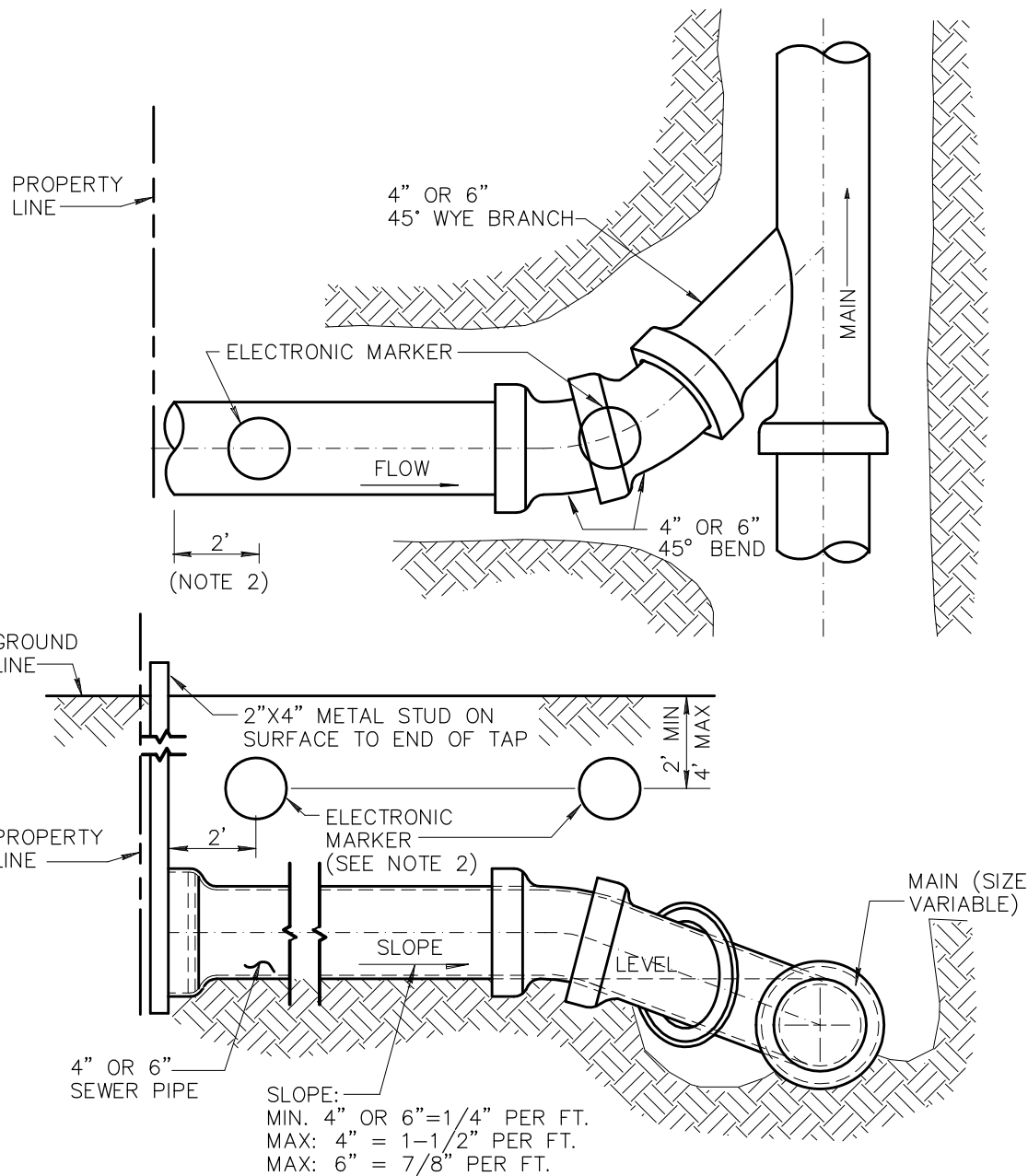
INDUSTRIAL WASTE CONTROL VAULT WITH MANHOLE

REVISED

01-01-2015

DETAIL NO.

429



ELECTRONIC MARKER PLACEMENT

NOTES:

1. ELECTRONIC MARKER SHALL BE A 3M MODEL 1424-XR/iD [4" DIAMETER SELF LEVELING MARKER BALL GREEN IN COLOR] OR APPROVED EQUAL OR AS REQUIRED BY THE LOCAL AGENCY.
2. MARKER SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S DIRECTIONS, 2' BACK FROM THE END OF THE SEWER SERVICE STUB AND CINCH TIED TO PIPE OR ABOVE PIPE AS REQUIRED BY LOCAL AGENCY. AN ADDITIONAL MARKER SHALL BE INSTALLED AT EACH SERVICE STUB BEND.
3. ELECTRONIC MARKER SHALL BE RESTORED BY CONTRACTOR IF DISTURBED WHEN PRIVATE SERVICE LINE CONNECTION IS INSTALLED.
4. MARKER SHALL BE USED IN ADDITION TO A 2"x4" METAL STUD.
5. CONSTRUCTION DETAIL APPLIES WHERE CONTRACTOR BUILDS HOUSE CONNECTION. TAP EXTENDS TO PROPERTY LINE IN ALLEYS OR STREETS OR TO EASEMENT LINE.
6. SIZE OF TAP SHALL BE DESIGNATED ON PLANS.
7. CONSTRUCT TAP AT MINIMUM SLOPE IF COVER WILL BE LESS THAN 5' AT PROPERTY LINE.
8. ALL FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321. THE CONTRACTOR MAY VARY FROM THE DRAWING TO USE THE APPROPRIATE WYES, TEE-WYES AND BENDS TO ENSURE NO MISALIGNMENT OF THE PIPE AND FITTINGS. BLOCK OR BRACE FITTINGS JOINTS TO ENSURE ZERO DEGREES ANGULAR JOINT DEFLECTION.
9. END OF TAP TO BE SEALED AND MARKED AS NOTED.

DETAIL NO.
440-1

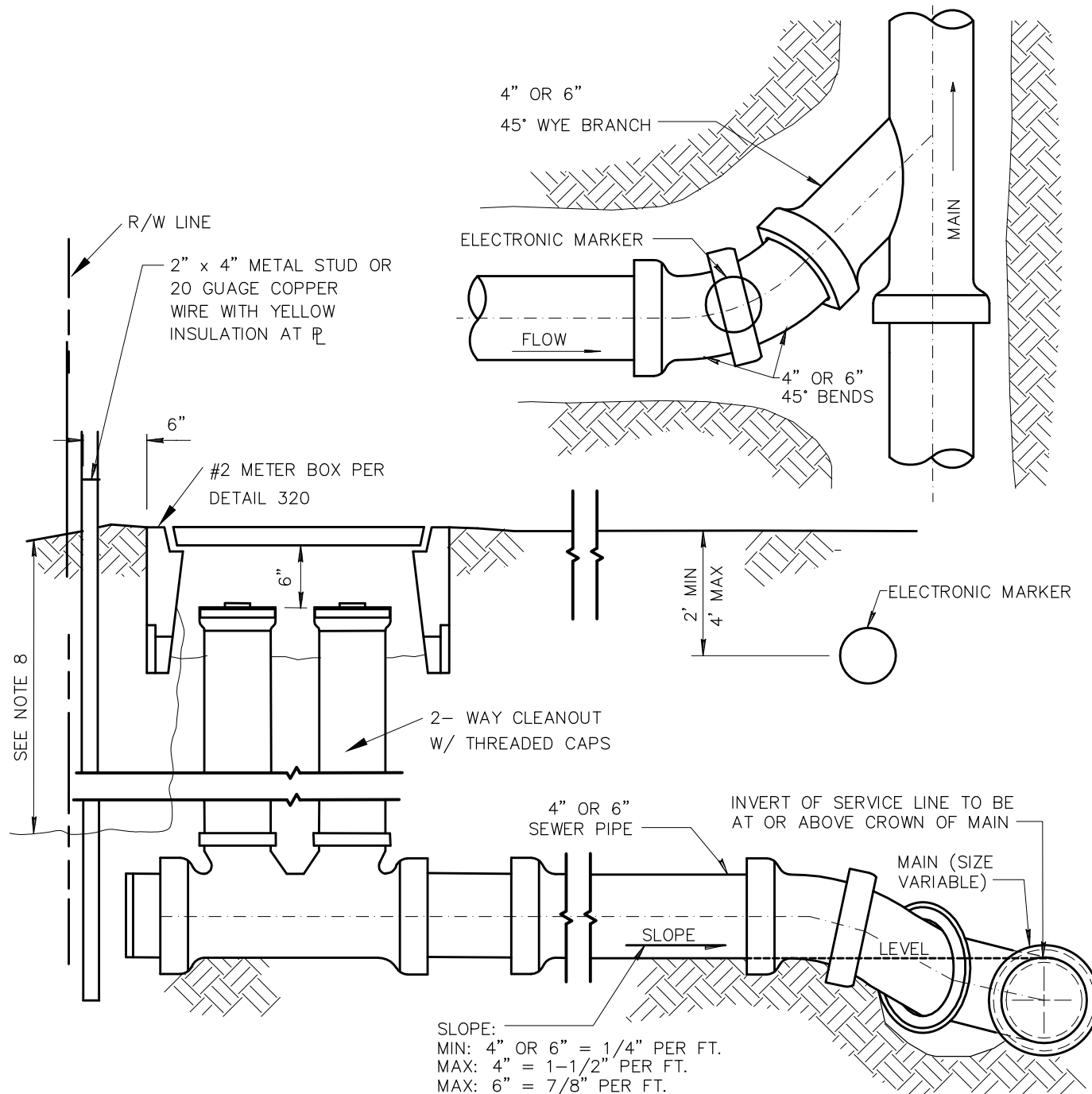


STANDARD DETAIL
ENGLISH

**TYPE 'A' - SEWER BUILDING CONNECTION
ELECTRONIC BALL MARKERS (STANDARD)**

REVISED
01-01-2007

DETAIL NO.
440-1



NOTES:

1. CONSTRUCTION DETAIL APPLIES WHERE CONTRACTOR BUILDS HOUSE CONNECTION. TAP EXTENDS TO PROPERTY LINE IN ALLEYS OR STREETS OR TO EASEMENT LINE.
2. SIZE OF TAP SHALL BE DESIGNATED ON PLANS.
3. CONSTRUCT TAP AT MINIMUM SLOPE IF COVER WILL BE LESS THAN 5' AT PROPERTY LINE.
4. IF DEPTH REQUIRES, MINIMUM SLOPE CAN BE REDUCED TO 1/8" PER FOOT PROVIDED STUB IS STAKED TO GRADE.
5. ALL FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321. THE CONTRACTOR MAY VARY FROM THE DRAWING TO USE THE APPROPRIATE WYES, TEE-WYES AND BENDS TO ENSURE NO MISALIGNMENT OF THE PIPE AND FITTINGS. BLOCK OR BRACE FITTING JOINTS TO ENSURE ZERO DEGREES ANGULAR JOINT DEFLECTION.
6. END OF TAP TO BE SEALED AND MARKED AS NOTED.
7. ELECTRONIC MARKER SHALL BE A 3M MODEL 1424-XR/iD [4" DIAMETER SELF LEVELING MARKER BALL GREEN IN COLOR] OR APPROVED EQUAL OR AS REQUIRED BY THE LOCAL AGENCY.
8. # 14 BARE COPPER LOCATOR WIRE ACCESSIBLE AT R/W AND AT PROPERTY OWNER CLEANOUT BOX NO GREATER THAN 4' DEEP.
9. STAMP OR WELD THE LETTER "S" ON LID OF METER BOX.

DETAIL NO.
440-2

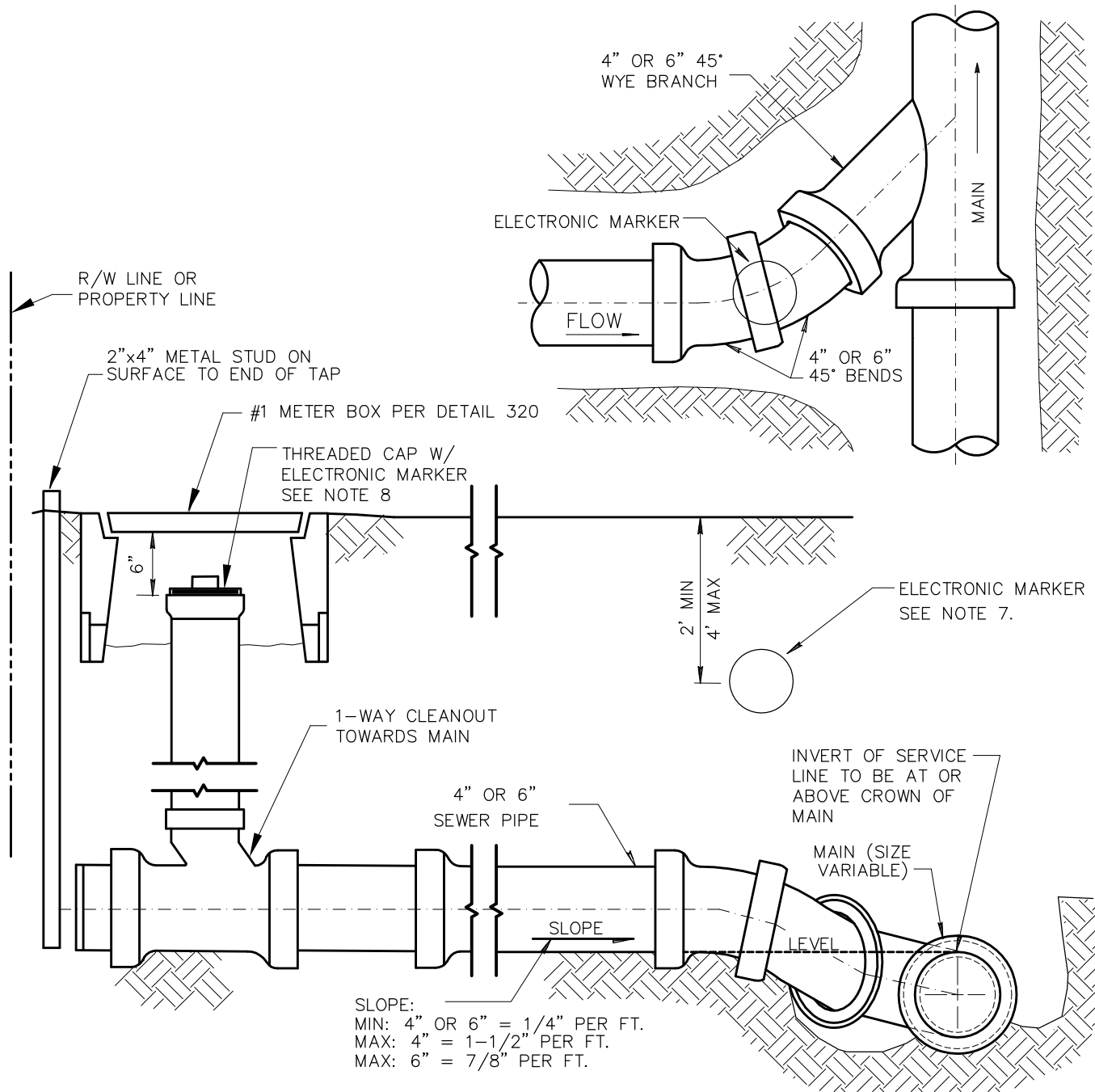


STANDARD DETAIL
ENGLISH

TYPE 'B' - SEWER BUILDING CONNECTION
TWO-WAY CLEANOUT AND METER BOX AT R/W
(WHEN SPECIFIED BY LOCAL AGENCY)

REVISED
01-01-2007

DETAIL NO.
440-2



NOTES:

1. CONSTRUCTION DETAIL APPLIES WHERE CONTRACTOR BUILDS HOUSE CONNECTION. TAP EXTENDS TO PROPERTY LINE IN ALLEYS OR STREETS OR TO EASEMENT LINE.
2. SIZE OF TAP SHALL BE DESIGNATED ON PLANS.
3. CONSTRUCT TAP AT MIN. SLOPE IF COVER WILL BE LESS THAN 5' AT PROPERTY LINE.
4. IF DEPTH REQUIRES, MINIMUM SLOPE CAN BE REDUCED TO 1/8" PER FOOT PROVIDED STUB IS STAKED TO GRADE.
5. ALL FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321. THE CONTRACTOR MAY VARY FROM THE DRAWING TO USE THE APPROPRIATE WYES, TEE-WYES AND BENDS TO ENSURE NO MISALIGNMENT OF THE PIPE AND FITTINGS. BLOCK OR BRACE FITTING JOINTS TO ENSURE ZERO DEGREES ANGULAR JOINT DEFLECTION.
6. END OF TAP TO BE SEALED AND MARKED.
7. ELECTRONIC MARKER SHALL BE A 3M MODEL 1424-XR/iD [4" DIAMETER SELF LEVELING MARKER BALL GREEN IN COLOR] OR APPROVED EQUAL OR AS REQUIRED BY THE LOCAL AGENCY.
8. INSTALL RAISED 4" THREADED PLUG IN CLEANOUT INCORPORATING 3M MODEL 1414 ELECTRONIC DISC MARKER. GREEN IN COLOR. LOCATOR PLUG TO BE GPK PRODUCTS MODEL #228-0004 DM OR APPROVED EQUAL.
9. STAMP OR WELD THE LETTER "S" ON LID OF METER BOX.

DETAIL NO.

440-3



STANDARD DETAIL
ENGLISH

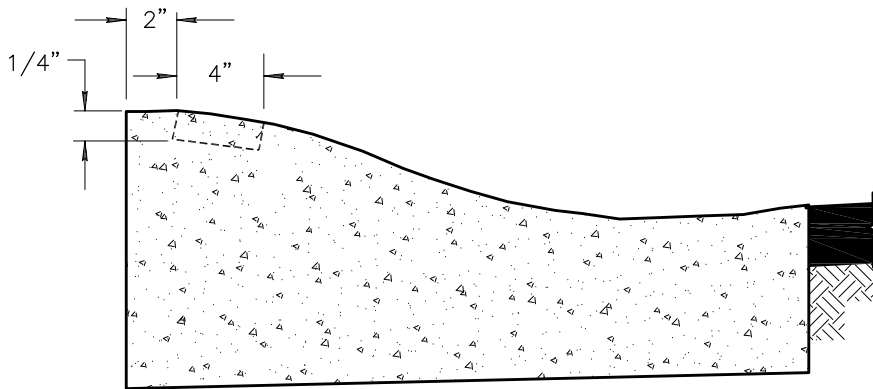
TYPE 'C' – SEWER BUILDING CONNECTION
ONE-WAY CLEANOUT AND METER BOX
(WHEN SPECIFIED BY LOCAL AGENCY)

REVISED

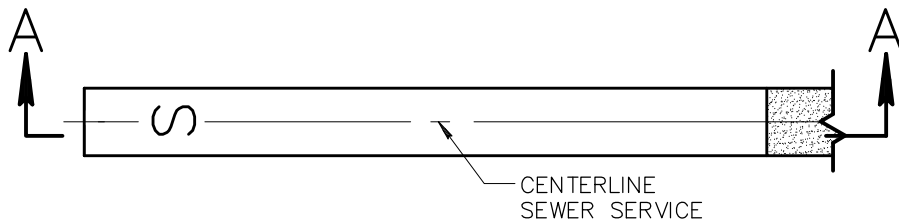
01-01-2007

DETAIL NO.

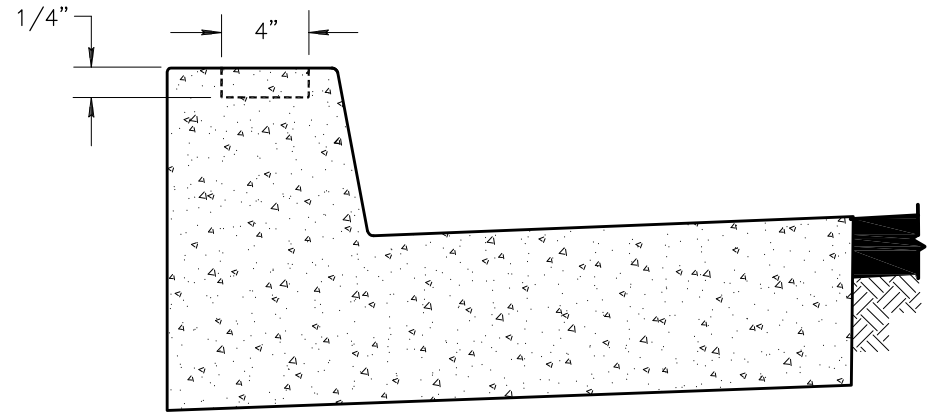
440-3



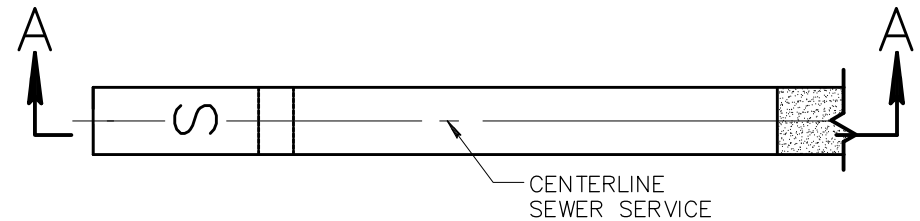
SECTION A-A



CURB STAMP ROLLED CURB



SECTION A-A



CURB STAMP VERTICAL CURB

NOTES:

1. STAMP TOP OF CURB WITH 4" TALL BY 1/4" DEEP "S" TO DESIGNATE SEWER SERVICE LINE CROSSING.

DETAIL NO.

440-4



STANDARD DETAIL
ENGLISH

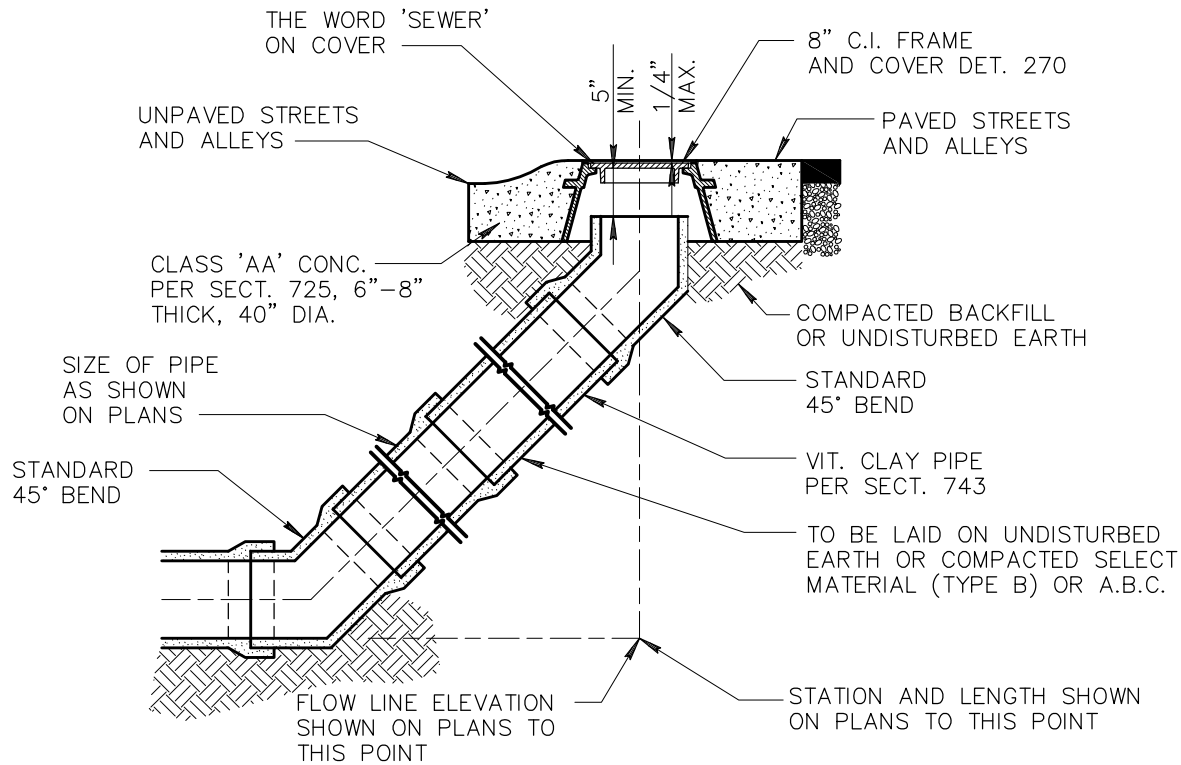
SEWER SERVICE CURB CROSSING
STAMP DETAIL

REVISED

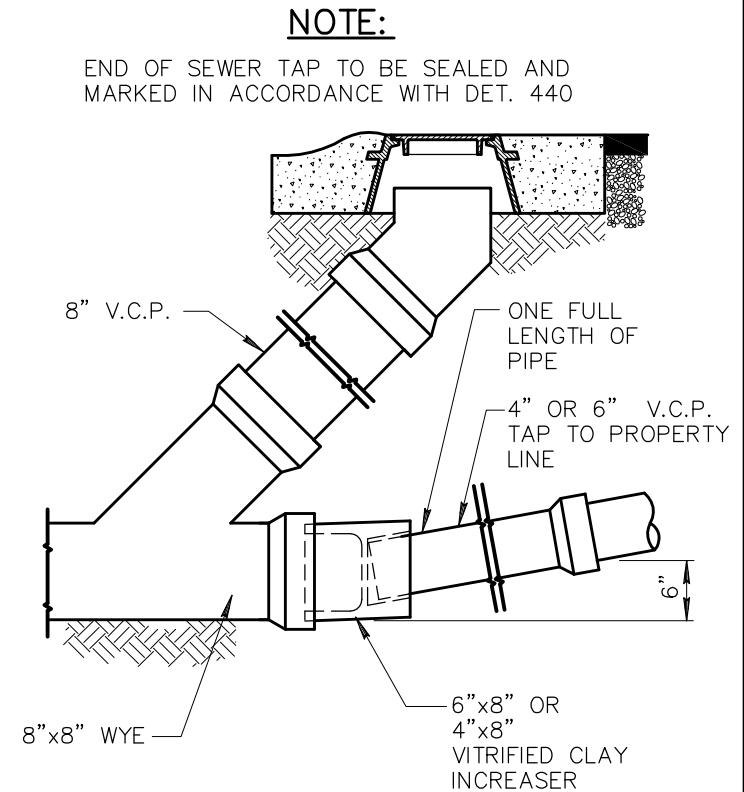
01-01-2006

DETAIL NO.

440-4



CLEANOUT INSTALLATION



SEWER TAP AT CLEANOUT

DETAIL NO.

441



STANDARD DETAIL
ENGLISH

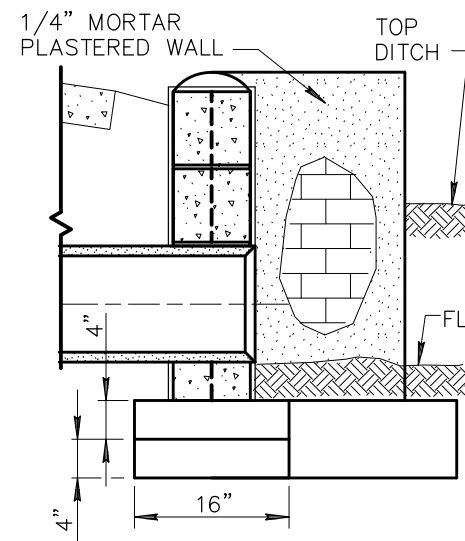
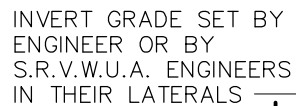
SEWER CLEANOUT

REVISED

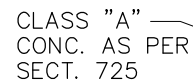
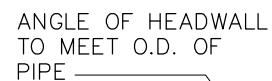
01-01-2001

DETAIL NO.

441



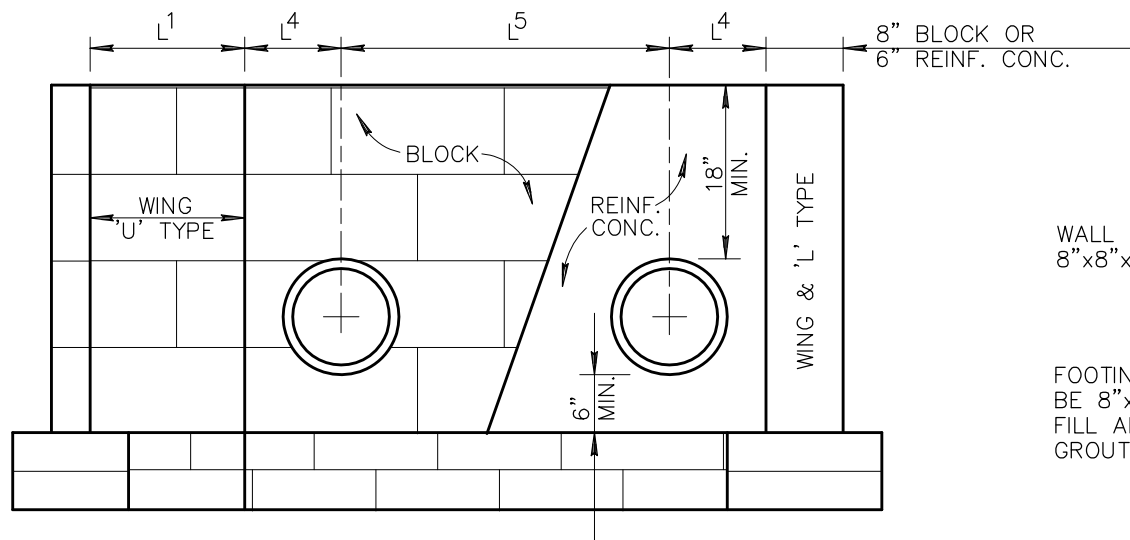
CLASS "A"
CONC.
AS PER
SECT. 725



NO.4 REINF. BAR FULL -
LENGTH IN EACH CORE.
CORES TO BE FILLED
WITH GROUT MIX 1:3

'L' TYPE
PLAN

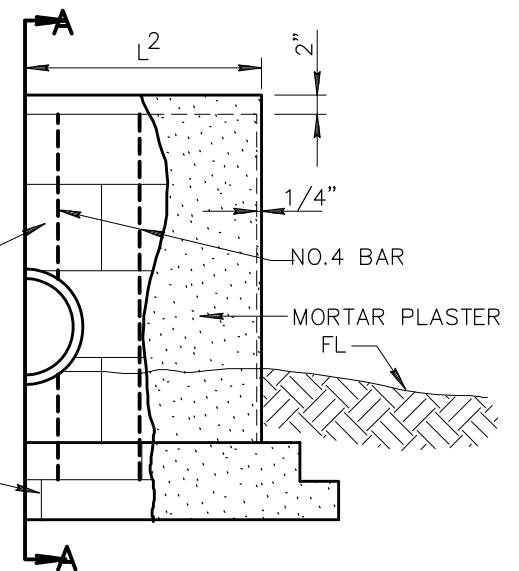




DOUBLE PIPE HEADWALL

WALL BLOCKS TO BE
8"x8"x16"

FOOTING BLOCKS TO BE
8"x8"x16".
FILL ALL CORES WITH
GROUT MIX 1:3.



ELEVATION

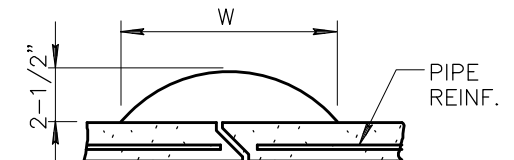
CONCRETE MASONRY UNITS (BLOCK)
HEADWALLS JOINED WITH CEMENT
MORTAR PLASTERED BOTH SIDES
OF WALL FULL HEIGHT AND SHALL
BE CURED PER SECT. 726.

NOTES:

1. ALL CONCRETE SHALL BE CLASS 'A' PER SECT. 505 & 725.
2. CONCRETE MASONRY UNITS (BLOCK) PER SECT. 510, 775 & 776.
3. CONCRETE REINF. SHALL BE NO.4 BAR 12" O.C. BOTH WAYS.

HEADWALL DIMENSIONS					
*NOMINAL PIPE SIZE	L ¹	L ²	L ³	L ⁴	L ⁵
12"	1'-4"	2'-0"	3'-8"	0'-10"	2'-10"
15"	2'-0"	2'-8"	4'-0"	1'-0"	3'-0"
18"	2'-0"	3'-8"	4'-8"	1'-2"	3'-4"
21"	2'-8"	4'-0"	5'-4"	1'-3"	3'-8"
24"	2'-8"	4'-0"	5'-4"	1'-6"	3'-11"
30"	2'-8"	5'-4"	6'-8"	1'-10"	4'-7"
36"	3'-4"	6'-8"	8'-0"	1'-10"	5'-2"
42"	4'-0"	8'-0"	9'-4"	2'-2"	5'-9"

* NOMINAL PIPE SIZE GIVEN FOR REINFORCED CONC. PIPE.



PIPE SIZE	W
12" - 21" INCL.	11"
24" - 42" INCL.	13"

DETAIL "A"

DETAIL NO.

501-2



STANDARD DETAIL
ENGLISH

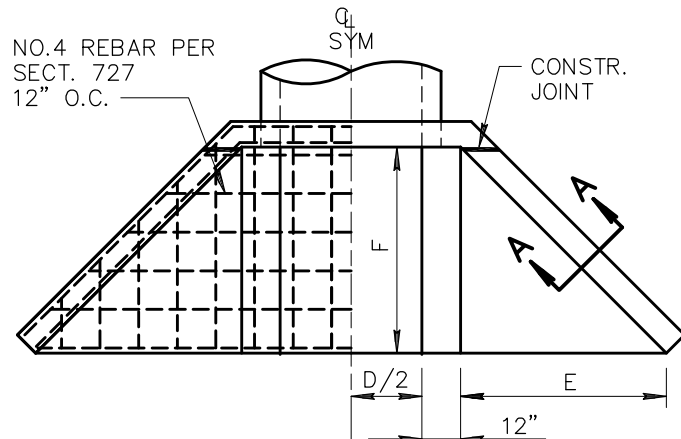
HEADWALL

REVISED

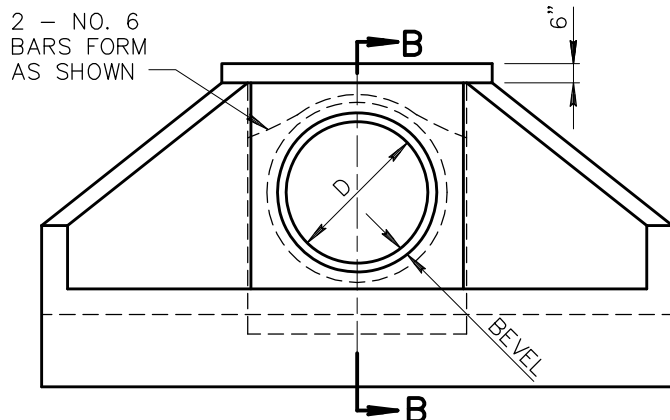
01-01-2012

DETAIL NO.

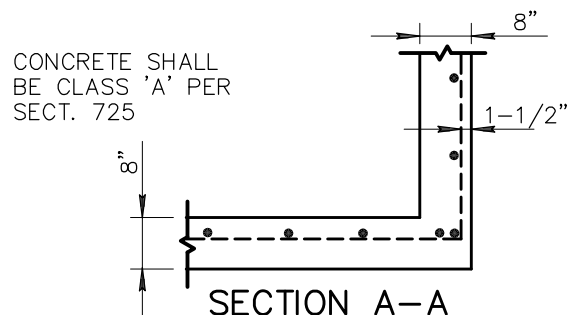
501-2



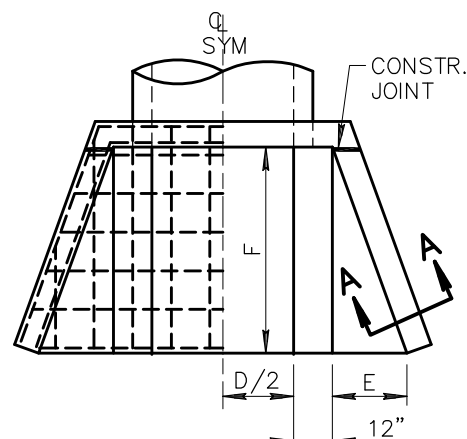
INLET HEADWALL



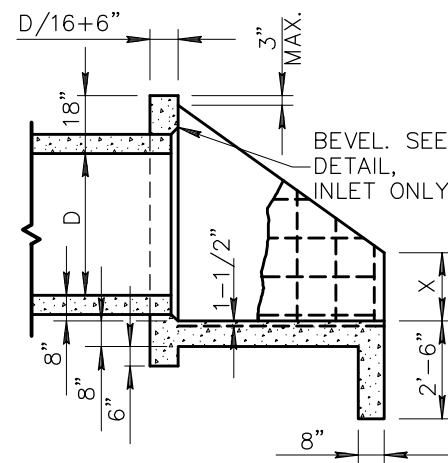
**INLET HEADWALL FACE ELEVATION
OUTLET SIMILAR**



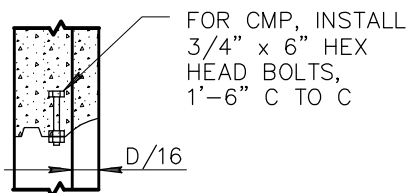
SECTION A-A



OUTLET HEADWALL



SECTION B-B



CMP BEVEL DETAIL

1:1 1/2 EMBANKMENT SLOPE

D	TYPE *	DIMENSIONS		
		F	E	X
42"	1 (IN)	5'-2"	5'-2"	1'-9"
	2 (OUT)	5'-2"	1'-11"	1'-9"
48"	3 (IN)	5'-8"	5'-8"	1'-11"
	4 (OUT)	5'-8"	2'-1"	1'-11"
54"	5 (IN)	6'-2"	6'-2"	2'-1"
	6 (OUT)	6'-2"	2'-3"	2'-1"
60"	7 (IN)	6'-8"	6'-8"	2'-3"
	8 (OUT)	6'-8"	2'-5"	2'-3"
66"	9 (IN)	7'-2"	7'-2"	2'-5"
	10 (OUT)	7'-2"	2'-7"	2'-5"
72"	11 (IN)	7'-8"	7'-8"	2'-7"
	12 (OUT)	7'-8"	2'-9"	2'-7"
78"	13 (IN)	8'-2"	8'-2"	2'-9"
	14 (OUT)	8'-2"	3'-0"	2'-9"
84"	15 (IN)	8'-8"	8'-8"	2'-11"
	16 (OUT)	8'-8"	3'-2"	2'-11"

1:4 EMBANKMENT SLOPE

D	TYPE *	DIMENSIONS		
		F	E	X
42"	17 (IN)	8'-8"	8'-8"	3'-0"
	18 (OUT)	8'-8"	3'-2"	3'-0"
48"	19 (IN)	8'-8"	8'-8"	3'-6"
	20 (OUT)	8'-8"	3'-2"	3'-6"
54"	21 (IN)	8'-8"	8'-8"	4'-0"
	22 (OUT)	8'-8"	3'-2"	4'-0"
60"	23 (IN)	9'-4"	9'-4"	4'-4"
	24 (OUT)	9'-4"	3'-5"	4'-4"
66"	25 (IN)	9'-8"	9'-8"	4'-9"
	26 (OUT)	9'-8"	3'-6"	4'-9"
72"	27 (IN)	9'-8"	9'-8"	5'-3"
	28 (OUT)	9'-8"	3'-6"	5'-3"
78"	29 (IN)	10'-0"	10'-0"	5'-8"
	30 (OUT)	10'-0"	3'-8"	5'-8"
84"	31 (IN)	10'-8"	10'-8"	6'-0"
	32 (OUT)	10'-8"	3'-11"	6'-0"

* (IN) REFERS TO INLET
(OUT) REFERS TO OUTLET

DETAIL NO.

501-3



STANDARD DETAIL
ENGLISH

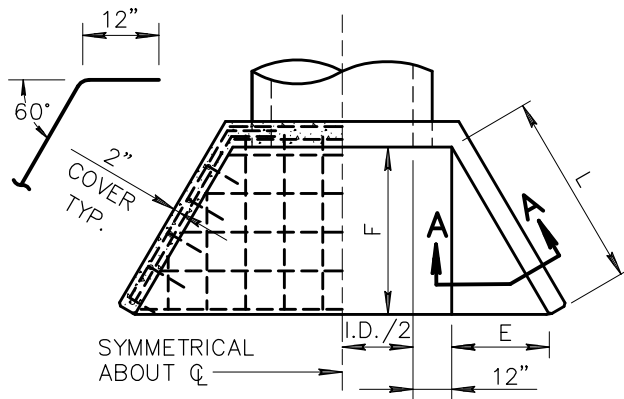
HEADWALL 42" TO 84" PIPE

REVISED

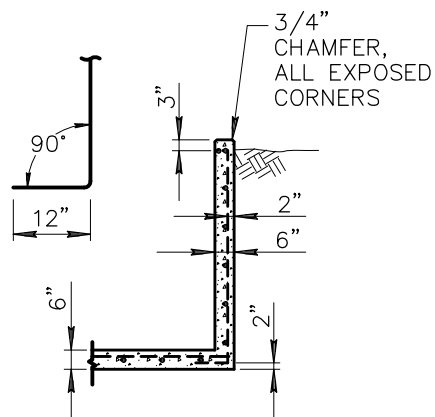
01-01-1998

DETAIL NO.

501-3

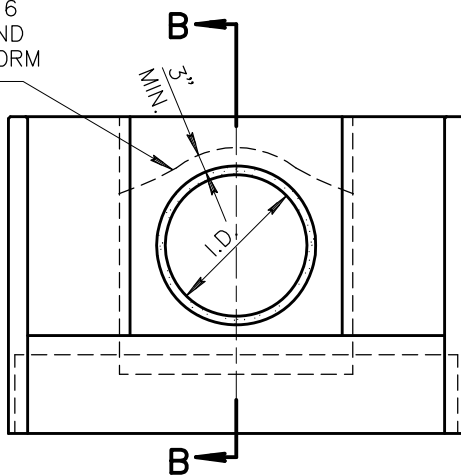


PLAN

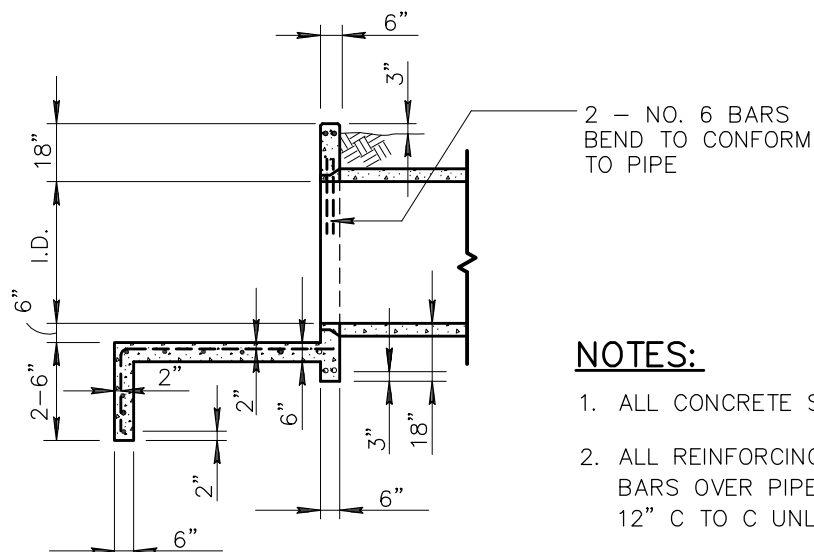


SECTION A-A

2 - NO. 6
BARS BEND
TO CONFORM
TO PIPE



ELEVATION

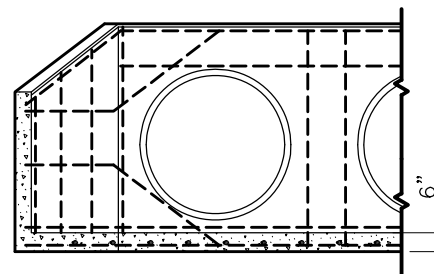


SECTION B-B

PIPE I.D.	DIMENSIONS		
	L	E	F (APPROX)
18"	2'-0"	1'-0"	1'-9"
24"	2'-0"	1'-0"	1'-9"
30"	3'-0"	1'-6"	2'-7"
36"	4'-0"	2'-0"	3'-6"
42"	5'-0"	2'-6"	4'-4"
48"	6'-0"	3'-0"	5'-2"
54"	7'-0"	3'-6"	6'-1"
60"	8'-0"	4'-0"	6'-11"

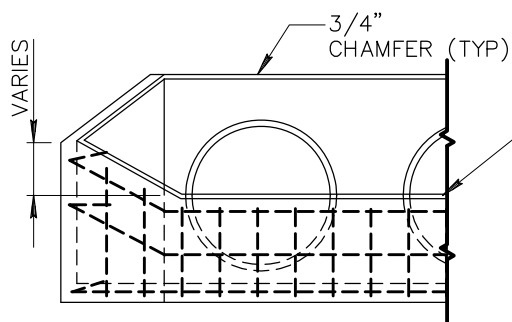
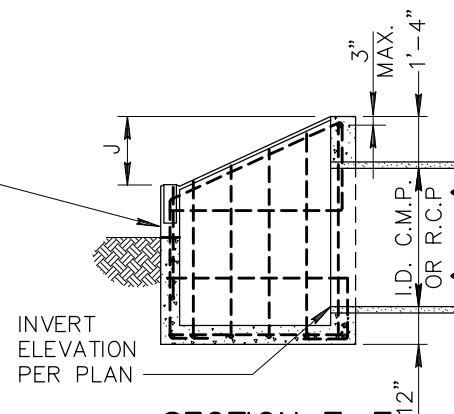
NOTES:

1. ALL CONCRETE SHALL BE CLASS 'A' PER SECT. 725.
2. ALL REINFORCING BARS SHALL BE NO. 4 EXCEPT NO. 6 BARS OVER PIPE. BAR SPACING APPROXIMATELY 12" C TO C UNLESS OTHERWISE NOTED.
3. 30° WING WALL FLARE SHOWN; 45° NORMALLY DESIRABLE.



SECTION Y-Y

PLAN

ELEVATION

SECTION Z-Z

NOTES:

1. HIGH POINT OF HEADWALL SHALL NOT PROJECT MORE THAN 3" ABOVE SLOPE.
2. ALL CONCRETE SHALL BE CLASS 'A' PER SECT. 725.
3. ALL REINFORCING BARS SHALL BE NO. 4, 12" C TO C AND 3" CLEAR TO INSIDE OF FLOOR AND WALLS.

PIPE	DIMENSIONS							
	W		A	B	E	F	J	K
	SINGLE	DOUBLE						
18"	2'-6"	5'-2"	2'-8"	1'-3"	0'-9"	1'-3.5/8"	9"	1'-6"
24"	3'-0"	6'-6"	3'-6"	1'-7.1/2"	1'-1.1/2"	1'-11.3/8"	11"	2'-3"
30"	3'-6"	7'-10"	4'-4"	2'-0"	1'-6"	2'-7.1/4"	1'-1"	3'-0"
36"	4'-0"	9'-2"	5'-2"	2'-4.1/2"	1'-10.1/2"	3'-3"	1'-4"	3'-9"
42"	4'-6"	10'-6"	6'-0"	2'-9"	2'-3"	3'-10.3/4"	1'-6"	4'-6"

DETAIL NO.

501-5



STANDARD DETAIL
ENGLISH

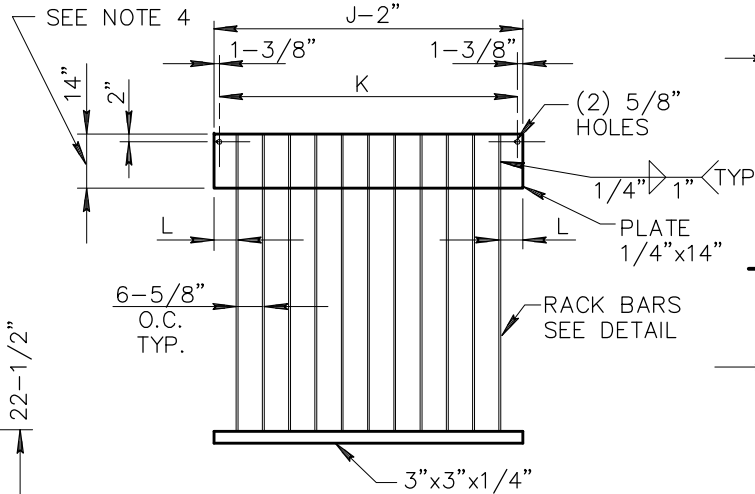
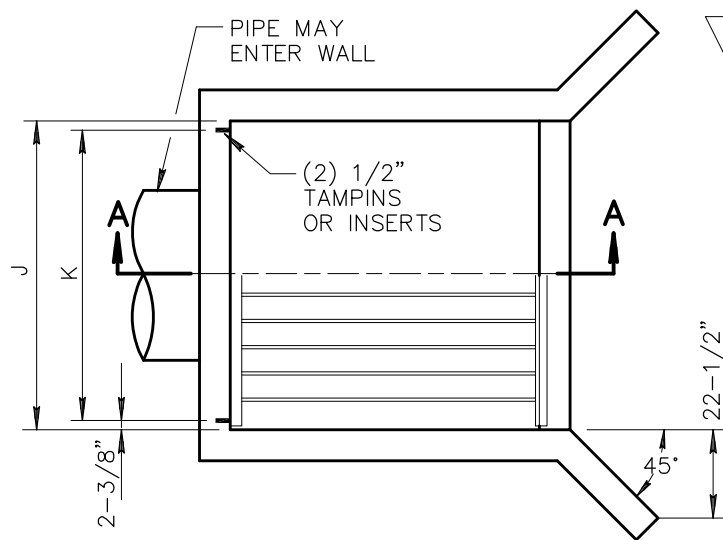
HEADWALL DROP INLET

REVISÉD

01-01-2014

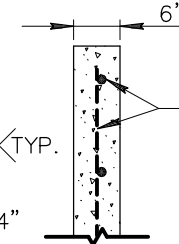
DETAIL NO.

501-5



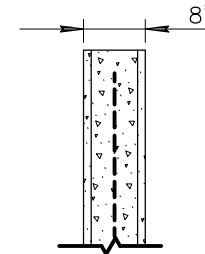
TRASH RACK

POURED WALLS

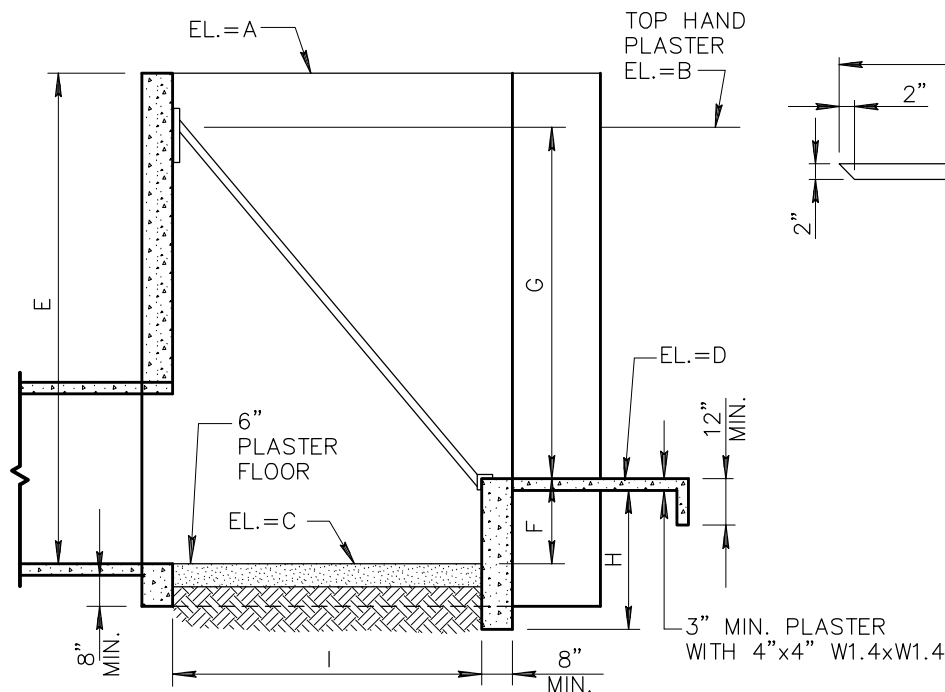


NO. 4 REINFORCED BARS 12\"/>

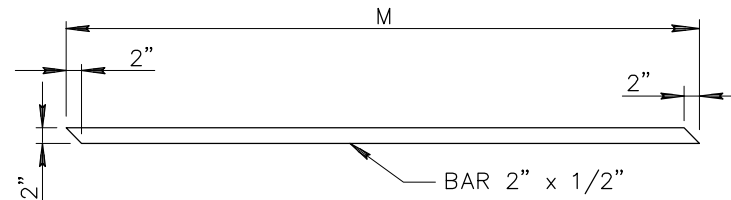
BLOCK WALLS



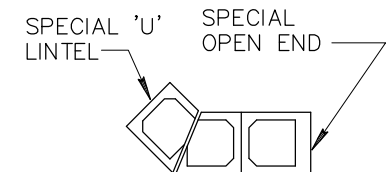
BLOCK HEADWALL TO HAVE ONE NO.4 REINF. BAR CENTERED IN EACH CORE FOR FULL HEIGHT AND CORES FILLED WITH CONCRETE OR CEMENT GROUT (3:1 RATIO). ALL BLOCKS TO BE JOINED WITH MORTAR. PLASTERED ON EXPOSED SURFACES THEN SPRAY WITH WHITE PIGMENTED CURING COMPOUND. SECT. 510, 727 & 776.



SECTION A-A



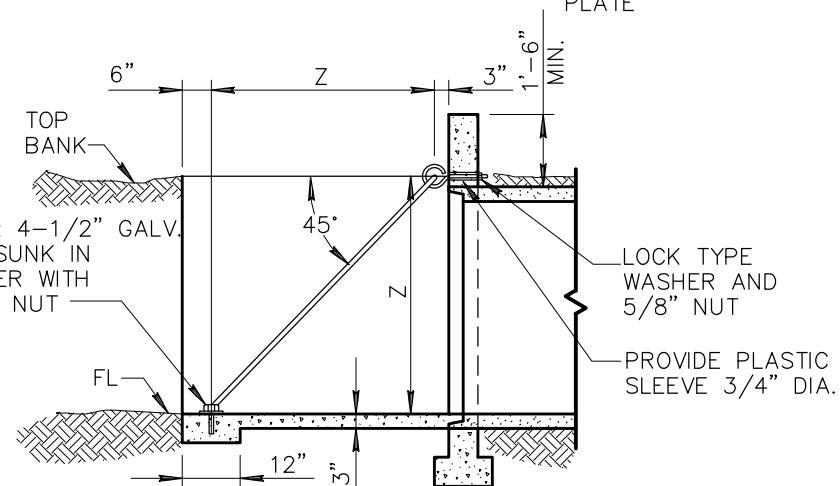
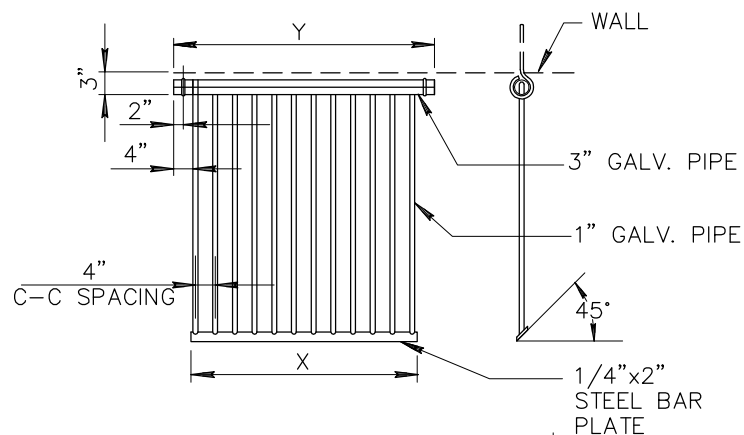
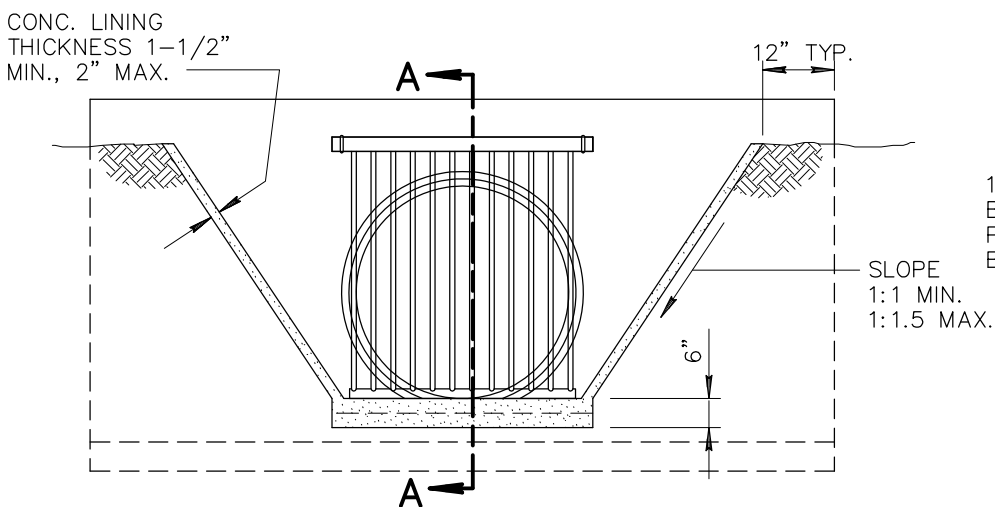
RACK BARS



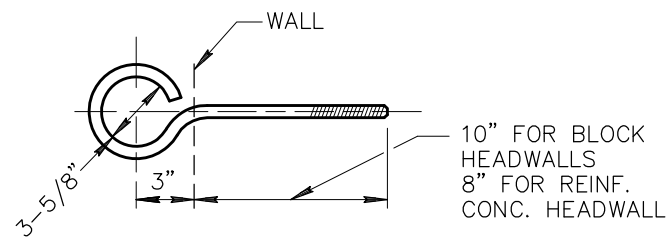
45° BLOCK CORNER

NOTES:

1. REMOVE ALL SCALE FROM RACK BARS. METAL SPRAY OR PAINT WITH ONE COAT ZINC CHROMATE OR RED LEAD PRIMER (INDUSTRIAL QUALITY). OVERCOAT WITH GREY INDUSTRIAL ENAMEL SECT. 790.
2. SHAPE, COMPACT AND PLASTER NEW DITCH FROM HEADWALL TO UNDISTURBED EXISTING DITCH. PLASTER TO EXTEND TO MINIMUM ELEVATION NOTED 3 FEET BEYOND CONNECTION TO UNDISTURBED EXISTING DITCH.
3. ELEVATIONS A, B, C & D AND DIMENSIONS E, F, G, H, I, J, K, L & M WILL BE SHOWN ON PLANS. DIMENSIONS SHOULD PROVIDE STANDARD SIZE BLOCK.
4. 14\"/>



SECTION A-A



EYE BOLT

TYPE BASED ON PIPE SIZE						
TYPE	PIPE SIZE	NO. OF BARS	LENGTH OF BARS	DIMENSIONS		
				X	Y	Z
A	18"	6	3'-7"	1'-9"	2'-5"	2'-5"
	24"	8	3'-7"	2'-5"	3'-1"	2'-5"
B	30"	10	4'-4.1 1/4"	3'-1"	3'-9"	2'-11.1 1/2"
C	36"	10	5'-1.1 1/2"	3'-1"	3'-9"	3'-6"
D	42"	12	5'-10.5 8/8"	3'-9"	4'-5"	4'-0.1 2/2"
E	48"	14	6'-7.3 3/4"	4'-5"	5'-1"	4'-7"

NOTE:
PAINT COVER BOTH SIDES
ONE PRIME COAT, TWO
FINISH COATS, SECT.
790, PAINT NO. 9

10 GAUGE SHEET
STEEL COVER

HANDLE EXTENDS
6" BELOW
TOP WHEN GATE
IS OPEN

STANDARD
CONCRETE
PIPE

CONCRETE AS
REQUIRED TO
SECURE GATE

FINISH
GRADE

VARIABLE

(2) 5/16"
HOLES
4" O.C.

1/4" ROD
HANDLE

2-1/2"

UNLESS OTHERWISE
SPECIFIED

GROUT JOINTS
WATER
TIGHT

GATE TYPE,
SIZE AND NO.
REQUIRED AS
GIVEN ON PLANS

SIZE OF PIPE
AS SHOWN
ON PLANS

TYPE 'A'

NOTES:

1. BRACE TO BE INSTALLED EVERY 2'
FROM TOP OF HEADGATE FRAME. BOTTOM
BRACE TO BE HIGH ENOUGH TO ENABLE
FULL OPENING OF HEADGATE.
2. INSTALL 1/2" BOLTS INTO LEAD
PLUG DRILLED TO WITHIN 1" OF
OUT SIDE OF STANDPIPE. SPACERS
TO BE INSTALLED AT EACH BOLT
BETWEEN HEADGATE FRAME AND INSIDE
OF STAND PIPE.
3. LOCATION OF 2" HOLE FOR GATE
STEM TO BE DETERMINED AFTER
INSTALLATION OF GATE.
4. CONCRETE SHALL BE
CLASS A PER SECT. 725.

PAINT ARROW ON OUTSIDE OF
STANDPIPE INDICATING DIRECTION
"TO OPEN" HEADGATE.

SEE NOTE 3

(4) 3/8" BOLTS TO BE
GROUTED INTO STANDPIPE
EQUI-DISTANT WITH
1-1/2"x3" RECTANGULAR
WASHERS AND NUTS

GALVANIZED EXPANDED
METAL LID (9 GAUGE)

SEE NOTE 2

REINF. CONC.
PIPE

VARIES
48" MIN.
52" MAX.

SEE NOTE 1

GROUT JOINTS
WATER TIGHT

FINISH
GRADE

18"
MIN.

1" C.R.S.
LIFT ROD

HEADGATE TO BE SWANSON
800 SERIES
OR APPROVED
EQUAL

SIZE OF
PIPE AS
SHOWN
ON PLANS

FORM CONC. AROUND
END OF PIPE BEHIND
HEADGATE FRAME

TYPE 'B'

DETAIL NO.

503



STANDARD DETAIL
ENGLISH

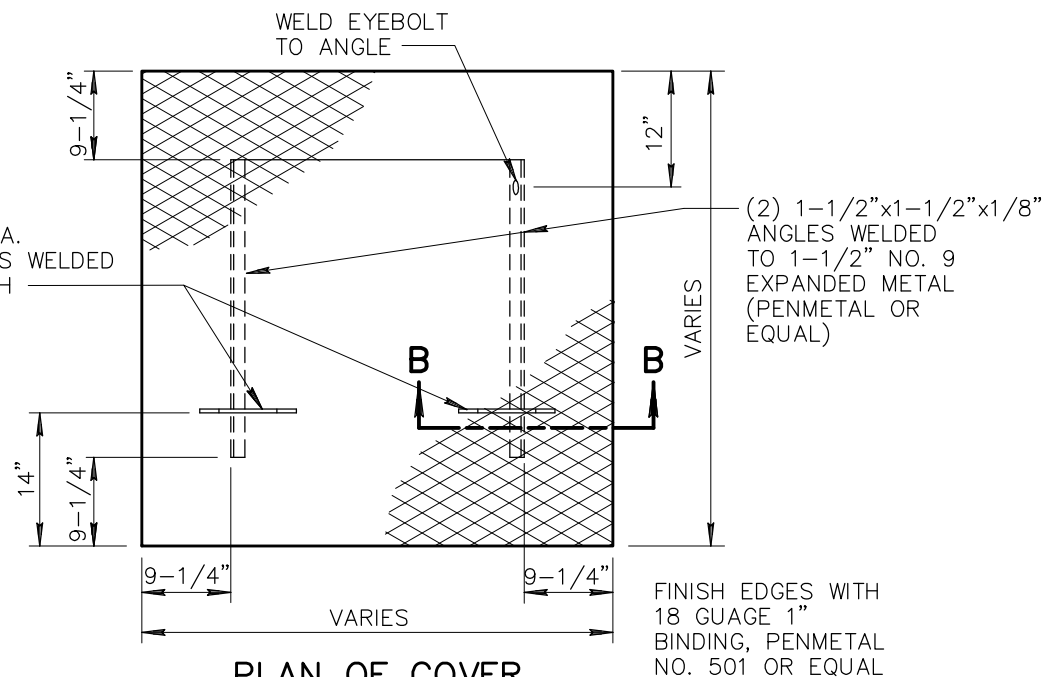
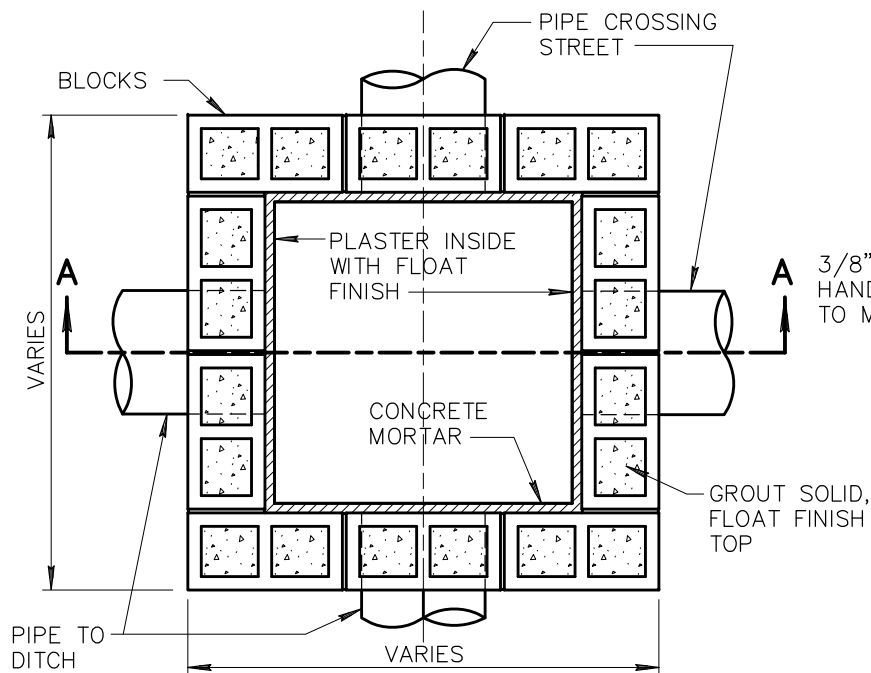
IRRIGATION STANDPIPE

REVISED

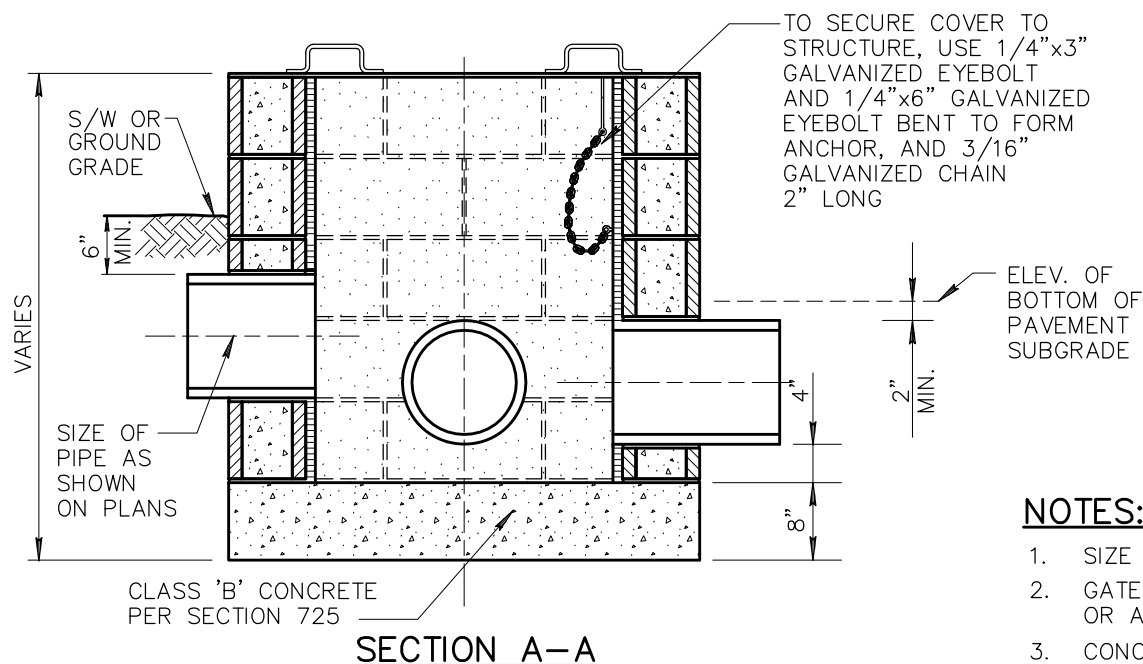
01-01-1998

DETAIL NO.

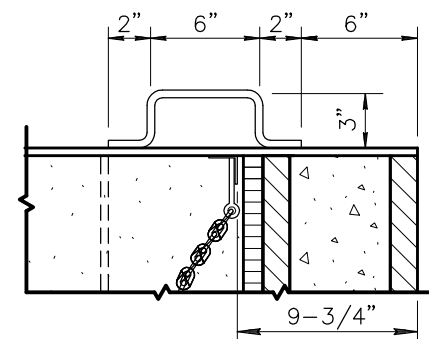
503



PLAN OF COVER



SECTION A-A



SECTION B-B

NOTES:

1. SIZE OF JUNCTION BOX TO BE DETERMINED BY THE ENGINEER.
2. GATE TYPE, SIZE AND NUMBER REQUIRED AS SHOWN ON PLANS OR AS SPECIFIED.
3. CONCRETE MASONRY UNITS (BLOCK) PER SECT. 510, 775 & 776

DETAIL NO.

504



STANDARD DETAIL
ENGLISH

CONCRETE BLOCK JUNCTION BOX

REVISED

01-01-1998

DETAIL NO.

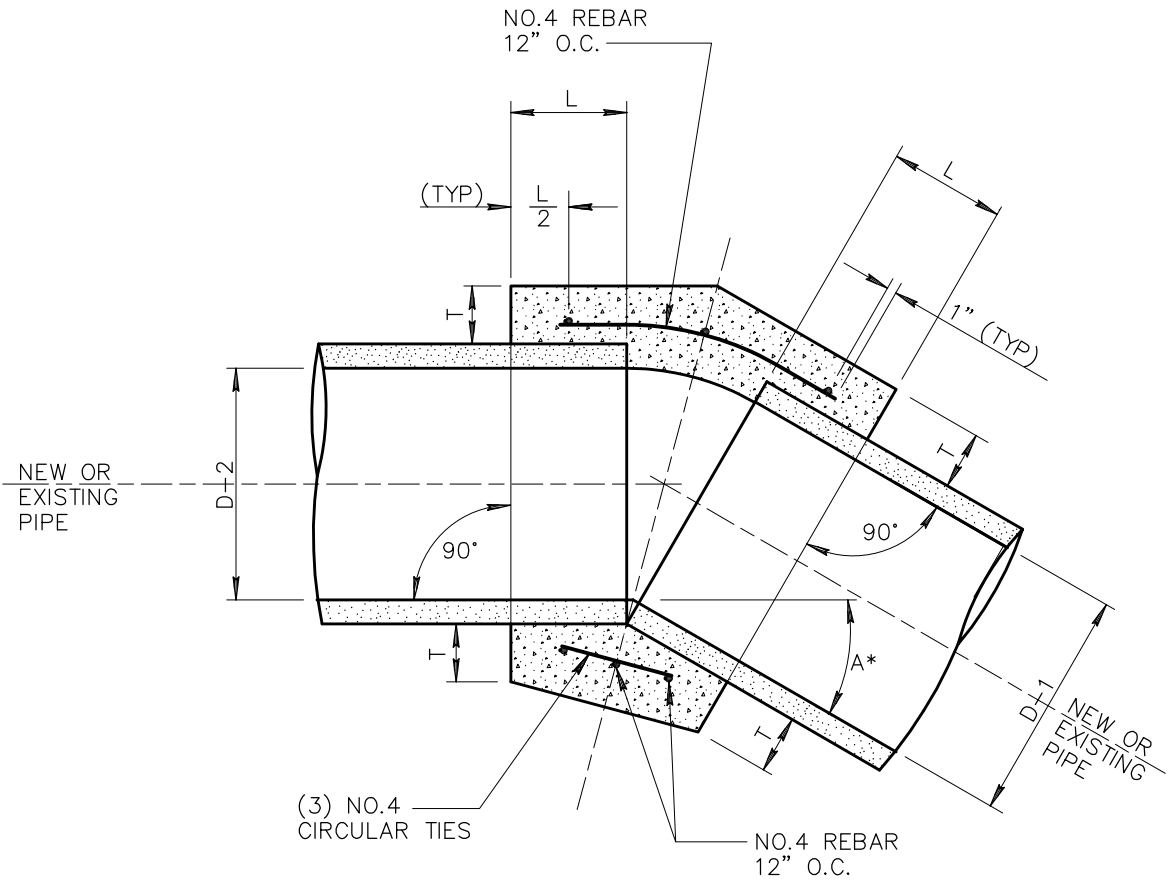
504

NOTES:

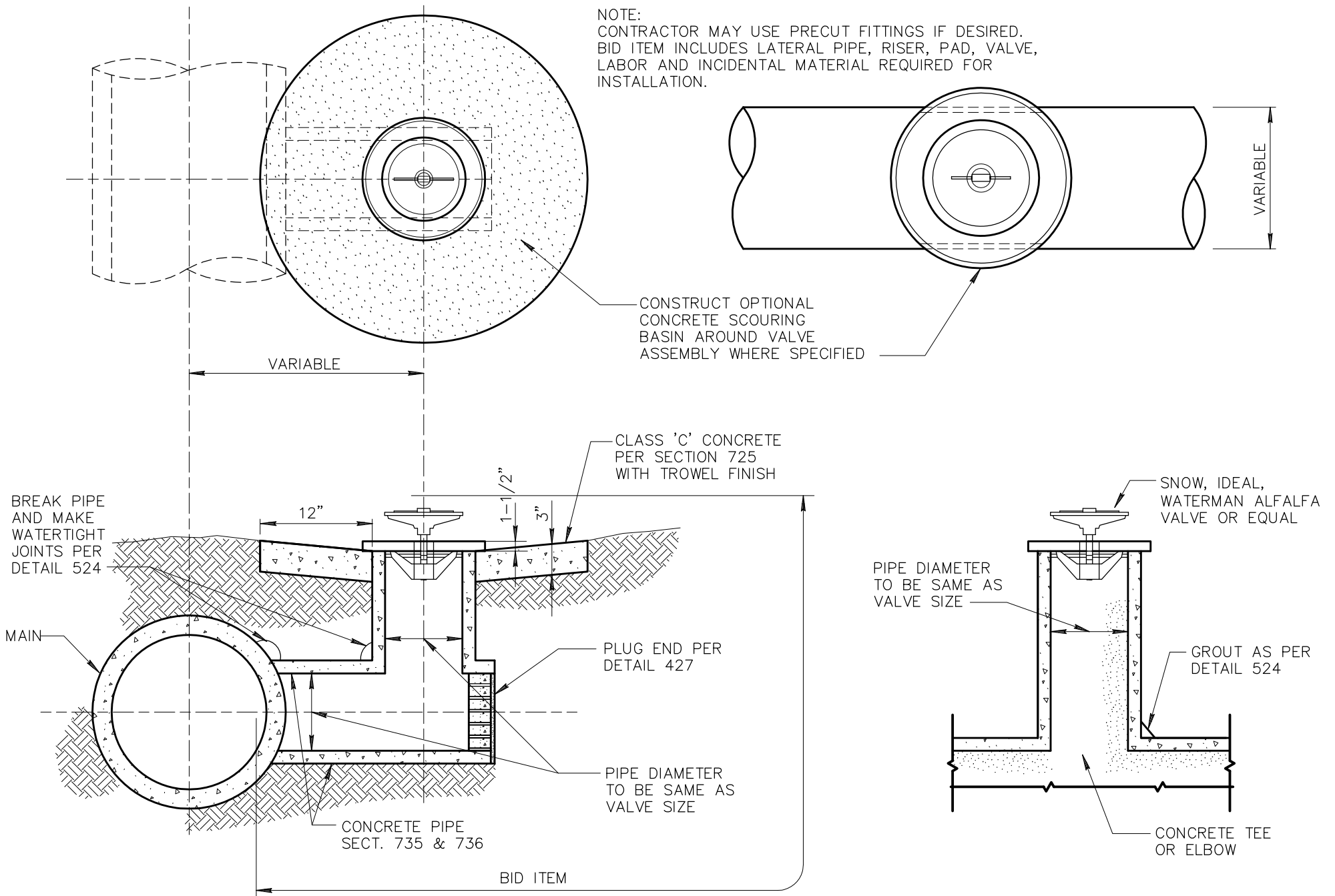
1. A CONCRETE COLLAR IS REQUIRED WHERE PIPES OF DIFFERENT DIAMETERS OR MATERIALS ARE JOINED, OR WHERE THE CHANGE IN ALIGNMENT OR GRADE EXCEEDS THAT ALLOWED FOR ON ORDINARY JOINTS.
2. WHERE PIPES OF DIFFERENT DIAMETERS ARE JOINED WITH A CONCRETE COLLAR, L AND T SHOULD BE THOSE OF THE LARGER PIPE. $D=D-1$, OR $D-2$ WHICHEVER IS GREATER.
3. FOR PIPE SIZES NOT LISTED AND LESS THAN 66" USE NEXT SIZE LARGER.
4. OMIT REINFORCING ON PIPE 24" OR LESS IN DIAMETER.
5. WHERE REINFORCING IS REQUIRED, THE DIAMETER OF THE CIRCULAR TIES SHALL BE....
OUTSIDE DIAMETER OF PIPE+T.
6. FIELD CLOSURES OF PIPE OF THE SAME DIAMETER AND WITHOUT CHANGE IN GRADE OR ALIGNMENT SHALL BE MADE WITH A CONCRETE COLLAR.
7. CONCRETE SHALL BE CLASS B PER SECT. 725.

A*=ANGLE OF DEFLECTION

TABLE		
D	L	T
12"	1.0'	4"
18"	1.0'	5"
24"	1.0'	6"
36"	1.5'	8"
48"	1.5'	10"
57"	1.5'	10"
60"	1.75'	11"
66"	1.75'	11"



NOTE:
CONTRACTOR MAY USE PRECUT FITTINGS IF DESIRED.
BID ITEM INCLUDES LATERAL PIPE, RISER, PAD, VALVE,
LABOR AND INCIDENTAL MATERIAL REQUIRED FOR
INSTALLATION.



DETAIL NO.

506



STANDARD DETAIL
ENGLISH

IRRIGATION VALVE INSTALLATION

REVISED

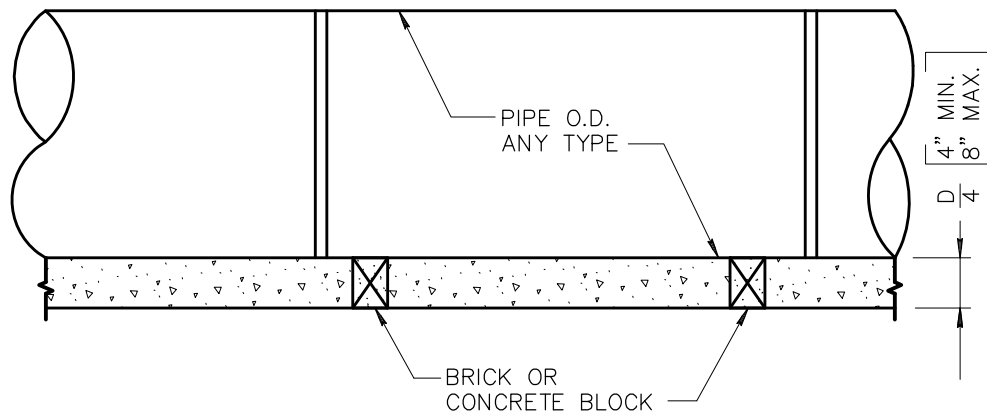
01-01-1998

DETAIL NO.

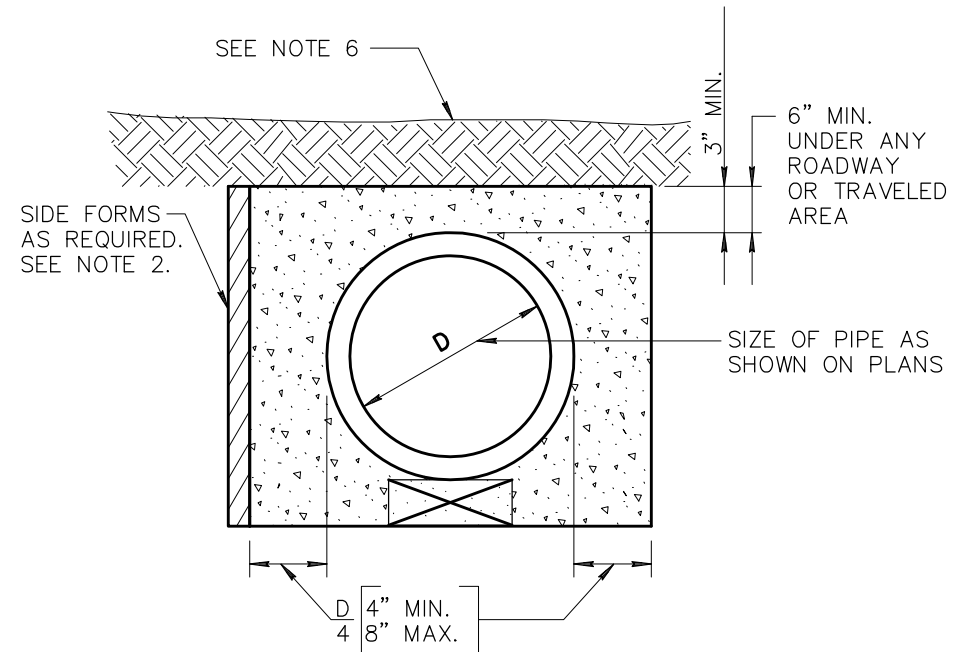
506

NOTES:

1. THIS DETAIL SHALL BE REQUIRED WHEN NEW OR EXISTING PIPE INSTALLATIONS WILL BE SUBJECT TO DAMAGE ANYTIME IN THE FUTURE DUE TO LACK OF PROPER COVER, AS DETERMINED BY THE ENGINEER.
2. FOR PIPE OVER 18" I.D. WOOD, METAL OR GYPSUM BOARD FORMS MUST BE USED TO FORM THE SIDES OF THE ENCASEMENT. GYPSUM BOARD FORMS MAY BE LEFT IN THE GROUND BELOW THE TOP OF THE ENCASEMENT. THIS SHALL BE OPTIONAL WITH POURING AGAINST TRENCH WALLS FOR ENCASEMENT OF 18" AND SMALLER PIPE.
3. FOR ALL SITUATIONS WHERE SIDE FORMS ARE USED, TRENCH WALLS SHALL BE OVER-EXCAVATED TO ALLOW SUFFICIENT ROOM TO OPERATE PROPER MECHANICAL COMPACTION EQUIPMENT.
4. CONCRETE WHICH SPILLS BEYOND 12" FROM THE SIDES OF THE PIPE FOR ANY REASON SHALL BE REMOVED BACK TO THE PROPER LINE PRIOR TO BACKFILLING.
5. SEE SECTION 601 FOR TRENCH PREPARATION.
6. CONCRETE TO BE CLASS 'A' PER SECT. 725.
7. COVER TO BE APPROVED BY ENGINEER.



LONGITUDINAL SECTION



END SECTION

DETAIL NO.

507



STANDARD DETAIL
ENGLISH

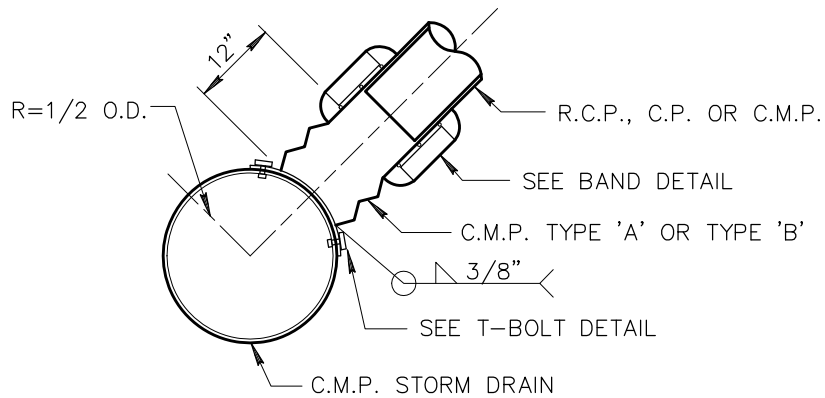
**ENCASED CONCRETE PIPE
(FOR SHALLOW INSTALLATION)**

REVISED

01-01-1998

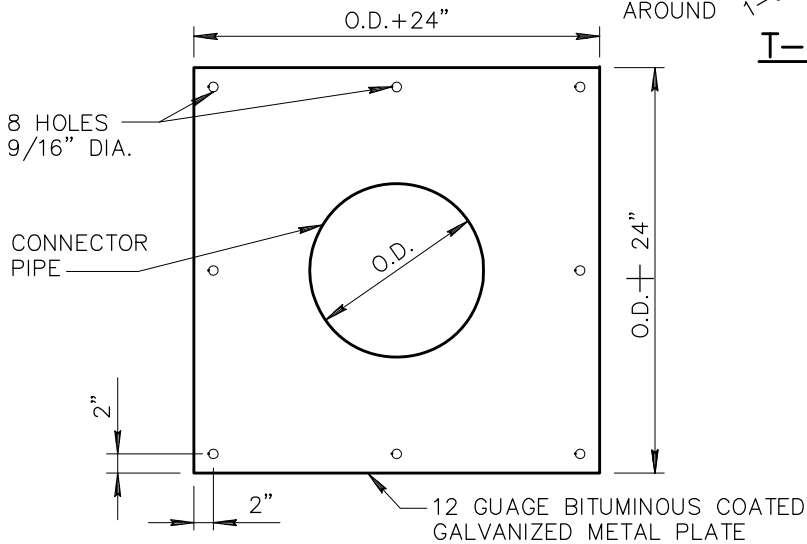
DETAIL NO.

507

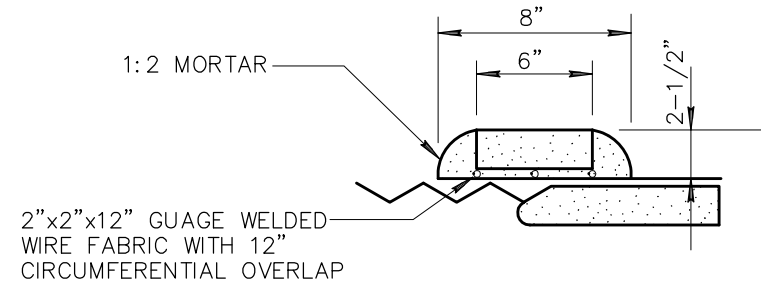
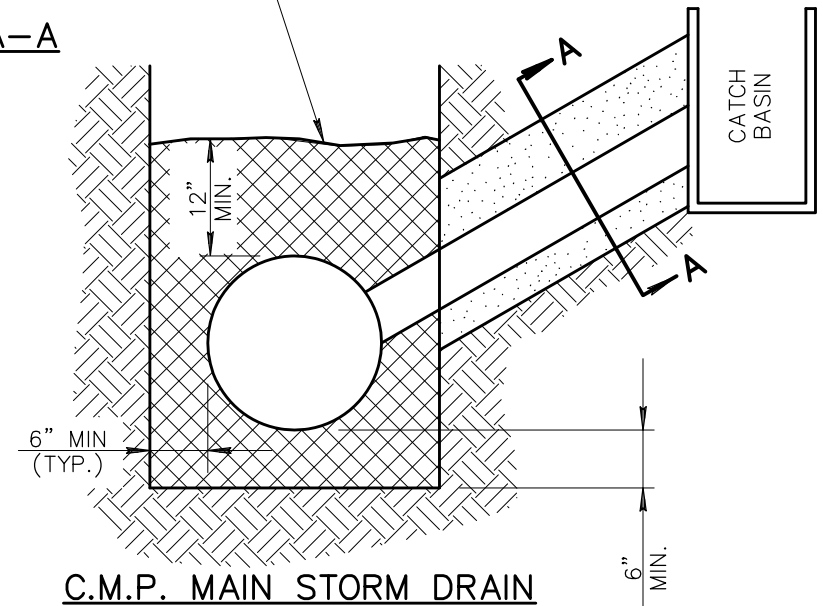
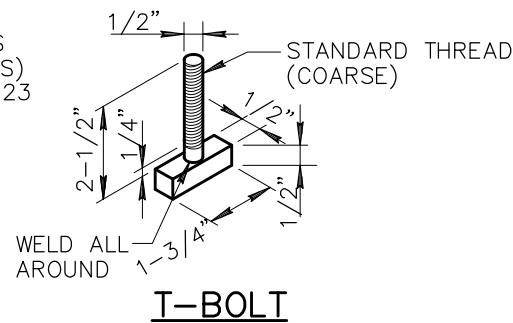
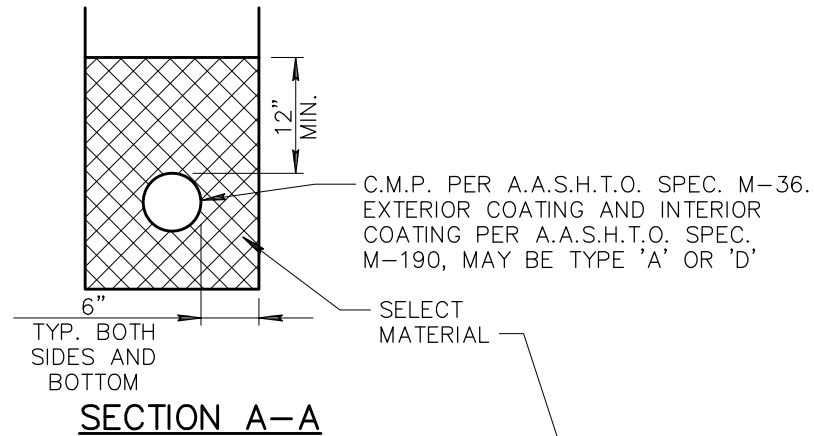


CONNECTOR CROSS SECTION

NOTE:
USE 5/8" WASHER AND NUT, ALL PIECES
(NUTS, WASHERS, AND FABRICATED BOLTS)
TO BE GALVANIZED AS PER A.S.T.M. A-123
LATEST REVISION.



C.M.P. CONNECTION TO MAIN STORM DRAIN 24" PIPE AND SMALLER



BAND DETAIL

DETAIL NO.

510



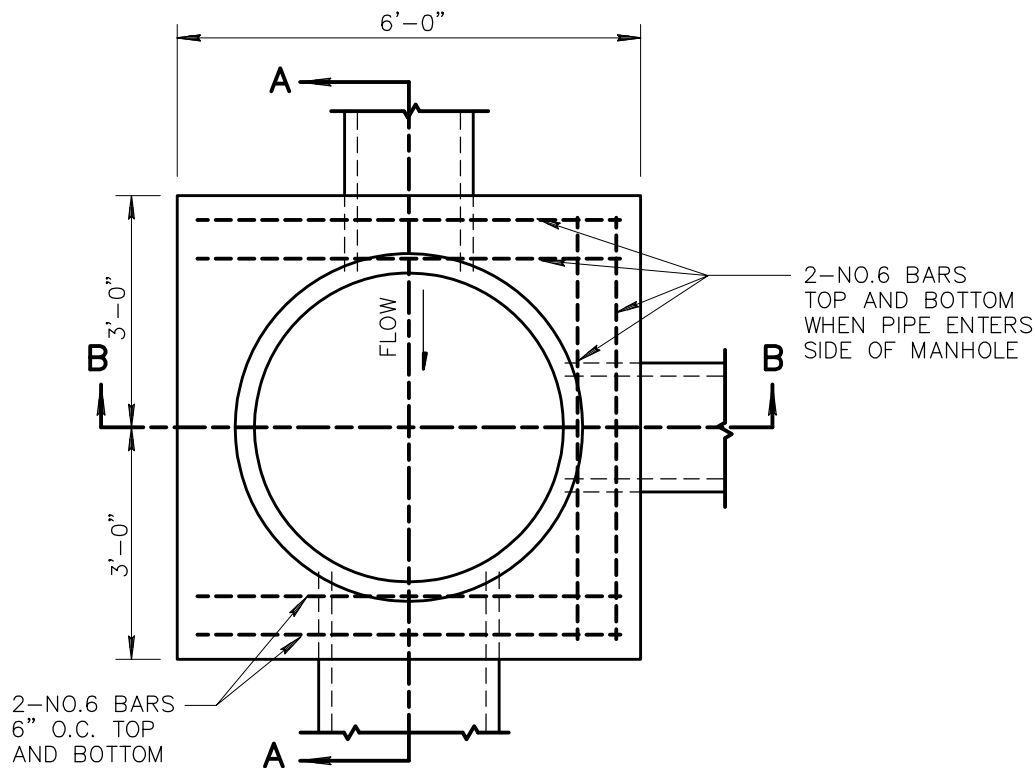
STANDARD DETAIL
ENGLISH

CORRUGATED METAL PIPE
AND INSTALLATION

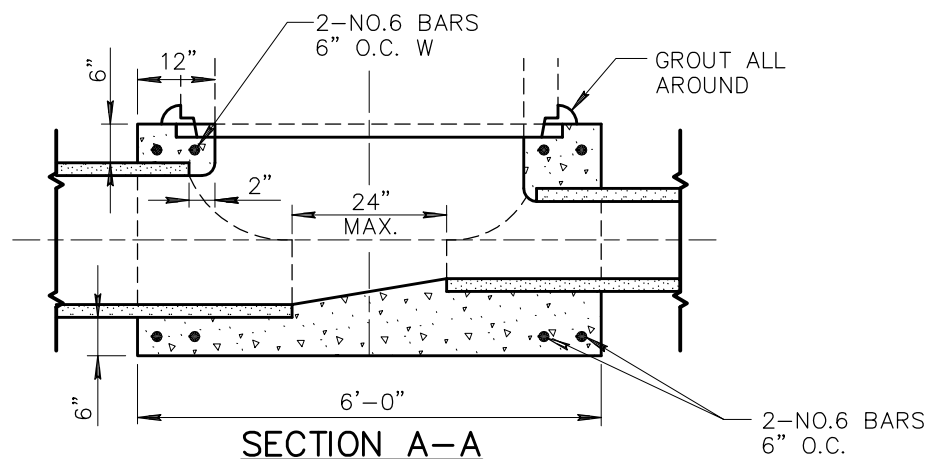
REVISED
01-01-1998

DETAIL NO.

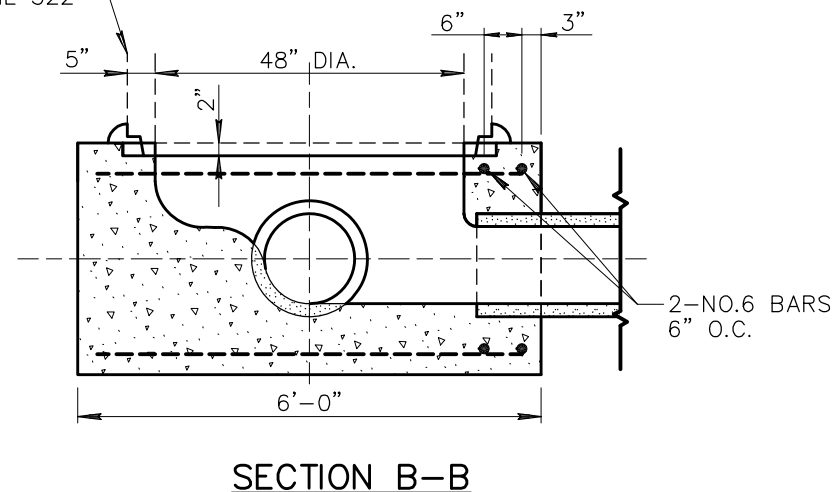
510



PLAN



MANHOLE SHAFT
PER DETAIL 522



NOTES

1. ALL CONCRETE TO BE CLASS 'A' PER SECT. 725, 505.
2. MATCH SPRING LINES OF PIPE ENTERING MANHOLE UNLESS OTHERWISE NOTED.
3. CUT PIPES TO ALLOW SETTING OF 4' DIA. CYLINDRICAL FORM FROM 6" ABOVE MAIN LINE PIPE TO SPRING LINE. CUT PIPE 2" LARGER THAN FORM TO ALLOW 2" CONCRETE OVER ENDS OF ALL CUT PIPE.
4. INVERT AND BASE OF MANHOLE TO BE POURED AND INVERT TO BE SHAPED BY HAND TO MAKE SMOOTH TRANSITION. FINISH WITH RUBBER FLOAT.
5. CENTER MANHOLE ON PIPE JOINT WHERE PIPE CHANGES SIZES, LEAVING A GAP OF 12" MINIMUM, 24" MAXIMUM.

DETAIL NO.

520



STANDARD DETAIL
ENGLISH

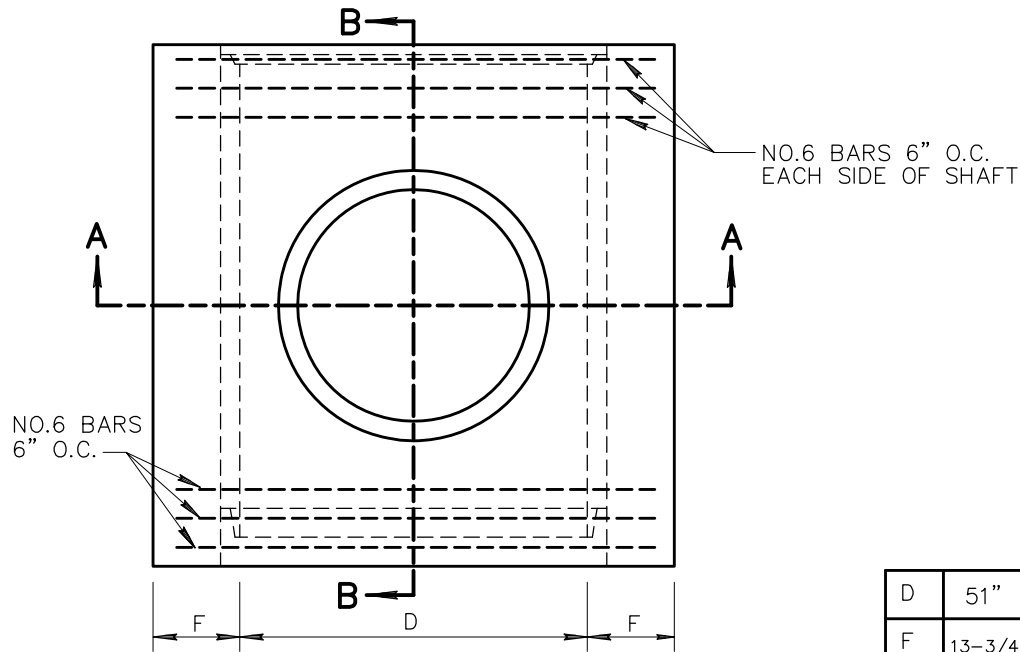
STORM DRAIN MANHOLE BASE (48" AND SMALLER)

REVISED

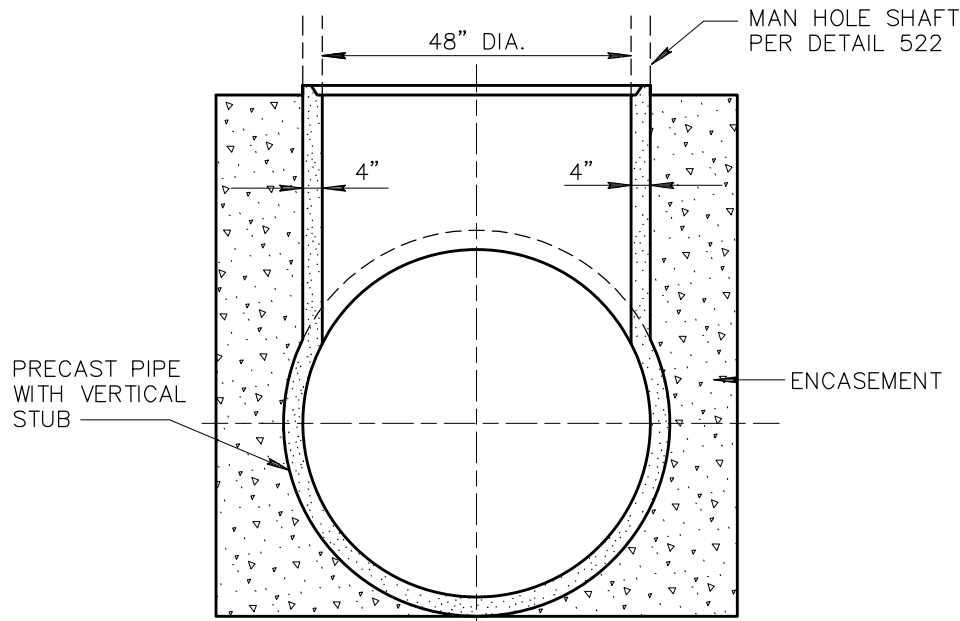
01-01-1998

DETAIL NO.

520



PLAN



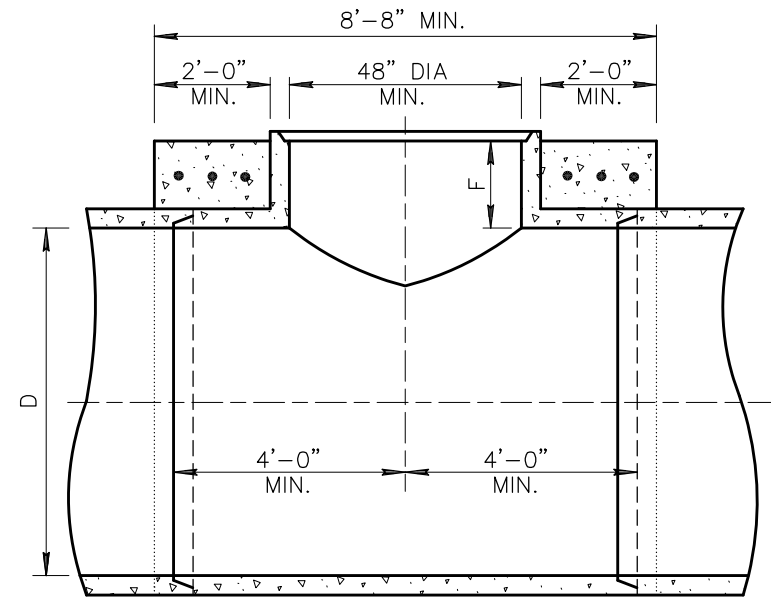
SECTION A-A

NOTES:

1. LINE PIPE AND STUB MAY BE CAST MONOLITHICALLY OR STUB MAY BE CAST ON TO LINE PIPE SECTION PRIOR TO COMPLETE CURING.
2. ALL LINE PIPE REINFORCEMENT SHALL BE TURNED UP INTO STUB.
3. THE VERTICAL STUB TO BE A.S.T.M. C-76 CLASS II WALL 'A' AND THE HORIZONTAL PIPE TO BE EQUAL TO STRENGTH OF PIPE ENTERING MANHOLE.
4. ALL REINFORCING STEEL SHALL CLEAR FACE OF CONCRETE BY 1-1/2" UNLESS SHOWN OTHERWISE.
5. CONCRETE ENCASEMENT SHALL BE CLASS 'A' PER SECT. 725 AND 505.

TABLE OF VALUES FOR 'F' & 'D'

D	51"	54"	57"	60"	63"	66"	69"	72"	78"	84"	90"	96"
F	13-3/4"	14-1/2"	15"	15-1/2"	16-1/4"	16-3/4"	17-1/2"	18"	19-1/4"	20-1/2"	21-3/4"	23"



SECTION B-B

DETAIL NO.

521



STANDARD DETAIL
ENGLISH

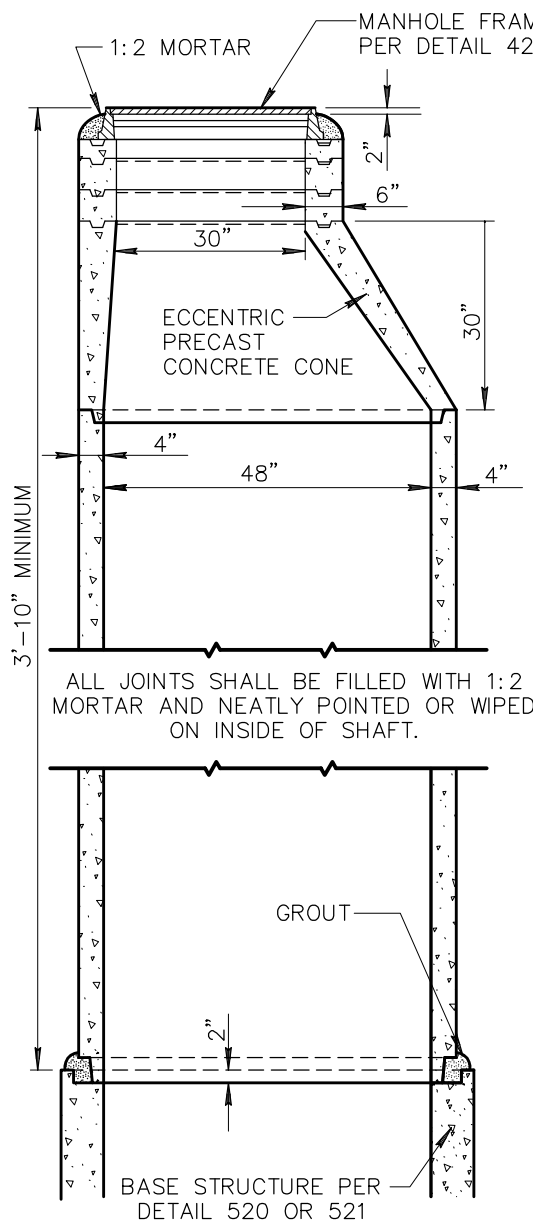
STORM DRAIN MANHOLE BASE (51" OR LARGER)

REVISED

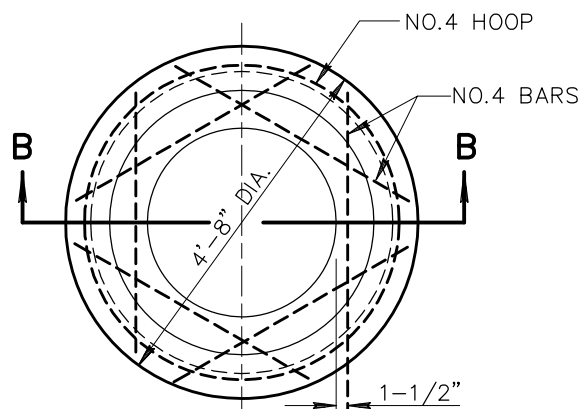
01-01-1998

DETAIL NO.

521

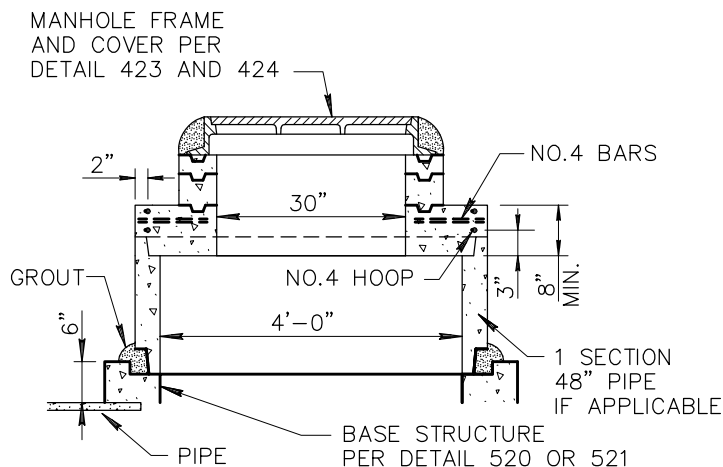


**VERTICAL SECTION OF
ECCENTRIC MANHOLE SHAFT**



PLAN

USE WHERE THERE IS 3'-10"
OR LESS COVER OVER PIPE

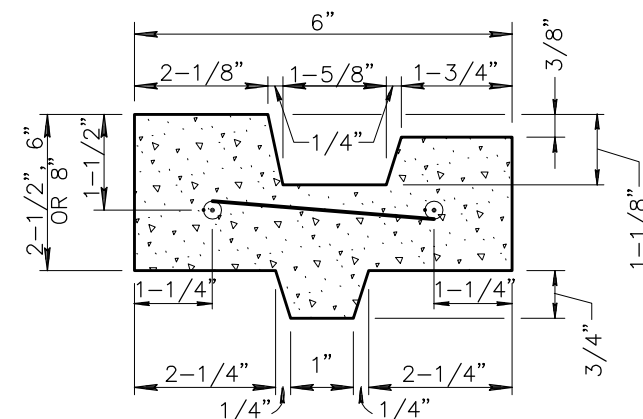


SECTION B-B

SHALLOW MANHOLE

NOTES:

1. PRECAST CONCRETE CONES AND SECTIONS TO BE A.S.T.M. C-478.
2. BRICK MAY BE USED IN LIEU OF OR IN COMBINATION WITH CONCRETE ADJUSTING RINGS.
3. PRECAST CONCRETE SECTIONS 48" DIA PIPE MAY BE FURNISHED IN STANDARD LENGTHS.
4. UNLESS OTHERWISE SHOWN ON PLANS, USE (2) 2-1/2" PRECAST CONCRETE ADJUSTING RINGS ON IMPROVED STREETS AND (4) 2-1/2" RINGS ON UNIMPROVED STREETS.
5. CONCRETE SHALL BE CLASS A PER SECTION 725 AND 505.



2-1/2" RINGS SHALL BE REINFORCED WITH TWO 1/4" ROUND STEEL HOOPS; 6" AND 8" RINGS SHALL BE REINFORCED WITH FOUR 1/4" HOOPS, TIED WITH NO. 14 A.S. & W. GAUGE WIRE 8" O.C.

**REINFORCED CONCRETE
ADJUSTING RING**

DETAIL NO.

522



STANDARD DETAIL
ENGLISH

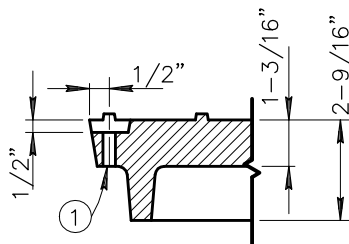
STORM DRAIN MANHOLE SHAFT

REVISED

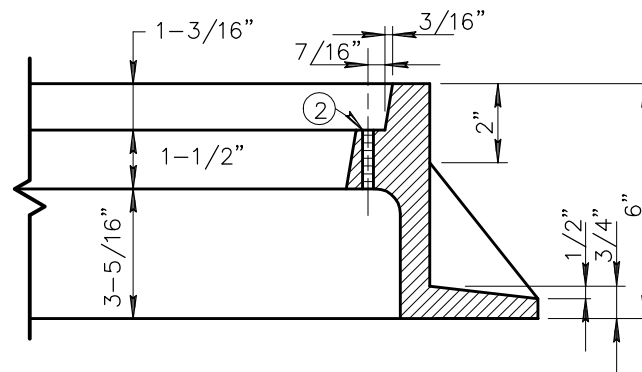
01-01-2015

DETAIL NO.

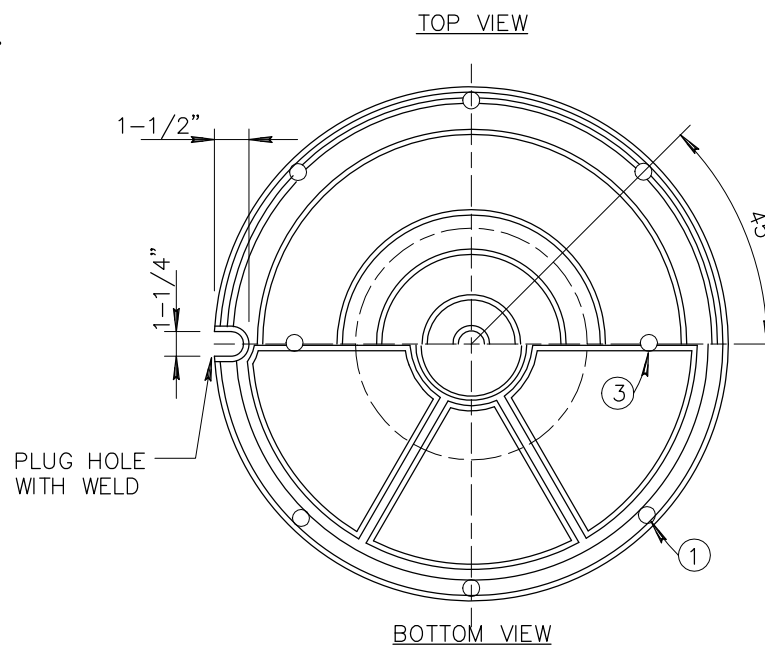
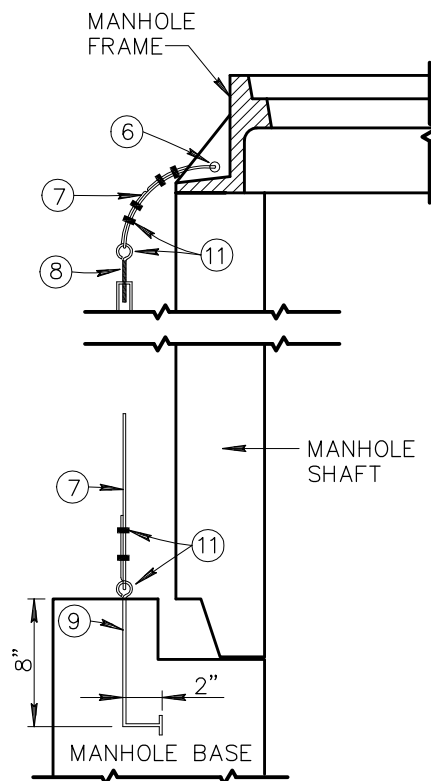
522



COVER SECTION



FRAME SECTION



STANDARD 24" M.H.
FRAME AND COVER

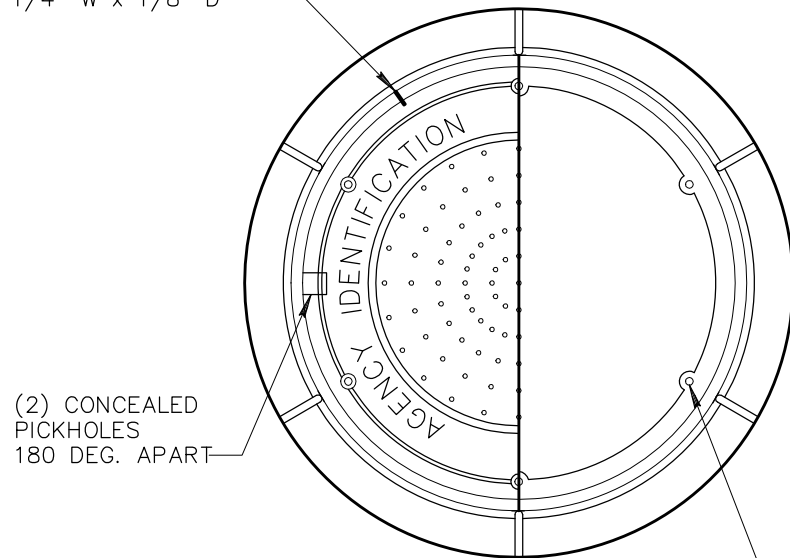
FOR A 30" M.H. OPENING, USE THE STD. WATER TIGHT 30" M.H. FRAME & COVER, AND ANCHOR THE FRAME AS OUTLINED IN THE INSTRUCTIONS NOTED ON THIS SHEET.

FOR A 24" M.H. OPENING, MODIFY THE STD. 24" M.H. FRAME & COVER, FOLLOWING THE NOTED PROCEDURES, ONE THRU FIVE.

NOTES:

- ① DRILL (8) HOLES $17/32$ " IN COVER FOR $1/2$ " CAPSCREWS, COUNTERBORE $1/2$ " DEEP BY $1-1/8$ " DIA. TO ACCOMODATE CAPSCREW AND SOCKET WRENCH. SPACE EQUALLY.
 - ② DRILL (8) HOLES AND TAP FOR $1/2$ " - 13 THREAD NATIONAL COARSE BOLT.
 - ③ DRILL, TAP AND COUNTERBORE (2) HOLES FOR $1/2$ " CAPSCREWS TO BE USED FOR LIFTING COVER. PLUG WITH CAPSCREWS.
 - ④ COVER AND FRAME MUST BE MATCHED, DRILLED AND TAPPED IN SETS.
 - ⑤ CASTING DIMENSIONS GIVEN ABOVE ARE FROM DET. 424, 24" MANHOLE FRAME AND COVER.
- BOTH 24" AND 30" FRAMES TO BE ANCHORED AS FOLLOWS:
- ⑥ DRILL $1/2$ " HOLE IN FILLET. DO NOT USE ADJACENT FILLETS.
 - ⑦ $1/4$ " STAINLESS STEEL CABLE. SECURED WITH CABLE CLAMPS.
 - ⑧ $1/2$ "x9" HOOK AND EYE TURNBUCKLE.
 - ⑨ $1/2$ " EYE BOLT WITH 1" DIA. EYE.
 - ⑩ INSTALL THREE CABLES PER 24" COVER (FOUR CABLES FOR 30" COVERS). EYEBOLTS TO BE SET DIRECTLY BELOW FILLETS USED.
 - ⑪ TRIPLE WRAP TURNBUCKLES AND CABLE CLAMPS WITH 1" WIDE TAPE, SAFE-T-CLAD, F.O.S. 655, OR APPROVED EQUAL.

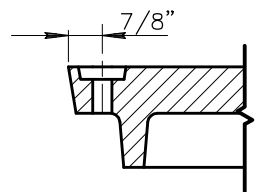
GROUND MATCH MARK
1/4" W x 1/8" D



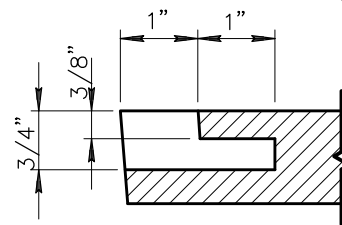
(2) CONCEALED
PICKHOLES
180 DEG. APART

NOTES:

1. DRILL (6) HOLES IN 30" COVER (4 HOLES IN 24" COVER) 17/32" CORED RECESS FOR 1/2" CAPSCREWS. SPACE EQUALLY (304 S.S.)
2. DRILL (6) HOLES IN 30" FRAME (4 HOLES IN 24" FRAME) AND TAP FOR 1/2" - NATIONAL COARSE BOLT (HEX HEAD).
3. COVER AND FRAME MUST BE MATCH MARKED, DRILLED AND TAPPED IN SETS.
4. DIMENSIONS, LETTERING, WEIGHTS AND MATERIALS SHALL CONFORM TO DET. 424.
5. REFER TO DETAIL 523-1 FOR INSTALLATION PROCEDURES.



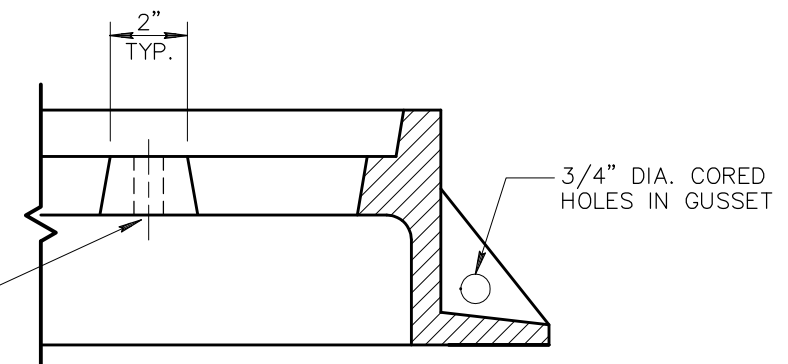
BOLT HOLE DETAIL



PICKHOLE DETAIL

COVER SECTION

TYP. BOLT PAD



FRAME SECTION

DETAIL NO.

523-2



STANDARD DETAIL
ENGLISH

PRESSURE MANHOLE

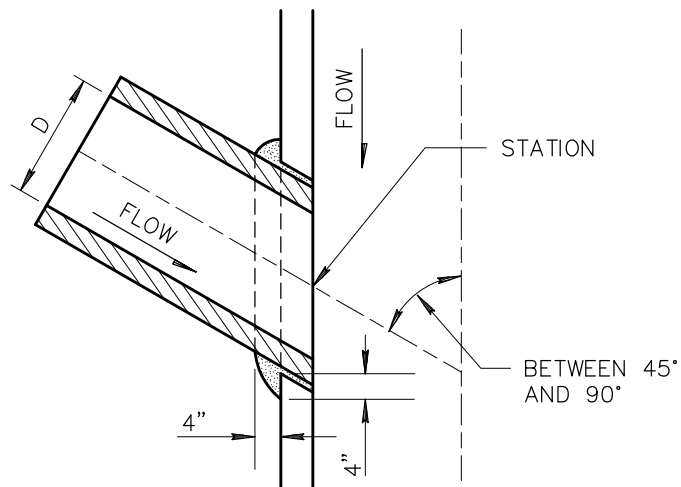
REVISED

01-01-1998

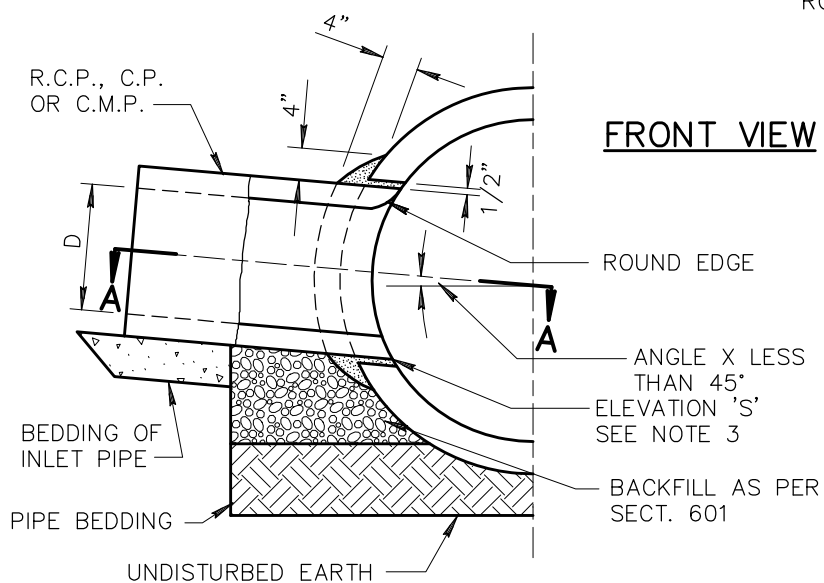
DETAIL NO.

523-2

TOP VIEW

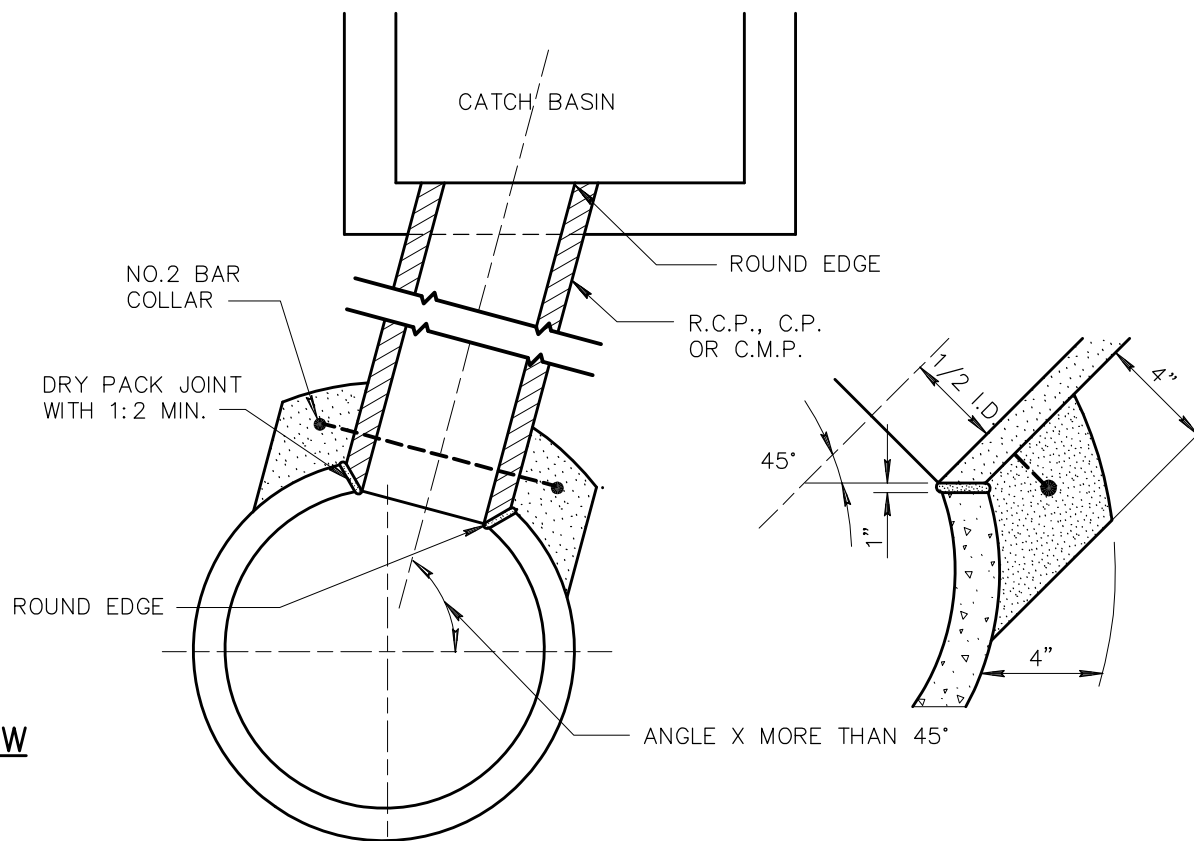


SECTION A-A



SIDE INLET
TYPE 1

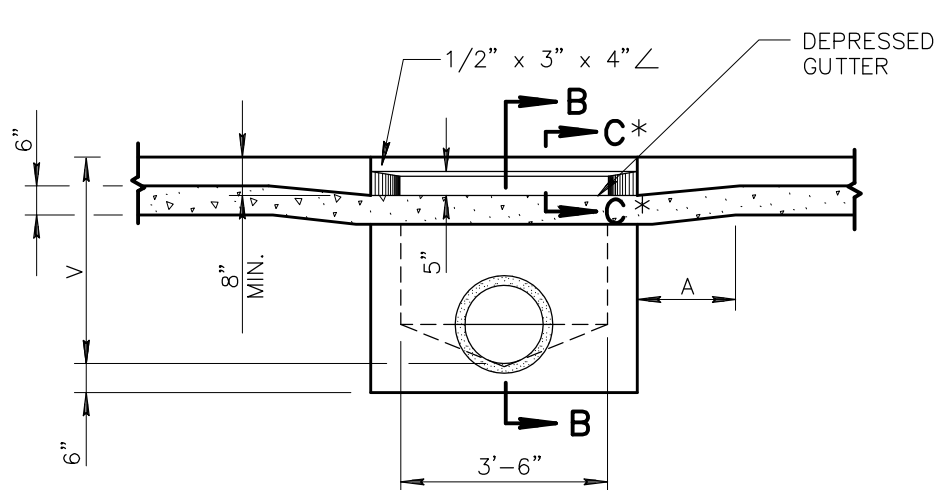
FRONT VIEW



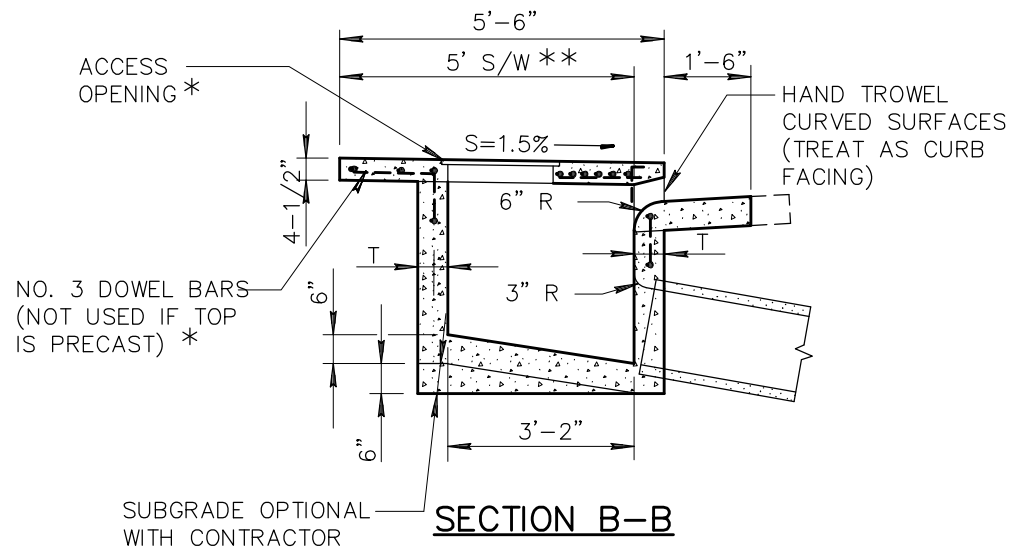
CATCH BASIN ABOVE STORM DRAIN
TYPE 2

NOTES:

1. D SHALL BE 24" OR LESS. FOR LARGER VALUE OF D USE MANHOLE OR JUNCTION STRUCTURE.
2. IN NO CASE SHALL THE OUTSIDE DIAMETER OF THE INLET EXCEED ONE HALF THE INSIDE DIAMETER OF THE MAIN STORM DRAIN.
3. CENTERLINE OF INLET SHALL BE ON RADIUS OF MAIN STORM DRAIN EXCEPT WHEN ELEVATION S IS SHOWN ON PLANS.
4. THE MINIMUM OPENING INTO THE STORM DRAIN SHALL BE THE OUTSIDE DIAMETER OF THE CONNECTING PIPE PLUS 1".
5. IF ANGLE X FROM HORIZONTAL IS 45° OR LESS USE TYPE 1.
IF ANGLE X IS 45° OR OVER USE TYPE 2.

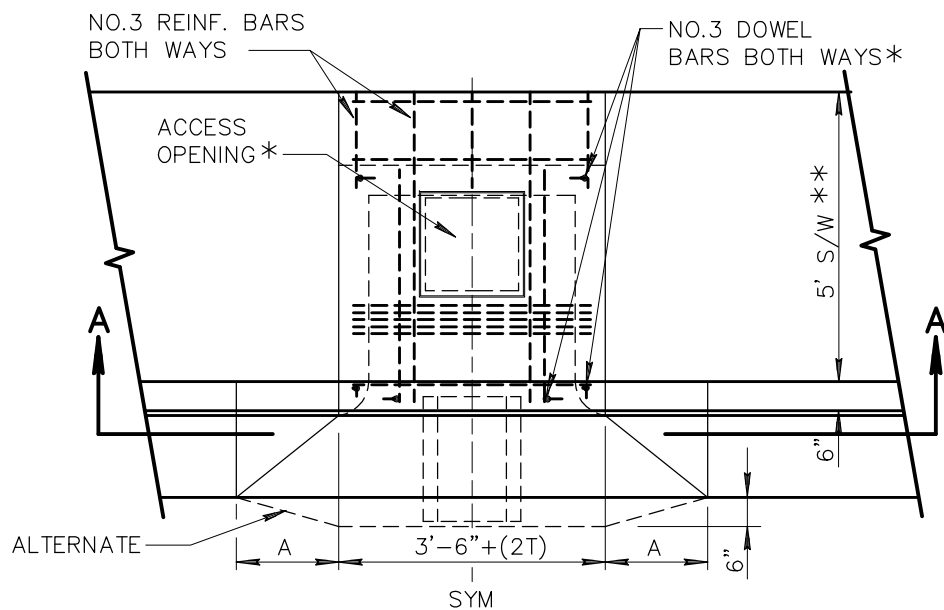


SECTION A-A



NOTES:

1. THE ENTIRE CATCH BASIN COVER MAY BE POURED IN PLACE OR PRECAST.
2. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
3. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO. 1 D PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. CONCRETE SHALL BE CLASS A PER SECTION 725.



PLAN VIEW

CURB	A
4"	3'-3"
6"	1'-9"
7"	1'-0"

DIMENSIONS

T=6" IF V=4' OR LESS
T=8" IF V IS BETWEEN 4' AND 8'
T=10" IF V IS 8' OR MORE (IF V EXCEEDS
10' SPECIAL DESIGN IS REQUIRED)
V=3'-6" UNLESS OTHERWISE SPECIFIED.

- * SEE DETAILS 536-1 AND 536-2 FOR DETAILS AND SECTIONS COMMON TO ALL CURB OPENING CATCH BASINS.
** 4' LOCATIONS WHERE 4' S/W IS REQUIRED.

DETAIL NO.

530



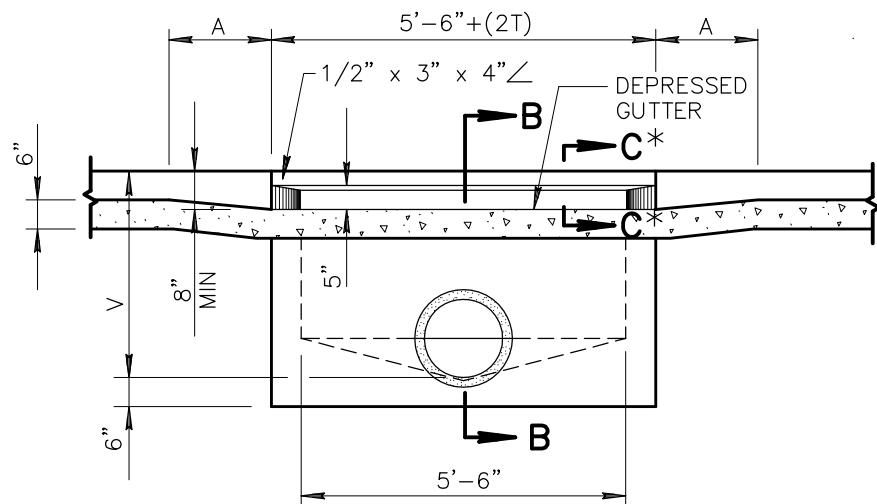
STANDARD DETAIL
ENGLISH

**3'-6" CURB OPENING
CATCH BASIN - TYPE 'A'**

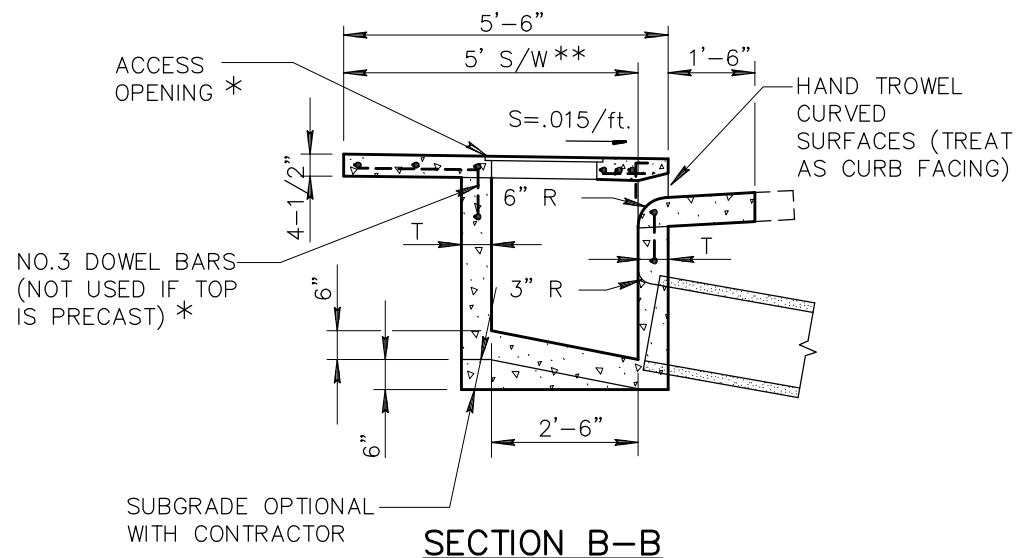
REVISED
01-01-1998

DETAIL NO.

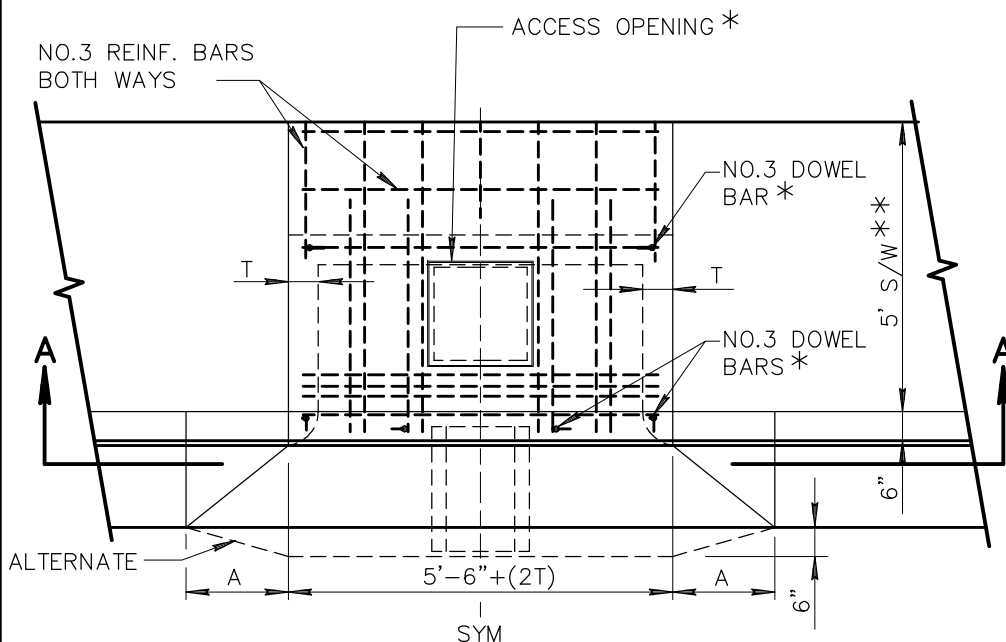
530



SECTION A-A



SECTION B-B



PLAN VIEW

NOTES:

1. THE ENTIRE CATCH BASIN COVER MAY BE POURED IN PLACE OR PRECAST.
2. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
3. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO. 1 D PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. CONCRETE SHALL BE CLASS A PER SECTION 725.

CURB	A
4"	3'-3"
6"	1'-9"
7"	1'-0"

DIMENSIONS

T=6" IF V=4' OR LESS
T=8" IF V IS BETWEEN 4' AND 8'
T=10" IF V IS 8' OR MORE (IF V EXCEEDS
10' SPECIAL DESIGN IS REQUIRED)
V=3'-6" UNLESS OTHERWISE SPECIFIED.

* SEE DETAILS 536-1 AND 536-2 FOR DETAILS AND SECTIONS
COMMON TO ALL CURB OPENING CATCH BASINS.
** 4' LOCATIONS WHERE 4' S/W IS REQUIRED.

DETAIL NO.

531



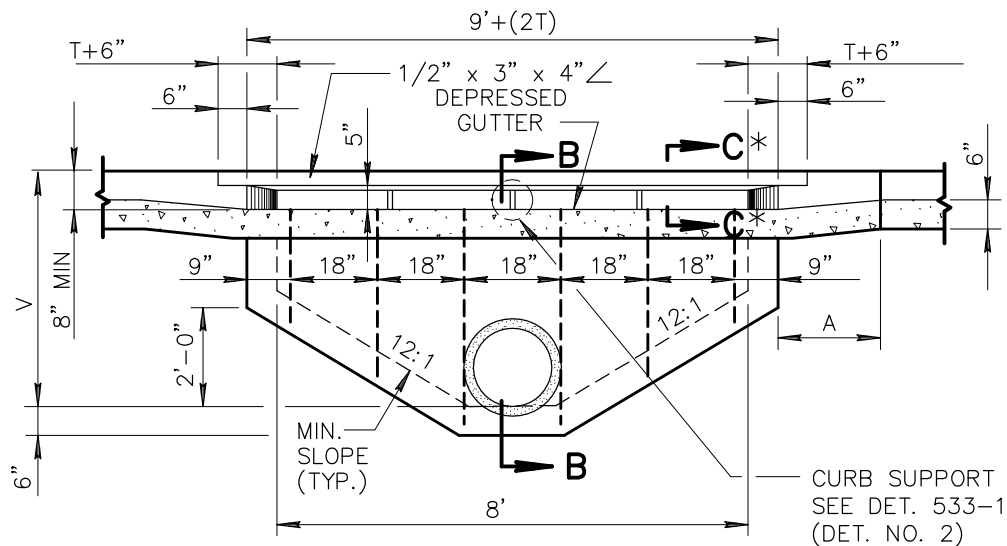
STANDARD DETAIL
ENGLISH

5'-6" CURB OPENING
CATCH BASIN - TYPE 'B'

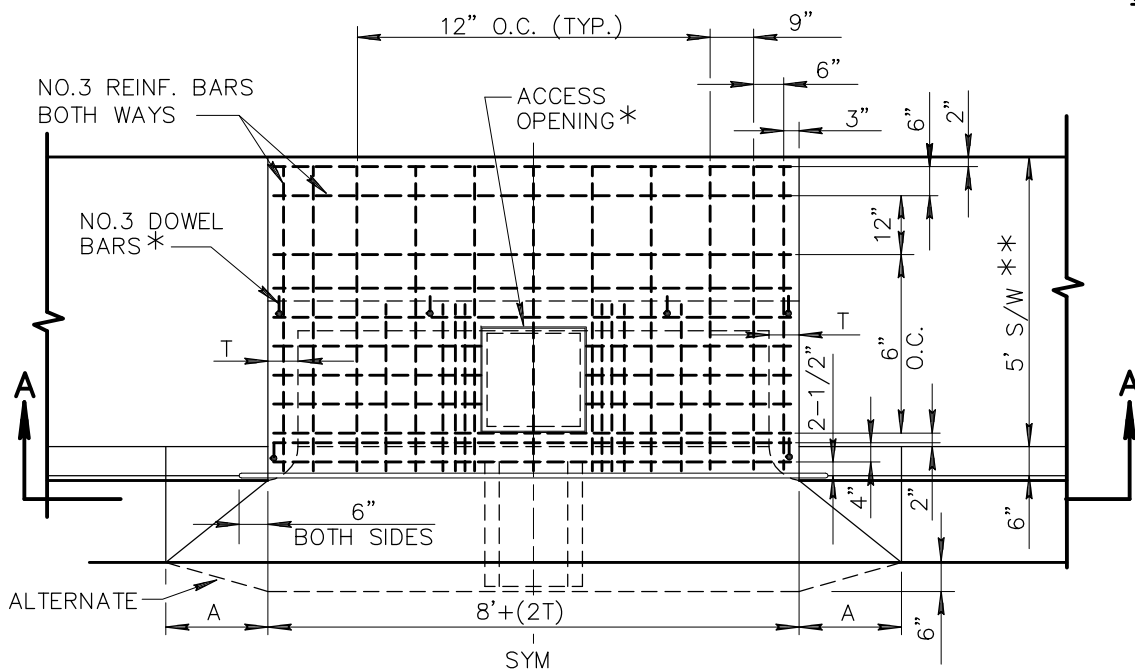
REVISED
01-01-1998

DETAIL NO.

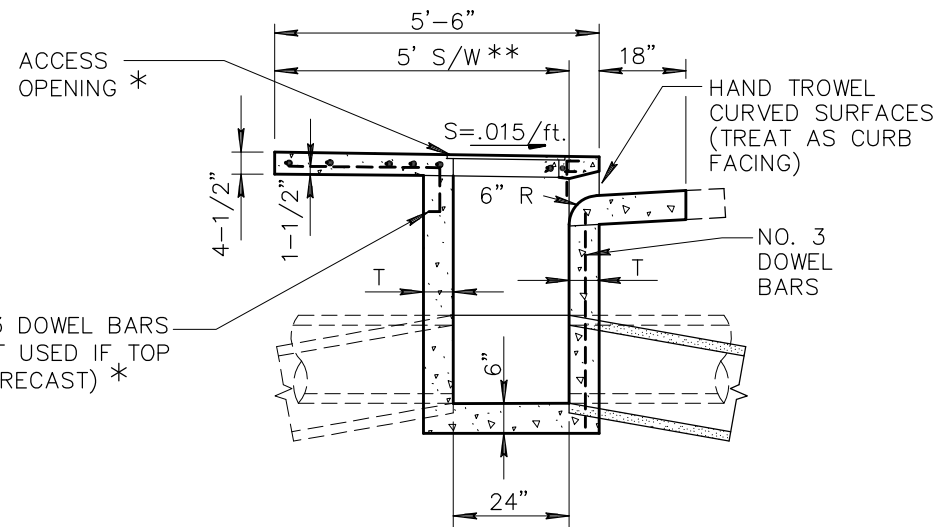
531



SECTION A-A



PLAN VIEW



SECTION B-B

NOTES:

1. THE ENTIRE CATCH BASIN COVER MAY BE POURED IN PLACE OR PRECAST.
2. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
3. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO.1 D PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. CONCRETE SHALL BE CLASS A PER SECTION 725.

CURB	A
4"	3'-3"
6"	1'-9"
7"	1'-0"

DIMENSIONS

T=6" IF V=4' OR LESS
T=8" IF V IS BETWEEN 4' AND 8'
T=10" IF V IS 8' OR MORE (IF V EXCEEDS 10' SPECIAL DESIGN IS REQUIRED)
V=4' UNLESS OTHERWISE SPECIFIED.

* SEE DETAILS 536-1 AND 536-2 FOR DETAILS AND SECTIONS COMMON TO ALL CURB OPENING CATCH BASINS.
** 4' LOCATIONS WHERE 4' S/W IS REQUIRED.

DETAIL NO.

532



STANDARD DETAIL
ENGLISH

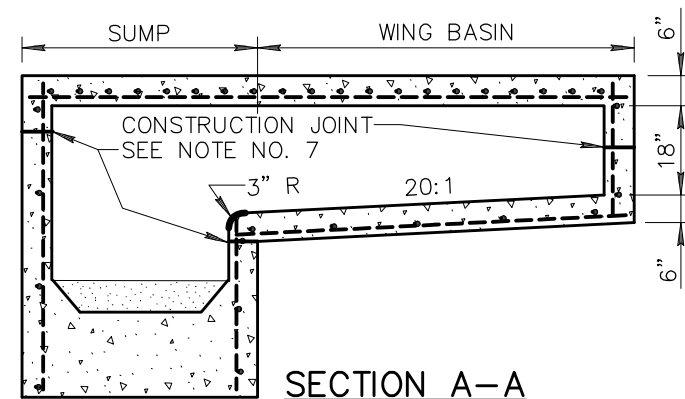
**8'-0" CURB OPENING
CATCH BASIN - TYPE 'C'**

REVISED

01-01-1998

DETAIL NO.

532

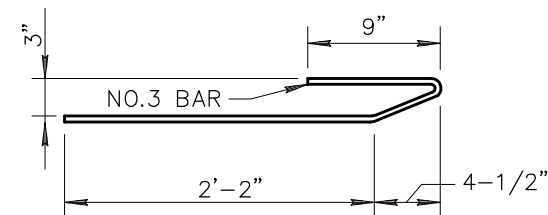


NOTE: REINFORCING BARS SHOWN ARE FOR ROOF SLAB ONLY.
SEE NOTE NO. 5 AND SECTIONS FOR OTHER REINFORCING.

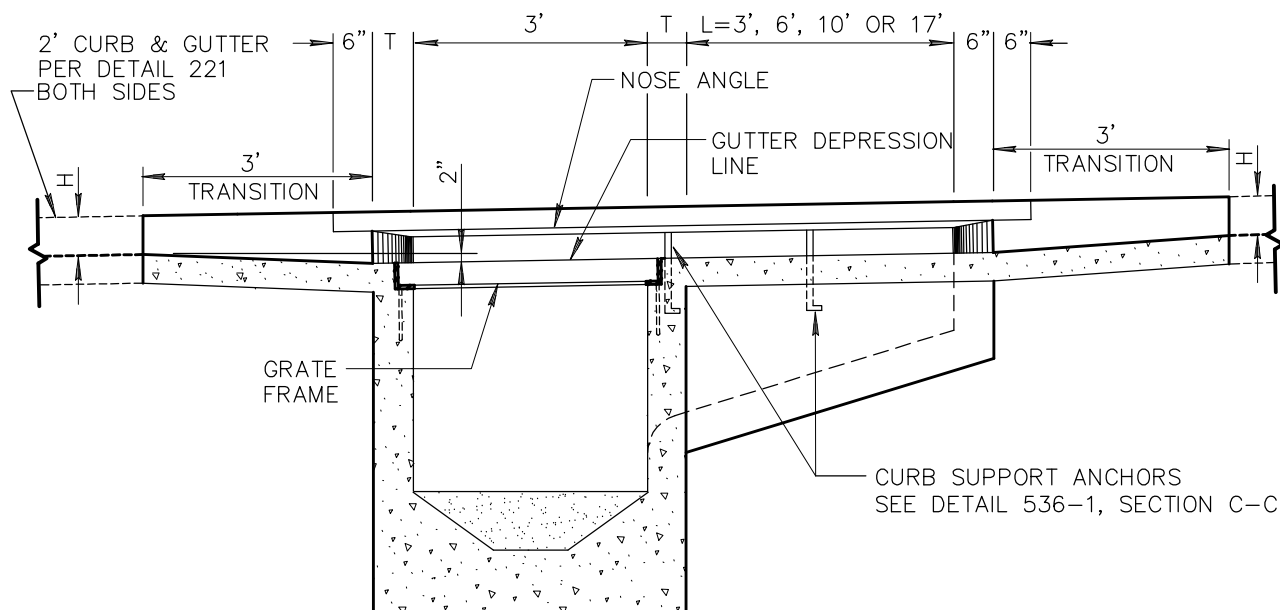
PLAN VIEW

-

V = 3'-3" MIN. WHEN L = 3'
V = 3'-5" MIN. WHEN L = 6'
V = 3'-7" MIN. WHEN L = 10'
V = 4'-0" MIN. WHEN L = 17'
T = 6" WHEN V IS LESS THAN 8'
T = 8" WHEN V IS EQUAL TO OR
GREATER THAN 8'
H = CURB HEIGHT PRIOR TO THE
TRANSITION

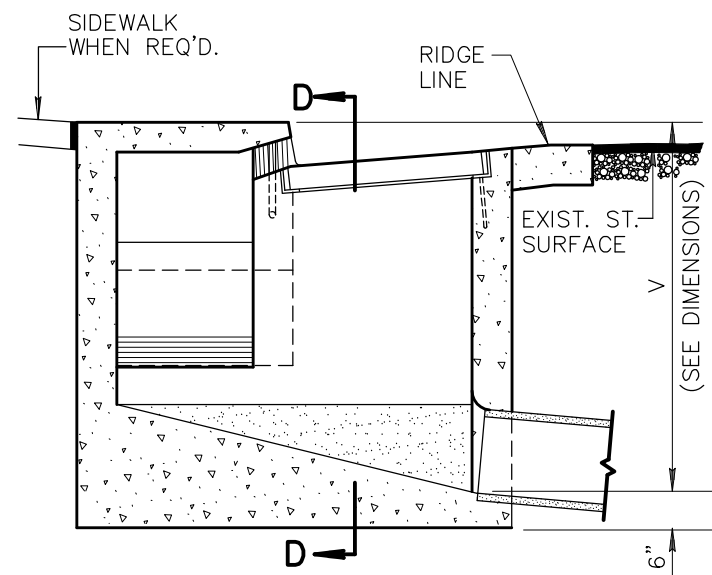


REINFORCEMENT DETAIL

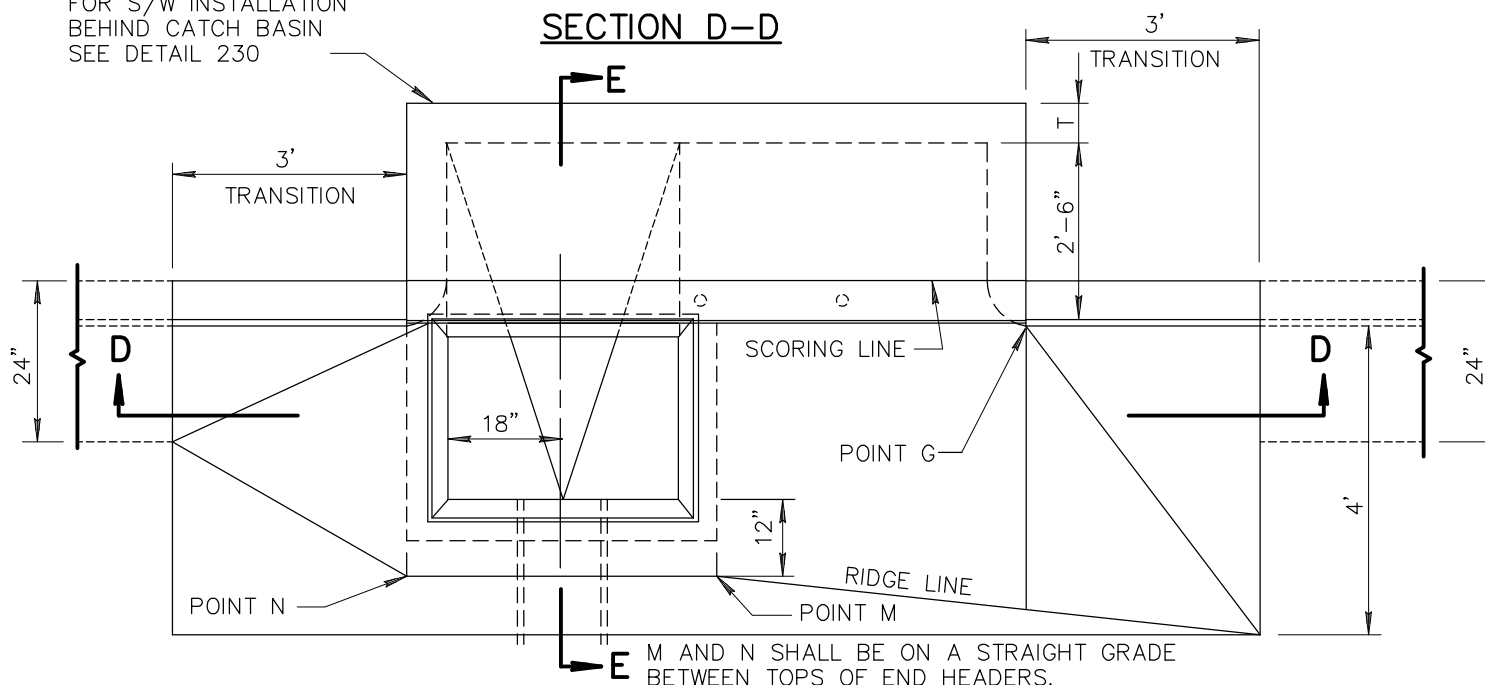


FOR S/W INSTALLATION BEHIND CATCH BASIN SEE DETAIL 230

SECTION D-D



SECTION E-E



PLAN VIEW

APRON NOTES:

9. APRON IS CONSTRUCTED ONLY WHEN SPECIFIED ON PLANS.
10. CONCRETE IN APRON SHALL BE NOT LESS THAN 8" THICK.
11. CURB FACES AT CATCH BASIN OPENING AND POINT G SHALL BE THAT OF THE EXISTING CURB FACE PLUS 2' OR AS OTHERWISE SHOWN.
12. ELEVATION AT THE OUTER CORNERS OF THE LOCAL DEPRESSION SHOWN ON THE PLANS ARE FOR THE FINISHED SURFACE.
13. SEE DETAIL 533-1 FOR ADDITIONAL DIMENSIONS, REBAR PLACEMENT AND OTHER INFORMATION TO CONSTRUCT CATCH BASIN.

DETAIL NO.

533-2



STANDARD DETAIL
ENGLISH

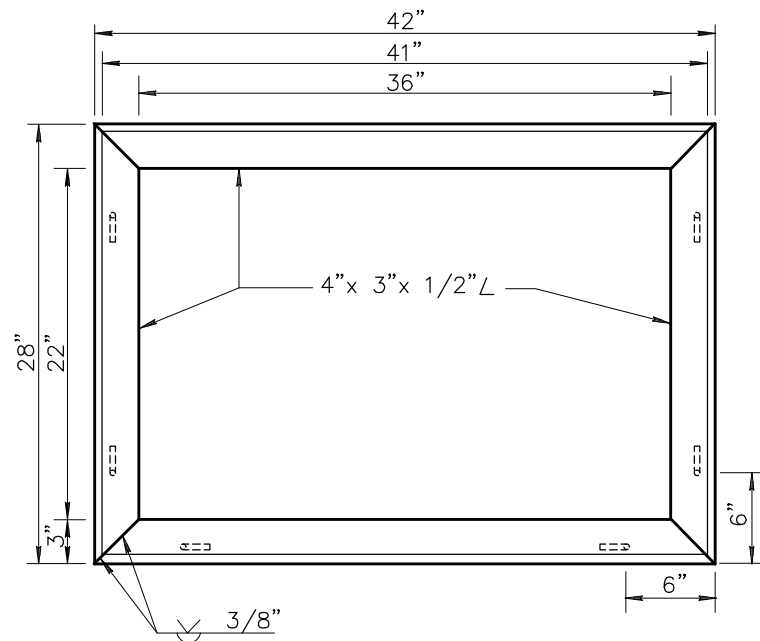
APRON FOR TYPE 'D' CATCH BASIN

REVISED

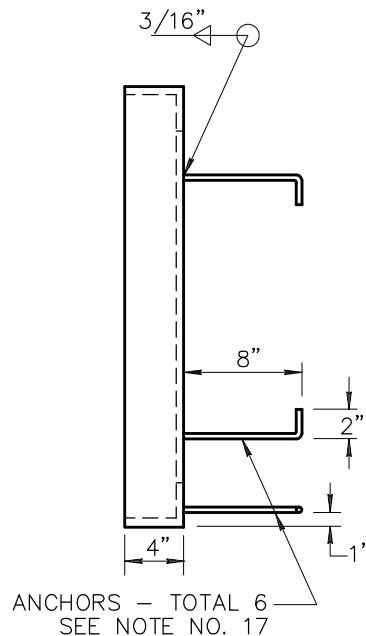
01-01-1999

DETAIL NO.

533-2

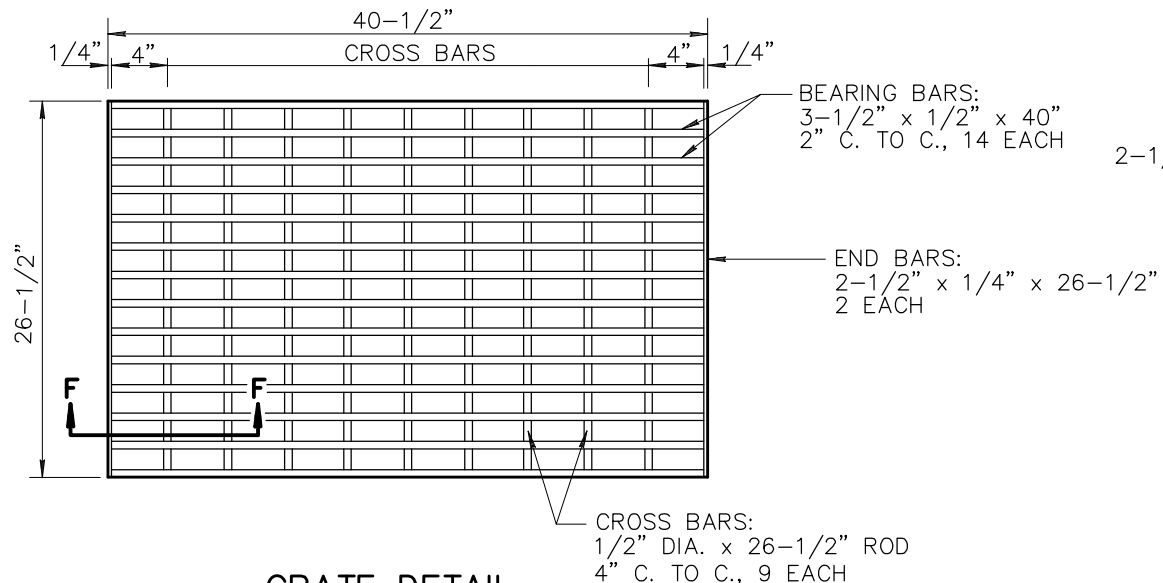


FRAME DETAIL

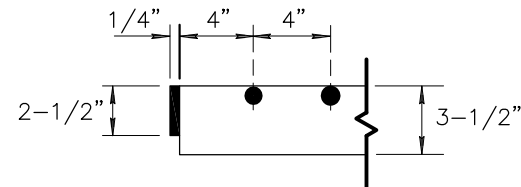


FRAME AND GRATE NOTES

14. FRAME AND GRATING SHALL BE TESTED FOR ACCURACY OF FIT AND SHALL BE MARKED IN SETS BEFORE DELIVERY.
15. ALL WELDING SHALL BE IN ACCORDANCE WITH STANDARD WELDING SPECIFICATIONS.
16. CROSS BARS AND END BARS MAY BE FILLET WELDED, RESISTANCE WELDED OR ELECTRO FORGED TO BEARING BARS.
17. ANCHORS SHALL BE 3/8" DIA. STEEL ROD, NO. 3 REBAR, 3/8" DIA. x 8" BOLTS OR 8" NELSON STUDS.
18. ALL PARTS SHALL BE OF STRUCTURAL GRADE STEEL.
19. ALL EXPOSED STEEL SHALL BE GALVANIZED OR PAINTED WITH ONE COAT #1 PAINT AND TWO FIELD COATS OF #10 PAINT.



GRATE DETAIL



SECTION F-F

DETAIL NO.

533-3



STANDARD DETAIL
ENGLISH

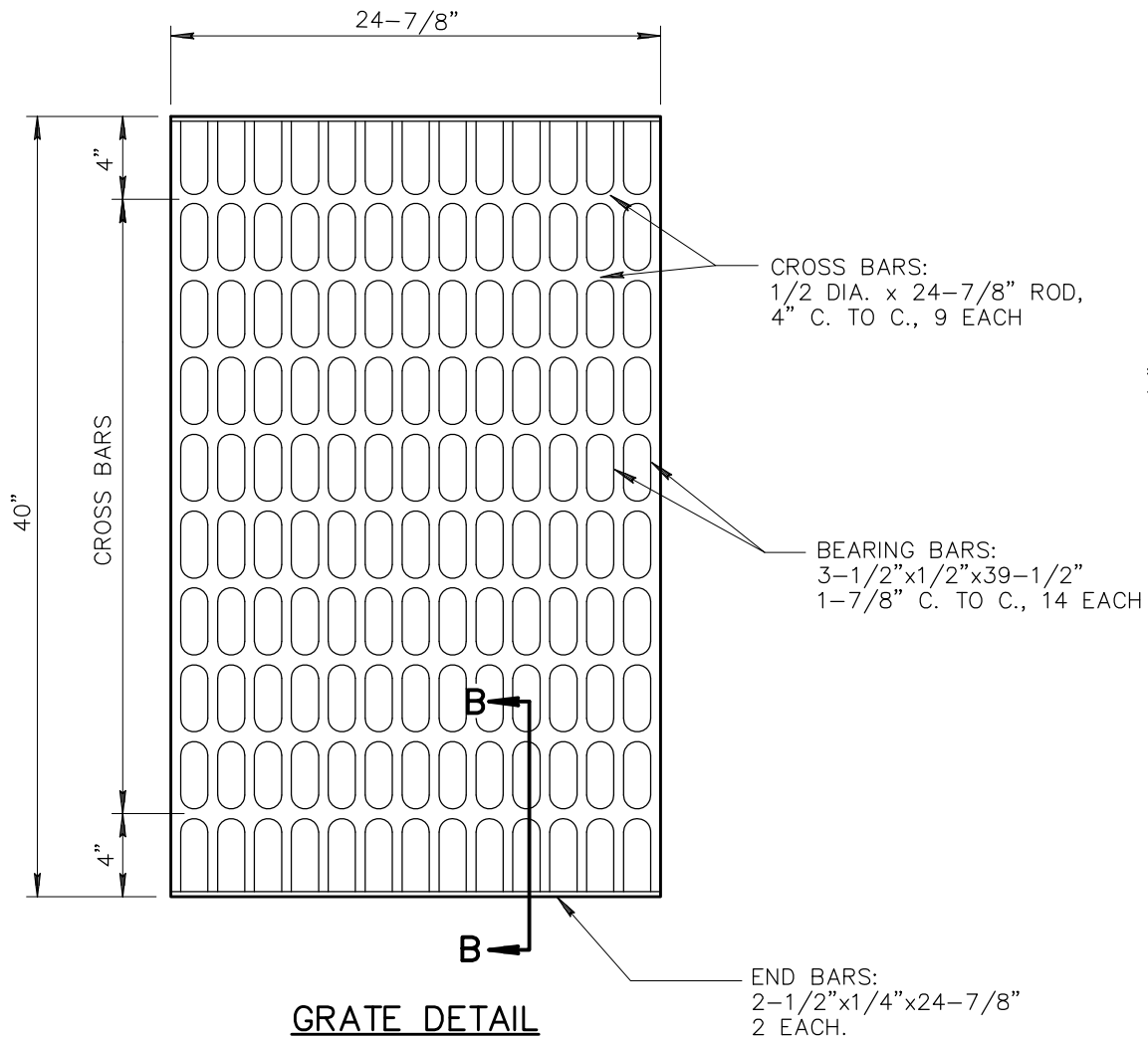
**FRAME AND GRATE
FOR TYPE 'D' CATCH BASIN**

REVISED

01-01-2007

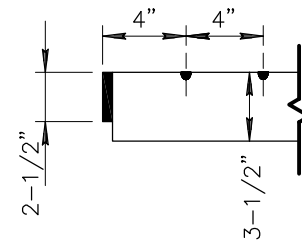
DETAIL NO.

533-3



GRATE DETAIL

GRATE OPENING: 4.344 SQ. FT.



SECTION B-B

DETAIL NO.

533-4



STANDARD DETAIL
ENGLISH

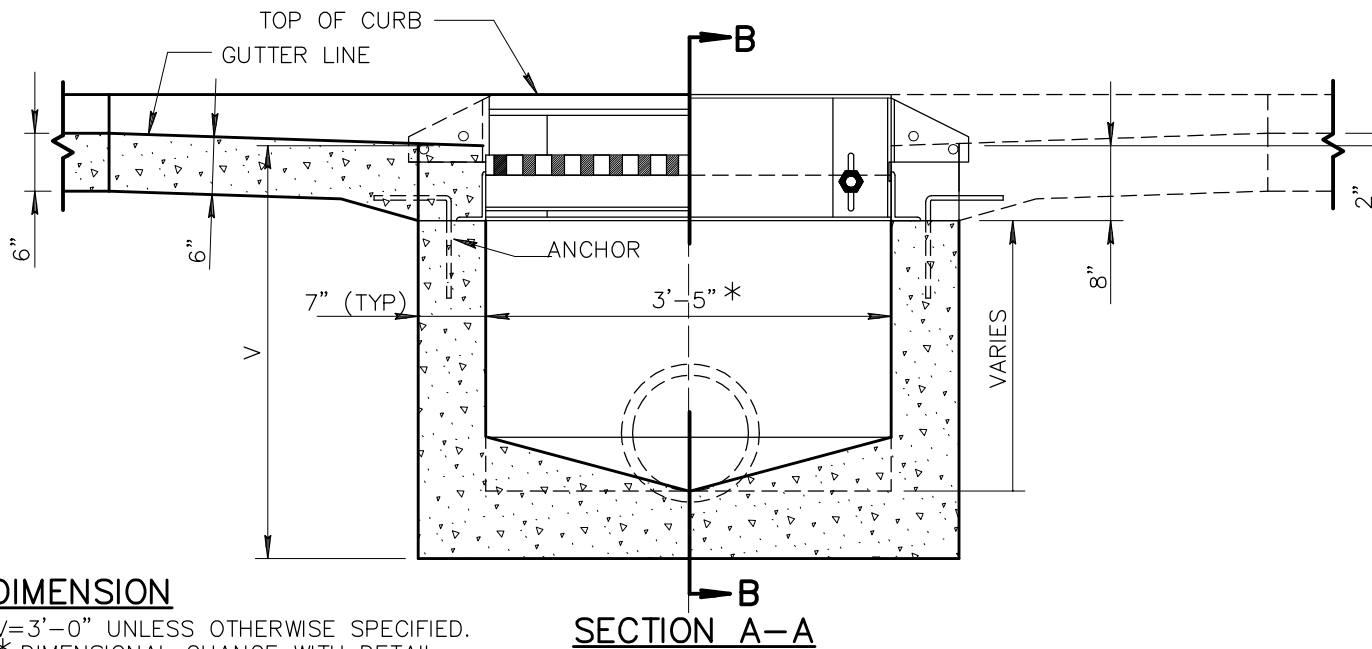
7'-0" CURB OPENING CATCH BASIN
TYPE 'D' - GRATE DETAILS

REVISED

01-01-2007

DETAIL NO.

533-4

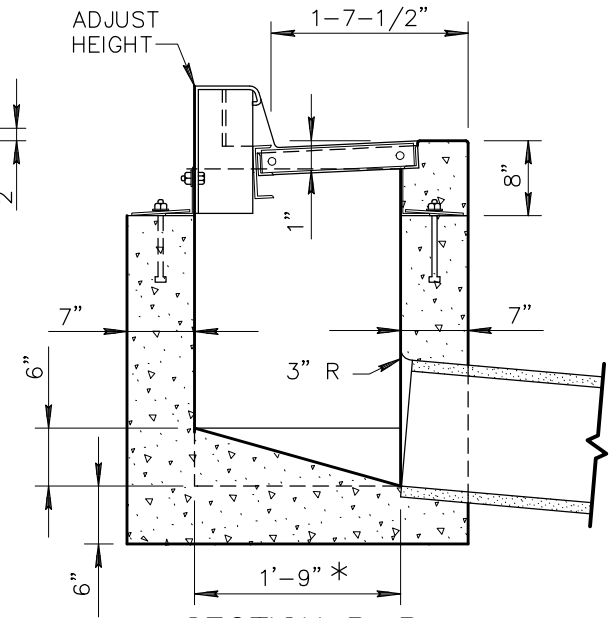


DIMENSION

V=3'-0" UNLESS OTHERWISE SPECIFIED.

* DIMENSIONAL CHANGE WITH DETAIL 534-3 AND DETAIL 534-4.

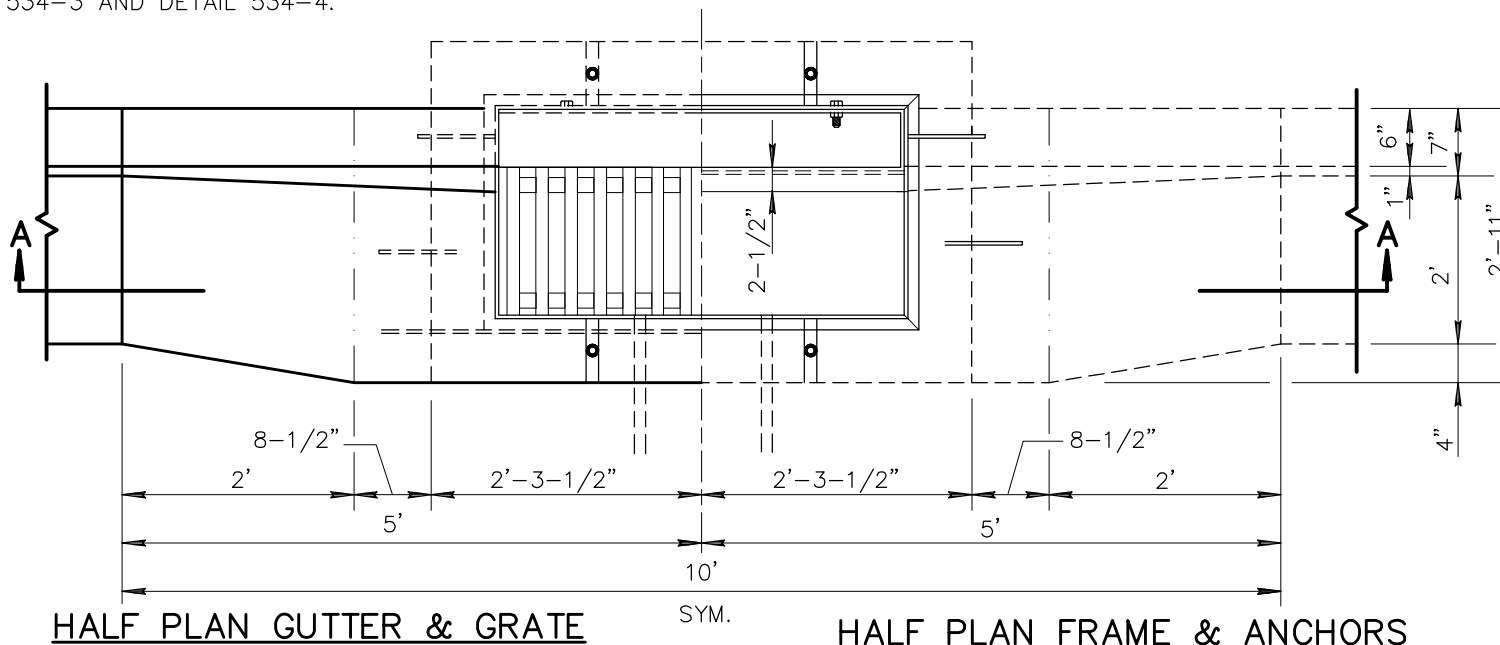
SECTION A-A



SECTION B-B

NOTES:

1. ADJUSTABLE CURB, FRAME AND GRATING UNITS SHALL BE STRUCTURAL STEEL OR CAST IRON
2. PIPES MAY ENTER OR LEAVE ANY WALL. BOTTOM OF BOX TO BE SLOPED TO OUTLET PIPE FROM ALL DIRECTIONS AND TROWELLED TO A HARD SMOOTH SURFACE.
3. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
4. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO. 1 PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. ALL CONCRETE, CLASS 'A' AS PER SECTION 725.



HALF PLAN GUTTER & GRATE

HALF PLAN FRAME & ANCHORS

DETAIL NO.

534-1



STANDARD DETAIL
ENGLISH

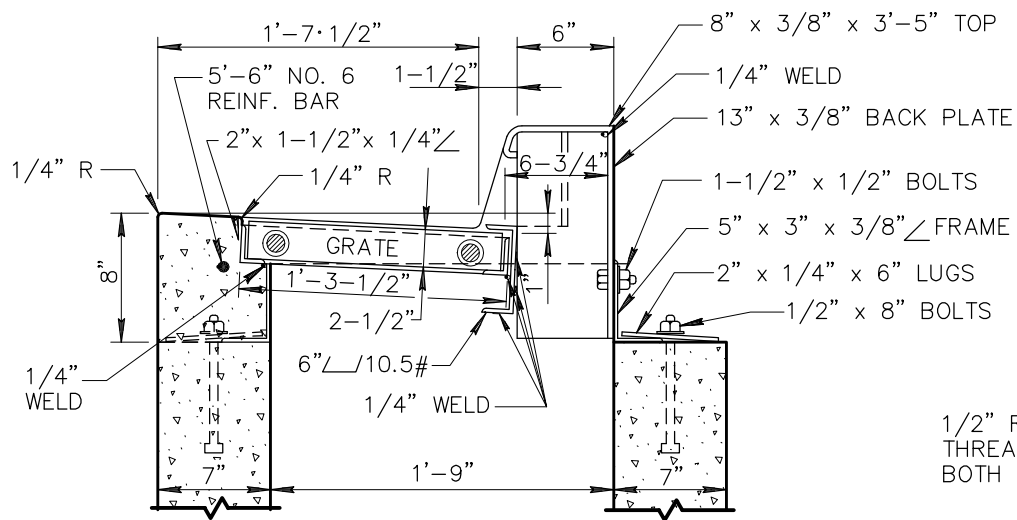
CATCH BASIN TYPE 'E'

REVISED

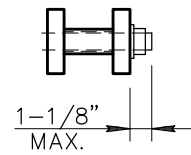
01-01-1998

DETAIL NO.

534-1

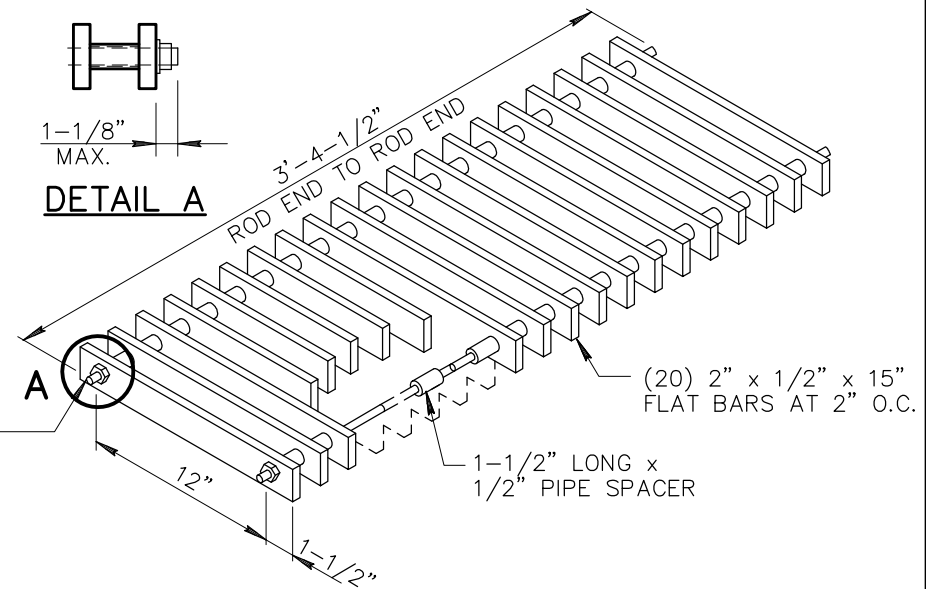


CROSS SECTION

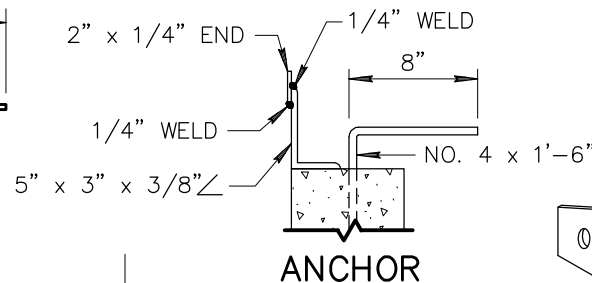
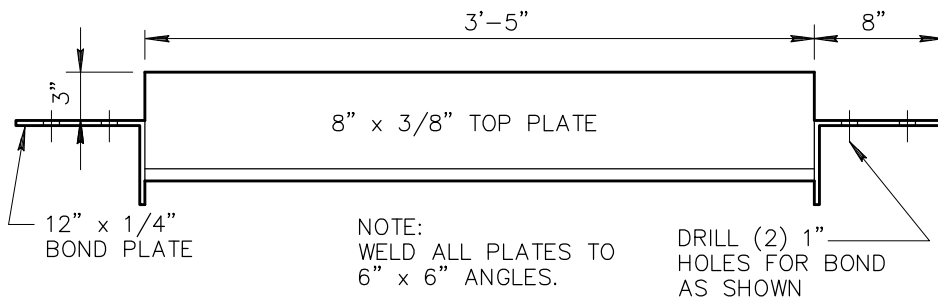


DETAIL A

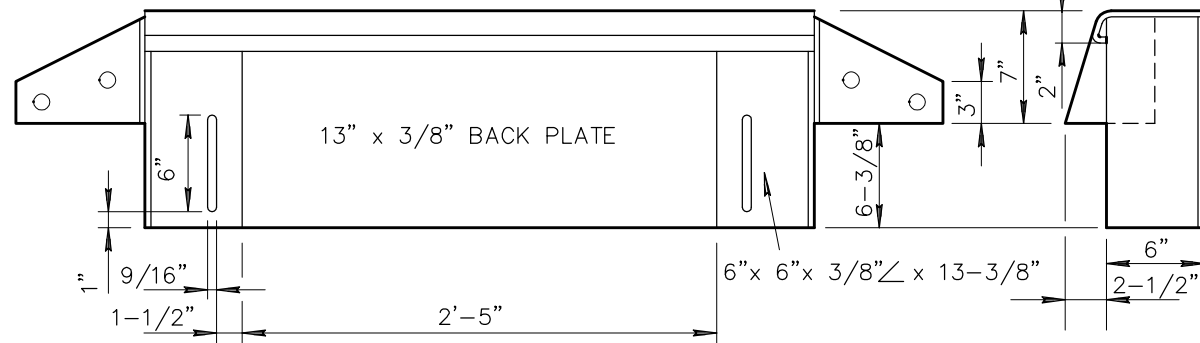
1/2" RODS
THREADED
BOTH ENDS



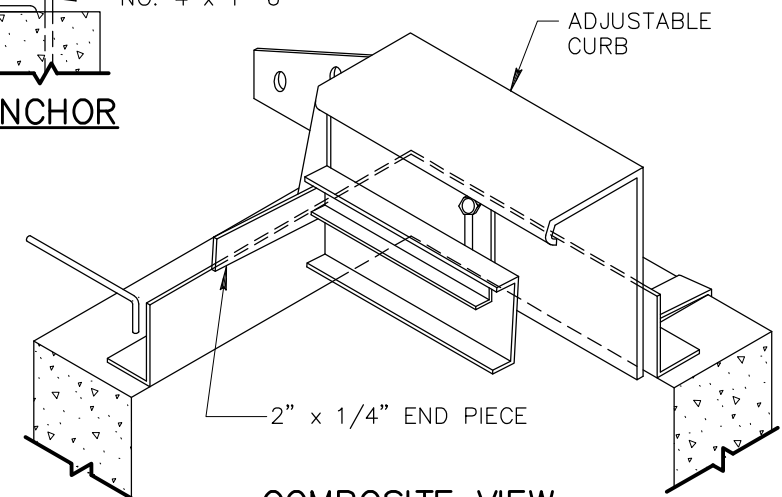
GRATE



ANCHOR



ADJUSTABLE CURB



COMPOSITE VIEW

DETAIL NO.

534-2



STANDARD DETAIL
ENGLISH

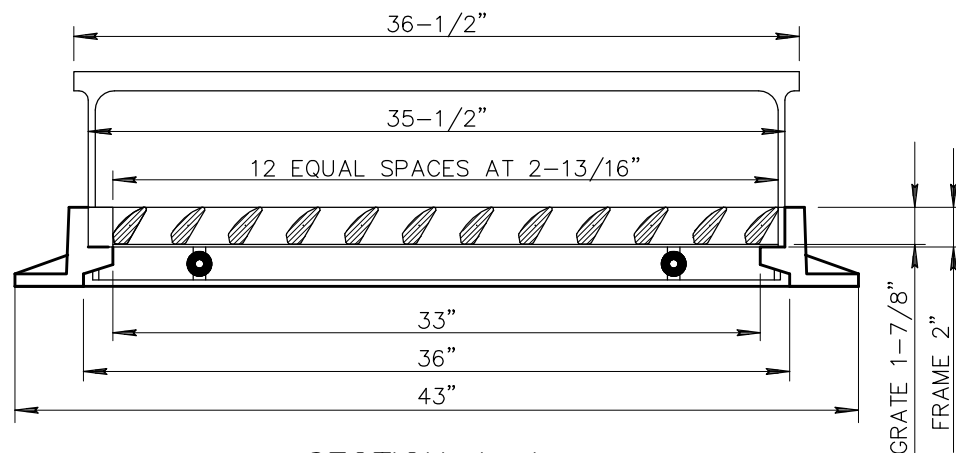
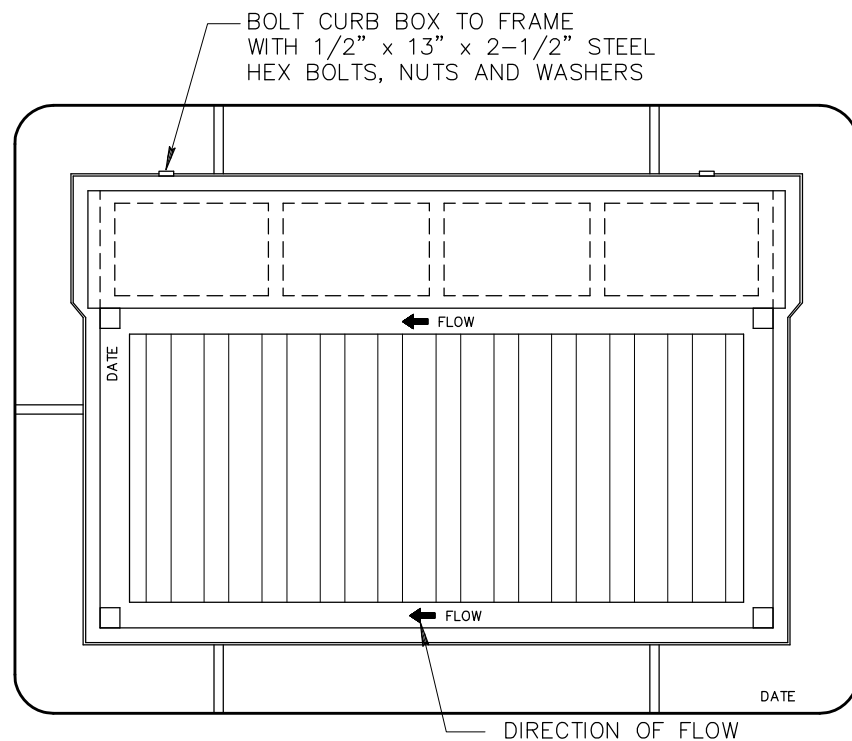
CATCH BASIN TYPE 'E' (DETAILS)

REVISED

01-01-1998

DETAIL NO.

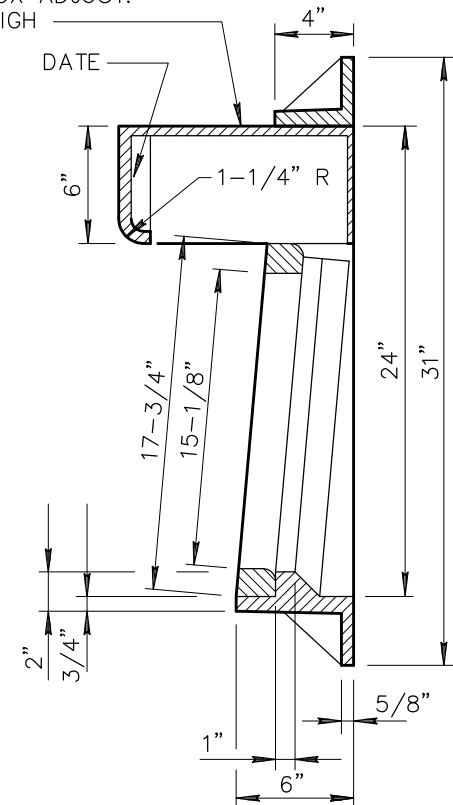
534-2



SECTION A-A

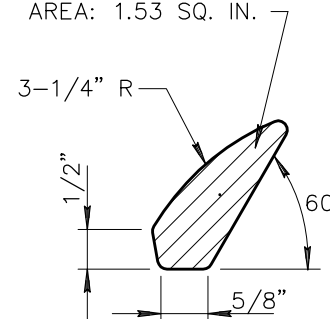
CAST IRON FRAME — GRATE — CURB BOX

CURB BOX ADJUST.
TO 9" HIGH



SECTION B-B

CROSS-SECTIONAL
AREA: 1.53 SQ. IN.



VANE DETAIL

NOTE:

DIMENSIONAL CHANGE REQUIRED FROM 3'-5"
WIDTH TO 3'-0" AND 1'-9" DEPTH TO 2'-0"
MATERIAL CAST GRAY IRON ASTM A-48-83 CLASS 35B.
FRAME WEIGHT 209 LBS; GRATE 140 LBS; CURB BOX 92 LBS.

DETAIL NO.
534-3

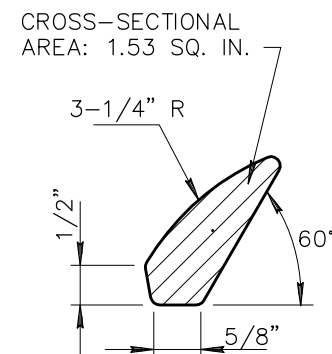
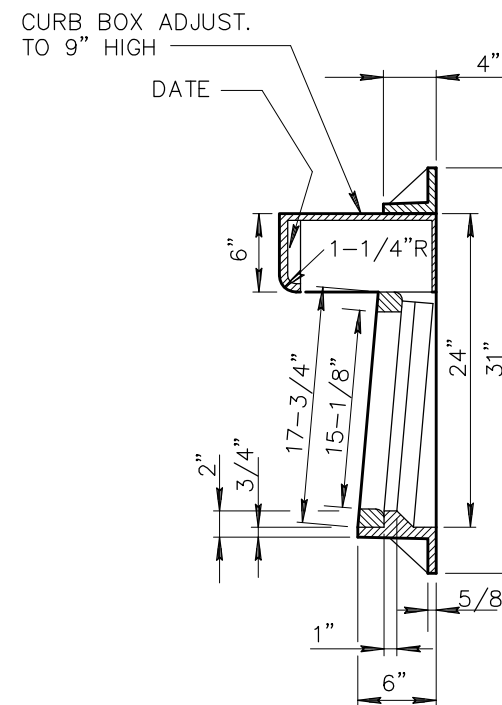
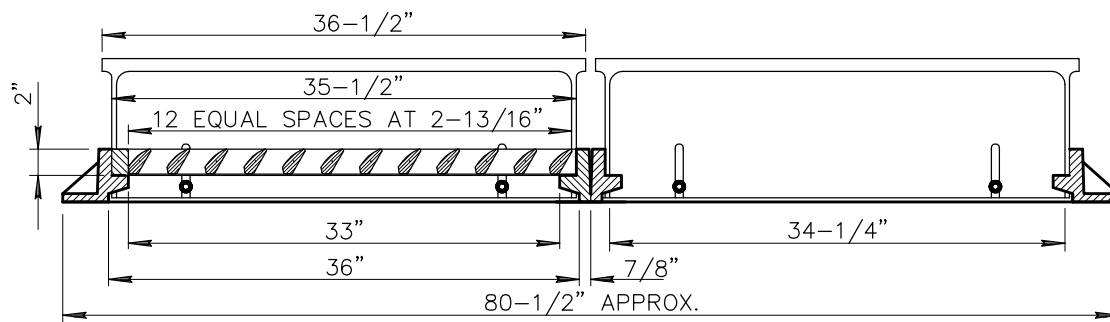
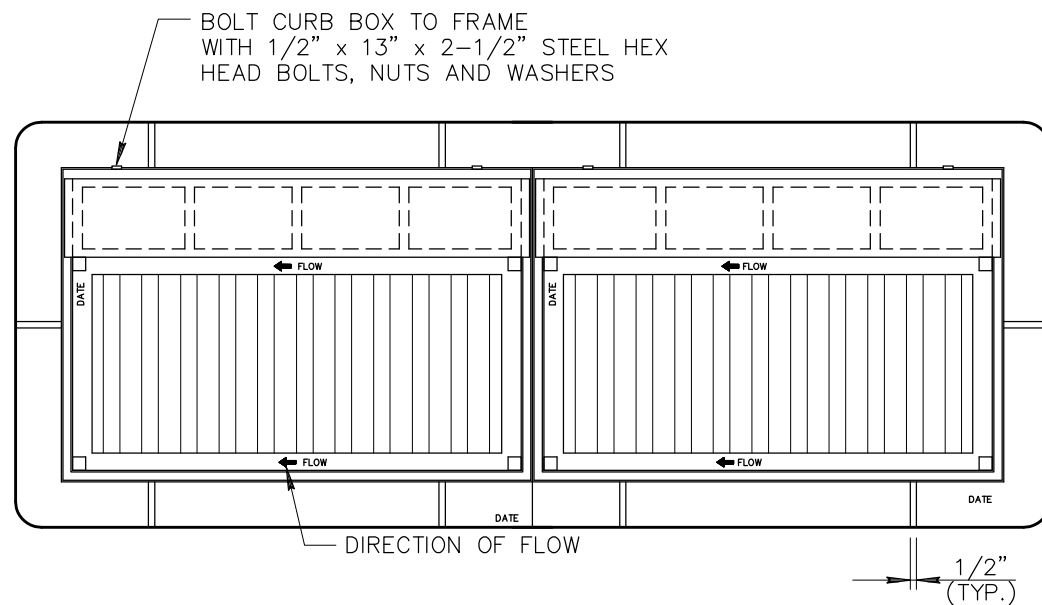


STANDARD DETAIL
ENGLISH

CATCH BASIN TYPE 'E' (DETAILS)

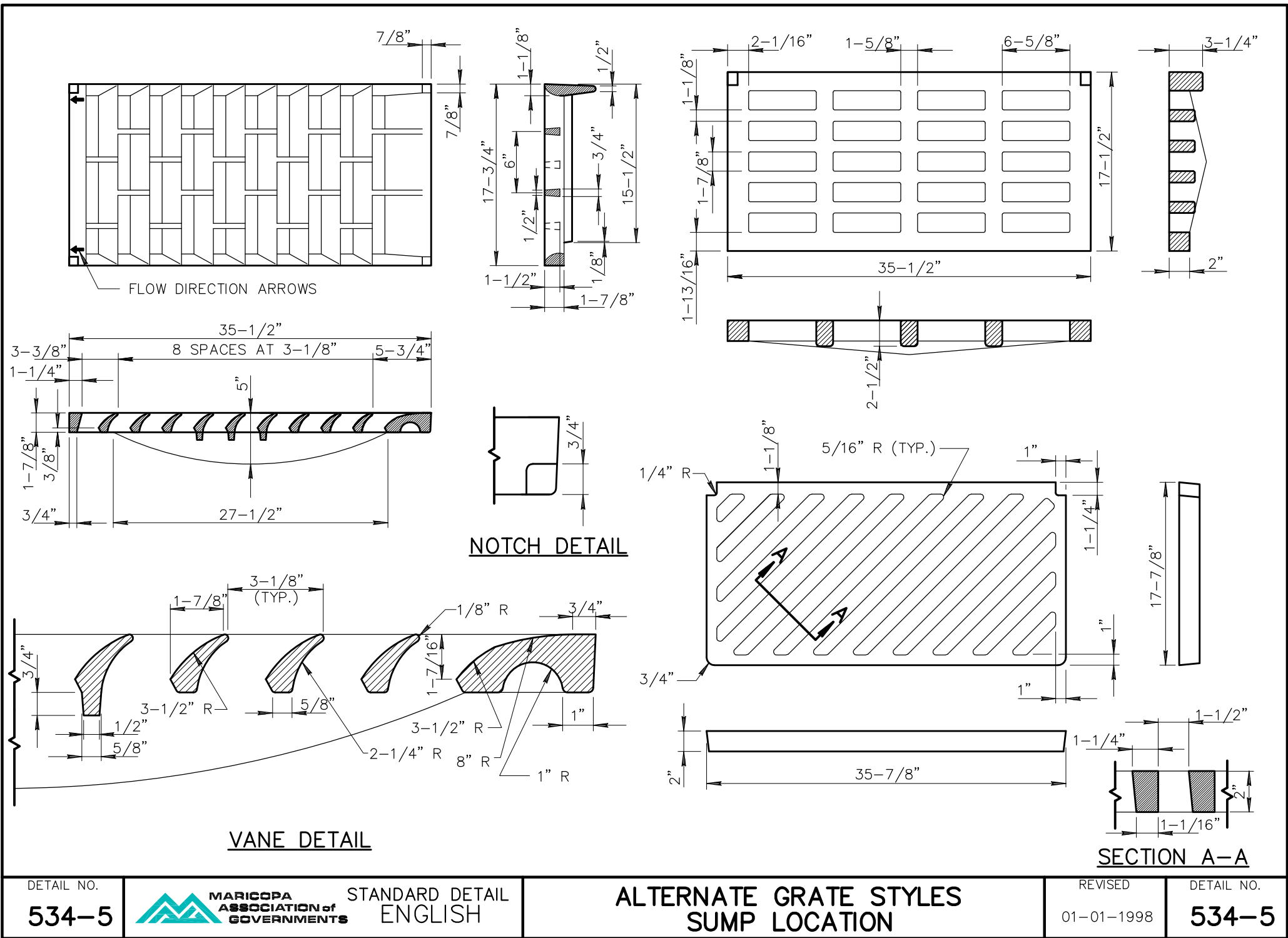
REVISED
01-01-1998

DETAIL NO.
534-3



NOTE:

DIMENSIONAL CHANGE REQUIRED FROM 3'-5"
WIDTH TO 6'-2", AND 1'-9" DEPTH TO 2'-0"
REQUIRES ONE CENTER STEEL I-BEAM 4" x 7.7 LBS.
MATERIAL CAST GRAY IRON ASTM A-48-83 CLASS 35B.
FRAME WEIGHT 197 LBS.; GRATE 140 LBS.; CURB BOX 92 LBS.



DETAIL NO.

534-5



STANDARD DETAIL
ENGLISH

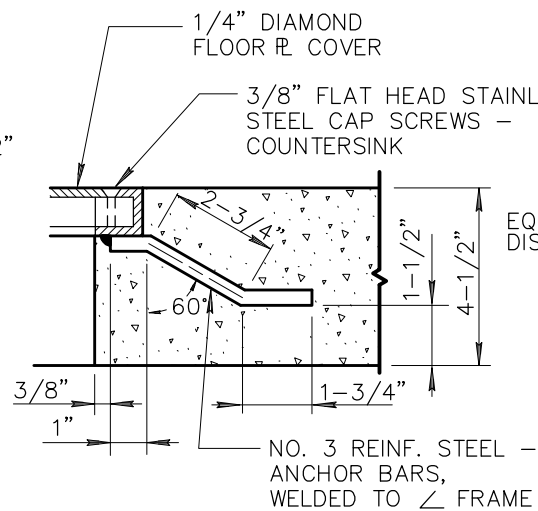
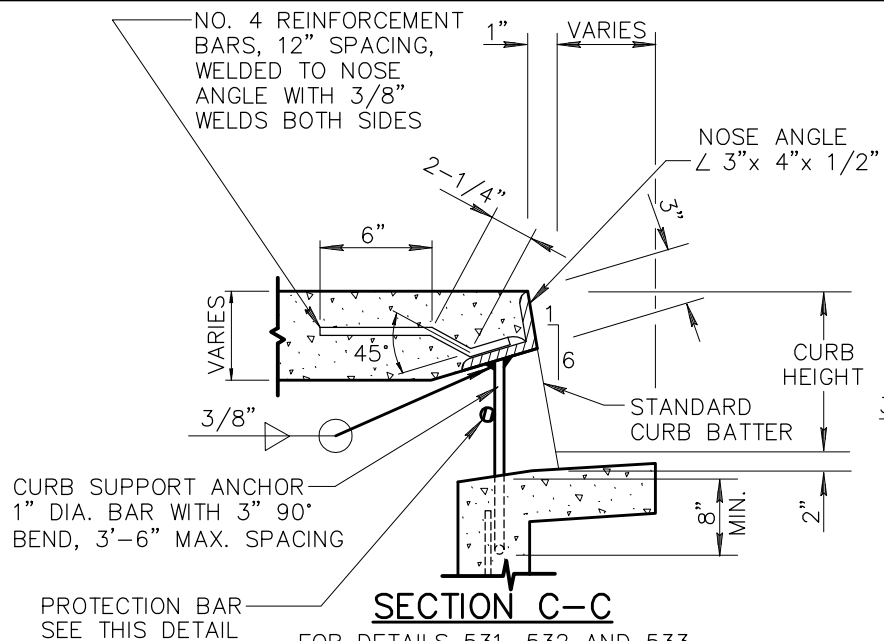
ALTERNATE GRATE STYLES
SUMP LOCATION

REVISED

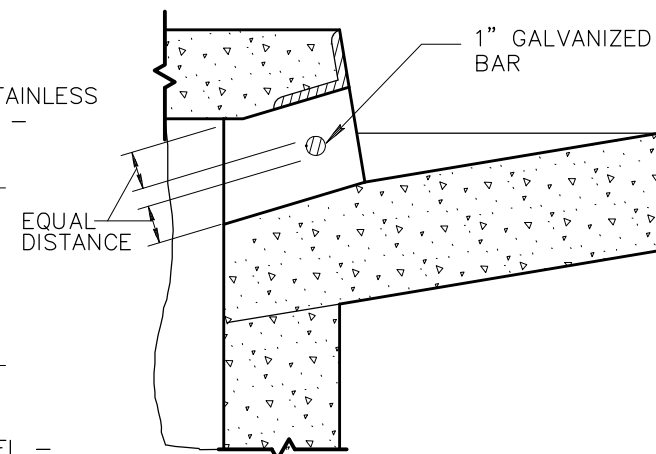
01-01-1998

DETAIL NO.

534-5



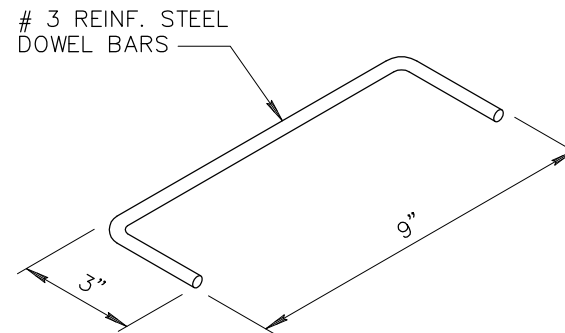
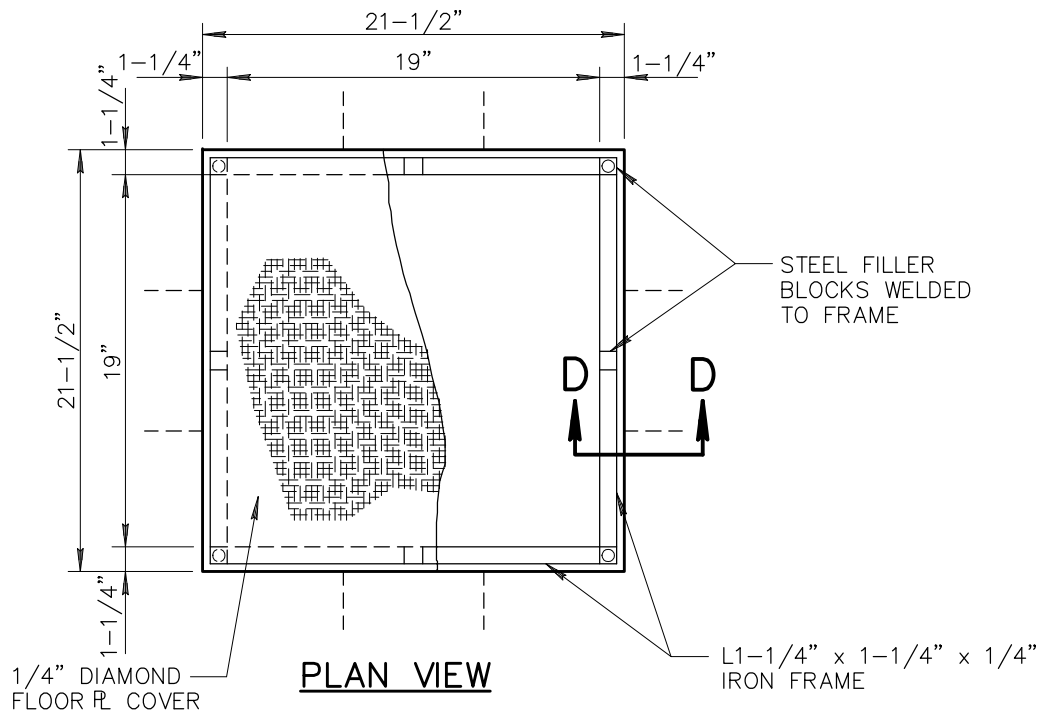
SECTION D-D



PROTECTION BAR

NOTES:

- 1) HORIZONTAL PLAIN ROUND GALVANIZED STEEL PROTECTION BAR SHALL BE USED WHEN CURB FACE IS 9" OR MORE.
- 2) THE BAR SHALL BE EMBEDDED 5" AT EACH END.



DOWEL BAR

DETAIL NO.

536-1



STANDARD DETAIL
ENGLISH

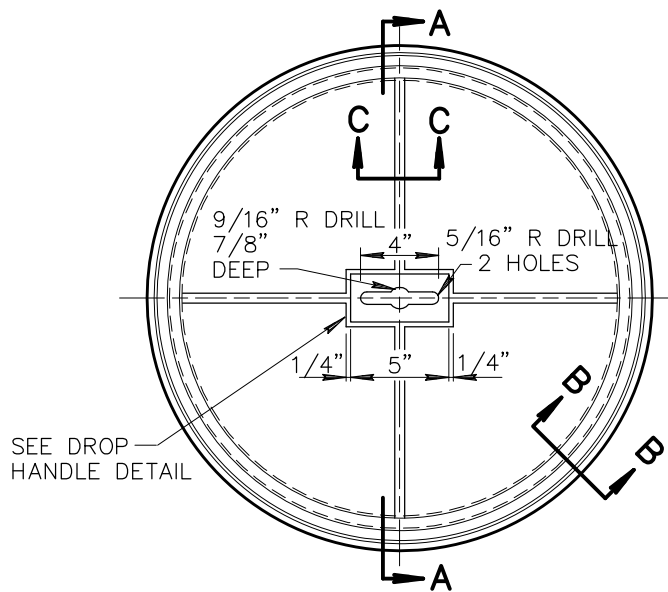
**COMMON DETAILS AND SECTIONS
FOR CURB OPENING CATCH BASINS**

REVISED

01-01-1999

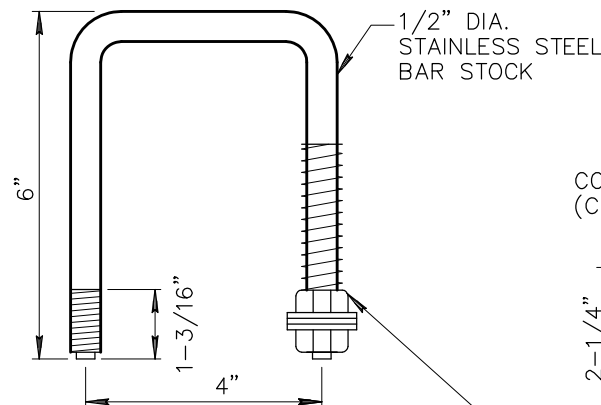
DETAIL NO.

536-1



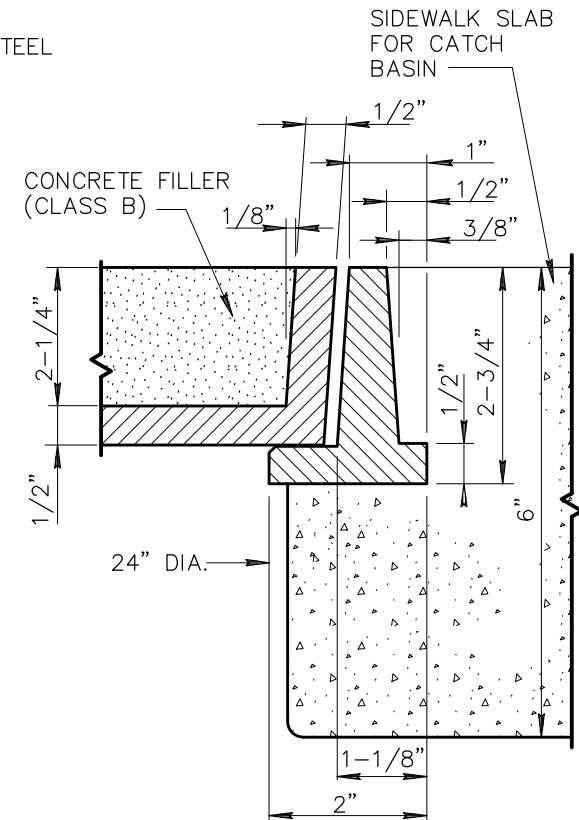
PLAN VIEW

SEE DROP
HANDLE DETAIL

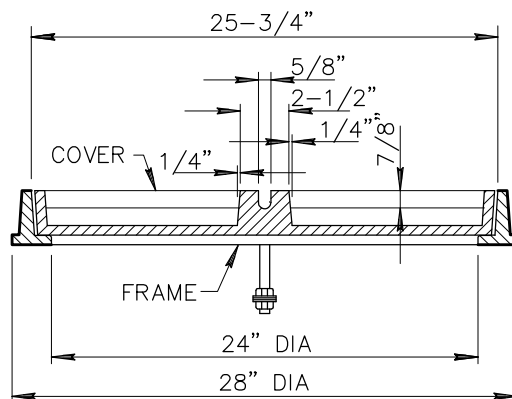


- FURNISH FOR EACH SIDE OF HANDLE
- 1 EACH 304-S.STL. SPRING
2-1/2" x 17/32" I.C. x 3/32"
 - 2 EACH 1/2" HEX NUT
 - 3 EACH 1/2" FLAT WASHER
 - 1 EACH 1/2" LOCK WASHER

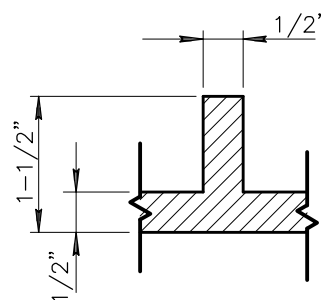
DROP HANDLE



SECTION B-B



SECTION A-A



SECTION C-C

NOTES:

1. FRAME SHALL BE NON-LOCKING.
2. FRAME AND COVER SHALL BE CAST IRON OR ASTM A-36 STRL. HORIZONTAL SURFACE OF COVER IN CONTACT WITH FRAME SHALL BE MACHINED. ASA B-46 ROUGHNESS SHALL NOT EXCEED 1/32".
3. COVER SHALL BE FILLED WITH CONCRETE AND BROOM FINISHED.
4. SMALL VARIATIONS IN DIMENSIONS OF FEATURES OF A MINOR NATURE THAT ARE PART OF THE FOUNDRY'S CASTING ARE PERMISSIBLE.

DETAIL NO.

536-2



STANDARD DETAIL
ENGLISH

**ALTERNATE COVER FOR
CURB OPENING CATCH BASINS**

REVISED

01-01-1998

DETAIL NO.

536-2

PLAN

SECTION B-B

DETAIL OF ANGLE FRAME GRATE SUPPORT

ALL CONCRETE SHALL BE
CLASS 'A' PER SECT. 725.
EXPOSED EDGES SHALL BE
FINISHED WITH A 1/2"
RADIUS.

BAR GRATE
SEE DETAIL 539

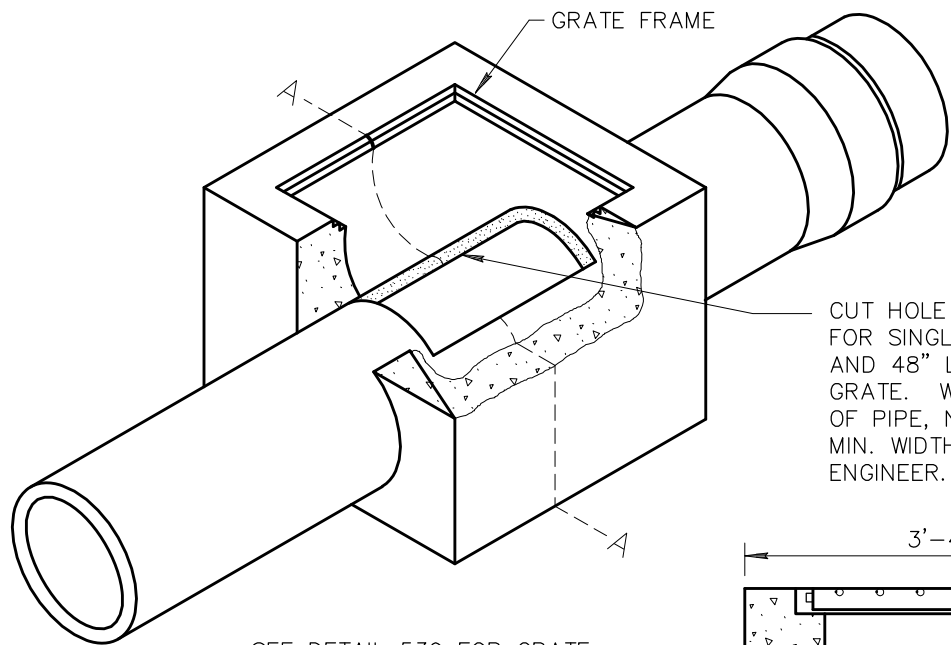
29" x 53" I.D.
GRATE FRAME

PLAN

SECTION A-A

DOUBLE GRATE

SECTION C-C



WHEN DOUBLE GRATE IS USED
INCREASE THE LENGTH OF THE
STRUCTURE ACCORDINGLY.

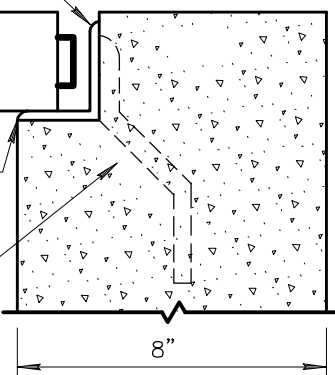
CUT HOLE IN PIPE 24" LONG
FOR SINGLE GRATE STRUCTURES
AND 48" LONG FOR DOUBLE
GRATE. WIDTH DEPENDS ON DIA.
OF PIPE, NOT TO EXCEED 22"
MIN. WIDTH TO BE SET BY PROJECT
ENGINEER.

SEE DETAIL 539 FOR GRATE

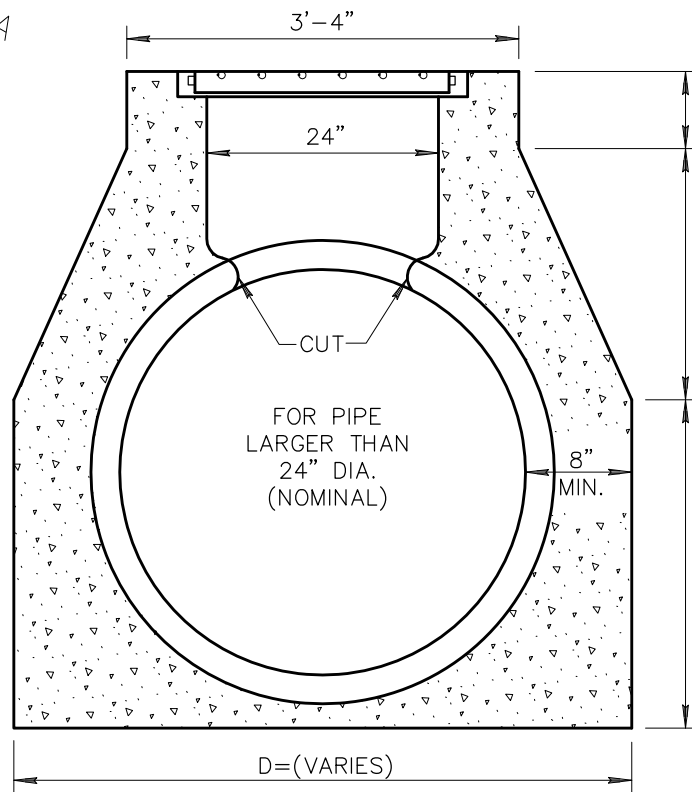
29" x 29" I.D. SINGLE FRAME
29" x 53" I.D. DOUBLE FRAME

3" x 2-1/2" x
1/2" ANGLE
IRON FRAME

1/2" DIA x 6"
LUGS WELDED
TO FRAME, 4
EACH - 1 ON
EACH CORNER
OF FRAME

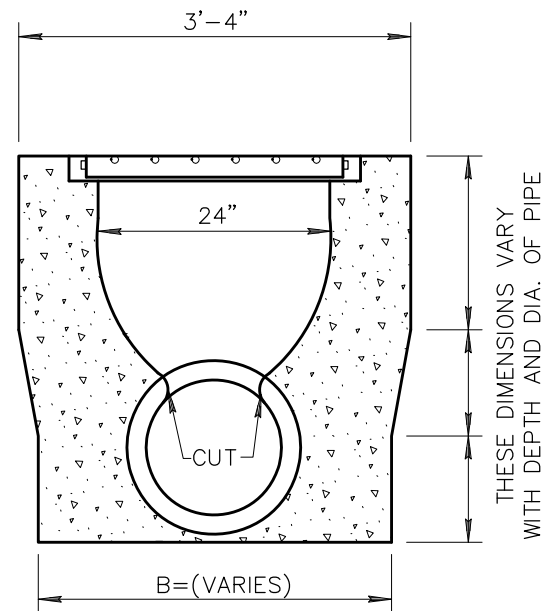


**DETAIL OF ANGLE
FRAME GRATE SUPPORT**

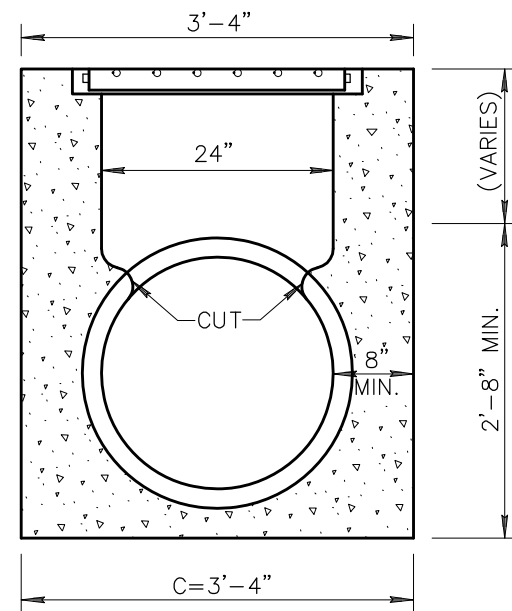


SECTION A-A

THESE DIMENSIONS VARY
WITH DEPTH AND DIA. OF PIPE



SECTION A-A



**SECTION A-A
24" PIPE (NOMINAL)**

DETAIL NO.

538



STANDARD DETAIL
ENGLISH

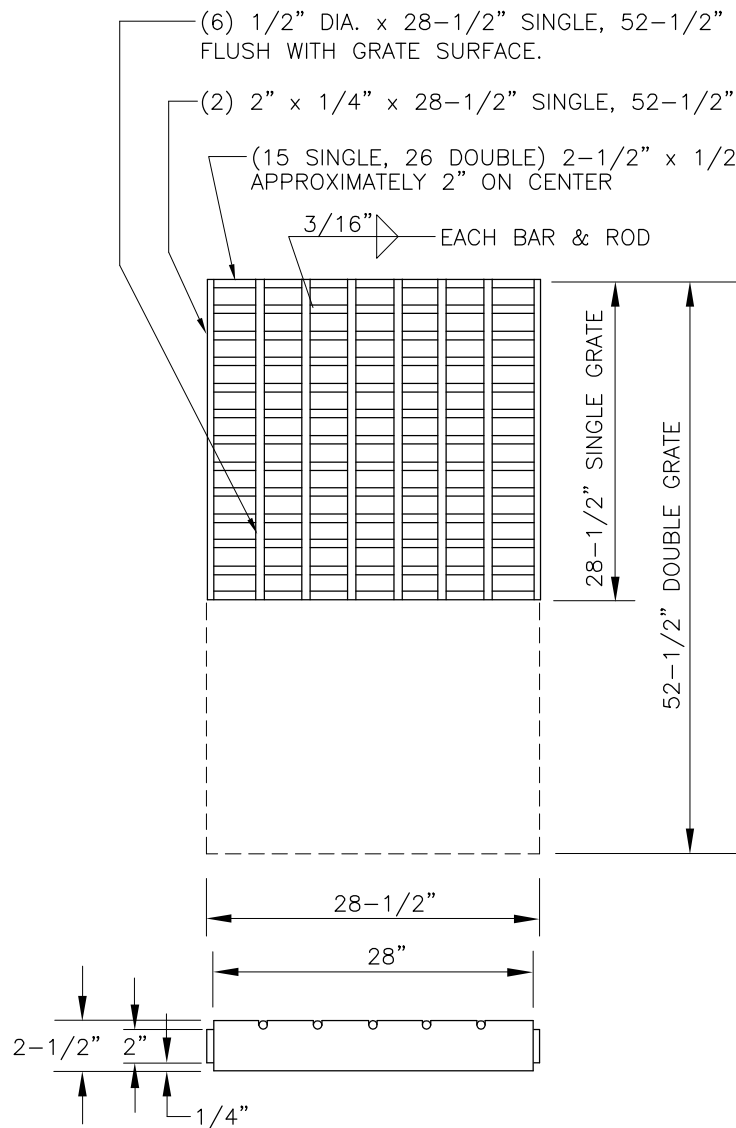
CATCH BASIN - TYPE 'H'

REVISIONS

01-01-1998

DETAIL NO.

538



NOTES:

1. ALL STEEL SHALL BE IN ACCORDANCE WITH A.S.T.M. A-36.
2. WELDING SHALL BE IN ACCORDANCE WITH A.W.S. SPECIFICATIONS.
3. FRAME AND GRATE SHALL BE TESTED FOR ACCURACY OF FIT AND SHALL BE MARKED IN SETS BEFORE DELIVERY.
4. THE COMPLETED ASSEMBLY SHALL BE GIVEN ONE SHOP COAT OF NO. 1 PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECTION 790.
5. THE GRATE SHALL BE FABRICATED TO WITHIN 1/8" SPECIFIED DIMENSIONS.

DETAIL NO.

539



STANDARD DETAIL
ENGLISH

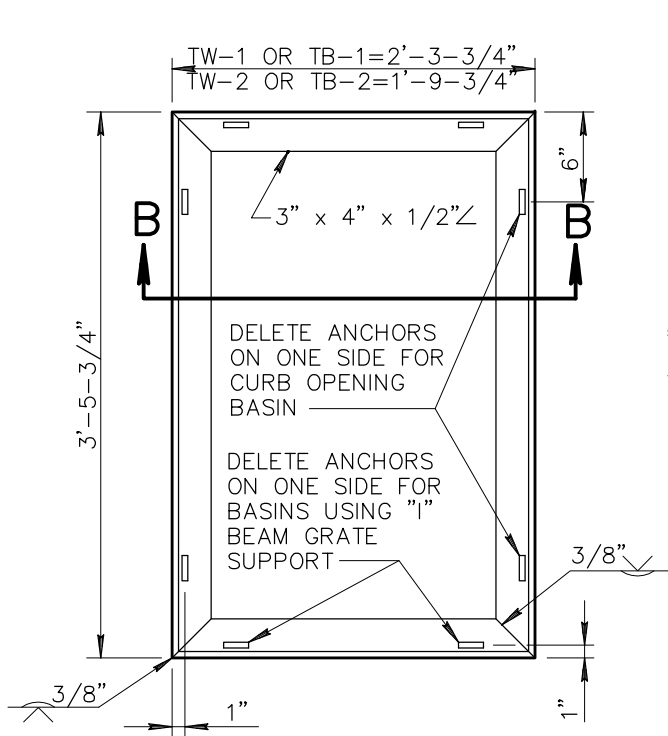
**GRATES FOR CATCH BASINS,
TYPE G AND H**

REVISED

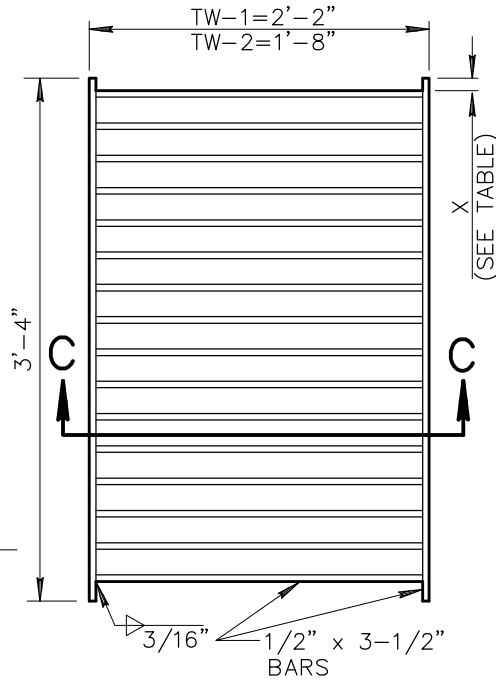
01-01-1998

DETAIL NO.

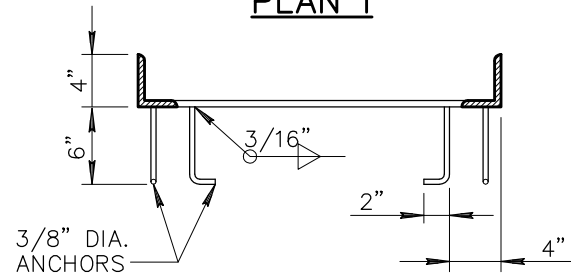
539



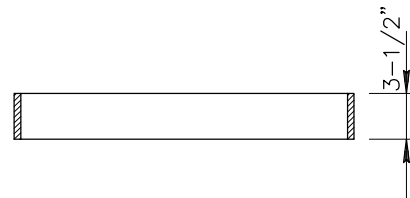
PLAN I



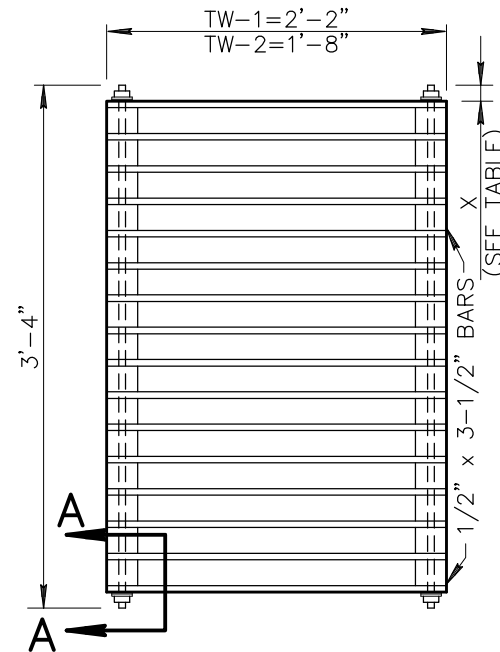
PLAN IA



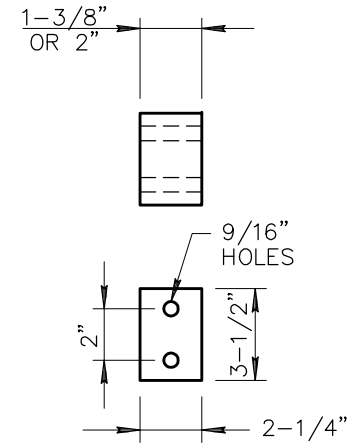
SECTION B-B



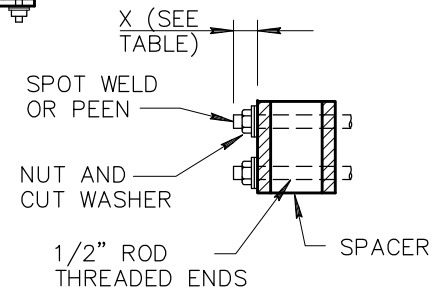
SECTION C-C
GRATE TYPES TW-1 AND TW-2



PLAN IB



BAR SPACER DETAIL



SECTION A-A

GRATE TYPES TB-1 AND TB-2

NOTES:

1. GRATING UNITS AND FRAMES SHALL BE FABRICATED FROM STRUCTURAL STEEL EXCEPT AS NOTED.
2. WELDING SHALL BE IN ACCORDANCE WITH STD. WELDING SPECS.
3. THE COMPLETED ASSEMBLY SHALL BE GIVEN TWO SHOP COATS OF NO. 1 PAINT AS PER SECT. 790.
4. FRAME AND GRATE SHALL FIT TO A MAX. ROCK OF 0.093" AT ANY POINT.
5. RESTRICT USE TO GRADES OF 3% OR LESS.

BAR TABLE

TYPE	CLEAR SPACING	NO. BARS	X	GRATE OPENING ft ²
TW OR TB-1.0	1"	26	1"	3.21
TW OR TB-1.1	1-3/8"	21	1"	3.32
TW OR TB-1.2	2"	16	1"	4.66
TW OR TB-2.0	1"	26	1"	2.32
TW OR TB-2.1	1-3/8"	21	1"	2.41
TW OR TB-2.2	2"	16	1"	2.65

TW INDICATES TRANSVERSE WELDED
TB INDICATES TRANSVERSE BOLTED

DETAIL NO.

540-1



STANDARD DETAIL
ENGLISH

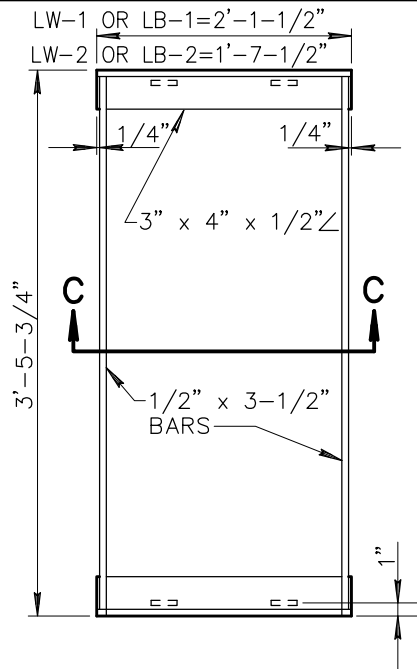
CATCH BASIN GRATES

REVISED

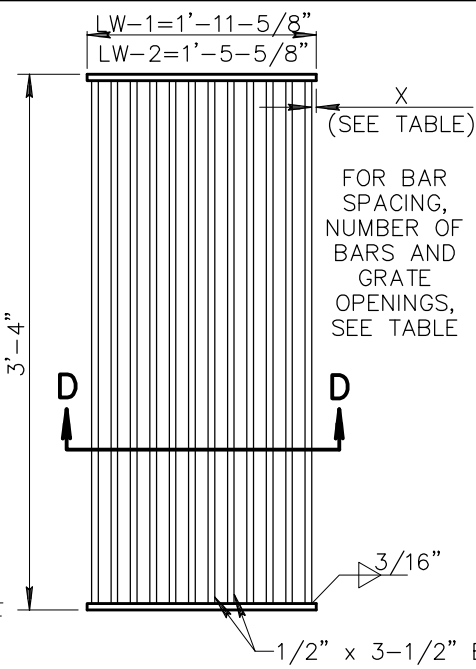
01-01-1998

DETAIL NO.

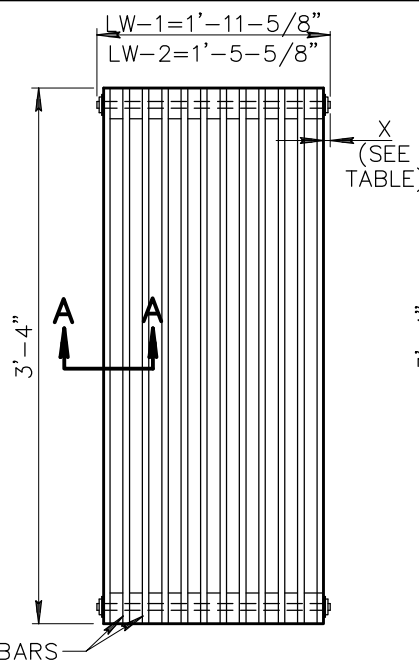
540-1



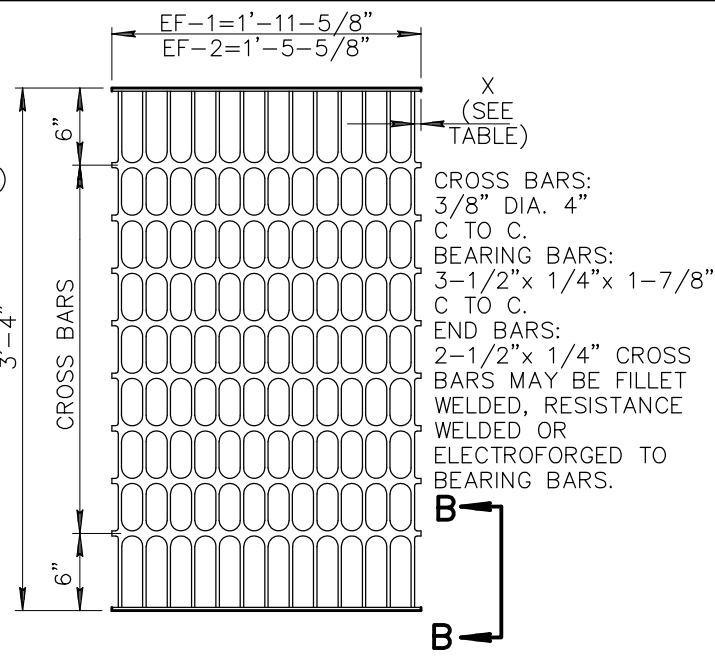
PLAN II



PLAN IIA

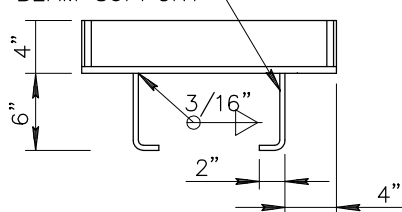


PLAN IIB

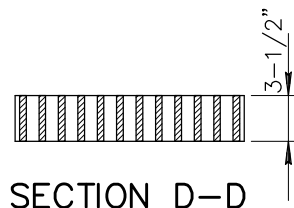


PLAN II

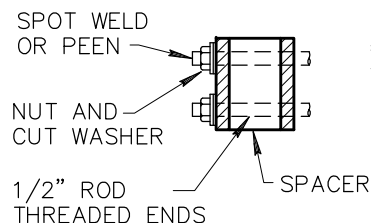
3/8" ANCHOR
DELETE ON END
WHEN USED WITH
I BEAM SUPPORT



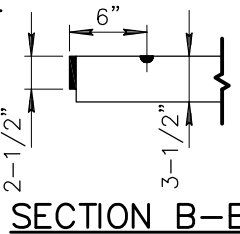
SECTION C-C



SECTION D-D



SECTION A-A

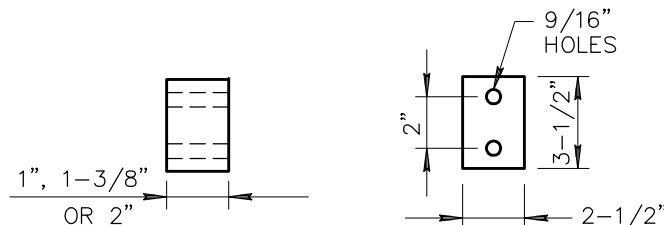


SECTION B-B

NOTES:

1. LW INDICATES LONGITUDINAL WELDED.
2. LB INDICATES LONGITUDINAL BOLTED.
3. EF INDICATES ELECTROFORGED.
4. GRATING UNITS AND FRAMES SHALL BE FABRICATED FROM STRUCTURAL STEEL 'A-36 EXCEPT AS NOTED.
5. ALL WELDING SHALL BE IN ACCORDANCE WITH STANDARD WELDING SPECIFICATIONS.
6. THE COMPLETED ASSEMBLY SHALL BE GIVEN ONE SHOP COAT OF NO. 1 PAINT.
7. FRAMES AND GRATES SHALL FIT TO A MAXIMUM ROCK OF 0.093" AT ANY POINT.
8. GRATE TYPE LW AND EF RESTRICTED TO SLOPES OF 3% OR LESS
9. GRATES TYPE LB USE LONGITUDINAL GRADES IN EXCESS OF 3% OR AS AN ALTERNATE TO TYPES LW OR EF ON GRADES OF 3% OR LESS.

GRATE TYPE	CLEAR BAR SPACING	NO. BARS	X	GRATE OPENING ft ²
LW OR LB-1.0	1"	16	5/16"	3.97
LW OR LB-1.1	1-3/8"	13	5/16"	4.34
LW OR LB-1.2	2"	9	1-9/16"	4.84
EF-1	1-5/8"	13	7/16"	4.66
LW OR LB-2.0	1"	12	5/16"	2.98
LW OR LB-2.1	1-3/8"	9	1-1/16"	3.35
LW OR LB-2.2	2"	7	1-1/16"	3.60
EF-2	1-5/16"	10	1/4"	3.48

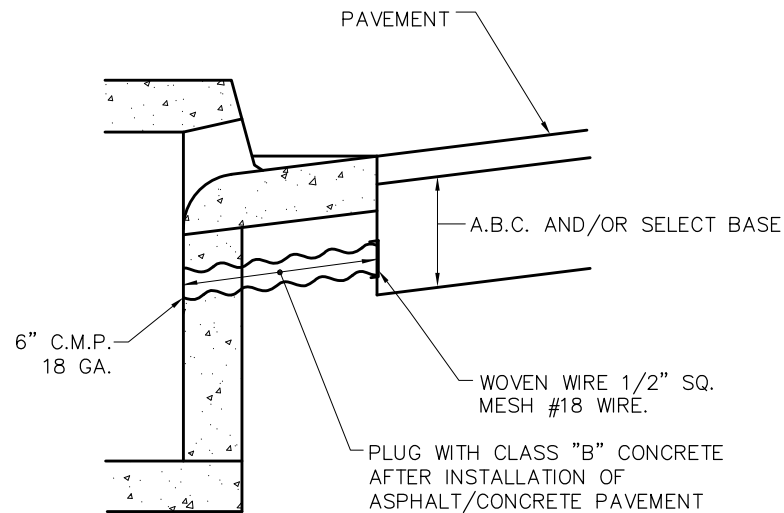


BAR SPACER DETAIL

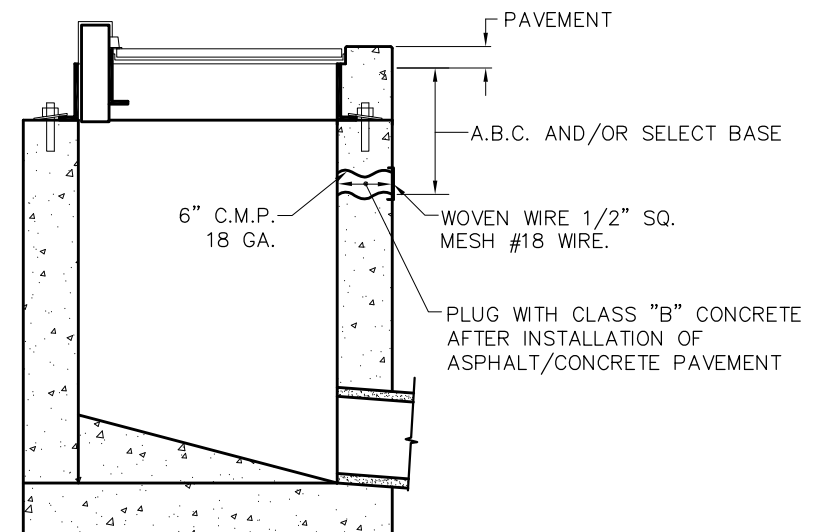
CAST IRON, CAST STEEL
OR STEEL BAR STOCK

NOTES:

1. INSTALL WHEN REQUIRED BY PLANS, SPECIFICATIONS, OR APPROVED BY THE ENGINEER.
2. SEE PROJECT PLANS FOR CATCH BASIN DETAILS AND PAVEMENT STRUCTURAL SECTION.



CURB OPENING INLET



GRATE OPENING INLET

DETAIL NO.

541



STANDARD DETAIL
ENGLISH

CATCH BASIN SUBGRADE DRAIN

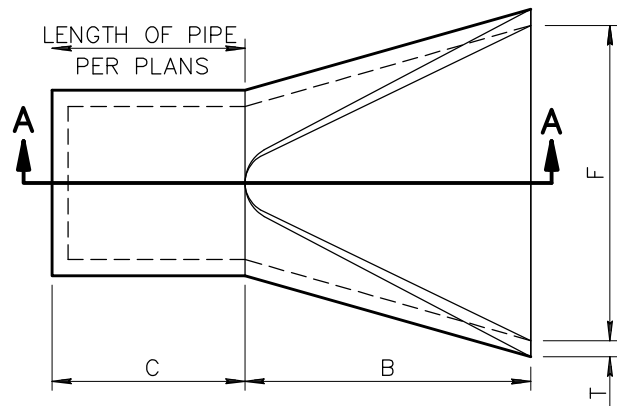
REVISED

01-01-2005

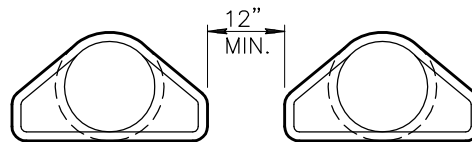
DETAIL NO.

541

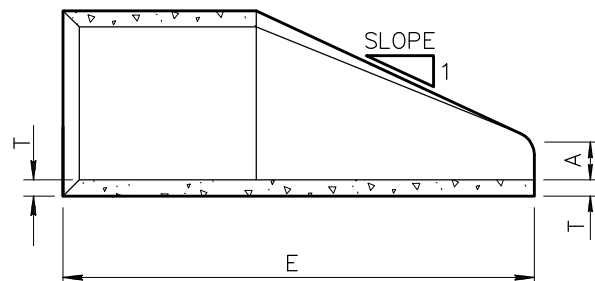
PIPE DIA.	APPROX. WEIGHT (LBS.)	DIMENSIONS — INCHES						APPROX. SLOPE
		T	A	B	C	E	F	
24"	1520	3	9-1/2	43-1/2	30	73-1/2	48	3
27"	1930	3-1/4	10-1/2	49-1/2	24	73-1/2	54	3
30"	2190	3-1/2	12	54	19-3/4	73-3/4	60	3
36"	4100	4	15	63	34-3/4	97-3/4	72	3
42"	5380	4-1/2	21	63	35	98	78	3
48"	6550	5	24	72	26	98	84	3
54"	8240	5-1/2	27	65	33-1/4	98-1/4"	90	2 1/2



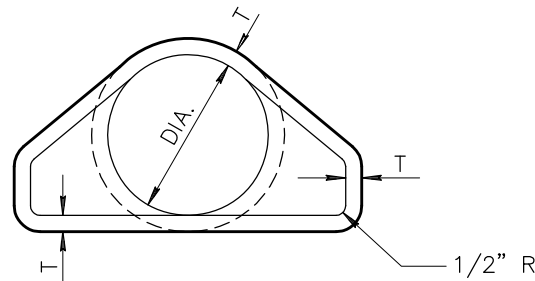
PLAN



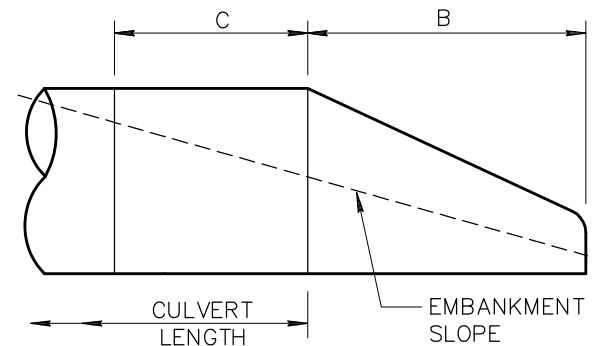
SPACING FOR MULTIPLE INSTALLATION



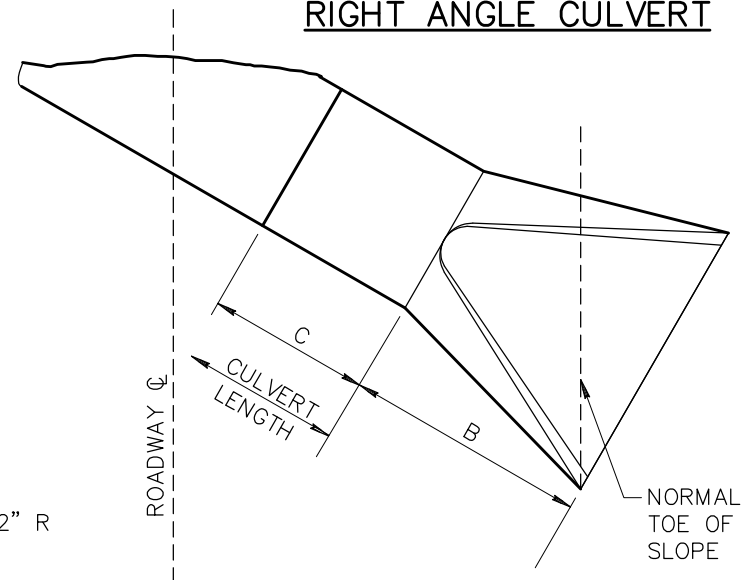
SECTION A-A



FRONT ELEVATION



RIGHT ANGLE CULVERT



SKewed CULVERT

NOTES

1. DESIGN OF END SECTION SHALL CONFORM TO STANDARD FOR REINFORCED CONCRETE PIPE.
2. END SECTION JOINT CONFORMATION SHALL MATCH THE PIPE JOINTS.
3. EMBANKMENT SLOPE SHALL BE WARPED TO MATCH SLOPE OF END SECTION.
4. CULVERT LENGTH IS AS SHOWN ON PLANS.

DETAIL NO.

545



STANDARD DETAIL
ENGLISH

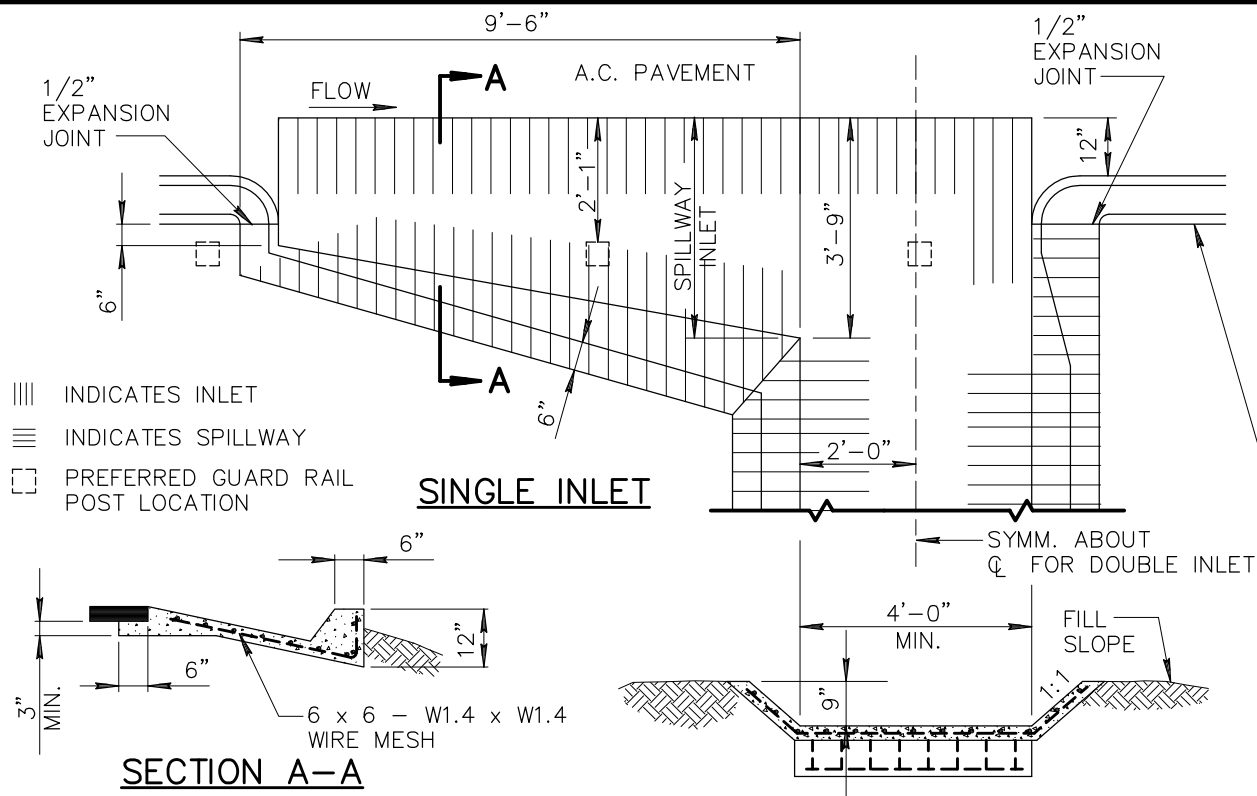
END SECTION—REINFORCED CONCRETE PIPE

REVISED

01-01-1998

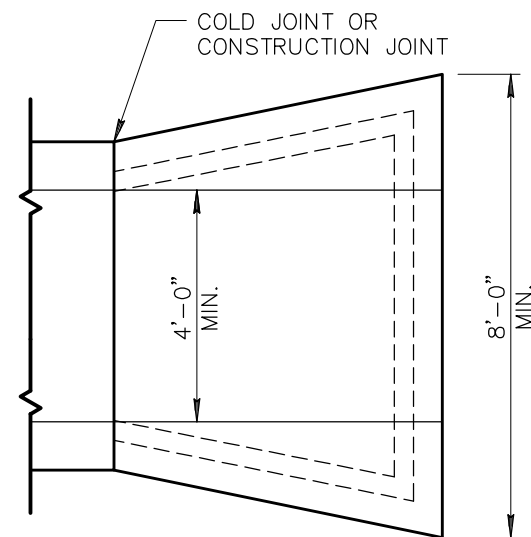
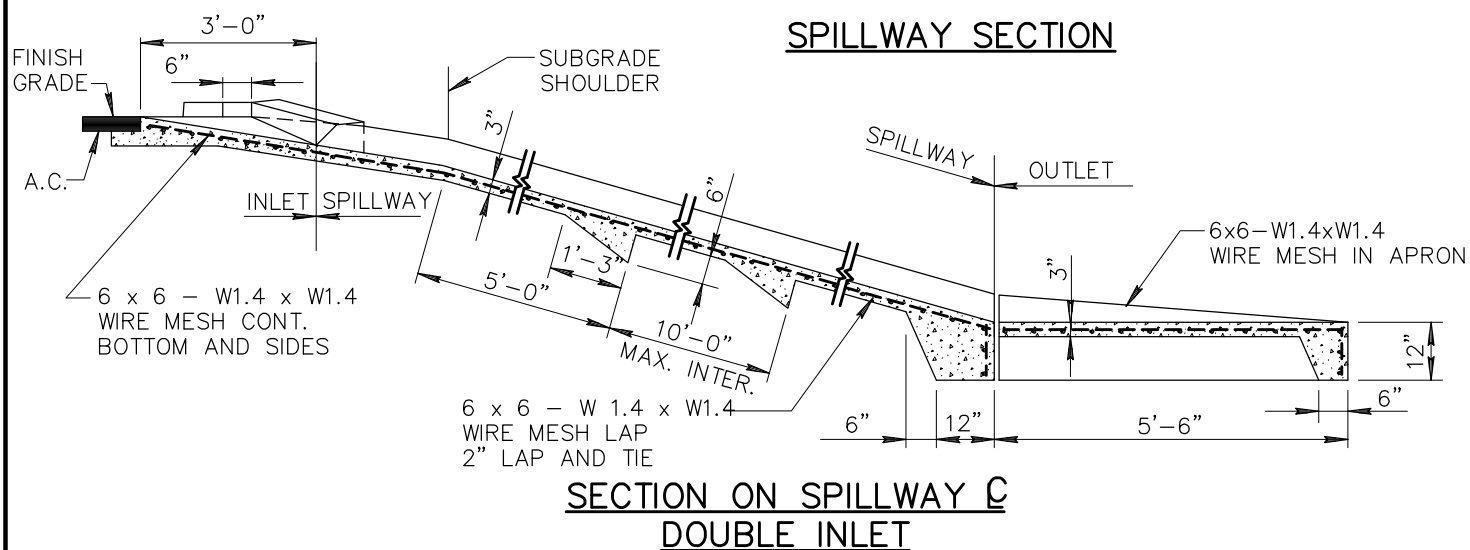
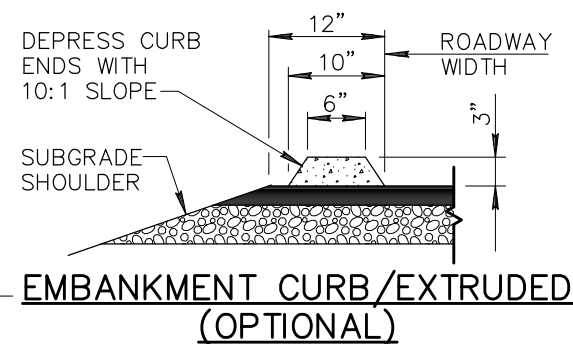
DETAIL NO.

545



NOTES:

1. WHERE ROCK IS ENCOUNTERED THE OUTLET MAY BE OMITTED.
2. ALL PORTIONS OF SPILLWAY TO BE TROWEL FINISHED.
3. CONCRETE FOR THE SPILLWAY INLET, SPILLWAY AND OUTLET SHALL BE CLASS 'B' PER SECT. 725.
4. WHEN THE OUTLET IS USED, THE WIRE MESH SHALL EXTEND THROUGH THE JOINT INTO THE OUTLET IN LIEU OF BENDING INTO THE KEY.



DETAIL NO.

550



STANDARD DETAIL
ENGLISH

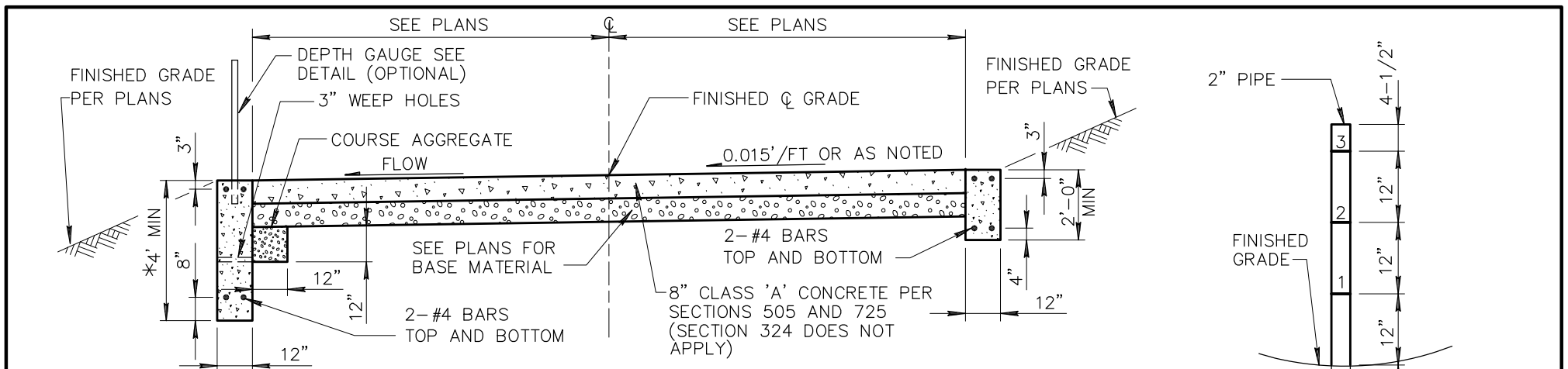
SPILLWAY INLET AND OUTLET

REVISED

01-01-1998

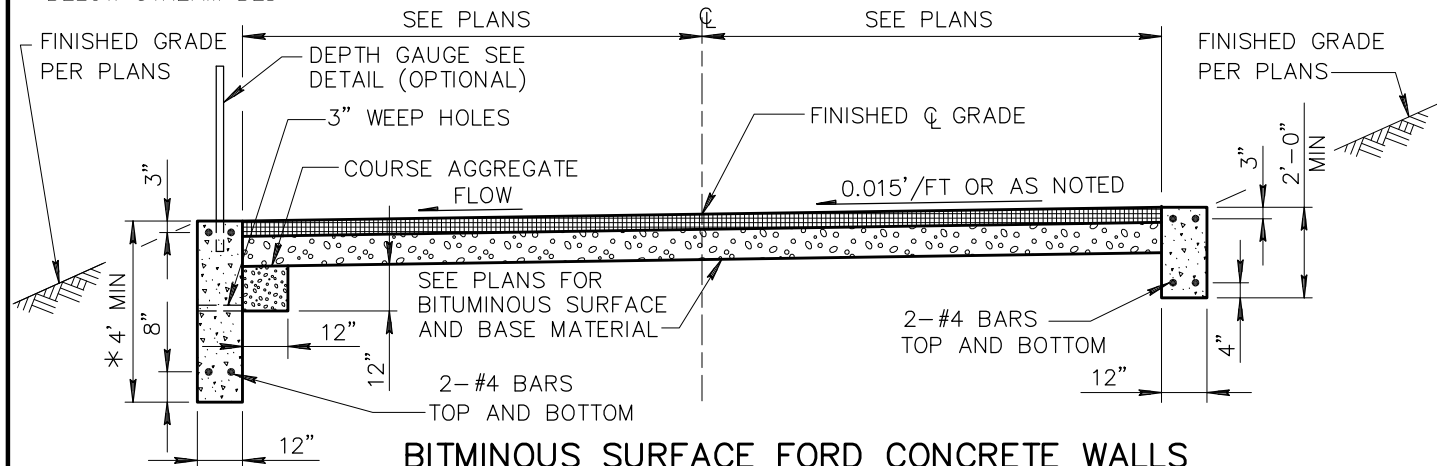
DETAIL NO.

550



CONCRETE SURFACE FORD CONCRETE WALLS

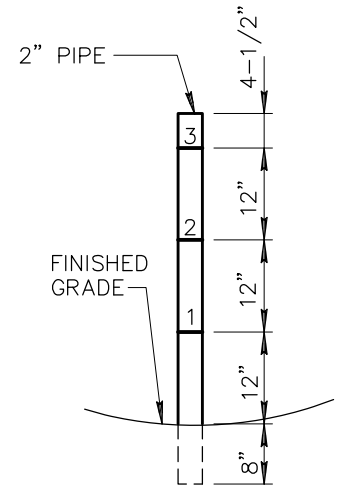
*MIN. DISTANCE
BELOW STREAM BED



BITUMINOUS SURFACE FORD CONCRETE WALLS

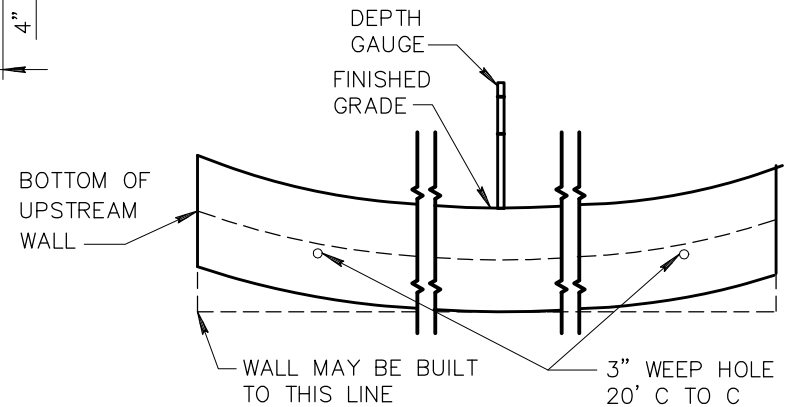
NOTES:

1. FORD WALLS SHALL BE CLASS 'A' CONCRETE PER SECT. 725.
2. DEPTH GAUGE SHALL BE PAINTED 2 COATS WHITE ENAMEL. NUMERALS AND MARKERS SHALL BE 1 COAT BLACK ENAMEL.
3. NUMBERS ON DEPTH GAUGE TO BE 2" HIGH.
4. HEIGHT OF DEPTH GAUGE PER PLANS.
5. REINFORCING BARS SHALL BE SET 3" CLEAR FROM SIDES OF CUT-OFF WALLS.
6. COURSE AGGREGATE AT WEEP HOLES SHALL BE ASTM C33 SIZE 57, ENCLOSED IN FILTER FABRIC (SECTION 796, CLASS B), AND EXTENDED Laterally A MINIMUM OF SIX-INCHES (6") ON EACH SIDE OF THE WEEP HOLE.



DEPTH GAUGE DETAIL

(OPTION OF THE CONTRACTING AGENCY)



ELEVATION LOOKING UPSTREAM

DETAIL NO.

552



STANDARD DETAIL
ENGLISH

FORD CROSSING AND CUT-OFF WALLS

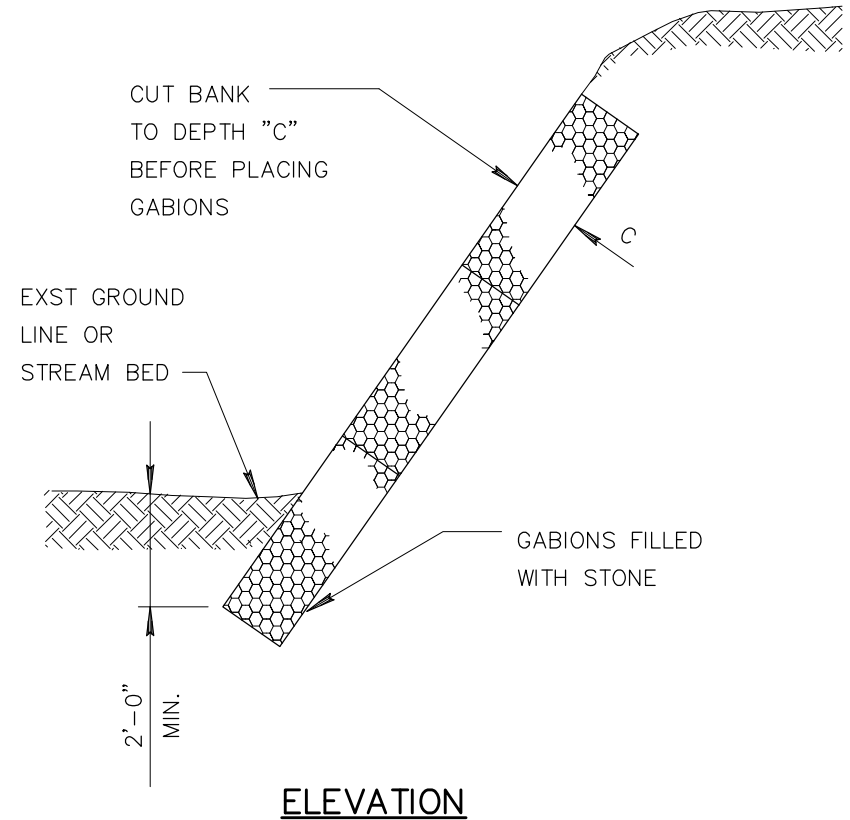
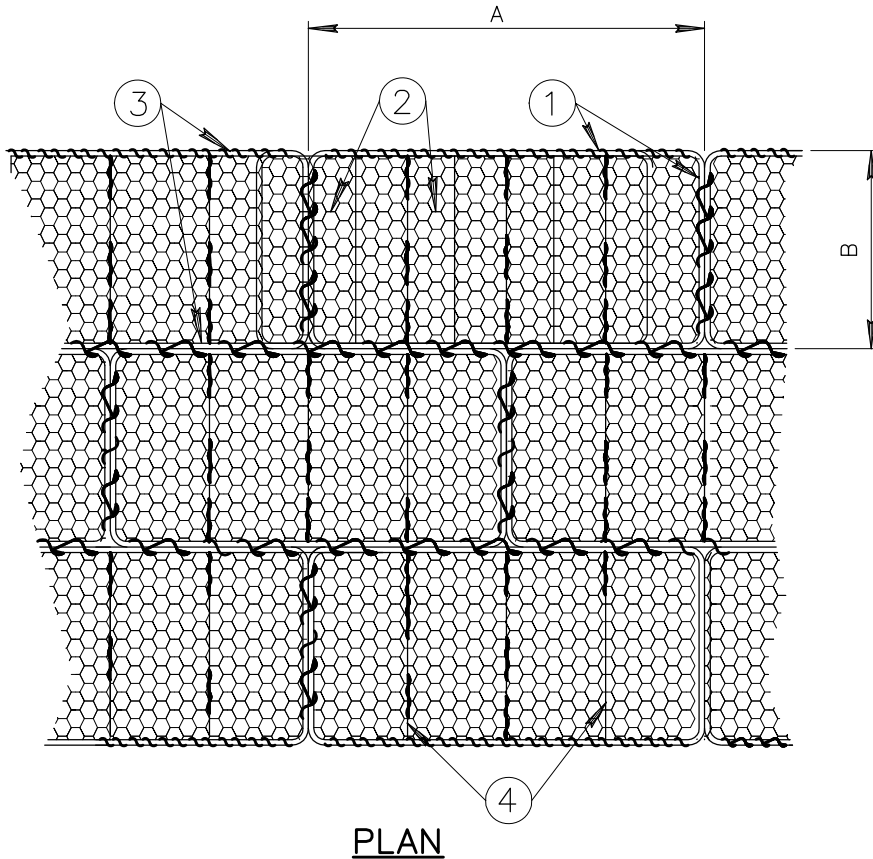
REVISED

01-01-2015

DETAIL NO.

552

TYPICAL GABIONS



- ① HEAVY GAUGE FRAME WIRE.
- ② HEAVY GAUGE TRIPLE-TWIST HEXAGONAL MESH (OR EQUAL) FASTENED TO FRAME WIRE.
- ③ CONTINUOUS HEAVY GAUGE WRAPPED AROUND FRAMES TO FASTEN GABIONS TO EACH OTHER.
- ④ PARTITIONS TO PREVENT SHIFTING, NORMALLY ONE PER 3' LENGTH. INSTALLED AT FACTORY.

NOMINAL SIZE COMBINATIONS					
LENGTH	WIDTH	DEPTH			
A	B	C			
6'	3'	1'	1.5'	3'	
9'	3'	1'	1.5'	3'	
12'	3'	1'	1.5'	3'	

NOTE:

OTHER SIZES AVAILABLE FROM MANUFACTURER.

DETAIL NO.

555



STANDARD DETAIL
ENGLISH

EROSION PROTECTION / GABIONS

REVISED

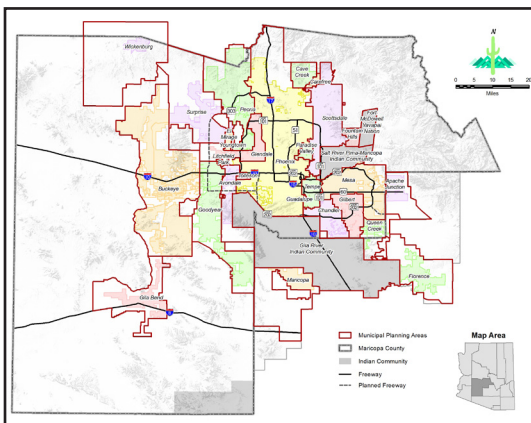
01-01-2010

DETAIL NO.

555



2016 Revision to the
2015 Edition



Uniform Standard Specifications and Details for Public Works Construction

Sponsored and Distributed by the



January 2016

NEW IN THE 2016 REVISION

Uniform Standard Specifications and Details for Public Works Construction—2016 Revision to the 2015 Edition

The MAG Standard Specifications and Details Committee, with assistance from five specialized working groups, considered 18 cases during the 2015 session. Of these, 14 were approved and included in this revision.

New Specifications:

- Section 322: Decorative Asphalt
- Section 608: Horizontal Directional Drilling

Specifications rewritten, or with major updates:

- Section 321: Placement and Construction of Asphalt Concrete Pavement
- Section 336: Pavement Matching and Surfacing Replacement
- Section 342: Interlocking Concrete Paver Installations
- Section 602: Trenchless Installation of Steel Casing
- Section 718: Preservative Seal for Asphalt Concrete

Specifications with minor updates:

- Section 325: Placement and Construction of Asphalt-Rubber Asphalt Concrete Pavement
- Section 334: Preservative Seal for Asphalt Concrete
- Section 345: Adjusting Frames, Covers and Valve Boxes

- Section 601: Trench Excavation, Backfilling and Compaction
- Section 625: Manhole Construction and Drop Sewer Connections
- Section 710: Asphalt Concrete
- Section 717: Asphalt-Rubber Asphalt Concrete
- Section 735: Reinforced Concrete Pipe
- Section 771: Galvanizing
- Section 772: Chain Link Fence

Specifications that have been deleted:

- Section 744: ABS Truss Pipe and Fittings

Details that have been updated:

- Detail 145: Safety Rail
- Detail 200-1: Trench Backfill and Surface Replacement
- Detail 200-2: Trench Backfill and Surface Replacement
- Detail 225: Interlocking Concrete Pavers
- Detail 270: Frame and Cover and Grade Adjustment

Changes made in the 2015 Edition

Uniform Standard Specifications and Details for Public Works Construction—2015 Edition

The MAG Standard Specifications and Details Committee considered 22 cases during the 2014 session. Of these, 18 were approved and included in this revision.

New Specifications:

- Section 607: Trenchless Installation of Smooth Wall Jacking Pipe
- Section 742: Precast Manhole

Specifications rewritten, or with major updates:

- Section 101: Abbreviations and Definitions
- Section 321: Placement and Construction of Asphalt Concrete Pavement
- Section 324: Portland Cement Concrete Pavement
- Section 325: Placement and Construction of Asphalt-Rubber Asphalt Concrete Pavement
- Section 405: Monuments
- Section 601: Trench Excavation, Backfilling and Compaction
- Section 610: Water Line Construction
- Section 611: Water, Sewer and Storm Drain Testing
(was *Disinfecting Water Mains*)
- Section 615: Sewer Line Construction
- Section 618: Storm Drain Construction
- Section 625: Manhole Construction and Drop Sewer Connections
- Section 735: Reinforced Concrete Pipe

Specifications with minor updates:

- Section 107: Legal Regulations and Responsibility to Public
- Section 206: Structure Excavation and Backfill
- Section 211: Fill Construction
- Section 310: Placement and Construction of Aggregate Base Course
- Section 336: Pavement Matching and Surfacing Replacement
- Section 340: Concrete Curb, Gutter, Sidewalk, Sidewalk Ramps, Driveway and Alley Entrance
- Section 342: Decorative Pavement, Concrete Paving Stone
- Section 345: Adjusting Frames, Covers, Valve Boxes, Meter Boxes and Pull Boxes
- Section 355: Utility Potholes-Keyhole Method
- Section 616: Reclaimed Water Line Construction
- Section 710: Asphalt Concrete
- Section 717: Asphalt-Rubber Asphalt Concrete
- Section 726: Concrete Curing Materials

- Section 739: Steel Reinforced Polyethylene Pipe and Fittings for Storm Drain, Irrigation and Sanitary Sewer
- Section 740: Polypropylene Pipe and Fittings for Storm Drain, Irrigation and Sanitary Sewer
- Section 750: Iron Water Pipe and Fittings
- Section 775: Brick and Concrete Masonry Units (Blocks)

Specifications that have been deleted:

- Section 603: Installation for High Density Polyethylene Pipe
(*Incorporated into Section 601.*)

New detail drawings:

- Detail 420-1: Concrete Sanitary Sewer Manhole
(*Replaces existing 420-1: Precast Concrete Sewer Manhole*)
- Detail 420-2: Precast Manhole Base
- Detail 420-3: Concrete Manhole Base
(*Replaces parts of existing 420-2 and adds details.*)

Details that have been updated:

- Detail 100-1: Index (Page 1 of 2)
- Detail 100-2: Index (Page 2 of 2)
- Detail 120: Survey Marker
- Detail 200-1: Backfill, Pavement and Surface Replacement
- Detail 200-2: Backfill, Pavement and Surface Replacement
- Detail 212: Utility Pothole Repair
- Detail 391-1: Valve Box Installation and Grade Adjustment
- Detail 391-2: Valve Box Installation and Grade Adjustment
- Detail 392: Debris Cap Installation
- Detail 421: Offset Manhole 8" to 30" Pipe
- Detail 422: Manhole Frame and Cover Adjustment
(*Deletes Brick Sewer Manhole drawing from existing Detail 422*)
- Detail 429: Industrial Waste Control Vault with Manhole
- Detail 522: Storm Drain Manhole Shaft
- Detail 552: Ford Crossing and Cut-off Walls

Details that have been deleted:

- Detail 428: Manhole Steps

Changes made in the 2014 Revision

Uniform Standard Specifications and Details for Public Works Construction—2014 Revision to the 2012 Edition

The MAG Standard Specifications and Details Committee considered 26 cases during the 2013 session. Of these, 23 were approved and included in 2015 Edition.

New Specifications:

- Section 602: Trenchless Installation of Steel Casing (*Replaces Section 602: Encasement of Water of Sewer Pipe by Jacking or Tunneling Operation*)
- Section 739: Steel Reinforced Polyethylene Pipe (SRPE)
- Section 740: Polypropylene Pipe and Fittings for Storm Drain, Irrigation, and Sanitary Sewer

Specifications rewritten, or with major updates:

- Section 309: Lime Stabilization or Modification of Subgrade
- Section 321: Placement and Construction of Asphalt Concrete Pavement
- Section 337: Crack Sealing
- Section 340: Concrete Curb, Gutter, Sidewalk, Sidewalk Ramps, Driveway and Alley Entrance
- Section 345: Adjusting Frames, Covers, Valve Boxes, and Water Meter Boxes
- Section 610: Water Line Construction
- Section 711: Paving Asphalt
- Section 729: Expansion Joint Filler

Specifications with minor updates:

- Section 107: Legal Requirements and Responsibility to Public
- Section 108: Commencement, Prosecution and Progress
- Section 301: Subgrade Preparation
- Section 311: Placement and Construction of Cement Treated Subgrade
- Section 324: Portland Cement Concrete Pavement

- Section 415: Flexible Metal Guardrail
- Section 430: Landscaping and Planting
- Section 505: Concrete Structures
- Section 605: Subdrainage
- Section 725: Portland Cement Concrete
- Section 735: Reinforced Concrete Pipe
- Section 795: Landscape Materials

Specifications that have been deleted:

- Section 737: Asbestos-Cement Pipe and Fittings for Storm Drain and Sanitary Sewer

New detail drawing:

- Detail 120: Survey Marker (*Replaces Details 120-1 and 120-2*)

Details that have been updated:

- Detail 201: Asphalt Pavement Edge Details
- Detail 221: Curb and Gutter Transition Type A to Type C Integral Roll Curb, Gutter and Sidewalk
- Detail 230: Sidewalks
- Detail 250-1: Driveway Entrances with Detached Sidewalk
- Detail 270: Frame and Cover
- Detail 391-1: Valve Box Installation and Grade Adjustment
- Detail 501-5: Headwall Drop Inlet

Details that have been deleted:

- Detail 120-2: Survey Marker (for Unincorporated Maricopa County)

Changes made in the 2013 Revision

Uniform Standard Specifications and Details for Public Works Construction—2013 Revision to the 2012 Edition

The MAG Standard Specifications and Details Committee considered 20 cases during the 2012 session. Of these, 17 were approved and included in the 2015 Edition.

New Specifications:

- None

Specifications rewritten, or with major updates:

- Section 107: Legal Regulations and Responsibility to Public
- Section 310: Placement and Construction of Aggregate Base
- Section 350: Removal of Existing Improvements
- Section 415: Flexible Metal Guardrail
- Section 701: Aggregate
- Section 702: Base Materials
- Section 710: Asphalt Concrete
- Section 711: Paving Asphalt

Specifications with minor updates:

- Section 108: Commencement, Prosecution and Progress
- Section 317: Asphalt Milling
- Section 321: Placement and Construction of Asphalt Concrete Pavement
- Section 332: Placement and Construction of Asphalt Emulsion Slurry Seal Coat
- Section 505: Concrete Structures

- Section 610: Water Line Construction
- Section 725: Portland Cement Concrete
- Section 728: Controlled Low Strength Materials
- Section 770: Structural and Rivet Steel, Rivets, Bolts, Pins and Anchor Bolts.

Specifications that have been deleted:

- Section 709: Reclaimed Asphalt Pavement
- Section 719: Recycled Asphalt Concrete Hot Mixed

New detail drawings:

- Detail 260: Alley Entrance (With Vertical Curb and Gutter)
- Detail 360-1: Dry Barrel Fire Hydrant Installation
- Detail 360-2: Wet Barrel Fire Hydrant Installation
- Detail 360-3: Fire Hydrant Installation Details

Details that have been updated:

- Detail 160: 6' Chain Link Fence and Gate
- Detail 201: Asphalt Pavement Edge Details
- Detail 250-2: Driveway Entrances with Sidewalk Attached to Curb

**UNIFORM STANDARD
SPECIFICATIONS
for
PUBLIC WORKS
CONSTRUCTION**

**SPONSORED and DISTRIBUTED
by the**



2016 Revision to the 2015 Edition

ARIZONA

FOREWORD

Publication of these Uniform Standard Specifications and Details for Public Works Construction fulfills the goal of a group of agencies who joined forces in 1966 to produce such a set of documents. Subsequently, in the interest of promoting county-wide acceptance and use of these standards and details, the Maricopa Association of Governments accepted their sponsorship and the responsibility of keeping them current and viable.

These specifications and details, representing the best professional thinking of representatives of several Public Works Departments, reviewed and refined by members of the construction industry, were written to fulfill the need for uniform rules governing public works construction performed for Maricopa County and the various cities and public agencies within Maricopa County who could not afford to promulgate such standards for themselves. Agencies in other regions or climes that desire to use these specifications may need to make adjustments for local conditions.

A uniform set of specifications and details, updated and embracing the most modern materials and construction techniques will reduce conflicts, provide clarity and lower construction costs for the benefit of the public.

Use of these standards for projects outside of the right-of-way should be reviewed by professional engineers and architects and applied with care to insure relevance to the planned work.

Specifications and details should be incorporated into project plans and specifications after careful review by the design engineer or architect of specific project needs. Not all specifications contained herein will apply to all projects. Prepared plans and specifications should clearly call out only those specific uniform specifications and details required for the project.

Uniform specifications and details are not a substitute for good engineering judgment. Unique conditions will arise that are outside the scope of these standards. When this happens, professional engineers and architects are required to use their judgment to amend these standards to best meet site-specific project needs in accordance with the rules set forth by the State of Arizona and policy statements made by the Arizona State Board of Technical Registration.

The Uniform Standard Specifications and Details for Public Works Construction are revised periodically and reprinted to reflect the changing technology of the construction industry. To this end a Specifications and Details Committee has been established as a permanent organization to continually study and recommend changes to the Specifications and Details. Interested parties may address suggested changes and questions to:

Standard Specifications & Details Committee
c/o Maricopa Association of Governments
302 North First Avenue, Suite 300
Phoenix, Arizona, 85003

Suggestions will be reviewed by the committee and appropriate segments of the construction industry and revisions will be published the first of each year. A copy of this publication is available for review on the internet at the website listed below. Please follow the links to the publications page and look for *Uniform Standard Specifications for Public Works Construction* and/or *Uniform Standard Details for Public Works Construction*:

www.azmag.gov

In the interest of regional uniformity, it is hoped that all using agencies will adopt these standards with minimal changes. It is recognized that because of charter requirements and for other reasons, some agencies will find it necessary to modify or supplement certain requirements. In the interest of regional uniformity, it is strongly recommended that using agencies bring desired modifications to the MAG Committee for consideration and inclusion into these standards.

TABLE OF CONTENTS

PART 100 - GENERAL CONDITIONS

Section	Last Revised	Title	Page
101	2015	Abbreviations and Definitions	101-1
102	2008	Bidding Requirements and Conditions	102-1
103	1999	Award and Execution of Contract	103-1
104	2012	Scope of Work	104-1
105	2008	Control of Work	105-1
106	1998	Control of Materials	106-1
107	2015	Legal Regulations and Responsibility to Public	107-1
108	2014	Commencement, Prosecution and Progress	108-1
109	2011	Measurements and Payments	109-1
110	2000	Notification of Changed Conditions and Dispute Resolution	110-1

PART 200 - EARTHWORK

Section	Last Revised	Title	Page
201	1999	Clearing and Grubbing	201-1
205	1998	Roadway Excavation	205-1
206	2015	Structure Excavation and Backfill	206-1
210	2009	Borrow Excavation	210-1
211	2015	Fill Construction	211-1
215	1998	Earthwork for Open Channels	215-1
220	2012	Riprap Construction	220-1
230	2010	Dust Palliative Application	230-1

PART 300 - STREETS AND RELATED WORK

Section	Last Revised	Title	Page
301	2014	Subgrade Preparation	301-1
306	2010	Mechanically Stabilized Subgrade- Geogrid Reinforcement	306-1
309	2014	Lime Slurry Stabilization or Modification of Subgrade	309-1
310	2015	Placement and Construction of Aggregate Base Course	310-1
311	2014	Placement and Construction of Cement Treated Subgrade	311-1
312	2012	Cement Treated Base	312-1
315	1998	Bituminous Prime Coat	315-1
317	2013	Asphalt Milling	317-1
320	1999	Road-Mixed Surfacing	320-1
321	2016	Placement and Construction of Asphalt Concrete Pavement	321-1
322	2016	Decorative Asphalt	322-1
324	2015	Portland Cement Concrete Pavement (PCCP)	324-1
325	2016	Placement and Construction of Asphalt-Rubber Asphalt Concrete	325-1
327	2012	Hot In-Place Recycling	327-1
329	1998	Tack Coat	329-1
330	1998	Asphalt Chip Seal	330-1
331	2009	Microsurfacing Specifications	331-1
332	2013	Placement and Construction of Asphalt Emulsion Slurry Seal Coat	332-1
333	2012	Fog Seal Coats	333-1
334	2016	Preservative Seal for Asphalt Concrete	334-1
335	2012	Placement and Construction of Hot Asphalt-Rubber Seal	335-1
336	2016	Pavement Matching and Surfacing Replacement	336-1
337	2014	Crack Sealing	337-1
340	2015	Concrete Curb, Gutter, Sidewalk, Curb Ramps, Driveway and Alley Entrance	340-1
342	2016	Interlocking Concrete Paver Installations	342-1
343	1998	Exposed Aggregate Paving	343-1
345	2016	Adjusting Frames, Covers and Valve Boxes	345-1
350	2013	Removal of Existing Improvements	350-1
355	2015	Utility Potholes-Keyhole Method	355-1
360	1998	Telecommunications Installation	360-1

PART 400 - RIGHT-OF-WAY AND TRAFFIC CONTROL

Section	Last Revised	Title	Page
401	1998	Traffic Control	401-1
405	2015	Survey Monuments	405-1
410	1998	Precast Safety Curbs	410-1
415	2014	Flexible Metal Guardrail	415-1
420	1998	Chain Link Fences	420-1
424	1998	Parkway Grading	424-1
425	1998	Topsoils	425-1
430	2014	Landscaping and Planting	430-1
440	1999	Sprinkler Irrigation System Installation	440-1

PART 500 - STRUCTURES

Section	Last Revised	Title	Page
505	2014	Concrete Structures	505-1
506	2012	Precast Prestressed Concrete Members	506-1
510	1998	Concrete Block Masonry	510-1
511	1998	Brick Masonry	511-1
515	1998	Steel Structures	515-1
520	2012	Steel and Aluminum Handrails	520-1
525	1998	Pneumatically Placed Mortar	525-1
530	2000	Painting	530-1

PART 600 – WATER, SEWER, STORM DRAIN AND IRRIGATION

Section	Last Revised	Title	Page
■ 601	2016	Trench Excavation, Backfilling and Compaction	601-1
■ 602	2016	Trenchless Installation of Steel Casing	602-1
604	2012	Placement of Controlled Low Strength Material	604-1
605	2014	Subdrainage	605-1
607	2015	Trenchless Installation of Smooth Wall Jacking Pipe	607-1
■ 608	2016	Horizontal Directional Drilling	608-1
610	2015	Water Line Construction	610-1
611	2015	Water, Sewer and Storm Drain Testing	611-1
615	2015	Sanitary Sewer Line Construction	615-1
616	2015	Reclaimed Water Line Construction	616-1
618	2015	Storm Drain Construction	618-1
620	2012	Cast-in-place Concrete Pipe	620-1
621	1998	Corrugated Metal Pipe and Arches	621-1
■ 625	2016	Manhole Construction and Drop Sewer Connections	625-1
630	2012	Tapping Sleeves, Valves and Valve Boxes on Water Lines	630-1
631	2012	Water Taps and Meter Service Connections	631-1

PART 700 - MATERIALS

Section	Last Revised	Title	Page
701	2013	Aggregate	701-1
702	2013	Base Materials	702-1
703	2012	Riprap	703-1
705	2012	Portland Cement Treated Base	705-1
708	2011	Asphalt Pavement Core Bonding Materials	708-1
■ 710	2016	Asphalt Concrete	710-1
711	2014	Paving Asphalt	711-1
712	1999	Liquid Asphalt	712-1
713	2012	Emulsified Asphalts Materials	713-1
714	2012	Microsurfacing Materials	714-1

Section	Last Revised	Title	Page
715	2012	Slurry Seal Materials	715-1
716	2012	Cover Material	716-1
717	2016	Asphalt-Rubber Asphalt Concrete	717-1
718	2016	Preservative Seal for Asphalt Concrete	718-1
725	2014	Portland Cement Concrete	725-1
726	2015	Concrete Curing Materials	726-1
727	2008	Steel Reinforcement	727-1
728	2013	Controlled Low Strength Material	728-1
729	2014	Expansion Joint Filler	729-1
735	2016	Reinforced Concrete Pipe	735-1
736	2012	Non-Reinforced Concrete Pipe	736-1
738	2012	High Density Polyethylene Pipe And Fittings for Storm Drain And Sanitary Sewer	738-1
739	2015	Steel Reinforced Polyethylene Pipe And Fittings for Storm Drain, Irrigation And Sanitary Sewer	739-1
740	2014	Polypropylene Pipe And Fittings for Storm Drain, Irrigation And Sanitary Sewer	740-1
741	2011	Lining for Reinforced Concrete Sanitary Sewer Pipe	741-1
742	2015	Precast Manhole	742-1
743	1998	Vitrified Clay Pipe	743-1
745	1998	PVC Sewer Pipe and Fittings	745-1
750	2015	Iron Water Pipe and Fittings	750-1
752	1998	Asbestos-Cement Water Pipe and Fittings	752-1
753	2000	Galvanized Pipe and Fittings	753-1
754	2012	Copper Pipe, Tubing and Fittings	754-1
755	2012	Polyethylene Pipe for Water Distribution	755-1
756	2008	Dry Barrel Fire Hydrants	756-1
757	1998	Sprinkler Irrigation System	757-1
758	2005	Concrete Pressure Pipe - Steel Cylinder Type	758-1
759	2002	Steel Pipe	759-1
760	1998	Coating Corrugated Metal Pipe and Arches	760-1
761	1998	Structural Plate Pipe, Arches, and Pipe Arches	761-1
770	2013	Structural and Rivet Steel, Rivets, Bolts, Pins, and Anchor Bolts	770-1
771	2016	Galvanizing	771-1
772	2016	Chain Link Fence	772-2
775	2015	Brick and Concrete Masonry Units (Blocks)	775-1
776	2012	Masonry Mortar and Grout	776-1
778	1998	Lumber	778-1
779	1998	Wood Preservatives	779-1
787	1999	Gray Iron Castings	787-1
790	1999	Paint	790-1
792	2010	Dust Palliative	792-1
795	2014	Landscape Material	795-1
796	2010	Geosynthetics	796-1
	2016	Index	Index-1

This Page Reserved for Future Use

PART 100

GENERAL CONDITIONS

Section	Last Revised	Title	Page
101	2015	<u>Abbreviations and Definitions</u>	101-1
102	2008	<u>Bidding Requirements and Conditions</u>	102-1
103	1999	<u>Award and Execution of Contract</u>	103-1
104	2012	<u>Scope of Work</u>	104-1
105	2008	<u>Control of Work</u>	105-1
106	1998	<u>Control of Materials</u>	106-1
107	2015	<u>Legal Regulations and Responsibility to Public</u>	107-1
108	2014	<u>Commencement, Prosecution and Progress</u>	108-1
109	2011	<u>Measurements and Payments</u>	109-1
110	2000	<u>Notification of Changed Conditions and Dispute Resolution</u>	110-1

This Page Reserved for Future Use

SECTION 101

ABBREVIATIONS AND DEFINITIONS

101.1 ABBREVIATIONS:

Wherever the following abbreviations are used in these specifications, standard details or on the plans, they are to be constructed the same as the respective expressions represented.

AASHTO	American Association of State Highway and Transportation Officials	Brg	Bearing
AAN	American Association of Nurserymen	BST	Bituminous Surface Treatment
AB	Aggregate base	BTB	Bituminous Treated Base
Aban	Abandon	BTU	British Thermal Units
ABC	Aggregate base course	BVC	Beginning of vertical curve
AC	Asphalt cement or concrete	C	Centigrade or Curb
ACB	Asphalt concrete base	CB	Catch Basin
ACI	American Concrete Institute	CBF&C	Catch basin frame & cover
ACP	Asbestos cement pipe	CC or C/C	Center to Center
ACPA	American Concrete Pipe Association	CE	City or County Engineer
ACWS	Asphalt concrete wearing surface	Cem	Cement
AFRB	Arizona Fire Rating Bureau	CF	Curb face
AGC	Associated General Contractors of America, Inc.	cfs	Cubic Feet per second
Agg	Aggregate	CIP	Cast Iron pipe
ADOT	Arizona Department of Transportation	CIPP	Cast-in-place concrete pipe
ADA	Americans With Disabilities Act of 1990	CL or C	Centerline
ADEQ	Arizona Department of Environmental Quality	CLR	Clear
Ahd	Ahead	Cm	Centimeter
AIA	American Institute of Architects	CMP	Corrugated metal pipe
AIEE	American Institute of Electrical Engineers	CO	Clean out
AISC	American Institute of Steel Construction	Col	Column
ANSI	American National Standards Institute	Conc	Concrete
APA	American Plywood Association	Const	Construct
Approx	Approximate	CP	Concrete pipe (non-reinforced)
APWA	American Public Works Association	CTB	Cement Treated Base
AR	Aged residue	Cu	Cubic
ARAC	Asphalt-Rubber Asphalt Concrete	Deg	Degree
ARIZ	Arizona Department of Transportation Test Method	DF	Douglas Fir
ARS	Arizona Revised Statutes	DG	Decomposed granite
ASCE	American Society of Civil Engineers	Dia	Diameter
ASME	American Society of Mechanical Engineers	Dim	Dimension
ASTM	American Society for Testing Materials	DIP	Ductile Iron Pipe
Ave	Avenue	Div	Division
AWPA	American Wood Preservers Association	Dr	Drive
AWSC	American Welding Society Code	Drwg	Drawing
AWWA	American Water Works Association	Dwy	Driveway
Bbl	Barrel	Ea	Each
BC	Beginning of curve	Ease	Easement
BCR	Beginning of curb return	E	East
Beg	Beginning	EC	End of curve
Bk	Book or Back	ECR	End of curb return
Blvd	Boulevard	El or Elv	Elevation
BM	Bench Mark or Board Measure	Equa or Eq	Equation
		EVC	End of vertical curve
		Ex or Exist	Existing
		F	Fahrenheit
		FB	Field book
		F & C	Frame & cover
		FH	Fire hydrant
		FL or F	Floor line or flow line
		Fl El	Floor Elevation
		Fnd	Found
		fps	Feet per second
		FS	Finished surface

SECTION 101

FSS	Federal Specifications and Standards	NFPA	National Fire Protection Association
Ft	Foot or feet	NP	Non-Plastic
G	Gutter	NPI	Non pay item
Ga	Gage	NSC	National Safety Council
Galv	Galvanized	NSF	National Sanitation Foundation
GL	Ground line	NTS	Not to Scale
Gpm	Gallons per minute	NW	Northwest
Gr	Grade	No	Number
H	High or height	OC	On Center
HC	House connection	OD	Outside Diameter
HH	Hand Hole	Oz	Ounces
Hdwl	Headwall	PC	Point of Curvature
Horiz	Horizontal	PCC	Point of Compound Curve or Portland Cement Concrete
Hwy	Highway	PI	Point of Intersection or Plastic Index
ICA	Industrial Commission of Arizona	PL	Property Line
ID	Improvement District or inside diameter	POC	Point of Curve
IE	Invert Elevation	POS	Point of Spiral
IEEE	Institute of Electrical and Electronic Engineers	PP	Power Pole
In	Inch	ppm	Parts per million
Inv	Invert	PRC	Point of Reverse Curve
IP	Iron Pipe	Prod	Produced
IPS	Iron Pipe Size	Prop	Proposed or Property
Irrig	Irrigation	psi	Pounds per square inch
Jt	Joint	psf	Pounds per square foot
JC	Junction Chamber	PT or POT	Point of Tangent
Jct	Junction	P&TP	Power and Telephone Pole
JS	Junction Structure	Pvmt	Pavement
L	Length	Q	Rate of flow
Lb	Pound	R	Radius
L&T	Lead and Tack	RC	Reinforced Concrete
LD	Local Depression	RCP	Reinforced Concrete Pipe
LF	Linear Feet	Rd	Road
LH	Lamp Hole	Rdwy	Roadway
Lin	Linear	Reinf	Reinforced, Reinforcing
Long	Longitudinal	Ret Wall	Retaining Wall
Lt	Left	RGRCP	Rubber Gasket Reinforced Concrete Pipe
M	Map or Maps	rpm	Revolutions Per Minute
MAG	Maricopa Association of Governments	Rt	Right
Max	Maximum	R/W	Right-of-way
MCR	Maricopa County Records	S	South or Slope
Meas	Measured	SAE	Society of Automotive Engineers
MH	Manhole	San	Sanitary
MHF&C	Manhole Frame and Cover	SC	Spiral to Curve
Min	Minutes or Minimum	SCCP	Steel Cylinder Concrete Pipe
Misc	Miscellaneous	SD	Storm Drain or Sewer District
ML or M	Monument Line	Sdl	Saddle
mm	Millimeter	Sec	Seconds
Mon	Monolithic or monument	Sect	Section
MTD	Multiple Tile Duct	SE	Southeast
N	North	Sht	Sheet
NBS	National Bureau of Standards	Spec	Specifications
NCPI	National Clay Pipe Institute	SPR	Simplified Practice Recommendation
NE	Northeast	Sp MH	Special Manhole
NEC	National Electric Code	Sq Ft Yd	Square Foot, Yard
NEMA	National Electrical Manufacturer's Association	SS	Sanitary Sewer

SECTION 101

St	Street
Sta	Station
Std	Standard
Str gr	Structural grade
Struct	Structure or structural
SW	Southwest
SWPPP	Stormwater Pollution Prevention Plan
T	Tangent Distance
Tel	Telephone
Temp	Temporary
TH	Test Hole
TP	Telephone pole
Tr	Tract
Trans	Transition
TS	Traffic signal or Tangent to spiral
TSC	Traffic signal conduit
Typ	Typical
UL	Underwriters' Laboratories Inc.
USC & GS	United States Coast and Geodetic Survey
USGS	United States Geological Survey
V	Velocity of flow
VC	Vertical curve
VCP	Vitrified clay pipe
Vert	Vertical
W	West or width
WI	Wrought iron
WS	Wearing surface
Wt	Weight
Yd	Yard
'	feet or minutes
"	inches or seconds
°	degrees
%	percent
#	number or pound
@	at
/	per
=	equals

SECTION 101

101.2 DEFINITIONS AND TERMS:

Whenever in these specifications or in other contract documents the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

Addendum: A supplement to any of the Contract Documents issued, in writing, after advertisement of but prior to the opening of bids for a contract.

Advertisement: The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

Agency: The governmental agency for which the construction is being done, either by permit or contract.

Architect: The individual or firm who has accomplished the architectural services for the project, including his representatives.

Arizona Test Method: Arizona Department of Transportation Materials Testing Manual test method.

Award: The formal action of the governing body is accepting a proposal.

Backfill: Material placed in an excavated space to fill such space. For trenches, see definitions for Initial Backfill and Final Backfill.

Base Course: The upper course of the granular base of a pavement or the lower course of an asphalt concrete pavement structure.

Bedding: A material layer placed on top of the trench foundation to the bottom of the pipe, typically 4-6 inches in height. The bedding establishes the line and grade for a conduit and provides support that is firm, but not hard.

Bidder: Any qualified individual, firm, partnership, corporation or combination thereof, acting directly or through a duly authorized representative who legally submits a proposal for the advertised work.

Board of Supervisors: The Maricopa County Board of Supervisors acting under the authority of the laws of the State of Arizona.

Bond Issue Project: A project financed from bonds issued by the City or County pledging credit or a revenue resource.

Bridge: A structure, including supports, erected over a depression or an obstruction, as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of roadway of more than 20 feet between undercopings of abutments or extreme ends of openings for multiple boxes.

(Length) The length of a bridge structure is the over-all length measured along the line of survey stationing back to back of backwalls of abutments, if present, otherwise end to end of the bridge floor; but in no case less than the total clear opening of the structure.

(Roadway Width) The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom or curbs or guard timbers or in the case of multiple heights of curbs, between the bottoms of the lower risers.

Budget Project: A project financed by funds from General Tax levies and shared revenue funds set aside in the annual budget adopted by the Council or Board of Supervisors.

Building: Any structure built for the support, shelter, or enclosure of persons, animals, chattel or movable property.

Building Code: A regulation adopted by the governing body establishing minimum standards of construction for the protection of the public health, safety, and welfare in terms of measured performance rather than in terms of rigid specification of materials and methods.

Calendar Day: Every day shown on the calendar.

SECTION 101

Call for Bids: The standard forms inviting proposals or bids.

“Careful and prudent manner”: means conducting excavation in such a way that when it approaches within twenty-four inches of the underground facility located and marked by the owner or operator, by stakes, paint or in some customary manner, the exact location is manually determined, and the uncovered facility is supported and protected.

Change Order: A written order issued by the Engineer to the Contractor to make changes in the work or to perform extra work, and setting forth conditions for payment and/or adjustment in time of completion.

City: A municipal corporation, organized and existing under and by virtue of the laws of the State of Arizona.

City/County Clerk: The duly authorized person who performs the duties of clerk for the Contracting Agency.

Completion Time: The number of calendar days for completion of an act, including authorized time extensions. In case a calendar date of completion is shown in the proposal in lieu of the number of calendar days, the contract shall be completed by that date. The time within which an act is to be done shall be computed by excluding the first and including the last day; and if the last day be Sunday or a legal holiday, that shall be excluded.

Conflicting Utility: An existing utility, shown or not shown on the plans is conflicting when any part of the utility falls within the dimensions of the new installation, such that it would be in physical contact with the new installation.

Construction Project: The erection, installation, remodeling, alteration, of durable facilities upon, under, or over the ground. This shall include, but is not limited to buildings, roadways and utility pipes, lines, poles or other structures.

Contingent Bid Item: This is a minor bid item which is likely, but not certain, to occur during the course of work. If the Engineer determines that this work is required, the Contractor will accomplish the work and payment will be made based on the contingent unit bid price included in the proposal. Since the quantity listed in the proposal is primarily for bid comparison, the amount of work required by the Engineer may vary materially from this.

Contract: The written instrument executed by the Contractor and the Contracting Agency by which the Contractor is bound to furnish all labor, equipment, and materials and to perform the work specified, and by which the Contracting Agency is obligated to compensate the Contractor therefore at the prices set forth therein. The Contract Documents are herewith by reference made a part of the contract as if fully set forth therein.

Contract Documents: All the integral documents of the contract, including but not limited to, Call for Bids, Plans, Standard Specifications and Details, Special Provisions, Proposal, Addenda, Performance Bond, Payment Bond, Certificates of Insurance, Ordinance, Contract, and Change Orders.

Contracting Agency: The legal entity that has contracted for the performance of the work or for whom the work is being performed.

Contractor: The individual, firm, partnership, corporation or combination thereof entering into a contract with the Contracting Agency to perform the advertised work.

Council: The City Council which by law constitutes the Legislative Department of the City.

County: Maricopa County, organized and existing under and by virtue of the laws of the State of Arizona.

Culvert: Any structure not classified as a bridge, which provides an opening under or adjacent to the roadway.

Days: Unless otherwise designated, days will be understood to mean calendar days.

Emergency: Unforeseen occurrences and combinations of circumstances involving the public welfare or the protection of work already done under the Contract Documents, or which endanger life or property and call for immediate action or remedy.

Engineer: The person, appointed as City or County Engineer by the Council or the Board of Supervisors, acting directly or through his duly authorized representative.

SECTION 101

Equipment: (Construction) — All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of work. (Installed) — All material or articles used in equipping a facility as furnishings or apparatus to fulfill a functional design.

Extra Work: An item of work not provided for in the contract as awarded but found essential to the satisfactory completion of the contract within its intended scope.

Final Backfill: The material placed in a trench above the initial backfill to the top of the trench or to the bottom of the road base material.

Flooding: Flooding will consist of the inundation of the entire lift with water, puddle with poles or bars to insure saturation of the entire lift.

Force Account Work: Work done by personnel of the Contracting Agency as in-house work.

Foundation: For buildings or structures, this will be the substructure. For a trench, the foundation is the bottom of the required trench excavation. The foundation surface is either native material, or replacement material when unsuitable material occurs, and is removed and replaced at the bottom of the required trench excavation.

Full Depth Pavement: An asphalt concrete pavement structure in which the granular base and subbase are replaced by proportionate thicknesses of asphalt concrete.

Haunching: The area of a pipe trench between the bottom of the pipe and the springline of the pipe.

Improvement District Project: A project financed by assessments against the property included in a special assessment district authorized under, or implemented by an act of the legislature of the State and/or a procedural ordinance of the City or County.

Initial Backfill: The material placed in a trench between the springline and 12 inches above the crown of the conduit.

Inspector: The Engineer's authorized representative assigned to make detailed inspections of contract performance.

Jetting: Jetting is the densification of material, using a continuous supply of water, under pressure, transmitted to the material through a rigid pipe of sufficient length to reach the bottom of the lift being densified. In all cases, the entire lift will be completely saturated working from the top to the bottom.

Laboratory: The established materials testing laboratory of the Contracting Agency's Engineering Department, or other laboratories acceptable to and/or authorized by the Engineer to test materials and work involved in the Contract.

Major Item: A major item shall be the total of any item of work and/or materials specified in the bid schedule that exceeds the amount established in Table [109-1](#).

Materials: Any substance specified in the project, equipment and other material used or consumed in the performance of the work.

Median: The portion of a divided highway separating the roadways used by traffic going in opposite directions.

Non Pay Item: An item of work for which no separate payment will be made under the proposal, but which must be included as an incidental cost for payment on an associated item included in the proposal.

Notice of Award: A letter from the City or County Clerk advising the Contractor that he is the successful bidder and the Council or Board of Supervisors has accepted his proposal.

Notice to Proceed: A directive issued by the Engineer, authorizing the Contractor to start the work or improvements required in the Contract.

SECTION 101

Obligee: One to whom another is obligated.

Open Trench: The excavated area shall be considered as open trench until all the aggregate base course for pavement replacement has been placed and compacted or, if outside of a pavement area, until the excavated area is brought to finish grade or natural grade.

Owner: The City or County, acting through its legally constituted officials, officers or employees.

Pavement: Any surfacing of streets, alleys, sidewalks, courts, driveways, etc., consisting of mineral aggregate bound into a rigid or semi-rigid mass by a suitable binder such as, but not limited to, Portland cement or asphalt cement.

Pavement Structure: The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

Pay Item: A detail of work for which separate payments are to be made under the Contract, as specified in the proposal.

Payment Bond: The security provided by the Contractor solely for the protection of claimants, supplying labor and materials to the Contractor or his Subcontractors.

Performance Bond: The security provided by the Contractor solely for the protection of the Contracting Agency and conditioned upon the faithful performance of the contract in accordance with the plans, specifications and conditions thereof.

Permit: The license to do construction in public rights-of-way and/or easements; issued by an Agency to a Contractor working for another party.

Pipe Embedment Zone: The area of a trench consisting of the bedding, haunching, and initial backfill areas.

Plans: All approved drawings or reproductions thereof pertaining to the work and details therefore, which are made a part of the Contract Documents.

Plant: The Contractor's and/or subcontractor's facilities, including but not limited to small tools and mobile equipment, located on and/or offsite, necessary for preparation of materials and prosecution of work for the project.

Principal: The individual, firm or corporation primarily liable on an obligation, as distinguished from a surety.

Professional Engineer: A person who has a current engineering registration granted by the Arizona State Board of Technical Registration in one or more branches of engineering recognized by the board.

Profile Grade: The trace of a vertical plan intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

Project: A specific coordinated construction or similar undertaking identified by a single project number and bid and awarded as one contract. On occasion two or more projects may be bid and awarded as a single contract.

Proposal: The offer of a bidder on the prescribed form, to perform the work and to furnish the labor and materials at the prices quoted.

Proposal Form: The approved form on which the Contracting Agency requires bids to be prepared and submitted for the work.

Proposal Guarantee: The security furnished with a bid to guarantee that the bidder will enter into the contract if his bid is accepted.

Proposal Pamphlet: The book or pamphlet pertaining to a specific project, containing proposal forms, special provisions and other information necessary for and pertinent to the preparation of the proposal or bid.

Referred Documents: On all work authorized by the Contracting Agency, any referenced documents in the specification, i.e., Bulletins, Standards, Rules, Methods of Analysis or test. Codes and Specifications of other Agencies, Engineering Societies or Industrial Associations, refer to the Latest Edition thereof, including Amendments, which are in effect and published at the time

SECTION 101

of Advertising for Bids or the issuing of a permit for the work, unless otherwise stated.

Right-of-way: A general term denoting land, property, or interest therein, usually in a strip acquired for or devoted to a street, highway, or other public improvement.

Road: A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

Roadside: A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

Roadside Development: Those items necessary to the complete roadway which provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the roadway.

Roadway: The portion of the right-of-way intended primarily for vehicular traffic, and including all appurtenant structures and other features necessary for proper drainage and protection. Where curbs exist, it is that portion of roadway between the faces of the curbs.

Sewers: Conduits and related appurtenances employed to collect and carry off water and waste matter to a suitable point of final discharge.

Shop Drawings: Drawings or reproduction of drawings, detailing; fabrication and erection of structural elements, falsework and forming for structures, fabrication of reinforcing steel, installed equipment and installation of systems, or any other supplementary plans or similar data, which the Contractor is required to submit for approval.

Shoulder: The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

Sidewalk: That portion of the roadway primarily constructed for the use of pedestrians.

Special Provisions: The special conditions, requirements, additions, and/or revisions to the Standard Specifications, applicable to the work, to cover conditions or requirements peculiar to the project under consideration.

Specifications: The descriptions, directions, provisions, and requirement for performing the work as contained in the Contract Documents.

Standard Details: Uniform detail drawings of structures or devices adopted as Standard Details by the Engineer.

Standard Specifications: Uniform general specifications adopted as Standard Specifications by the Engineer.

Springline: The vertical location having a maximum horizontal dimension or in box sections, the mid-height of the vertical wall.

Storm Drain: Any conduit and appurtenance intended for the reception and transfer of storm water.

Street: Streets, avenues, alleys, highways, crossings, lanes, intersections, courts, places, and grounds now open or dedicated or hereafter opened or dedicated to public use and public ways.

Structures: Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, end walls, sewers, service pipes underdrains foundation drains, fences, swimming pools, and other features which may be encountered in the work and not otherwise classed herein.

Subbase: The lower course of the base of a roadway, immediately above the subgrade.

SECTION 101

Subcontractors: Those having direct contracts with the Contractor and those who furnish material worked into a special design according to the Plans and Specifications for the work, but not those who merely furnish material not so worked.

Subgrade: The supporting structures on which the pavement and its special undercourses rest.

Substructure: All of that part of the structure or building below the bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames, together with the backwalls, wingwalls and wing protection railings.

Superintendent: The Contractor's authorized representative in responsible charge of the work.

Superintendent of Streets: The person duly appointed by the Council of the Contracting Agency, as provided by the Arizona Revised Statutes.

Superpave Mix: Asphalt mix in compliance with the Gyrotory Mix design requirements of Section 710.3.2.2.

Superstructure: The entire structure or building except the substructure.

Supplemental Specifications: Additions and revisions to the Standard Specifications that are adopted subsequent to issuance of the printed book.

Supplementary General Conditions: Requirements, or revisions, to the Standard General Conditions, applicable to the work, and to cover conditions or requirements peculiar to the project under consideration.

Surety: The individual, firm or corporation, bound with and for the Contractor for the acceptable performance, execution, and completion of the work, and for the satisfaction of all obligations incurred.

Surface Course: The finished or wearing course of an asphalt concrete pavement structure.

Title or Headings: The titles or headings of the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

Township, City, Town or District: A subdivision of the County used to designate or identify the location of the proposed work.

Traveled Way: The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

“Underground Facility”: means any item which shall be buried or placed below ground for use in connection with the storage or conveyance of water, sewage, electronic, telephone or telegraphic communications, electric energy, oil, gas or other substances, and shall include, but not be limited to pipes, sewers, conduits, cables, valves, lines, wires, manholes, attachments and those portions of poles and their attachments below ground.

Utility: Pipe lines, conduits, ducts, transmission lines, overhead or underground wires, railroads, storm drains, sanitary sewers, irrigation facilities, street lighting, traffic signals, and fire alarm systems, and appurtenances of public utilities and those of private industry, businesses or individuals solely for their own use or use of their customers which are operated or maintained in, on, under, over or across public right-of-way or public or private easement.

Waterworks (Water Supply System): The reservoirs, pipe lines, wells, pumping equipment, purification works, mains, service pipes, and all related appliances and appurtenances utilized in the procurement, transportation and delivery of an adequate, safe, and palatable water supply for the Contracting Agency.

Work: Any or all of the improvements mentioned and authorized to be made, and the construction, demolition, reconstruction, and repair of all or any portion of such improvements, and all labor, services, incidental expenses, and material necessary or incidental thereto.

Working Day: A calendar day, exclusive of Saturdays, Sundays, and Contracting Agency recognized legal holidays, on which weather and other conditions not under the control of the Contractor will permit construction operations to proceed for the

SECTION 101

major part of the day with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time.

101.3 In order to avoid cumbersome and confusing repetition of expressions in these specifications, it is provided that whenever anything is, or is to be, done, if, as, or, when, or where contemplated required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected, or condemned, it shall be understood as if the expression were followed by the words by the Engineer or to the Engineer.

- End of Section -

SECTION 102

BIDDING REQUIREMENTS AND CONDITIONS

102.1 ELIGIBILITY AND PREFERENCE:

The employment of Contractors and Subcontractors on Public Works shall be governed by the provisions of Section 34-241 of the Arizona Revised Statutes.

102.2 CONTENTS OF PROPOSAL PAMPHLET:

The prospective bidder may examine and/or purchase plans, special provisions, and proposal pamphlets at the Engineering Office of the Contracting Agency advertising for bids.

The proposal pamphlet will state the location of the contemplated construction; give the description of the various quantities of work to be performed or materials to be furnished, and have a bid schedule of pay items for which unit bid prices are invited. In addition, it will state the form and amount of the proposal guarantee, the time in which the work shall be completed and include additional instructions not included in these specifications.

The plans, the standard specifications, the standard details, the special provisions, the contracting agency's supplements and all supplementary documents are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In a case of a discrepancy or conflict, the order in which the various documents shall govern is as follows from highest to lowest: addenda, special provisions, plans, agency's supplements to the standard specifications, agency's supplements to the standard details, standard specifications and standard details.

Each and every provision of law and clause required by law to be inserted in the contract shall be deemed to be inserted herein, and the contract shall be read and enforced as though it were included herein.

102.3 INTERPRETATION OF QUANTITIES IN PROPOSAL:

The quantities appearing in the proposal are approximate only and are to be used for the comparison of bids. Payment to the Contractor will be made only for the actual quantities of work performed and accepted or materials furnished in accordance with the contract at the unit bid price in the proposal.

After the contract is awarded the quantities of work listed by any pay item, or all pay items, may be increased or decreased a reasonable amount at the discretion of the Contracting Agency, without in any way invalidating the unit bid price.

102.4 EXAMINATION OF PLANS, SPECIAL PROVISIONS AND SITE OF WORK:

The Contracting Agency will prepare plans and special provisions in accordance with acceptable engineering standards, giving such direction as will enable any competent Contractor to carry them out.

The bidder shall examine the site of the proposed work and all documents pertaining to the work. It is mutually agreed that the submission of a proposal shall be considered prima facie evidence that the bidder has made such examination and is familiar with the character, quality and quantity of the work to be performed and material to be furnished.

Logs of the test holes, ground water levels, and any accompanying soil reports as furnished by the Contracting Agency are furnished for general information only. The field condition so set forth shall not constitute a representation or warranty expressed or implied that such conditions are actually existent. Bidders shall make their own investigations and form their own estimates of the site conditions.

After the submission of the proposal, no complaint or claim that there was any misunderstanding as to the quantities, conditions or nature of the work will be entertained.

SECTION 102

102.5 PREPARATION OF PROPOSAL:

The bidder shall submit his proposal on the forms obtained from the Contracting Agency. The bidder shall specify a unit bid price and extension in words, figures or both, whichever is required, for each pay item where units and approximate quantities are given.

The proposal total will be obtained by adding the extension amount or lump sum indicated for the individual pay items. If there is a conflict between words and figures, the words shall apply. If there is a conflict between the unit bid price and the extension for a particular pay item, the unit bid price shall govern. In either case, the Contracting Agency shall correct the discrepancy in accordance with the above procedure and the corrected proposal total will apply.

In addition, the following shall be completed by the bidder on the proposal:

(A) Acknowledge receipt of and agree that the proposal is based on the listed Addenda received with and/or after receipt of the proposal pamphlet.

(B) Note the bidders Arizona State Contractor's License number and classification.

(C) Signatures in ink and attested or witnessed as applicable.

102.6 SUBCONTRACTORS LIST:

When required, the List of Subcontractors form will be attached to the proposal pamphlet. The bidder shall submit this form with his proposal, in a separate sealed envelope, listing the firm name and business address of each specialty subcontractor to whom he proposes to subcontract any portion of the work. Only one name shall be listed for each category.

The bidder may list himself to perform one or more of the listed categories of work for which he has any requisite State licenses when required.

102.7 IRREGULAR PROPOSALS:

Proposals will be considered irregular and may be rejected for the following reasons:

(A) If the proposal is on a form other than that furnished by the Contracting Agency; or if the form is altered or any part thereof is detached.

(B) If there are unauthorized additions, statements, conditional or alternate bids, or irregularities of any kind.

(C) If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.

(D) If the proposal does not contain a unit price for each pay item listed except in the case of authorized alternate pay items.

(E) If, when required, the bidder fails to accomplish and submit the List of Subcontractors form.

102.8 PROPOSAL GUARANTEES

No proposal will be read unless accompanied by a proposal guarantee in the proper amount and in the form provided in the proposal pamphlet. The guarantee shall be made payable and acceptable to the Contracting Agency as a guarantee that the bidder, if awarded the contract, will execute the contract documents and furnish the required bonds and certificates of insurance to be forfeited if the Contractor fails or refuses to enter into a contract as required by the bid documents.

The proposal guarantee shall be in the form of a certified check, cashier's check, or surety bond for ten percent of the amount of the bid. The surety bond shall be executed solely by a surety company or companies holding a certificate of authority to

SECTION 102

Transact surety business in the State of Arizona issued by the Director of the Department of Insurance. The surety bond shall not be executed by an individual surety or sureties. In addition, said company or companies shall be rated "Best A-" or better as required by the Contracting Agency, as currently listed in the most recent Best Key Guide, published by the A.M. Best Company.

102.9 SUBMISSION OF PROPOSAL:

The proposal and proposal guarantee shall be submitted in a sealed envelope. The outside, lower right-hand corner of which shall be marked as follows:

Bid of _____, Contractor
For _____
_____ Project No. _____ Contracting Agency

Envelopes shall be mailed or delivered to the office of the Contracting Agency, and must be received before the time and date specified in the Call for Bids or any Addenda.

Proposals received after the time and date specified will be returned, unopened, to the bidder.

102.10 WITHDRAWAL OR REVISION OF PROPOSAL:

Any bidder may withdraw or revise a proposal after it has been deposited with the Contracting Agency, provided his request is received by the Contracting Agency, in writing or by telegram, before the time specified for opening proposals or as stipulated herein.

102.11 PUBLIC OPENING OF PROPOSALS:

Proposals will be opened and read publicly at the time and place specified in the Call for Bids or any Addenda. Bidders, their authorized agents and other interested parties are invited to be present.

When proposals for more than one project are to be opened at the same time, any bidder may, after the time set for the opening proposals, request to withdraw his second or succeeding proposal prior to the opening of proposals for that project. Should this occur, there will be a brief delay in the opening of proposals to permit the bidder to submit his request. Upon receipt of the bidder's written request, by the Contracting Agency, his proposal will be returned unopened.

102.12 DISQUALIFICATION OF BIDDERS:

Either of the following reasons may be considered as being sufficient for the disqualification of a bidder and the rejection of his proposal:

(A) Receipt of more than one proposal for the same work from an individual, partnership or corporation under the same or different names.

(B) Evidence of collusion among bidders or assistance from any officer of the Contracting Agency, or of any Department thereof.

102.13 SUCCESSFUL BIDDERS:

Unless otherwise specified in the proposal pamphlet, the successful bidder may obtain 7 sets of plans and special provisions, for the project from the Contracting Agency, at no cost.

- End of Section -

SECTION 103

AWARD AND EXECUTION OF CONTRACT

103.1 CONSIDERATION OF PROPOSALS:

After the proposals, for the contemplated work, have been opened and read as provided in these specifications, the respective totals will be checked and compared by the Contracting Agency. The basis of comparison will be to verify the accuracy of the total proposal by checking the extensions and additions. In the event of a discrepancy, in the amount bid for a pay item, the unit bid price will govern unless obviously in error. The results of such comparison will be considered public information.

The right is reserved to award the contract to the lowest and/or best responsible bidder, or to reject all proposals and to readvertise for any reason the Contracting Agency determines.

In case all proposals are rejected, any subsequent changes, additions, addenda, or new sets of plans and special provisions will be provided to all purchasers of the first issue of the plans and special provisions at no additional charge, except that out-of-town bidders will pay shipping charges.

103.2 RETURN OF PROPOSAL GUARANTEE:

All proposal guarantees, except those of: the two lowest responsible bidders on Bond Issue and Budget Projects; the lowest responsible bidder or the lowest responsible bidders of alternative plans and specifications on Improvement District Projects, will be returned immediately following the opening and checking of proposals. The retained proposal guarantee or guarantees will be returned immediately after the contract documents have been executed by all parties.

103.3 AWARD OF CONTRACT:

The Contracting Agency, through its duly authorized body or agent will award the contract to the lowest and/or best responsible bidder, or all proposals will be rejected, as soon as practicable after the date of opening proposals.

No proposal shall be withdrawn for a period of 50 days after opening without consent of the Contracting Agency through the body or agent duly authorized to accept or reject the proposal except that in the case of Federally-assisted projects, or other projects award of which is conditioned on the approval of an agency not under the control of the Contracting Agency, withdrawal shall be made within a period of 50 days after opening without such consent.

If written notice of the acceptance of a proposal is delivered to the successful bidder within the times noted above, or at any time thereafter before such proposal has been withdrawn, the bidder shall execute and deliver a contract in the prescribed form, within 10 days after receipt of such notice or his proposal guarantee shall be forfeited as provided elsewhere herein. Concurrently with the contract, the Contractor shall submit all documentation required to enable the agency to execute the contract.

The successful bidder will be furnished a Notice of Award on:

(A) Bond Issue or Budget Projects by letter, to the address shown on the proposal.

(B) Improvement District Projects by publication in accordance with the requirements of Arizona Revised Statutes, Section 9-681.

103.4 CANCELLATION OF AWARD:

The Contracting Agency reserves the right to cancel the award of any contract at any time before the execution of said contract by all parties, without any liability against the Contracting Agency.

103.5 REQUIREMENT OF CONTRACT BONDS:

Concurrently with the submittal of the contract, the Contractor shall furnish the Contracting Agency the following bonds, which shall become binding upon the award of the contract to the Contractor.

SECTION 103

(A) A Performance Bond in an amount equal to the full contract amount conditioned upon the faithful performance of the contract in accordance with plans, specifications and conditions thereof. Such bond shall be solely for the protection of the Contracting Agency awarding the contract.

(B) A Payment Bond in an amount equal to the full contract amount solely for the protection of claimants supplying labor or materials to the Contractor or his Subcontractors in the prosecution of the work provided for in such contract.

Each such bond shall include a provision allowing the prevailing party in a suit on such bond to recover as a part of his judgment such reasonable attorney's fees as may be fixed by a judge of the court.

Each such bond shall be executed by a surety company or companies holding a certificate of authority to transact surety business in the State of Arizona issued by the Director of the Department of Insurance. The bonds shall not be executed by an individual surety or sureties. The bonds shall be made payable and acceptable to the Contracting Agency. The bonds shall be written or countersigned by an authorized representative of the surety who is either a resident of the State of Arizona or whose principal office is maintained in this State, as by law required, and the bonds shall have attached thereto a certified copy of Power of Attorney of the signing official. In addition, said company or companies shall be rated "Best A-" or better as required by the Contracting Agency, as currently listed in the most recent Best Key Rating Guide, published by the A.M. Best Company.

103.6 CONTRACTOR'S INSURANCE:

103.6.1 General: The Contractor shall agree to carry all insurance which may be required by Federal and State Laws, County and City Ordinances, Regulations and Codes. Neither the Contractor nor any subcontractor shall commence work under a contract until the Contracting Agency has approved the insurance. The entire project covered by the contract will be at the Contractor's risk until final acceptance by the Contracting Agency.

Concurrently with the submittal of the contract, the Contractor shall furnish the Contracting Agency the following:

(A) **Public Liability and Property Damage Insurance:** The Contractor shall provide and maintain, during the life of the contract, General Liability, Automobile Liability, and Worker's Compensation Insurance as follows:

INSURANCE

MINIMUM LIMITS OF LIABILITY

GENERAL LIABILITY	\$1,000,000 Combined Single Limit —
Comprehensive Form	
Premises/Operations	
Underground Explosion	
and Collapse Hazard	
Exclusions Deleted	
(where applicable)	
Products/Completed	
Operations	
Contractual	
Independent Contractors	
(OCP)	
Broad Form Property Damage	
Personal Injury with Exclusion	
"C" Deleted	

SECTION 103

AUTOMOBILE LIABILITY	\$1,000,000 Combined Single Limit
Owned	
Hired	
Non-Owned	
EXCESS LIABILITY	As required
Umbrella Form	
WORKER'S COMPENSATION & EMPLOYERS' LIABILITY	Statutory Limits
BUILDER RISK/COURSE OF CONSTRUCTION	As required

The Contracting Agency shall have no responsibility or liability for such insurance coverage.

The Contractor shall furnish a Certificate of Insurance on a form approved by the Contracting Agency. The Certificate shall be issued by an insurance company authorized to transact business in the State of Arizona, or be named on the list of Unauthorized Insurers maintained by the Arizona Department of Insurance. Insurance coverage shall not expire until all the work has been completed and the project has been accepted by the Contracting Agency. If an insurance policy does expire during the life of the contract, the Contractor shall provide a renewal certificate of the required insurance coverage to the Contracting Agency not less than thirty (30) days prior to the expiration date.

(B) Worker's Compensation and Employer's Liability: A Letter of Certification, from the Industrial Commission of Arizona, that the Contractor is insured by the State Compensation Fund or is an authorized self-insurer or a Certificate of Insurance issued by an insurance company authorized by the Arizona Department of Insurance to provide Workmen's Compensation and Employer's Liability Insurance in the State of Arizona.

(C) Builders Risk/Course of Construction: When the project includes construction of a new building or addition to an existing building, the Contractor shall also obtain insurance coverage for at least, as a minimum, the perils of fire, extended coverage, vandalism and malicious mischief for the full amount of the contract. The Contractor shall be responsible for any deductibles, mutual waiver of subrogation and any co-insurance for the construction that is the subject of this contract.

(D) Additional Insured: The Contracting Agency, its officers, agents and employees shall be named as insurers on policies listed in (A) and (C) and this shall also be indicated on the Certificates of Insurance issued to the Contracting Agency. The Contractor's coverage shall be primary for any and all losses arising out of the performance of this contract.

(E) Owner Protective Policy: In addition to other insurance the Contractor is required herein to provide and maintain in its own name, the Contractor shall also provide and maintain a separate policy of insurance, at its sole cost and expense, naming the Contracting Agency as the insured and providing primary coverage for the Contracting Agency in an amount not less than One Million Dollars, or other minimum amount determined by the Agency, for personal injury or death, per person and per occurrence, and not less than \$500,000 for property damage for any damage or injury suffered as a result of any work performed by Contractor or its employees, representatives, contractors or subcontractors in connection with the Project or Permit. Such policy shall also provide the Contracting Agency coverage, in the amounts specified above, for any and all damages or injury suffered as a result of alleged acts or omissions of the Contracting Agency in connection with, directly or indirectly, the Project or Permit. Such policy shall be primary and not contributory to any insurance maintained by the Contracting Agency. The insurance company writing such policy must have a BEST rating of not less than "A-" and be licensed by the Arizona Department of Insurance to do business in the State of Arizona. The form of the policy must be approved by the Contracting Agency before the notice to proceed will be issued.

103.6.2 Indemnification of the Contracting Agency Against Liability: To the fullest extent permitted by law, the Contractor, its successors, assigns and guarantors, shall pay, defend, indemnify and hold harmless the Agency, its agents, representatives, officers, directors, officials and employees from and against all allegations, demands, proceedings, suits, actions, claims, damages, losses, expenses, including but not limited to, attorney fees, court costs, and the cost of appellate proceedings, all claim adjusting and handling expense, related to, arising from or out of or resulting from any actions, acts, errors, mistakes or omissions caused in whole or part by the Contractor relating to work or services in the performance of the

SECTION 103

Contract, including but not limited to, any Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable and any injury or damages claimed by any of the Contractor's and Subcontractor's employees.

103.7 EXECUTION AND APPROVAL OF CONTRACT:

The Contractor shall execute the contract with the Contracting Agency as follows:

(A) Bond Issue or Budget Projects within 10 calendar days after the date of Notice of Award of contract from the Contracting Agency.

(B) Improvement District Projects, not less than 15 or more than 20 calendar days after the date of the first publication of Notice of Award, if no objections have been filed.

The Contracting Agency will approve and execute the contract within 10 calendar days following receipt of signed contract and acceptable bonds and certificates of insurance.

No contract shall be considered in effect until it has been fully executed by all parties concerned.

Information relative to the execution of contract documents may be obtained from the Engineering Office of the Contracting Agency advertising for bids.

103.8 FORFEITURE OF PROPOSAL GUARANTEES:

If the Contractor fails or refuses to enter into the contract, within the time stated, then the Contracting Agency may declare a forfeiture of his proposal guarantee as liquidated damages for failure to enter into the contract.

- End of Section -

SECTION 104

SCOPE OF WORK

104.1 WORK TO BE DONE:

104.1.1 General: The Contractor shall perform all work as may be necessary to complete the contract in a satisfactory and acceptable manner in full compliance with the plans, specifications and terms of the contract.

In the event a conflict exists between Contract Documents the order of precedence listed in descending order shall be as follows:

- Change Orders
- Addenda
- Special Provisions
- Project Plans
- Contracting Agency's supplements to the MAG Uniform Standard Specifications and Details
- MAG Uniform Standard Specifications
- MAG Standard Details

Unless otherwise specified in the special provisions, The Contractor shall furnish all labor, materials, equipment, transportation, utilities, services and facilities required to perform all work for the construction of the project within the time specified.

104.1.2 Maintenance of Traffic: The Contractor's operations shall be in accordance with the traffic manual and/or policies of the appropriate public agency having jurisdiction over the project and Section [401](#). These operations shall cause no unnecessary inconvenience to the public and public access rights shall be considered at all times. Unless otherwise authorized in the specifications or on a temporary basis by the Engineer, traffic shall be permitted to pass through the work area. The Contractor shall coordinate with the various agencies both commercial and public, involved in the collection and removal of trash and garbage, so that adequate services are maintained.

Safe and adequate pedestrian and vehicular access shall be provided and maintained to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, motel, hospitals, fire stations, police stations, and establishments of a similar nature. Access to residential properties shall be in accordance with Section [107](#).

Grading operations, roadway excavation and fill construction shall be conducted and maintained in such a manner as to provide a reasonably satisfactory and safe surface for vehicular and pedestrian traffic. When rough grading is completed, the roadbed shall be brought to and maintained in a reasonably smooth condition, satisfactory and safe for vehicular traffic at the posted speed limit. Pedestrian walkways shall be provided and maintained in a like manner. The Contractor shall accomplish any additional grading operations and/or repairs, including barricade replacement or repairs during working and nonworking periods which, in the opinion of the Engineer, are required.

In the event of abnormal weather conditions, such as windstorms, rainstorms, etc., the Contractor shall immediately inspect his work area and take all necessary actions to insure that public access and safety are maintained.

The Contractor shall provide the Engineer with the emergency address of his representatives as required by Section [105](#).

104.1.3 Water Supply:

Water shall consist of providing a water supply sufficient for the needs of the project and the hauling and applying of all water required.

The Contractor shall make arrangements for and provide all necessary water for his construction operation and domestic use at his own expense.

SECTION 104

If the Contractor purchases water from a water utility at a fire hydrant on or near the project, all arrangements shall be made by him at his own expense and payment made direct to the water utility as agreed upon.

The Contractor shall use only those hydrants designated by the water utility in charge of water distribution and in strict accordance with its requirements for hydrant use.

The Contractor shall furnish all connections, wrenches, valves and small tools that may be necessary to meet the requirements of the water utility pertaining to hydrant use.

The tank truck and/or trailer shall meet all safety and licensing regulations and the water shall be applied by sprinkling with tank trucks equipped with spray bars and suitable apparatus.

No measurement will be made of water, unless otherwise provided for in the special provisions or proposal.

The cost of watering will be included in the proposal price for the construction operation to which such watering is incidental or appurtenant.

104.1.4 Cleanup and Dust Control: Throughout all phases of construction, including suspension of work, and until final acceptance of the project, the Contractor shall keep the work area clean and free from rubbish, excess materials and debris generated by Construction Activities.

At disposal sites and storage sites, other than agency landfills, the Contractor shall be responsible for all required dust control measures. This includes temporary yard or staging areas.

The Contractor shall take whatever steps, procedures or means required preventing any dust nuisance due to his construction operations. The dust control measures shall be maintained at all times to the satisfaction of the Engineer and in accordance with the requirements of the Maricopa County Bureau of Air Pollution Control Rules and Regulations.

Failure of the Contractor to comply with the Engineer's cleanup orders may result in an order to suspend work until the condition is corrected. No additional compensation or time will be allowed as a result of such suspension and the Engineer has the authority to take such other measures as may be necessary to remedy the situation. Subsection [104.2.5](#) applies.

104.1.5 Final Cleaning Up: Before final acceptance, all private or public property and grounds occupied by the Contractor in connection with the work shall be cleaned of all rubbish, excess materials, temporary structures and equipment, and all parts of the work area shall be left in an acceptable condition.

104.2 ALTERATION OF WORK:

***104.2.1 By the Contracting Agency:** The Contracting Agency reserves the right to make, at any time during the progress of the work, such alterations in the details of construction and such increases or decreases in quantities as may be found necessary or desirable. Such alterations and changes shall not invalidate the contract nor release the surety and the Contractor agrees to perform the work as altered, the same as if it had been a part of the original contract. The Engineer will issue Change Orders to cover unforeseen circumstances which make it impossible to carry out the work in accordance with the original contract plans and specifications.

If the alterations or changes made by the Contracting Agency increases or decreases the total cost of the contract or the total cost of any major item by more than 20 percent, either party may request an adjustment in payment in accordance with Section [109](#).

104.2.2 Due to Physical Conditions:

*(A) Should the Contractor encounter or discover during the process of the work, subsurface or latent physical conditions at the site differing materially from those indicated in the contract, or unknown physical conditions at the site of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract, the Engineer shall be promptly notified in writing of such conditions before they are disturbed. The Engineer will thereupon promptly investigate the conditions and, if he finds they do so materially differ and cause an increase or decrease

*Not applicable to Improvement District Projects.

SECTION 104

in the cost of or the time required for performance of the contract, an equitable adjustment will be made and the contract modified in writing accordingly.

*(B) If at the time of opening up any portion of the work, material from which the subgrade, backfill or bedding is to be constructed contains an excess of moisture so that the required compaction cannot be obtained without additional manipulation, the Engineer will determine the cause of such condition. If the cause of such condition is determined to have been unforeseeable and beyond the control of and without fault or negligence of the Contractor, the Engineer will determine whether the material shall be aerated or removed and replaced. Such work shall be done as directed and will be paid for as provided in Section [109](#).

*(C) Failure to notify the Engineer of the conditions described in A and B above prior to doing any work may be just cause to reject any claims for additional monies and/or time.

*(D) Material in ditches and ditch banks that contains moisture in an amount considered excessive by the Engineer shall be removed and shall be aerated to the extent required by the Engineer before compaction is affected. No measurement or direct payment for the removal and aeration of such material will be made.

*(E) After any portion of the work has been opened up, saturation of material caused by irrigation water, storm drainage, weather or such similar causes will be considered as within the responsibility of the Contractor.

***104.2.3 Due to Extra Work:** The Contractor shall perform unforeseen work, for which there is no unit bid price in the proposal, whenever it is deemed necessary or desirable by the Engineer in order to fully complete the work as contemplated. Such work shall be governed by all applicable provisions of the contract documents and payment will be made in accordance with the provisions set forth in Section [109](#).

Should the Contractor claim that any instructions received involve extra work under the contract, he shall give the Engineer written notice within two work days after receipt of such instructions, and in any event before proceeding to execute the work, except in emergencies endangering life or property. No claim shall be valid unless written notice is given.

If this extra work is performed by others, the Contractor agrees to cooperate fully with the other source accomplishing this work and agrees that this action shall not invalidate the Contract or release the surety.

104.2.4 At the Contractor's Request: Changes in the plans or specifications, which do not materially affect and are not detrimental to the work or to the interests of the Contracting Agency, may be granted to facilitate the work. Requests shall be in writing and submitted to the Engineer for approval. These changes, if approved and when resulting in a saving to the Contractor, will be made at an equitable reduction in cost or in no case at any additional cost to the Contracting Agency.

104.2.5 Due to the Failure of the Contractor to Properly Maintain the Project:

(A) If the Contractor fails to provide adequate Maintenance of Traffic or Cleanup and Dust Control or to correct deficiencies resulting from abnormal weather conditions, the Engineer has the authority to suspend the work wholly or in part until this condition has been corrected.

(B) If the Contractor fails to comply with the Engineer's written order to provide adequate maintenance of traffic, cleanup, dust control, or to correct deficiencies resulting from abnormal weather conditions, the Engineer has the authority to have this work accomplished by other sources.

(C) The Contractor agrees to cooperate fully with the other source accomplishing this work and agrees that this action shall not invalidate the Contract or release the surety.

- End of Section -

SECTION 105

CONTROL OF WORK

105.1 AUTHORITY OF THE ENGINEER:

The Engineer will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions which may arise as to the interpretation of the plans and specifications; all questions as to the acceptable fulfillment of the contract on the part of the Contractor. The Engineer's estimates and decisions shall be final and conclusive. In case any question should arise, relative to the Contract Documents, the determination or decision of the Engineer shall be a condition precedent to the right of the Contractor to receive final approval of the work being questioned under the contract.

In giving instructions, the Engineer may make minor changes in the work, not involving extra work and not inconsistent with the purpose of the work, except in emergencies endangering life or property.

The Engineer will suspend the work wholly or in part due to the failure of the Contractor; to correct conditions unsafe for the workmen or the general public; for failure to carry out provisions of the contract; for failure to carry out orders; for such periods as he may deem necessary due to unsuitable weather; for conditions considered unsuitable for the prosecution of the work or for any other condition or reason deemed to be in the public interest.

105.2 PLANS AND SHOP DRAWINGS:

The Contractor shall submit, for review, a proposed schedule of shop drawings and product data submittals. This schedule will include concrete and asphalt concrete mix designs unless they are previously approved supplier's mix design. The schedule will show the needed response date for each submittal and will indicate the relationship of the submittal to the project construction schedule.

Shop drawings for major temporary support structures such as falsework, shoring, soldier piles, and other major temporary structures that facilitate construction shall be prepared by and bear the seal and signature of a Professional Engineer. Temporary support structures for Minor Structures as defined in Section [505.1.1](#) are exempt from this requirement.

The Contractor shall submit five (5) copies of each shop drawing, product data or mix design to the Engineer for review. Each submittal shall be numbered sequentially and shall be submitted in accordance with the schedule established in conjunction with the Contracting Agency so as to cause no delay in the work schedule. The Contractor shall certify, by stamp or letter, that he has reviewed and approved the submittal and that it conforms to the requirements of the contract documents. If this certification is not included, the submittal will be returned without action.

At the time of each submittal, the Contractor shall define and delineate in writing, separate from the certification, any deviations from the contract documents. If the Engineer accepts this deviation, he will authorize the deviation by issuing a change order or if the deviation is minor by endorsement to the letter.

The Engineer will review and return the submittals in accordance with the previously established response date. The review will be only for conformance with the design concept of the work and for compliance with the information contained in the contract documents. The review of a specified item, as such, will not indicate review of the assembly in which the item functions. Review by the Engineer will not relieve the Contractor from responsibility for any errors or omissions in the submittals nor from his responsibility for complying with the contract documents. The only exception is deviations accepted in accordance with the preceding paragraph.

If the submittal is acceptable, one (1) copy with each page stamped "Furnish as Submitted" will be returned to the Contractor. The Contractor shall submit additional copies (as required) to the Engineer.

If the Engineer determines that the submittal requires corrections or is to be rejected, one (1) copy stamped "Furnish as Noted" or "Revise and Resubmit" will be returned to the Contractor. The Contractor will submit five (5) corrected or new copies.

The copy stamped "Furnish as Submitted," returned to the Contractor, will become a part of the contract documents and will be kept at the job site. Any work done prior to the receipt of this review will be at the Contractor's risk and expense.

SECTION 105

105.3 CONFORMITY WITH PLANS AND SPECIFICATIONS:

All work performed and all materials furnished shall be in conformity with the lines, elevations, grades, cross-sections, dimensions and material requirements, including tolerances, shown on the plans or indicated in the specifications.

In the event the Engineer finds the materials or the finished product in which the materials are used not in conformity with the plans and specifications, but that reasonably acceptable work has been produced, he shall then make a determination if the work shall be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials as he deems necessary to conform to his determination based on engineering judgment.

In the event the Engineer finds the materials or the finished product in which the materials are used or the work performed are not in conformity with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by the Contractor at no additional cost to the Contracting Agency.

In all instances wherein the items and/or specifications require installation or construction in accordance with either manufacturers' or suppliers' recommendations and/or instructions, said recommendations and/or instructions shall be submitted with the applicable portion clearly marked for approval prior to the commencement of work on that item or portions of the contract.

105.4 COORDINATION OF PLANS AND SPECIFICATIONS:

The Contractor shall take no advantage of any apparent error or omission in the plans or specifications. In the event the Contractor discovers such an error or omission, he shall immediately notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications.

105.5 COOPERATION OF CONTRACTOR:

The Contractor will be supplied with a minimum of seven sets of approved plans and special provisions, one set of which the Contractor shall keep available on the work site at all times.

The Contractor shall give the work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the Engineer, his inspectors, and other Contractors in every way possible.

The Contractor shall at all times be present at the work in person or represented by a competent superintendent. The superintendent shall be authorized to receive and fulfill instructions from the Engineer and who shall supervise and direct the work. No less than fourteen days prior to the scheduled/planned Notice to Proceed, the Contractor shall submit to the Engineer for review and approval, the name and qualifications of the proposed superintendent. When the superintendent is approved, he shall not be changed by the Contractor without written approval of the Engineer. Instructions and information given by the Engineer to the Contractor's superintendent shall be considered as having been given to the Contractor.

(A) All phases of the project such as concrete work, pipe work, etc., shall be under the direct supervision of a foreman or his designated representative on the site who shall have authority to accept instructions, with respect to that particular phase of the project, and take action required to properly carry out the work.

(B) In the event of noncompliance with the above, the Engineer may require the Contractor to stop work on that part of the project until the required supervision is present.

The Contractor shall file with the Engineer, the names, addresses, and telephone numbers of representatives who can be contacted, at any time, in case of emergency. These representatives must be fully authorized and equipped to correct unsafe or excessively inconvenient conditions on short notice.

SECTION 105

Emergencies may arise during the progress of the work which may require special effort or require extra shifts of men to continue the work beyond normal working hours. The Contractor shall be prepared in case of such emergencies from whatever cause, to do all necessary work promptly.

105.6 COOPERATION WITH UTILITIES:

The Contracting Agency will notify all utility companies, all pipe line owners, or other parties affected, and endeavor to have all necessary adjustments of the public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction, made as soon as practicable.

The Contractor shall comply with the requirements of Arizona Revised Statutes-40-360.21 through 40-360.29 (one call system, Blue Stake) in notification to the interested utility owners prior to start of construction. The Contractor shall resolve all problems with the utility owners concerned.

Where water user's association facilities obstruct construction of the work, the Contractor shall contact officials of the association relative to the shutdown of irrigation water and shall acquaint himself with and conform to the requirements of the association.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cableways, signals and all other utility appurtenances within the limits of the proposed construction which are to be relocated or adjusted are to be moved by the owners at their expense except as otherwise provided for in the special provisions or as noted on the plans. In the event an existing service is found to be in a materially different location than shown on the plans and requires additional or more costly work on the part of the Contractor, the procedures in Section [104](#), will apply.

It is understood and agreed that the Contractor has considered in his proposal all of the permanent and temporary utility appurtenances in their present or relocated positions as shown on the plans and that no additional compensation will be allowed for any delays, inconvenience, or damage sustained by him due to any interference from the said utility appurtenance or the operation of moving them. If delays are encountered because utility owners have not relocated or adjusted their facilities, the contract time will be adjusted in accordance with Section [108](#).

It shall be the responsibility of the Contractor to ascertain the need for bracing or shoring of utility poles during the construction of the project and no additional compensation will be allowed for such bracing or shoring.

In general, the contract will indicate various utility items, certain of which are to be relocated or adjusted by the utility owner and others by the Contractor. Any work performed by the Contractor for any utility company, separate from the contract shall be paid for by the utility company and will not be a part of the agency contract.

105.6.1 Notifications Requirement in the Event of Any Damage to or Dislocation of Underground Facilities: In the event of any damage to or dislocation of any underground facility, the Contractor responsible for the excavation operation shall immediately notify the owner of such facility and shall not attempt to repair any facility, except those intended for the conveyance or storage of water and sewage. The excavation shall be left open until the arrival of representatives of the owner. The owner will dispatch its representative promptly to examine the underground facility and, if necessary, make repairs.

105.6.2 Work Within a Railroad Right of Way: When a railroad right of way is included in the work, the Contractor shall:

(A) Comply with the rules and regulations of the railroad company relative to the required manner of constructing said portion of the work; and shall perform the work so as not to endanger or interfere with the safe operation of the track(s) and property of the railroad company and of the traffic moving on such track(s).

(B) Carry the kinds and amounts of insurance and bonds required by the railroad company for the period of time in which work is performed on or adjacent to the railroad company's property, and until such work has been satisfactorily completed and all tools, equipment and materials have been removed from the railroad company's property and such property is left in a clean and presentable condition.

SECTION 105

(C) Contact the railroad company at least 48 hours in advance of performing any construction within the right of way of any track(s).

105.7 COOPERATION BETWEEN CONTRACTORS:

The Contracting Agency reserves the right at any time to contract for and perform other or additional work on or near the work covered by the contract.

When separate contracts are let within the limits of any one project, each Contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the Contracting Agency from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by him because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. He shall join his work with that of others in an acceptable manner and shall perform it in proper sequence to that of the others.

The Contracting Agency will not honor any claim for extra compensation due to delays, extra work, or extension of time caused by any other Contractors working within the limits of the same project.

105.8 CONSTRUCTION STAKES, LINES AND GRADES:

The Engineer will set construction stakes establishing lines and grades for road work, curbs, gutters, sidewalks, structures and centerlines for utilities and necessary appurtenances as he may deem necessary, he will furnish the Contractor with all necessary information relating to the lines and grades. These stakes and marks shall constitute the field control by and in accordance with which the Contractor shall establish other necessary controls and perform the work.

The Contractor shall perform the work in accordance with the Engineer's stakes and marks, and shall be charged with full responsibility for conformity and agreement of the work with such stakes and marks.

The Contractor shall be held responsible for the preservation of all stakes and marks, and if the construction stakes or marks have been carelessly or willfully destroyed or disturbed by the Contractor, the cost for replacing them will be charged against him and will be deducted from the payment for the work.

The Contractor shall give notice to the Engineer not less than two working days in advance of when he will require survey services in connection with any portion of the work.

The Contractor shall set the construction stakes for buildings establishing lines, grades, and elevations to include necessary utilities and appurtenances and shall be responsible for their conformance with plans and specifications. The Engineer will establish or designate a control line or bench mark of known location and elevation for use as a reference.

105.9 DUTIES OF INSPECTOR:

The Engineer may provide the Inspector, assistants, and other field staff to assist the Engineer in observing performance of the work of the Contractor. Through onsite observations of the work in progress and field checks of materials and equipment, the Inspector shall endeavor to provide further protection for the Contracting Agency against defects and deficiencies in the work of the Contractor; but, the furnishing of such services will not make the Inspector responsible for or give the Inspector control over construction means, methods, techniques, sequences, or procedures or for safety precautions or programs, or responsibility for the Contractor's failure to perform the work in accordance with the contract documents.

SECTION 105

Inspectors employed by the Contracting Agency will be authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector will not be authorized to alter or waive the provisions of the contract. The inspector will not be authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

The inspector will, however, have the authority to reject work or materials until any questions at issue can be referred to and decided by the Engineer.

105.10 INSPECTION OF WORK:

Inspection of the work by the Engineer or his authorized representative shall not be considered as direct control of the individual workman and his work. The direct control shall be solely the responsibility of the Contractor's foreman and superintendent.

The Engineer shall be permitted to inspect all materials, and each part or detail of the work at any time for the purpose of expediting and facilitating the progress of the work. He shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

Any work done or materials used without supervision and inspection by an authorized Contracting Agency representative may be ordered removed and replaced at no additional cost to the Contracting Agency. Failure to reject any defective work or materials shall not in any way prevent later rejection when such defect is discovered nor obligate the Engineer to final acceptance.

When any unit of government or political subdivision is to pay a portion of the cost of the work covered by the contract, its representatives shall have the right to inspect the work. Such inspection shall in no sense make any unit of government or political subdivision a party to the contract, and shall in no way interfere with the rights of either party to the contract.

105.11 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK:

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner.

No work shall be done without lines and grades having been given by the Engineer. Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans, or as given, or any extra work done without authority, will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at no additional cost to the Contracting Agency.

105.12 MAINTENANCE DURING CONSTRUCTION:

The Contractor shall maintain the work during construction and until the project is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces to the end so that the roadway or structures are kept in satisfactory conditions at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations. All cost of maintenance work during construction and before the project is accepted shall be included in the unit bid price on the various pay items.

105.13 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE:

If the Contractor, at any time, fails to perform maintenance during construction, the Engineer will immediately notify the Contractor of such noncompliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Engineer may immediately proceed to maintain the project. The entire cost of this maintenance will be deducted from monies due or to become due the Contractor on his contract.

SECTION 105

105.14 PARTIAL USE OR OCCUPANCY:

Should an urgent or unforeseen need occur, the Contractor agrees to let the Contracting Agency use or occupy a unit or portion of the project, such as a structure, utility service, or a section of road or pavement, prior to final acceptance.

Prior to such use or occupancy the Contracting Agency will prepare a written agreement with the Contractor and accomplish a partial acceptance inspection. The written agreement will include a revised construction schedule, responsibilities for maintenance of the partial acceptance and continued construction of the original project to final acceptance, payments, insurance and bond requirements.

105.15 ACCEPTANCE:

(A) Partial Acceptance: If at any time during the prosecution of the project the Contractor substantially completes a unit or portion of the project, such as a structure, utility service, or a section of road or pavement, he may request the Engineer to make final inspection of that work. If the Engineer finds, upon inspection, that the work has been satisfactorily completed in compliance with the contract he may accept the work as being completed and the Contractor may be relieved of further responsibility for that work. Such partial acceptance shall in no way void or alter any terms of the contract.

(B) Final Acceptance: Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer will make an inspection. If all construction provided for and contemplated by the contract is found completed to his satisfaction, the inspection shall constitute the final inspection and the Engineer will make the final acceptance. The Contractor will be notified in writing of this acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed. In such event, the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of the final inspection.

- End of Section -

SECTION 106

CONTROL OF MATERIALS

106.1 SOURCE OF MATERIALS AND QUALITY:

All construction materials to be used on the work or incorporated into the work, equipment, plant, tools, appliances or methods to be used on the work shall be subject to the inspection and approval or rejection of the Engineer.

The materials used on the work shall meet all quality requirements of the contract. In order to expedite the inspection and testing of materials, the Contractor shall notify the Engineer of his proposed source of materials prior to delivery. At the option of the Engineer, materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce specified products the Contractor shall furnish materials from other sources.

Unless otherwise noted, all materials used in the project shall be new and unused. Additionally, any new materials used in this project that are damaged during the construction of the project and prior to final acceptance, as determined by the Engineer, shall be replaced by the Contractor with new material at no additional cost to the Contracting Agency.

106.2 SAMPLES AND TESTS OF MATERIALS:

All materials to be incorporated in the work may be subject to sampling, testing and approval, and samples furnished shall be representative of the materials to be used. The Engineer may select samples, or may require that samples be delivered by the Contractor to a laboratory designated by the Engineer.

The Contracting Agency will pay for the initial or normal test required by the Engineer to guard against unsuitable materials or defective workmanship. Additional tests, required due to failure of the initial or normal test(s), shall be paid for by the Contractor. The Engineer will designate the laboratory which will accomplish the additional test(s).

The procedures and methods used to sample and test materials will be determined by the Engineer. Unless otherwise specified, samples and tests will be made in accordance with either: the Materials Testing Manual of the Contracting Agency; the standard methods of AASHTO or ASTM, which were in effect and published at the time of advertising for bids.

The laboratory responsible for the test shall furnish at least one copy of the test results to the Contracting Agency or his designated representative, to the Contractor, and to the appropriate material supplier.

With respect to certain manufactured materials, the Engineer may permit the use of some materials prior to sampling and testing provided they are delivered with either a certificate of compliance or analysis or both, stating that the materials comply in all respects with the requirements of the specifications. These certificates shall be furnished in triplicate and clearly identify each delivery of materials to the work area. The certificates shall be signed by a person having legal authority to bind the supplier or manufacturer.

106.3 PLANT INSPECTION:

The Engineer may undertake the inspection of materials at the source. In this event, the following conditions shall be met:

(A) The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom he has contracted for materials.

(B) The Engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.

It is understood that the Contracting Agency reserves the right to retest all materials, prior to their use in the work, upon delivery.

SECTION 106

106.4 TRADE NAMES AND SUBSTITUTIONS:

Plans and specifications may contain references to equipment, materials or patented processes by manufacturer, trade name, make or catalog number. Unless the name is followed by words indicating that no substitution is permitted, such references shall be regarded as establishing a standard of quality, finish, appearance, performance or, as indicated, a selection based upon compatibility with existing equipment or materials.

The use of an alternate or substitute item or source may be permitted, subject to the following:

- (A) No consideration will be given to a substitution prior to the award of the contract.
- (B) Only substitutions submitted by the Contractor will be accepted for review. The substitution shall be submitted in writing to the Engineer.
- (C) The submittal shall certify that the substitution will perform the functions and achieve the results called for by the general design, be similar and of equal substance, and be suited to the same use as that specified.
- (D) The submittal shall state any required changes in the contract documents to adapt the design to the proposed substitution. This will include all changes required of other contractors/subcontractors affected by the resulting changes.
- (E) The submittal shall contain an itemized estimate of all costs and credits that will result directly or indirectly from the acceptance of such substitution, including costs of design, license fees, royalties, testing, Engineer's evaluation, claims of other contractors/subcontractors, etc. Also, the submittal shall include any adjustment in the contract time created by the substitution.
- (F) The Contractor, on request of the Engineer, shall submit samples or any additional information the Engineer may deem necessary to evaluate the acceptability of the substitution. The Engineer will evaluate the information provided, perform tests when necessary and make comparisons. The Engineer will then make the final decision as to the acceptability of the proposed substitution. The Contractor will be notified in writing by the Engineer as to whether his substitution has been accepted or rejected.
- (G) The submittal, for purposes of review, number of copies, etc., shall follow the procedures as outlined in Section [105.2](#), except in the case of response time. If the Engineer does not respond in a timely manner, which in turn, impacts the substitution, the Contractor shall continue to perform the work in accordance with the contract and the substitution will be considered rejected. Also, no adjustment in the contract time will be granted for nonacceptance of the substitution.
- (H) There will be no additional costs to the Contracting Agency for the substitution. If the substitution yields a net savings in the contract price, the amount of savings shall be divided between the Contracting Agency and the Contractor in a percentage established by the Contracting Agency.
- (I) If the substitution is accepted and an adjustment in the contract cost and/or contract time is in order, a change order will be issued to the Contractor for the changes.

106.5 STORAGE OF MATERIALS:

The Contractor shall provide storage facilities and exercise such measures as will insure the preservation of the quality and fitness of all materials and/or equipment to be used in the work. Stored materials and/or equipment, even though approved before storage, may again be inspected prior to their use in the work. Stored items shall be located so as to facilitate their prompt inspection. That portion of the right-of-way and easements not required for public travel may be used for storage purposes, when approved by the Engineer. Any additional storage area as required must be provided by the Contractor. Private property shall not be used for storage purposes without written permission of the owner or lessee. If requested, by the Engineer, copies of such written permission shall be made available.

SECTION 106

106.6 HANDLING MATERIALS:

All materials and/or equipment shall be handled in such a manner as to preserve their quality and fitness for the work.

106.7 UNACCEPTABLE MATERIALS:

All materials and/or equipment not conforming to the requirements of the specifications, whether in place or not, may be rejected. Rejected materials and/or equipment shall be removed immediately from the site of work unless otherwise permitted by the Engineer. No rejected material and/or equipment, the defects of which have been subsequently corrected, shall be used until approved in writing by the Engineer.

106.8 FURNISHED MATERIALS:

Materials and/or equipment, furnished by the Contracting Agency, will be delivered or made available to the Contractor as indicated in the special provisions. The cost of handling and placing shall be considered as included in the contract price for the pay item with which they are used.

The Contractor will be held responsible for all materials and/or equipment accepted by him and will make good any shortages, deficiencies and damages which may occur after such acceptance.

- End of Section -

SECTION 107

LEGAL REGULATIONS AND RESPONSIBILITY TO PUBLIC

107.1 COMPLIANCE WITH LAWS:

The Contractor shall keep fully informed of, observe and comply with all Federal and State laws, County and City ordinances, regulations, codes and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any way affect the conduct of the work. The Contractor warrants that all items supplied and work performed under the contract have been sold, produced, delivered and furnished in strict compliance with all such laws, ordinances, regulations, codes, orders and decrees to which the items, work and Contractor are subject. Upon request, Contractor shall execute and deliver to the Agency such documents as may be required by the Agency to evidence compliance with such laws, ordinances, regulations, codes, orders and decrees. The Contractor shall protect and indemnify the Contracting Agency and its representatives against any claim or liability arising from or based on the violation of such, whether by the Contractor or the Contractor's employees.

107.2 PERMITS:

Permits, bonding and insurance requirements shall be as required by statutes, codes, ordinances or regulations.

The Public Agency, when acting as the Contracting Agency, may obtain some of the required permits. It is the duty of the Contractor to determine that all necessary permits have been obtained. The Contractor shall, at the Contractor's own expense, obtain all the required permits which have not been furnished. The Contractor shall comply with all permit requirements until the Contract is completed or the permit is closed-out or transferred. The Contractor shall be responsible to close out all permits except those authorized by special provision to be transferred.

In all cases, the Contractor or the person supervising the authorized work shall notify the appropriate permit agency so as to insure proper inspection by the agency concerned.

107.3 PATENTED DEVICES, MATERIALS AND PROCESSES:

If the Contractor employs any design, device, material, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner. The Contractor and the surety shall indemnify and save harmless the Contracting Agency, any affected third party or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the Contracting Agency for any costs, expenses, and damages which it may be obligated to pay by reason of any infringement, at any time during the prosecution or after the completion of the work.

107.4 ARCHAEOLOGICAL REPORTS:

Attention is directed to Sections 41-844 and 41-865 Arizona Revised Statutes. In view of the above, it shall be a provision of every contract that when archaeological features are encountered or unearthed in the excavation of material pits or of the roadway prism, or other excavation, the Contractor shall report promptly to the Director of the Arizona State Museum and the Contracting Agency. The Contractor will be allowed extra time as appropriate in accordance with the provisions of Section [108](#).

107.5 SAFETY, HEALTH AND SANITATION PROVISIONS:

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the Arizona State Department of Health or as specified by the Maricopa County Health Department, Sanitary Code.

The Contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions, on his own responsibility or as the Engineer may determine, reasonably necessary to protect the life and the health of employees on the job, the safety of the public and to protect property in connection with the performance of the work covered by the contract.

Precaution shall be exercised by the Contractor at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws, pertaining to such protection including all Federal and State occupational safety and health acts, and standards and regulations promulgated there under.

SECTION 107

107.5.1 Asbestos Materials: If asbestos materials are encountered during any building remodeling/demolition work, the Contractor shall comply fully with the Arizona Administrative Code, A.A.C. R18-2-901 and notify the Engineer. An extension of contract time will be granted for any delay resulting from the asbestos material in accordance with Section [108](#).

107.5.2 Lead-Containing Paint: Paint and similar surface coating materials that contain lead compounds and in which the lead content exceeds 0.06 percent of the total weight of the non-volatile content of the paint or the weight of the dried paint film is declared a banned hazardous product and will not be used (Consumer Product Safety Act Part 1303 dated 9-1-77).

107.6 PUBLIC CONVENIENCE AND SAFETY:

The Contractor shall at all times so conduct his work as to assure the least possible obstruction to traffic and adjacent residents. The safety, convenience, and the protection of persons and property, of the general public and residents along the street, highway, and areas adjacent to the work area shall be provided for by the Contractor.

107.6.1 Contractor's Marshaling Yard: If the Contractor or his subcontractor utilizes property outside the limits of the project in the performance of the contract, the Contractor/subcontractor shall comply with the following:

107.6.1.1 Contractor's Marshaling Yard when the Agency is the Contracting Party:

(A) Prior to occupying the property, the Contractor shall provide written notification as to the number and location of all properties to be used. The notification shall specify in detail how the Contractor proposes to use each property and how he proposes to comply with (B) through (D) below. Also, the Contractor shall provide a statement, signed by the property owner(s), which gives the Contractor permission to use the property.

(B) The property(s) shall be adequately maintained to control dust, mud, trash and other pollutants from leaving the property.

(C) Work on the property(s) shall be scheduled so as to comply with the Agency Noise Ordinance.

(D) Use of the property(s) such as location of stored materials, service of equipment, etc., shall be conducted to minimize impact on adjacent properties.

(E) The Contractor shall leave the property in a condition, as determined by the Engineer, equivalent to that which existed prior to entry. In no case shall any use cause, or allow to remain, any negative impact to adjoining properties or right-of-way unless such impact existed prior to the Contractors' use.

(F) The Contractor shall obtain a written release signed and dated from each property owner after completion of use. Each release shall state that, at the time of signing, the owner accepts the property in its present condition from the Contractor and relieves the Contractor and the Agency from any or all claims for the use or damage to said property. A copy of each release shall be submitted to the Engineer.

(G) This Subsection also applies to all levels of subcontractors who will need to obtain marshaling yards for the project, which will be separate from that of the Contractor. It will be the responsibility of the Contractor to obtain copies of the various documents from the subcontractors, as required above, and provide them to the Engineer.

107.6.1.2 Contractor's Marshaling Yard when the Agency is not the Contracting Party (private development, utility work, subdivision construction, etc): All conditions will apply as in Subsection [107.6.1.1](#) except that the permit holder will be responsible for obtaining all documents. The permit holder will retain the documents and make them available to the Agency upon request.

107.6.2 The Contractor shall comply with the Agency Code concerning work hours and noise level during construction.

107.7 BARRICADES AND WARNING SIGNS:

The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs

SECTION 107

and other traffic control devices, and shall take all necessary precautions for the protection of the work and safety of the public. Roads, partially or fully closed to traffic, shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness. Suitable warning signs shall be provided to properly control and direct traffic.

The Contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road. Such warning signs shall be constructed and erected in accordance with the Traffic Barricade Manual prepared or adopted by the Contracting Agency's Traffic Engineering Department which is hereby made a part of these specifications.

107.8 USE OF EXPLOSIVES:

The use of explosives or blasting agents is controlled by the Uniform Fire Code, which is generally administered by the Fire Department of the Agency. The Contractor shall obtain a special permit from the Agency's Fire Department for the use of explosives. A copy of this permit shall be delivered to the Engineer prior to the use of explosives. If the Agency does not use the Uniform Fire Code or have a department for enforcement of this Code, the Contractor shall use explosives only when authorized in writing by the Engineer. The approval by the Engineer for the use of explosives shall not relieve the Contractor from his responsibilities for proper use and handling of the explosives or for any and all damages resulting from their use.

Explosives shall be transported, stored, handled and used in accordance with the provisions and requirements of all applicable laws, ordinances and regulations. Work shall be done in accordance with recommendations of the AGC Manual of Accident Prevention in Construction, the Institute of Makers of Explosives, and the Occupational Safety and Health Administration Regulations (29 CFR 1926.1(U)). In addition to the applicable regulations, the Contractor shall:

- (A) Exercise the utmost care not to endanger life or damage property.
- (B) Furnish and erect special signs to warn the public of his blasting operations. They shall be located and maintained so as to be clearly evident to the public during all critical periods of blasting operations.
- (C) Notify each public utility company, having structures adjacent to the work, of his intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to advise the Contractor of any precautions that should be taken to protect their structures from damage.
- (D) Make a survey of adjacent properties, before commencing blasting operations, locating on drawings and by photographs all existing cracks and damages to structures. A copy shall be filed with the Engineer, including a report.
- (E) Blasting shall be accomplished in such a manner that nearby buildings, structures, railways, highways, etc. will be safe from rocks and other projectiles. Adequate blasting mats or other means of protection shall be employed when blasting in congested area or close proximity to any of the above improvements. Steel mats shall not be allowed within 2,000 feet of power lines.
- (F) At the time of firing, the Contractor shall station men along the road at sufficient distance from the blasting operation to flag down any vehicles.

The Contracting Agency reserves the right to order the discontinuance of blasting operations at any time.

107.9 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE:

The Contractor shall be responsible for the preservation of all public and private property and shall protect carefully from disturbance or damage all land monuments and property marks until the Engineer has witnessed or otherwise referenced their location and shall not move them until directed.

SECTION 107

The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing the work, or at any time due to defective work or materials, and said responsibility will not be released until the project shall have been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the nonexecution thereof by the Contractor, he shall restore, at no cost to the Contracting Agency, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or he shall make good such damage or injury in an acceptable manner. Such damage will include but not be limited to landscaped areas. The contractor shall regrade the disturbed area as directed and restore the surface material to match existing in type and quality.

When construction is within temporary construction easements, the Contractor shall restore all disturbed areas to a condition equal to or better than the existing improvements. Such restoration will include but not be limited to asphalt, walkways, fences, lights, sprinklers, landscaping, etc. In the case of landscaping, the Contractor may remove and store sod and plant material. If, in the determination of the Engineer, the sod and/or plant material did not survive the transplanting in good condition, the Contractor shall replace the sod and/or plant material to match in type and quality. Also, the Contractor may salvage any sprinkler system materials, lighting materials, etc. In the event that it is not feasible to reinstall the salvaged material, new material shall be installed.

The Contractor shall not dump spoil or waste material on private property without first obtaining from the owner written permission for such dumping. All such dumping shall be in strict conformance with the Grading and Drainage Ordinance of the Contracting Agency.

Access to private property shall be maintained to keep inconvenience to the property owner to a minimum. Prior to any construction in front of driveways the Contractor shall notify the property owner 24 hours in advance. Inconvenience caused by construction across driveways and sidewalks shall be kept to a minimum by restoring the serviceability as soon as possible. If it is necessary to leave open excavation for a long period of time, the Contractor shall provide structurally adequate steel plates to bridge the excavation.

107.10 CONTRACTOR'S RESPONSIBILITY FOR WORK:

The Contractor shall properly guard, protect, and take every precaution necessary against injury or damage to all finished or partially finished work, by the action of the elements or from any other cause until the entire project is completed and accepted by the Engineer. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work before final acceptance at no cost to the Contracting Agency. Partial payment for completed portions of the work shall not release the Contractor from such responsibility.

In case of suspension of the work for any cause whatever, the Contractor shall be responsible for the project and shall take such precautions as may be necessary to prevent damage to the project and shall erect any necessary temporary structures, signs, or other facilities at no cost to the Contracting Agency.

107.11 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES:

At points where the Contractor's operations are adjacent to properties of utility firms or other property, damage to which might result in considerable expense, loss, or inconvenience, work shall not commence until all arrangements necessary for the protection thereof have been made.

The Contractor shall cooperate with the owners of any underground or overhead utilities in their removal and rearrangement operations in order that these operations may progress in a reasonable manner, that duplication of work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted.

If any utility service is interrupted as a result of accidental breakage, the Contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority.

SECTION 107

The Contractor shall expose all underground utilities and structures which might interfere with the construction of the project, in order to permit survey location prior to construction.

The Contractor shall assume full responsibility for damages to any underground facility/utility as a result of failing to obtain information as to its location, failing to excavate in a careful and prudent manner or failing to take measures for protection of the facilities/utilities. The Contractor is liable to the owner of the underground facility/utility for the total cost of the repair.

107.12 FURNISHING RIGHT-OF-WAY:

The Contracting Agency will provide right-of-way and easements for all work in advance of construction. Any exceptions will be indicated in the special provisions.

107.13 PERSONAL LIABILITY OF PUBLIC OFFICIALS:

In carrying out any provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the contract, there shall be no liability upon the Contracting Agency, Engineer, or their authorized representatives, either personally or as officials of the Contracting Agency, it being understood that in all such matters they act solely as agents and representatives of the Contracting Agency.

107.14 NO WAIVER OF LEGAL RIGHTS:

Upon completion of the work, the Contracting Agency will expeditiously make final inspection and notify the Contractor of acceptance. Such final acceptance, however, shall not preclude or stop the Contracting Agency from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Contracting Agency be precluded or stopped from recovering from the Contractor or his surety, or both, such overpayment as it may sustain, or by failure on the part of the Contractor to fulfill his obligations under the contract. A waiver on the part of the Contracting Agency of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the contract and in addition to any specific remedy provided the Contracting Agency in the contract documents, shall be liable to the Contracting Agency for latent defects, fraud or such gross mistakes as may amount to fraud, or as regards the Contracting Agency's rights under any warranty or guaranty or remedy required by law.

- End of Section -

SECTION 108

COMMENCEMENT, PROSECUTION AND PROGRESS

108.1 NOTICE TO PROCEED:

(A) On Bond Issue and Budget Projects, neither the Contractor nor any Subcontractor shall commence work on a project prior to receipt of the written Notice to Proceed from the Contracting Agency. The Contractor shall commence work as soon as practicable after the starting date specified in the Notice to Proceed. All work under the contract shall be completed within the number of calendar days stated in the proposal, plus extensions, beginning with the day following the starting date specified in the Notice to Proceed.

(B) On Improvement District Projects, the Contractor shall commence work within 10 days from the date of execution of the contract with the Contracting Agency. All work under the contract shall be completed within the number of calendar days stated in the proposal, plus any days extended on the contract, beginning with the day following the date of execution of the contract. The time set for completion of the project will be established by the Contracting Agency, in accordance with Arizona Revised Statutes Section 9-683.

The Contractor shall notify the Field Engineering Inspection Section 24 hours in advance of the time and place where work will begin and the Survey Section two working days in advance for staking.

108.2 SUBLETTING OF CONTRACT:

The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the contract or contracts, or of his right, title, or interest therein, without written consent of the Contracting Agency.

Subcontracts shall be in accordance with and the Contractor shall be bound by the following provisions:

(A) All subcontracts shall be subject to the approval of the Engineer.

(B) All subcontracts shall be in writing and shall provide that all work to be performed there under shall be performed in accordance with the terms of the contract.

(C) Subcontractors shall conform to the regulations governing employment of labor.

(D) The subcontracting of any portion of the work will in no way release the Contractor of his liability under the contract and bonds.

(E) On all contracts for pipeline construction, roadway construction or roadway maintenance, the Contractor shall perform, with his own organization, work amounting to not less than 50 percent of the total contract cost.

On other types of contracts the individual agency shall determine the percentage or waive this requirement.

108.3 CORRESPONDENCE TO THE CONTRACTOR:

A written notice, to the Contractor from the Contracting Agency, shall be considered delivered and the service thereof completed, when said notice is posted, by certified mail, to the said Contractor at his last given address, or delivered in person to the Contractor or his authorized representative on the work.

108.4 CONTRACTOR'S CONSTRUCTION SCHEDULE:

*For Improvement District Project: The words "superintendent of Streets" will be substituted for the word "Engineer." Any Extension contract time will be determined by the Superintendent of Streets with the consent of the governing body.

SECTION 108

The Contractor, when required, shall furnish the Engineer a construction schedule for his review. The Engineer's review of the Contractor's schedule is for purposes of: (1) the Contracting Agency's staffing the project as may be required; (2) to insure general compliance with the contract documents as it relates to the completion of all work; and (3) to monitor and evaluate the construction status for purposes of approving progress payments. In the event the schedule does not contain sufficient information to meet the above purpose, as determined by the Engineer, the Contractor shall resubmit a new schedule with the additional information requested by the Engineer. The right to determine the sequence of the work is a function vested solely in the Engineer and the construction schedule, when established, shall not be changed without the written consent of the Engineer. The orderly procedure of all work to be performed shall be the full responsibility of the Contractor.

Review of a submitted schedule by the Engineer shall in no way be construed as an affirmation or admission that the schedule is reasonable or workable which responsibilities remain the obligations of the Contractor. When the schedule shows a completion prior to the contract completion date, this extra time between the contract completion date and the scheduled completion date (float), may be used by the Contracting Agency without additional compensation to the Contractor. The Contracting Agency shall not be liable to the Contractor for any damages for delay if the Contractor completes the work prior to expiration of the original Contract completion date or as modified by approved change orders, if any.

108.5 LIMITATION OF OPERATIONS:

The Contractor shall conduct the work at all times in such a manner and sequence that will assure the least interference with traffic and inconvenience to the public. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

All traffic affected by the construction will be regulated in accordance with the current Traffic Barricade Manual prepared or adopted by the Contracting Agency's Traffic Engineering Department.

Except in emergencies endangering life or property, written permission shall be obtained from the Engineer to perform any work after regular working hours, on weekends, or legal holidays. Prior to the start of such work, the Contractor shall arrange with the Engineer for the continuous or periodical inspection of the work, surveys and tests of materials, when necessary.

If, in the opinion of the Engineer, the Contractor has fallen behind the approved progress schedule, the Contractor shall take such steps as may be required by the Engineer, including but not limited to, increasing the number of personnel, shifts, and/or overtime operations, days of work, and/or amount of construction equipment until such time as the work is back on schedule. He shall also submit for approval no later than the time of submittal of the next request for partial payment, such supplementary schedule or schedules as may be deemed necessary to demonstrate the manner in which the approved rate of progress will be regained, all at no additional cost to the Contracting Agency.

108.6 CHARACTER OF WORKMEN; METHODS AND EQUIPMENT:

The Contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by the specifications.

All workmen shall be competent and have sufficient skill, knowledge and experience in their class of work and in the operation of equipment required to perform all work properly and satisfactorily.

Any person employed by the Contractor or any Subcontractor who, in the opinion of the Engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed from the work by the Contractor or Subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the Engineer. The Contractor or Subcontractor shall keep the Contracting Agency harmless from damages or claims for compensation that may occur in the enforcement of this Section.

*For Improvement District Project: The words "superintendent of Streets" will be substituted for the word "Engineer." Any Extension contract time will be determined by the Superintendent of Streets with the consent of the governing body

SECTION 108

Should the Contractor or Subcontractor fail to remove such person as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until such orders are complied with.

All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that it will not damage property adjacent to the work area.

When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed, the Contractor is free to use any methods or equipment that he demonstrates to the satisfaction of the Engineer will accomplish the work in conformity with the requirements of the specifications.

When the specifications state the construction shall be performed by the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than those specified, he may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed to be used and an explanation of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing construction work in conformity with the specifications. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet the specifications, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining construction with the specified methods and equipment. The Contractor shall remove the deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the construction items involved nor in contract time as result of authorizing a change in methods or equipment under these provisions.

108.7 DETERMINATION AND EXTENSION OF CONTRACT TIME:

The number of calendar days allowed for the completion of the work included in the contract will be as stated in the proposal and will be known as the contract time.

When the contract time is on a calendar day basis it shall consist of the number of calendar days specified, including all weekends and legal holidays. All calendar days elapsing between the effective dates of any written notice from the Engineer to suspend work and to resume work following suspensions, not the fault of the Contractor, shall be excluded.

When the contract completion time is a fixed calendar date it shall be the date on which all work on the project shall be completed and meet final inspection.

If the Contractor finds it impossible for reasons beyond his control to complete the work within contract time as specified or as extended, he shall immediately submit a written request to the Engineer for an extension of time setting forth therein the reasons which he believes will justify the granting of his request. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Engineer* finds that the work was delayed because of conditions beyond the control and through no fault of the Contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect the same as though it were the original time for completion.

108.8 GUARANTEE AND WARRANTY PROVISIONS:

The Contractor shall guarantee the work against defective workmanship and materials for a period of one year from the date of its final acceptance under the contract, ordinary wear and tear and unusual abuse or neglect excepted.

Any omission on the part of the Engineer to condemn defective work or materials at the time of construction shall not be deemed an acceptance, and the Contractor will be required to correct defective work or materials at any time before final acceptance and within one year thereafter.

*For Improvement District Project: The words "superintendent of Streets" will be substituted for the word "Engineer." Any Extension contract time will be determined by the Superintendent of Streets with the consent of the governing body

SECTION 108

Should any defects develop within one year from the date of final acceptance due to faults in workmanship or materials the Contractor shall, within 14 calendar days of receipt of written notice from the Contracting Agency begin making the necessary repairs to the satisfaction of the Engineer. Such work shall include the repair or replacement of other work or materials damaged or affected by making the above repairs or corrective work, all at no additional cost to the Contracting Agency.

If defects develop which are determined by the Engineer to be an emergency, the Engineer shall notify the Contractor, via the most expeditious means, regarding the nature and condition of the defects. In turn, the Contractor shall immediately dispatch necessary forces to correct the defect or the emergency condition. If the Contractor, in his initial action, resolves the emergency condition but not the defect, a letter as discussed above will follow and normal procedures for corrections will be employed. If immediate or appropriate action, satisfactory to the Engineer, is not taken by the Contractor, or if the Contractor cannot be contacted, the Engineer will deploy necessary forces to correct and/or secure the deficiency. Costs of the Engineer's action shall be paid by the Contractor and/or his bonding agency. Should it later be determined that the defects requiring such emergency action are not the responsibility of the Contractor, the Contractor will be paid for all costs incurred as a result of these demands in accordance with Subsection [109.5](#). Such action by the Engineer will not relieve the Contractor of the guarantees required by this Section or elsewhere in the Contract Documents.

In case of work, materials, or equipment for which written warranties are required by the special provisions, the Contractor shall provide or secure from the appropriate Subcontractor or supplier such warranties addressed to and in favor of the Contracting Agency and deliver same to the Engineer prior to final acceptance of the work. Delivery of such warranties shall not relieve the Contractor from any obligation assumed under any other provisions of the contract.

The warranties and guarantees provided in this subsection of the contract documents shall be in addition to and not in limitation of any other warranties, guarantees or remedies required by law.

108.9 FAILURE TO COMPLETE ON TIME:

For each and every calendar day that work shall remain incompleted after the time specified for the completion of the work in the proposal, or as adjusted by the Engineer, the sum per calendar day shown in Table [108-1](#), unless otherwise specified in the proposal form, may be deducted from monies due to or to become due to the Contractor, not as a forfeit or penalty but as liquidated damages. This sum is fixed and agreed upon between the parties because the actual loss to the Contracting Agency and to the public caused by delay in completion will be impractical and extremely difficult to ascertain and determine.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time fixed for its completion may have been extended, will in no way operate as a waiver on the part of the Contracting Agency of any of its rights under the contract

TABLE 108-1		
LIQUIDATED DAMAGES		
Original Contract Amount		Daily Charges
From More Than	To and Including	Calendar Day or Fixed Date
\$ 0	\$ 25,000	\$ 210
25,000	50,000	250
50,000	100,000	280
100,000	500,000	430
500,000	1,000,000	570
1,000,000	2,000,000	710
2,000,000	5,000,000	1,070
5,000,000	10,000,000	1,420
10,000,000	—	1,780

SECTION 108

108.10 FORFEITURE AND DEFAULT OF CONTRACT:

It is further agreed to by the Contractor that if he:

- (A) Fails to begin the work under the contract within a reasonable time, or
- (B) Fails to perform the work with sufficient workmen and equipment or with sufficient materials to assure the prompt completion of said work, or
- (C) Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or
- (D) Discontinues the prosecution of the work, or
- (E) Fails to resume work which has been discontinued within a reasonable time after notice to do so, or
- (F) At any time colluded with any party or parties, or
- (G) Allows any final judgment to stand against him unsatisfied for a period of 14 calendar days, or
- (H) For any cause whatsoever, fails to carry on the work in an acceptable manner, the Engineer will give notice in writing to the Contractor and his surety of such delay, neglect, or default, and advise them that the work must be resumed immediately.

If the Contractor or surety, within a period of 14 calendar days after such notice, has not proceeded in accordance therewith, then the Contracting Agency will, upon written notification from the Engineer of the fact of such delay, neglect or default and the Contractor's failure to comply with such notice, have full power and authority without violating the contract, to take the prosecution of the work out of the hands of the Contractor. The Contracting Agency may appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of said contract in an acceptable manner.

All costs and charges incurred by the Contracting Agency, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due said Contractor. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the Contracting Agency the amount of such excess.

***108.11 TERMINATION OF CONTRACT**

The Contracting Agency may terminate the contract or a portion thereof if conditions encountered during the progress of the work make it impossible or impracticable to proceed with the work or a local or national emergency exists.

When contracts, or any portion thereof, are terminated before completion of all work in the contract, adjustments in the amount bid for the pay items will be made on the actual quantity of work performed and accepted, or as mutually agreed for pay items of work partially completed or not started. No claim for loss of anticipated profits will be considered.

Termination of the contract or any portion thereof shall not relieve the Contractor of his responsibilities for the completed work nor the surety of its obligation for and concerning any just claims arising out of the work performed.

- End of Section -

*For Improvement District Project: The words "superintendent of Streets" will be substituted for the word "Engineer." Any Extension contract time will be determined by the Superintendent of Streets with the consent of the governing body

SECTION 109

MEASUREMENTS AND PAYMENTS

109.1 MEASUREMENT OF QUANTITIES:

All work completed under the contract will be measured by the Engineer according to United States standard measures. The methods of measurement and computation to be used in determination of quantities of materials furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice. A station, when used as a definition or term of measurement, will be 100 linear feet.

Unless otherwise specified, longitudinal measurements will be made along the grade line.

Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the Engineer.

The term ton will mean the short ton consisting of 2,000 pounds avoirdupois.

Unless otherwise specified, structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

In computing volumes of excavations or fill, the average end area method or other acceptable methods as determined by the Engineer will be used.

Volumes will be computed at 60 F, using ASTM [D1250](#) for asphalt or ASTM [D633](#) for tars.

Lumber will be measured by the thousand board foot measure actually used in the work. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term lump sum, when used as a pay item, will mean complete payment for the work described.

Sundry items which have a basis for measurement and payment herein and which are incidental to or required in the construction of the work but are not included as items in the fee schedule shall be considered an integral part of the contract, and all labor, materials, etc. required for such items shall be furnished by the Contractor and the cost of same included in the unit price.

Where the units of measurement shown on the proposal form or the methods of measurement specified in the project special provisions differ from the measurement and payment provisions of the Uniform Standard Specifications, the project documents shall have precedence.

109.2 SCOPE OF PAYMENT:

Measurement and payment for pay items in the proposal will be as indicated in the applicable standard specification or in the special provisions.

When payment is specified to be made on the basis of weight, the weighing shall be done by a licensed public weighmaster or the weighmaster's deputy on a device licensed or certified as defined by Arizona Revised Statutes Section 41-2091 and 41-2093. The Contractor shall furnish the Engineer with duplicate Weighmaster's Certificates showing the actual net weights together with the information required by the rules adopted by the Department of Weights and Measures as authorized by Arizona Revised Statutes Section 41-2065. The Contractor shall furnish the Engineer with duplicate Weighmaster's Certificates at the time of delivery unless the Engineer designates a different submittal time. The Contracting Agency will accept the certificates as evidence of the weight delivered.

Payment for the various items in the proposal will be made at the unit price in the proposal, and shall be compensation in full for furnishing all labor, materials, equipment and appurtenances necessary to complete the work in a satisfactory manner as shown on the plans and as required in the specifications, with all connections, testing, and related work completed. Each item, fixture, piece of equipment, etc., shall be complete with all necessary connections and appurtenances, for the satisfactory use and

SECTION 109

operation of said item. No additional payment will be made for work related to any item unless specifically called for in the proposal. This compensation shall also cover all risk, loss, damage or expense of whatever character arising out of the nature of the work or the prosecution thereof, subject to the provisions of Section [107](#).

The unit prices shall include all costs for salaries and wages, all payroll additives to cover employee benefits, allowances for vacation and sick leave, company portion of employee insurance, social and retirement benefits, all payroll taxes, contributions and benefits imposed by any applicable law or regulation and any other direct or indirect payroll-related costs. The unit prices shall also include all costs for indirect charges, overhead, mileage, travel time, subsistence, materials, freight charges for materials to Contractor's facility or project site, equipment rental, consumables, tools, insurance costs, all applicable taxes and fees, as well as Contractor's fee and profit. The unit prices shall further include all site clean-up costs, hauling of construction debris, and proper disposal in accordance with all laws and regulations and the project plans and specifications.

Payment will be made for only those items listed in the proposal. All materials and work necessary for completion of the project are included in proposal items. Work or materials not specifically identified by a proposal item are considered as included in the unit price of related proposal items.

Unless otherwise specified, payment will not be made for unused materials.

109.2.1 Taxes and Fees: Taxes are deemed to include all sales, use, consumer and other taxes that are legally enacted at the time of submittal of the project fee proposal, whether or not they are yet effective or merely scheduled to go into effect. Any such taxes shall be paid by Contractor and shall be included in the unit prices.

The Contractor shall also be responsible to contact all municipalities and other governmental agencies having jurisdictional authority over the project or the project area to determine if they will charge the Contractor other fees (e.g., permit fees) for the project work. Unless otherwise specified in the project documents or on the proposal form, the Contractor shall include the cost of such fees in the unit prices on the proposal form.

109.3 ASSIGNMENT OF PAYMENTS:

The Contractor shall not assign payments of a contract or any portion thereof without approval of surety and written consent of the Contracting Agency.

Claims for monies due or to become due the Contractor may be assigned to a bank, trust company, or other financing institution, and may thereafter be further assigned and reassigned to any such institution. Any such assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in such financing. Any assignment of money shall be subject to all proper setoffs and withholdings in favor of the Contracting Agency and to all deductions provided for in these specifications.

109.4 COMPENSATION FOR ALTERATION OF WORK:

All compensation due the Contractor for alteration of work shall be documented by a Change Order. Except in emergency situations or as otherwise directed by the Engineer, the Contractor shall not proceed with Change Order work until said Change Order has been approved by the Agency.

***109.4.1 By The Contracting Agency:**

(A) For a decrease greater than 20 percent in either the total cost of the contract or the total cost of a major item and when a reasonable cost analysis supports an increase in the pro rata share of fixed cost chargeable to this item in total, an increase adjustment in the monies due the Contractor may be made. This adjusted compensation will not exceed 80 percent of the

*Not applicable to Improvement District Projects

SECTION 109

original lump sum contract amount or, if for a unit price item, the adjustment will not exceed 80 percent of the original extended unit price. This does not apply to items labeled as contingent items in the proposal.

(B) For an increase greater than 20 percent in either the total cost of the contract or the total cost of a major item, any adjustment made will only apply to that cost in excess of 120 percent of the original total cost of the contract or, in the case of a major item, in excess of 120 percent of the original proposed extended unit price. If either party presents a reasonable cost analysis that shows a change in the pro rata share of fixed costs chargeable to this item in total, an increase or decrease adjustment will be made. This increase or decrease adjustment will be made on such basis as is necessary to cover a reasonable estimate of cost, plus an allowance, not to exceed 15 percent, for overhead and profit. If the parties are unable to reach an agreement, the Engineer has the authority to order the excess work done on an actual cost basis as specified in Section [109.5](#).

(C) For either an increase or decrease in cost, no claim shall be made by the Contractor for any loss of anticipated profits.

***109.4.2 Due to Physical Conditions:**

(A) If the Engineer, after his investigation of the site conditions, agrees that they materially differ from those indicated in the contract and would cause an increase in the Contractor's cost of accomplishing the work, new unit prices or a lump sum cost (for the additional work only) may be negotiated. If the parties are unable to reach an agreement on price, the Engineer has the authority to order this additional work accomplished on an actual cost basis as specified in Section 109.5.

(B) If the Engineer, after his investigation of the site conditions, finds that these conditions do not materially differ from those indicated in the contract, he has the authority to order the work to be accomplished at the original price(s).

***109.4.3 Due to Extra Work:** If the Contractor can present valid, factual evidence, satisfactory to the Engineer, that the work in question is an item not provided for in the contract as awarded then a unit price or lump sum cost, for this item only, may be negotiated. If the parties are unable to reach an agreement on price or cost, the Engineer has the authority to order the extra work accomplished on an actual cost basis as specified in Section [109.5](#).

109.4.4 Made at the Contractor's Request: Any alterations, if approved, will be a reduction in cost or at no additional cost to the Contracting Agency.

109.4.5 Due to Failure of Contractor to Properly Maintain the Project:

(A) For any suspension of work during normal working hours due to failure of the Contractor to properly maintain the project, there will be no additional compensation or time allowed.

(B) If the Engineer provides the Contractor with a written order to provide adequate maintenance of traffic, adequate cleanup, and adequate dust control or to correct deficiencies resulting from abnormal weather conditions and the Contractor fails to comply in the time frame specified, the Contracting Agency may have the work accomplished by other sources. The Contracting Agency will deduct the cost of accomplishing the work from monies due or to become due to the Contractor. Computation of the cost will be in accordance with Section [109.5.4.2](#).

109.4.6 Allowable Mark-Ups: Only the allowable mark-ups as defined in Section [109.5](#) shall be allowed. Additional compensation for other items, including extended overhead and conditions, shall not be considered or allowed.

***109.5 ACTUAL COST WORK:**

The compensation for actual cost work performed by the Contractor (Subcontractor) shall be determined by the Engineer in the following manner.

*Not applicable to Improvement District Projects

SECTION 109

109.5.1 Equipment: For all equipment, the use of which has been authorized by the Engineer, except for small tools and manual equipment, the Contractor will be paid in accordance with the latest Schedule of Equipment Rates used by the Arizona Department of Transportation. Payment for equipment will be made following the calculations in Section [109](#) of the Arizona Department of Transportation Standard Specifications for Road and Bridge Construction. The value of 0.933 shall be used for the adjustment factor F used in the rental rate formulas ($F = 0.933$).

109.5.2 Material: For all material, accepted by the Engineer and used in the work, the Contractor will be paid the actual cost of such material including transportation cost, to which total cost will be added a sum equal to 15 percent thereof.

109.5.3 Labor: For all labor and for the foreman, when he is in direct charge of the operation, the Contractor will be paid:

(A) The actual wages paid plus the current percentage thereof as determined by the Arizona Department of Transportation which is deemed to cover the Contractor's cost incurred as a result of payment imposed by State or Federal Law and payments that are made to, or on behalf of, the workman other than the actual wage. Actual wage is defined as the required current hourly rate paid to the labor classification concerned and does not include any fringe benefits or dislocation allowances. If the Contractor is not required to pay fringe benefits equivalent to the Current rates published in the Federal Register, an equitable deduction will be made from the current percentage established by the Arizona Department of Transportation.

(B) For the first \$50,000 of labor cost computed under paragraph (A) above, the Contractor will be paid an amount equal to (15) fifteen percent for overhead and profit.

(C) For all labor cost computed under paragraph (A) above, in excess of \$50,000 but not exceeding \$100,000, the Contractor will be paid an amount equal to (12) twelve percent for overhead and profit.

(D) For any labor cost computed under paragraph (A) above in excess of \$100,000 the Contractor will be paid an amount equal to (10) ten percent for overhead and profit.

109.5.4 Work Performed by Subcontractors or Other Sources:

109.5.4.1 Work Performed by Subcontractors: If it is determined by the Engineer that portions of the Actual Cost Work to be performed requires specialized labor or equipment not normally used by the Contractor and such work is then authorized to be performed by a subcontractor(s), the subcontractor(s) will be paid by the Contractor in accordance with the actual cost work procedures outlined herein. The Contractor will be paid by the Contracting Agency the full amount of the subcontract plus the following percentages for administration and supervision.

(A) For the first \$10,000 accumulated total of all change order work performed by subcontractors (less mark-up for overhead and profit), the Contractor will be paid an amount equal to 10 percent of the accumulated total for administration and supervision. If the accumulated total is \$3,000 or less, the Contractor will be paid \$300 for administration and supervision.

(B) For all change order work in excess of \$10,000 accumulated total performed by subcontractors (less mark-up for overhead and profit), the Contractor will be paid an amount equal to five percent of the accumulated total for administration and supervision.

109.5.4.2 Work Performed by Other Sources: If the Contracting Agency has work performed by other sources, in accordance with Section [109.4.5](#) (B), the Contracting Agency will deduct, from monies due or to become due to the Contractor, the full amount of the cost of accomplishing the work by other sources plus the following percentages for administration and supervision:

(A) For the first \$10,000 accumulated total of work performed by other sources, the Contracting Agency will deduct an amount equal to 10 percent of the accumulated total for administration and supervision. If the accumulated total is \$3,000 or less, the Contracting Agency will deduct \$300 for administration and supervision.

*Not applicable to Improvement District Projects

SECTION 109

(B) For all work in excess of \$10,000 accumulated total performed by other sources, the Contracting Agency will deduct an amount equal to 5 percent of the accumulated total for administration and supervision.

109.5.5 Documentation:

(A) Except in emergency situations, the Contracting Agency will not be liable for any Actual Cost Work performed by the Contractor prior to written authorization by the Engineer or prior to full execution of a written agreement by all parties concerned.

(B) Payment for work performed on an actual cost basis will not be made until the Contractor has furnished the Engineer, on forms agreed to by the Contracting Agency, duplicate itemized statements of such work, including subcontractor(s) costs, detailed as follows:

- (1) Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.
- (2) Designation, dates, daily hours, total hours, rental rates and extension for each unit of equipment, and machinery.
- (3) Quantities of material, prices, extension and transportation cost on a daily basis. These charges shall be substantiated by vendor invoices.

(C) The Engineer will compare his records with the statement furnished by the Contractor, resolving any differences and making the required adjustments. This statement when agreed upon and signed by both parties, shall be the basis of payment for the work performed.

109.5.6 Bonds and Insurance: The Contractor shall be paid for the actual cost plus (10%) ten percent for Administrative cost when the Contractor can provide evidence of payment for premiums on required payment and performance bonds, premiums on railroad and/or airport extended liability insurance, and premiums for property damage and/or public liability insurance. No duplication of payment for Contractor's costs included under Section [109.5.3](#) (A) will be allowed.

109.5.7 Authority of Engineer: The Engineer is in charge of Actual Cost Work and has the authority to direct which labor and equipment will be used, to suspend operations, and to refuse to pay for any labor or equipment which he feels is not doing productive work.

109.6 PAYMENT FOR IMPROVEMENT DISTRICT PROJECTS:

Payment to the Contractor shall be made in accordance with ARS Sections 48-523 to 48-613, both inclusive.

As soon as the Contractor has fulfilled his contract, the Superintendent of Streets shall estimate the benefits arising from the work and make assessments to cover the work performed and specified in the contract, including incidental expenses in accordance with ARS Section 48-589.

The Contractor agrees to accept payment in the form of Assessments with attached Warrants and/or Improvement Bonds at the rate of interest declared in the resolution of intention prepared by the Contracting Agency.

***109.7 PAYMENT FOR BOND ISSUE AND BUDGET PROJECTS:**

(A) Partial Payments: The Contracting Agency will make a partial payment to the Contractor on the basis of an estimate prepared by the Contractor or Engineer for work completed through the last day of the preceding calendar month. Payment will be within 14 calendar days after the estimate has been certified and approved by the Engineer and received by the owner.

*Not applicable to Improvement District Projects

SECTION 109

The Contracting Agency will retain 10 percent of all estimates as a guarantee for complete performance of the contract in accordance with Arizona Revised Statutes Section 34-221 or 34-607, unless the Contractor elects to deposit securities in accordance with Arizona Revised Statutes Section 34-221, Paragraph C.5. or 34-607, Paragraph B.5.

When the Contractor is fifty percent completed, one-half of the amount retained shall be paid to the Contractor provided he is making satisfactory progress on the contract and there is no specific cause or claim requiring a greater amount to be retained. After the contract is fifty percent completed, no more than five percent of the amount of any subsequent progress payments made under the contract will be retained providing the Contractor is making satisfactory progress on the project. Except that, if at any time the owner determines satisfactory progress is not being made, ten percent retention shall be reinstated for all progress payments made under the contract subsequent to the determination.

Any material or equipment which will become an integral part of the completed project will be considered for partial payment in the Contractor's monthly progress payments. The intent of making partial payments is to provide the Contractor payment for direct material or equipment purchased. The purpose is to minimize the effect of escalating costs by procuring key materials. It is not the intent to pay for all materials but only those meeting the following conditions.

- (1) A total value of all items requested for payment must be greater than \$20,000. No payment will be processed until the material or equipment has been observed, reviewed or verified by the Contracting Agent representative. Only the material or equipment meeting the requirements of the plans and specifications will be paid. Payment for material or equipment does not constitute final acceptance.
- (2) Materials or equipment must be stored or stockpiled either on site, in a warehouse, or secured storage area. The Contractor assumes all responsibility for protection of these materials or equipment and shall insure them to cover loss or damage to same without additional liability or added costs to the Agency for providing this security, insurance, and storage.
- (3) The Contractor will provide access to the storage area or warehouse upon request of the Contracting Agent's representative for the purpose of verifying the inventory of items paid for under this Section. None of the materials or equipment paid for under this Section will be removed from the storage site until incorporated into the work of the project. The storage site shall be within the general geographical area of the project.
- (4) The Contractor shall provide a paid invoice and/or lien waiver for items paid for under this Section. The Agency will not pay more than the invoice price for the item or items, less retention.
- (5) The Engineer may exclude individual payment requests which in the Engineer's judgment do not warrant storage and prepayment under the intent of this Section.

(B) Final Payment: When the project has been accepted as provided in Section [105](#), and within 30 calendar days after final inspection of the work completed under the contract, the Engineer will render to the Contracting Agency and the Contractor, a final estimate which will show the amount of work performed and accepted under the contract. All prior estimates and partial payments will be subject to correction in the final estimate for payment.

Within sixty (60) calendar days after final acceptance, the Contracting Agency will pay the Contractor all amounts due him under the contract, except that before final payment will be made, the Contractor shall satisfy the Contracting Agency by affidavit that all bills for labor and materials incorporated in the work have been paid. The Contractor's Affidavit may be obtained from the Engineering Office of the Contracting Agency.

If payment will be longer than 60 days after final completion and acceptance, the owner will provide the Contractor specific written findings for reasons justifying the delay in payment.

The acceptance of the project and the making of the final payment shall not constitute a waiver by the Contracting Agency/Owner of any claims arising from faulty or defective work appearing after the completion or from failure of the Contractor to comply with the requirements of the contract documents.

SECTION 109

109.8 PAYMENT FOR DELAY:

The procedures contained in this Section shall not be construed to void any provision of the contract which require notice of delays, provides for negotiation of other procedures for settlement or provide for liquidated damages.

109.8.1 Failure to Locate or Incorrect Location of Utilities: Arizona Revised Statutes 40-360.28 indicates that if a person (owner, operator, or agent) fails to locate or incorrectly marks the location of the underground facility in a timely manner, the person (owner, operator, or agent) becomes liable for resulting damages, costs and expense to the injured party.” The Contracting Agency will deny any claims for damages or delays if another owner or operator is at fault.

109.8.2 Contracting Agency Delays: Arizona Revised Statutes 34-221 states “A contract for the procurement of construction shall include a provision which provides for negotiations between the Agent and the Contractor for the recovery of damages related to expenses incurred by the Contractor for a delay for which the Agent is responsible, which is unreasonable under the circumstances and which was not within the contemplation of the parties to the contract.” In this case, if the Contractor sustains damages which could not have been avoided by the judicious handling of forces, equipment and plant or by reasonable revision in the Contractor's schedule of operation, the compensation for such damages will be negotiated. The Contractor shall notify the Engineer of the condition in writing by the next work day. Failure to notify the Engineer within this time may be just cause to reject any claims for such damages.

Compensation for such damages will be negotiated as follows:

(A) The Engineer shall be satisfied that the Contractor has made every reasonable effort to prosecute the work despite any delays encountered or revisions in the Contractor's scheduling of work.

(B) The Compensation paid to the Contractor shall be in accordance with Section [109](#).

109.8.3 Extension of Contract Time: For any such delays, the contract time will be adjusted in accordance with Section [108.7](#).

109.9 DOLLAR VALUE OF MAJOR ITEM:

TABLE 109-1	
DOLLAR VALUE OF MAJOR ITEM	
Original Contract Amount	Dollar Value of Major Item
\$0.00 to \$1,000,000.00	\$50,000 or 10% of original contract amount, whichever is less
\$1,000,000.00 to \$5,000,000.00	5.0% of original contract amount
\$5,000,000.00 or greater	\$250,000.00 or 2.5% of original contract amount, whichever is greater

109.10 PAYMENT FOR MOBILIZATION/DEMobilIZATION:

The Agency will compensate Contractor for a single round trip mobilization/demobilization of Contractor's personnel, equipment, supplies and incidentals, including establishment of offices, buildings and other facilities required for the performance of the work on the project, as well as preparatory work and operations prior to the commencement of the work on the project site.

Mobilization/demobilization will be measured for payment by the lump sum as a single complete unit of work. Payment for mobilization/demobilization will be made at the contract lump sum price. Payment shall be made in equal one-third portions. The first payment will be paid with the Contractor's initial billing. The second payment will be made when the total payments to the Contractor for the pay items, exclusive of payments for mobilization/demobilization, equal greater than one-half of the initial contracted amount, exclusive of mobilization/demobilization. The remaining one-third will be paid as part of the final payment due to the Contractor.

SECTION 109

When other contract items are adjusted as provided in Section [109](#), and if the costs applicable to such items of work include mobilization costs, such mobilization costs will be considered as recovered by Contractor in the lump sum price paid for mobilization, and will be excluded from consideration in determining compensation under Section [109](#).

If the Contractor performs a second or additional mobilization/demobilization of personnel, material and/or equipment at the Engineer's express written request, the Agency will compensate the Contractor for such expenses at the Contractor's actual costs. The Contractor shall provide all documentation for these costs at the request of the Engineer.

For projects that do not list mobilization/demobilization as a pay item, a single round trip mobilization/demobilization shall be considered a non-pay item for said projects, the cost of which shall be spread across other appropriate items. Should a second or additional mobilization/demobilization be required at the Engineer's express written request, compensation for such shall be handled as detailed in the foregoing paragraph.

- End of Section -

SECTION 110

NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION

110.1 GENERAL:

When changes are initiated by the Contracting Agency, or as a result of decisions rendered by the Agency, inaction of the Agency or changed conditions unknown to all parties at the time of bid, the Contractor may request an adjustment to the contract amount and/or contract time. This Section does not preclude the use of legal remedies in the event of claims or litigation brought by third parties. The procedure for this adjustment is a two step process, (1) Initial Notification and Dispute Resolution and (2) Administrative Process for Dispute Resolution, as discussed below:

110.2 INITIAL NOTIFICATION AND DISPUTE RESOLUTION:

110.2.1 Notification: As required by these Specifications or any time the Contractor believes that the action or decision of the Contracting Agency, lack of action by the Contracting Agency, or for some other reason will result in or necessitate the revision of the contract, the Engineer must be notified immediately. If within two working days the identified issue has not been resolved between the Contracting Agency and the Contractor, the Contractor shall provide a written notice. At a minimum, the written notice shall provide a description of the nature of the issue, the time and date the problem was discovered, and if appropriate, the location of the issue. After initial written notice has been provided, the Engineer will proceed in accordance with Subsection [104.2](#). In addition to proceeding in accordance with Subsection [104.2](#), the Contracting Agency and the Contractor must make every effort to resolve the issue identified in the initial notice. Only if the issue cannot be quickly resolved will it be necessary to proceed to the next step in this subsection.

110.2.2 Dispute Resolution: Once the above process has been exhausted or within seven calendar days of the date of the initial written notice, whichever is sooner, the following steps will be taken:

(A) The Contractor shall provide in writing the following information to the Engineer. If known, a cost analysis may be included with the information.

- (1) The date of occurrence and the nature and circumstances of the issue for which initial notice was given.
- (2) Name, title, and activity of each Contracting Agency or all other persons knowledgeable of the issue.
- (3) Identity of any documents and the substance of any oral communication related to the issue.
- (4) Basis for an assertion that the work required is a change from the original contract work or schedule.
- (5) Identity of particular elements of contract performance for which a change in compensation and/or time may be sought, including:
 - (a) Pay item(s) that have been or may be affected by the issue and any adjustments to unit price(s) that are required;
 - (b) Labor and/or materials that will be added deleted or wasted by the problem and what equipment will be idled or required;
 - (c) Delay and disruption in the manner and sequence of performance that has been or will be caused;
 - (d) Adjustments to delivery schedule(s), staging, and contract time due to the dispute and
 - (e) Estimate of the time within which the Contracting Agency must respond to the notice to minimize cost, delay, or disruption of issue.
- (6) Any other items or information germane to the dispute.
- (7) The Contractor's written certification, under oath, attesting to the following:
 - (a) The request is made in good faith.
 - (b) Supportive data is accurate and complete to the Contractor's best knowledge and belief.
 - (c) When provided, the amount requested accurately reflects the Contractor's actual cost incurred.

In complying with this request, the Contractor shall use the Contracting Agency's certification form.

(B) Within ten calendar days after the Contractor's submission in accordance with the above paragraph, the Engineer will respond in writing to the Contractor to:

- (1) Confirm that a supplemental agreement is necessary and, when necessary, give appropriate direction for further performance, or

SECTION 110

- (2) Deny that the contract has been revised and, when necessary, direct the Contractor to proceed with the contract work, or
- (3) Advise the Contractor that adequate information has not been submitted to decide whether (1) or (2) applies, and indicate the needed information and date it is to be received by the Engineer for further review. The Contracting Agency will respond to such additional information within ten calendar days of receipt from the Contractor.

110.2.3 Conditions: The failure of the Contractor to comply with the requirements of this subsection constitutes a waiver of entitlement to additional compensation or a time extension.

110.3 ADMINISTRATIVE PROCESS FOR DISPUTE RESOLUTION:

110.3.1 General: If the Contractor rejects the decision of the Engineer in Subsection [110.2.2](#) (B) above, the Contractor may begin the Administration Process to resolve the dispute.

The notice provision set forth in Subsection [110.2](#) is a contractual obligation assumed by the Contractor in executing the contract. It is understood that the Contractor will be forever barred from recovering against the Contracting Agency if the Contractor fails to give notice of any act or failure to act, by the Engineer, or the happening of any event, thing, or occurrence, in accordance with Subsection [104.2](#) Alteration of Work.

The administrative process for the resolution of disputes is sequential in nature and is composed of the following levels:

- Level I. (Representative reviewed by: *e.g. Construction Engineer*)
- Level II. (Representative reviewed by: *e.g. Assistant County/City Engineer*)
- Level III. (Representative reviewed by: *e.g. County/City Engineer*)

Note: The above stated titles may vary depending on the Contracting Agency's organization.

These three levels of review; the specific titles; the financial authority of each; and the names of people assigned to each level shall be provided at the preconstruction conference. The equivalent information regarding the Contractor's organization shall also be provided at the preconstruction conference.

Except as provided elsewhere herein, no dispute will be accorded a particular level of review unless the dispute has been reviewed at the preceding level and the Contractor rejects the decision in writing within the time period specified, or both parties agree that the decision for compensation is above that levels authority.

Unless specifically requested otherwise by the Contracting Agency, submission of additional information by the Contractor or Engineer, at any level of the review process shall cause the process to revert to Level I.

110.3.2 Required Information: At a minimum, the information described in Subsection [110.2](#) must accompany each dispute. If the following applies, it shall also be provided in addition to the information required by Subsection [110.2](#).

(A) If additional compensation is sought, the Contractor shall submit the exact amount sought as required by Subsection [110.2.2](#) (A) (5) broken down into the following categories:

- (1) Direct Labor
- (2) Direct Materials
- (3) Equipment
- (4) Job Overhead
- (5) General and Administrative Overhead
- (6) Subcontractor's Work (broken down as 1, 2, 3 and 4 above)
- (7) Other categories as specified by the Contractor.

(B) If additional time is sought, the Contractor shall provide a comprehensive time impact analysis showing the delay(s) and how they affect the critical path. The time impact analysis must include both the original and as-built critical path schedules and must be supported by documentation such as delivery schedules, invoices, correspondence, memoranda of telephone calls, payroll data, daily work schedules, etc. NOTE: The path of the longest

SECTION 110

duration of continuous and dependent work activities through the schedule network is identified as the Critical Path and is the minimum amount of time required to build the project as depicted by the schedule.

(C) The Contractor shall also notify the Contracting Agency's Level I Representative in writing that all documentation in support of the dispute has been provided and that the administrative review process should begin. No formal action will be taken by the Level I Representative until this written notification is received. The documentation provided to the Level I Representative shall serve as the basis for evaluating the Contractor's position regarding the dispute throughout the administrative process.

110.3.3 Process: The Contracting Agency's Level I Representative will render a written decision regarding the matter in dispute within two working days of receipt of the Contractor's notification that the dispute resolution process should begin.

The Contractor shall, upon receipt of the decision by the Level I Representative, either accept or reject the decision in writing. If the Contractor does not reject the Level I Representative's decision within two working days of its receipt, the Contractor will be deemed to have accepted the decision, the dispute will be considered withdrawn from the administrative process, and there will be no further remedy.

If the Contractor rejects the decision of the Level I Representative, the dispute will be forwarded by the Level I Representative to the Level II Representative. The Level II Representative will, within seven working days of receipt of the dispute information from the Level I Representative, schedule and hold a meeting to review the dispute with the Contractor. This time limit may be extended by mutual agreement of the parties. The Level II Representative will, within seven working days of the meeting, issue a written decision, with justification, regarding the dispute.

The Contractor shall, within seven working days of receipt of the decision, either accept or reject it in writing. If the Contractor does not reject the Level II decision within seven working days, the Contractor will be deemed to have accepted the decision and the dispute will be considered withdrawn from the administrative process and there will be no further remedy.

If the Contractor rejects the decision of the Level II Representative, the Level II Representative will forward the dispute to the Level III Representative. The Level III Representative will, within fourteen working days of receipt of the dispute information from the Level II Representative, schedule and hold a meeting with the Contractor. This time limit may be extended by mutual agreement of the parties. The Level III Representative will, issue a written decision within fourteen working days of the meeting, with justification, regarding the dispute.

The Contractor shall, within fourteen working days of the receipt of the decision of the Level III Representative, either accept or reject it in writing. If the Contractor does not reject the Level III Representative's decision within fourteen working days, the Contractor will be deemed to have accepted the decision, the dispute will be considered withdrawn from the administrative process, and there will be no further remedy.

If the Contractor rejects the decision of the Level III Representative, there will be no further administrative review of the dispute. The resolution will then proceed as follows:

(A) Mediation: Prior to filing for arbitration or litigation, the Contractor may request non-binding mediation by filing a request for mediation in writing with the Engineer. If agreeable, the Engineer will then arrange for a mutually agreeable mediator. Such request for mediation shall be made within thirty calendar days from the date of the Level III Representative's decision as provided for in this subsection.

In connection with the mediation, each party shall bear its own costs, attorney's fees, and expert fees. Any fees and expenses assessed by the mediator shall be borne equally by the parties.

(B) Dispute Review Board/Arbitration: The decision of the Level III Representative in relation to the claim shall be final unless the dispute review board or arbitration is chosen as follows:

- (1) Where the amount in controversy is less than or equal to the amount authorized in Subsection [110.3.4](#), the sole remedy shall be the Dispute Review Board as prescribed in Subsection [110.5](#) unless both parties mutually agree to utilize arbitration as prescribed in Subsection [110.4](#).

SECTION 110

(2) Where the amount in controversy is more than authorized in Subsection [110.3.4](#), the Contractor reserves the right to initiate litigation pursuant to Section 12-821 et seq. of the Arizona Revised Statutes, or if mutually agreed upon, the parties may choose to resolve the controversy utilizing either the Dispute Review Board as prescribed in Subsection [110.5](#) or Arbitration as prescribed in Subsection [110.4](#).

110.3.4 Amount of Dispute: For the purposes of this subsection, the amount in controversy may not exceed \$200,000.00. A claim for adjustment in compensation shall mean an aggregate of operative facts giving rise to the rights of the party for which it is seeking to enforce. That is to say, a claim under this subsection is defined as the event, transaction or set of facts that give rise to a claim for compensation, costs, expenses or damages.

In making a determination whether the amount in controversy is \$200,000.00 or less, the parties shall not consider, quantify or take into account any requested extensions of contract time, or the release or remission of liquidated damages assessed or accrued prior to the dispute in question, under Subsection [108.7](#) and [108.9](#) of the Specifications.

Any party having a claim, adjustment or dispute for an amount in excess of \$200,000.00 may waive or abandon the dollar amount of any such claim in excess of \$200,000.00 so as to bring the claim, adjustment or dispute within the scope and coverage of this subsection, provided that the amount allowed to any such party by the arbitration award shall not exceed \$200,000.00. Various damages claimed by the party for a single claim may not be divided into separate proceedings to create claims within the \$200,000.00 limit.

110.4 ARBITRATION:

If the parties mutually agree to pursue arbitration as prescribed in Subsection [110.3.3](#), then a Demand for Arbitration shall be filed in writing with the American Arbitration Association or United States Arbitration and Mediation of Arizona, and a copy served thereof upon the Level III Representative or Contractor, whichever applicable. Such Demand for Arbitration shall be made by the party within thirty calendar days of the date of the Level III Representative's decision as provided for in Section [110.3](#) above, unless a mediation process is already underway, in which case the Demand for Arbitration shall be made within thirty days of the termination of the mediation process. The scope of the arbitration proceeding shall be restricted and limited to the matters originally presented to the Level III Representative for decision or determination and shall include no other matters. All arbitration of claims shall be conducted in Phoenix, Arizona or other mutually selected location in accordance with the rules of the arbitration service hearing the dispute.

The claim shall be submitted to a single arbitrator who shall be selected by the parties from a list of arbitrators furnished by the arbitration service. Each party shall alternately strike names from the list until only one name remains. The person whose name thus remains on the list of arbitrators is their first choice, but if that person is not available to serve, the two persons whose names were last stricken are acceptable, with the one whose name was last stricken being the first alternate.

Unless agreed to otherwise, the parties shall select the arbitrator within ten calendar days after each has received a copy of the list of arbitrators.

Each party to the arbitration shall bear its own costs, attorney fees and expert fees. Any other costs and fees assessed by the arbitration service shall be divided equally between the parties to the arbitration.

The decision or award of the arbitrator shall be supported by substantial evidence and, in writing, contain the basis for the decision or award and findings of fact. The decision or award by the arbitrator when made shall be final and nonappealable except as provided in Section 12-1512, Arizona Revised Statutes. Both parties to the Contract shall be bound by the Arbitration Award for all purposes and judgment may be entered upon it in accordance with applicable law in the Superior Court of Arizona.

110.5 DISPUTE REVIEW BOARD:

If the Dispute Review Board is utilized as prescribed in Subsection [110.3.3](#), the Engineer shall be notified within thirty days after the Level III Representative decision. The Dispute Review Board is a three member board independent of the parties involved in the issue. The Agency and Contractor shall each select a member for this board. The third member shall be a mutually agreed upon independent member. This Review Board must be selected within fourteen calendar days after notice to

SECTION 110

the Level III Representative. Each member shall agree to impartially serve the Agency and Contractor. Fees and expenses of Board Members are to be shared equally by Agency and Contractor. The Dispute Review Board shall meet within thirty days of the selection of the board, unless, by mutual agreement, another date is selected. The scope of the Dispute Review Board shall be restricted and limited to the matters originally presented to the Level III Representative for decision or determination and shall include no other matters. The Board shall consider and evaluate the dispute and render a written decision that assigns financial responsibilities and allocates adjustments in the contract time, if applicable, within seven calendar days after the meeting. The decision of the dispute Review Board will be final.

110.6 FINAL DOCUMENTATION AND PAYMENT:

If at any step in the process a dispute is resolved, the Contractor must sign a supplemental agreement setting forth the resolution of the dispute and including an unconditional release as to any and all matters arising from the dispute. In addition, when the agreement results in a change in contract amount and/or time, a change order shall be prepared by the Contracting Agency for said changes and signed by both parties within 30 days from the date of the agreement. Payment of the change order will be made to the appropriate party(s) in accordance with Section [109](#).

- End of Section -

PART 200
EARTHWORK

Section	Last Revised	Title	Page
201	1999	<u>Clearing and Grubbing</u>	201-1
205	1998	<u>Roadway Excavation</u>	205-1
206	2015	<u>Structure Excavation and Backfill</u>	206-1
210	2009	<u>Borrow Excavation</u>	210-1
211	2015	<u>Fill Construction</u>	211-1
215	1998	<u>Earthwork for Open Channels</u>	215-1
220	2012	<u>Riprap Construction</u>	220-1
230	2010	<u>Dust Palliative Application</u>	230-1

This Page Reserved for Future Use

SECTION 201

CLEARING AND GRUBBING

201.1 DESCRIPTION:

This work shall consist of removing objectionable material from the right-of-way, easements and such other areas as may be specified in the special provisions. Clearing and grubbing shall be performed in advance of grading operations.

201.2 PRESERVATION OF PROPERTY:

Existing improvements, adjacent property, utilities and other facilities, and trees and plants not to be removed, shall be protected from injury or damage resulting from the Contractor's operations, see Section [107](#).

201.3 CONSTRUCTION METHODS:

The construction site and areas on each side of the roadway from centerline to the toe of an embankment, the top of a cut slope, the slope rounding limit or to a line 10 feet outside the edge of the surfaced area, whichever is greater, but not beyond the limits of the right-of-way, shall be cleared of all trees, stumps, brush, roots, rubbish, debris and other objectionable matter, except as follows.

All trees and shrubs found suitable for improvement and beautification, which will not interfere with excavation or embankment or cause disintegration of the improvements shall not be disturbed. In any event, the Contractor shall avoid, as far as practicable, injury to shrubbery, vines, plants, grasses and other vegetation growing outside of the clearing limits. The dragging and the piling of materials of various kinds and the performing of other work which may be injurious to vegetation shall, insofar as practicable, be confined to areas which have no vegetation or which will be covered by embankment or disturbed by excavation during grading operations.

For the full width of all water courses within the right-of-way lines, no stump, root or other obstruction shall be left higher than the natural stream bed.

From excavated areas, all stumps, roots and other obstructions 3 inches or over in diameter shall be grubbed to a depth of not less than 18 inches below finish grade.

In embankment areas or other areas to be cleared outside the road prism slope lines, all stumps, roots and other obstructions shall not be left higher than specified in Table [201-1](#).

TABLE 201-1	
EMBANKMENT CLEARING AND GRUBBING	
Height of Embankment Over Stump	Height of Clearing and Grubbing
0 Feet to 2 Feet	All stumps or roots 6 inches or over in diameter shall be grubbed to 18 inches below original grade. All others shall be cut flush with the ground.
2 Feet to 3 Feet	All stumps 1 foot and over in diameter shall be grubbed to 18 inches below original grade. All others shall be cut flush with the ground.
Over 3 Feet	No stumps shall be left higher than the stump top diameter, and in no case more than 18 inches.

Cavities left below subgrade elevation by removal of stumps or roots shall be carefully backfilled and compacted.

Tree branches extending over the roadway, which hang within 12 feet of the profile grade or that restrict sight distance shall be cut off close to the trunk or stem of the tree in a neat and workmanlike manner. The Contractor shall remove additional tree branches under the direction of the Engineer, in such a manner that the tree will present a balanced appearance. Scars resulting from the removal of branches shall be treated with a heavy coat of an approved tree sealant.

All tree trunks, stumps, brush, limbs, roots, vegetation and other debris removed in clearing and grubbing shall be removed to locations outside of and out of sight of the right-of-way, or otherwise disposed of so as to leave the construction site and adjacent areas in a neat and finished condition, free from unsightly debris.

SECTION 201

201.4 REMOVAL AND DISPOSAL OF SALVAGEABLE ITEMS:

Items and materials of salvage value as determined by the Engineer, unless incorporated in the new work, shall remain the property of the Contracting Agency and shall be stored in adjacent areas as directed by the Engineer. Such items and materials shall be carefully removed and in such a manner as to permit reuse.

201.5 PAYMENT, CLEARING AND GRUBBING:

Unless otherwise provided in the special provisions or bid proposal, no payment will be made for clearing and grubbing as such; the cost thereof shall be included in the bid price for the construction or installation of the items to which said clearing and grubbing are incidental or appurtenant.

201.6 MEASUREMENT, REMOVAL AND DISPOSAL OF TREES:

If the proposal includes separate estimates of quantities for the removal of trees, the tree will be classified by size as follows:

(A) Trees 12 inches or less in diameter at 1-foot above the original ground surface will be included in the bid price for clearing and grubbing or excavation and no additional compensation will be allowed therefore.

(B) Trees more than 12 inches in diameter at 1-foot above the original ground will be included as separate bid item and payment will be made at the unit bid price quoted in the proposal.

201.7 PAYMENT, REMOVAL AND DISPOSAL OF TREES:

Payment for removal of trees will be on a unit price for each tree measured and removed, in accordance with the above classifications, at the unit price stipulated in the proposal.

- End of Section -

SECTION 205

ROADWAY EXCAVATION

205.1 DESCRIPTION:

Roadway excavation shall consist of excavation involved in the grading and construction of roadways, except structure excavation, trench excavation and any other excavation separately designated.

205.2 UNSUITABLE MATERIAL:

Material shall be considered unsuitable for fill, subgrade, shoulders and other uses if it contains organic matter, soft spongy earth, or other matter of such nature that compaction to the specified density is unobtainable.

Material that is unsuitable for the intended use shall be excavated and removed from the site or otherwise disposed of as directed by the Engineer.

The removal and disposal of such unsuitable material will be paid for as roadway excavation.

205.3 OVERSHOOTING:

Material outside the authorized cross-section which may be shattered or loosened because of blasting shall be removed by the Contractor at no additional cost to the Contracting Agency. The Contractor shall discontinue any method of blasting which in the opinion of the Engineer leads to excessive overshooting or is dangerous to the public or destructive to property or to natural features.

205.4 SLIDES AND SLIPOUTS:

Material outside the planned roadway or ditch slopes which in the opinion of the Engineer is unstable and constitutes potential slides, material which has come into the roadway or ditch, and material which has slipped out of new or old embankments shall be excavated to designated lines or slopes either by benching or in such manner as directed by the Engineer. Such material shall be used in the construction of the embankments or disposed of as directed by the Engineer.

The removal and disposal of slide and slipout material as specified above, not resulting from overshooting as specified above, will be paid for at the contract prices for roadway excavation; however, if due to the character of the work, the removal and disposal of such material is not properly compensable at the contract prices for roadway excavation, the work may be paid for as extra work provided the Contractor requests in writing such payment prior to performing any such work.

Only those quantities of slide or slipout material which are actually removed as ordered by the Engineer will be paid for.

205.5 SLOPES:

Excavation slopes shall be finished in conformance with the lines and grades shown on the plans. Debris and loose material shall be removed. When completed, the average plane of the slopes shall conform to the slopes indicated on the plans and no point on the completed slopes shall vary from the designated plane by more than 6 inches measured at right angles to the slope, except where excavation is in rock no point shall vary more than 2 feet from the designated plane of the slope. In no case shall any portion of the slope encroach on the roadbed.

Tops of excavation slopes and ends of excavations shall be rounded as shown on the plans and these quantities will not be included in the quantities of excavation to be paid for. This work will be considered as a part of finishing slopes and no additional compensation will be allowed therefore.

Embankment slopes shall be finished in conformance with lines and grades shown on the plans. When completed the average plane of slopes shall conform to slopes indicated on the plans and no point on the completed slopes shall vary from the designated plane by more than 6 inches measured at right angles to the slope.

SECTION 205

205.6 SURPLUS MATERIAL:

Unless otherwise shown on the plans, specified in the special provisions, or approved by the Engineer, no surplus excavated material shall be disposed of within the right-of-way. The Contractor shall make all arrangements for disposal of the material at off-site locations as may be approved by the Engineer, and shall upon request file with the Engineer the written consent of the owner of the property upon which he intends to dispose of such material.

If the quantity of surplus material is shown on the plans or specified in the special provisions, the quantity shown or specified is approximate only. The Contractor shall satisfy himself that there is sufficient material available for the completion of the embankments before disposing of any indicated surplus material inside or outside the right-of-way. Any shortage of material caused by premature disposal of surplus material by the Contractor, shall be replaced by him and no compensation will be allowed the Contractor for such replacement.

205.7 MEASUREMENT:

The following earthwork operations will be measured as roadway excavation for the quantities of material involved.

Excavating the roadway prism including public and private road approaches, connections and driveways; excavating unsuitable material when shown on the plans or specified in the special provisions; excavating slides and slipouts not resulting from overshooting; excavating surplus material; excavating selected material and topsoil from within the limits of project and removing such materials from stockpiles when stockpiling is ordered; excavating ditches and excavating borrow.

The Engineer will compute the quantities of material excavated by a method which in his opinion is best suited to obtain an accurate determination.

Excavation in excess of the planned or authorized cross-section will not be paid for, except as provided above. The Contractor shall backfill and compact unauthorized excavated areas to the original ground elevation of authorized section at no additional cost to the Contracting Agency.

Material resulting from excavating ditches or channels may be used to construct roadway embankments, dikes, or for other purposes, or disposed of, as directed by the Engineer.

Care shall be exercised to prevent excavating below the grade for the bottom of the ditch and areas excavated below grade shall be filled with suitable material and compacted by the Contractor at no additional cost to the Contracting Agency.

205.8 PAYMENT:

Quantities of roadway excavation will be paid for at the contract unit price per cubic yard. Such price shall include excavating, sloping, rounding tops and ends of excavations, loading, depositing, conditioning, spreading, and compacting the material complete in place and disposal of surplus material.

When the proposal does not include a pay item for roadway excavation the cost thereof shall be considered as being included in the price bid for the construction or installation of the items to which such roadway excavation is incidental or appurtenant.

- End of Section -

SECTION 206

STRUCTURE EXCAVATION AND BACKFILL

206.1 DESCRIPTION:

Structure excavation shall consist of the removal of material for the construction of foundations for bridges, manholes, retaining walls, box culverts, head walls for culverts, and other structures, and other excavation designated on the plans or in these specifications or in the special provisions as structure excavation.

Structure backfill shall consist of furnishing material, if necessary, and placing and compacting backfill material around structures to the lines designated on the plans or specified or directed by the Engineer.

Structure excavation and structure backfill shall include the furnishing of all materials and equipment and the providing of other facilities which may be necessary to perform the excavations and place and compact the backfill, and the subsequent removal of these facilities, except where they are required or permitted by the plans, special provisions or Engineer to remain in place.

206.2 FOUNDATION MATERIAL TREATMENT:

When footing concrete or masonry is to rest upon rock, the rock shall be fully uncovered and the surface thereof shall be removed to a depth sufficient to expose sound rock. The rock shall be roughly leveled off or cut to approximate horizontal and vertical steps, and shall be roughened. Seams in the rock shall be grouted under pressure or treated as the Engineer may direct and the cost thereof will be paid for as extra work.

When no piles are used and footing concrete or masonry is to rest on an excavated surface other than rock, care shall be taken not to disturb the bottom of the excavation and final removal of the foundation material to grade shall not be made until just before the concrete or masonry is placed. Excavation below grade shall be replaced with the same class of concrete specified for the structure or with 1 ½ sack controlled low strength material as specified in Section [728](#). When the replacement material is structural concrete, the material shall be placed at the same time as the structure material. Placement of controlled low strength material shall be per Section [604](#) which will require a time lag between placement of the material and the structural concrete. The placement of the additional material shall be at no cost to the Agency except when over-excavation is directed by the Engineer.

The excavation for structures shall be completed to the bottom of the footings before any piles are driven therein, and excess material remaining in the excavation after pile driving shall be removed to the elevation of the bottom of the footings.

When piles are used and ground displacement results from pile driving operations, the Contractor shall at his expense excavate or backfill the footing area to the grade of the bottom of the footing as shown on the plans with structure backfill material.

206.3 INSPECTION:

When any structure excavation is completed, the Contractor shall notify the Engineer who will make an inspection of the excavation. No concrete or masonry shall be placed until the excavation has been approved by the Engineer.

206.4 STRUCTURE BACKFILL:

206.4.1 Preparation for Structure Backfill: Prior to the placement of structure backfill, the Contractor shall remove all loose, unstable materials from the sides of the structure excavation that may constitute a safety concern or impact proposed backfill operations. The Contractor shall then compact the bottom of the remaining open structure excavation to a uniform density of not less than 95 percent maximum dry density. With the approval of the compaction of the bottom of the open structure excavation by the Engineer, the Contractor may start the placement of the Structure Backfill.

206.4.2 Structure Backfill for Earth Retaining Structures: Structure Backfill to be placed against concrete structures designed to retain earth loads, such as bridge abutment backwalls and wingwalls, box culvert outside walls and wingwalls, and retaining walls:

SECTION 206

(A) Shall conform to the material and the graduation requirements for Select Material, Type A or B in Table [702-1](#) unless otherwise approved by the Engineer.

(B) Shall not be placed until the concrete has reached its full design strength.

(C) Shall be placed in layers not more than 8 inches in depth before compaction, when compacted by pneumatic or mechanical tamping devices.

(D) Shall be uniformly compacted to at least 95 percent of maximum density.

EXCEPTION: Catch basins constructed in accordance with standard details and having the outlet invert depth equal to or less than six feet may place structure backfill when the concrete has attained a minimum compressive strength of 2500 psi in compression as specified in Section [725](#) and in no case less than 72 hours after casting.

206.4.3 Structure Backfill for Structures Other than Earth Retaining: Structure Backfill placed against concrete structures not designed to retain earth loads:

(A) Shall not be placed until the concrete has attained a minimum compressive strength of 2500 psi in compression as specified in Section [725](#) and in no case less than 72 hours after casting.

(B) Shall be uniformly compacted to at least 95 percent of maximum density.

206.4.4 Structure Backfill for Structures within Paved Areas: Where a structure is located within an existing street, proposed street, or paved area shall be compacted to the minimum density specified in Table [601-2](#), for Type I or shall be filled with ½ sack or 1 sack controlled low strength material as specified in Sections [604](#) and [728](#).

206.4.5 Structure Backfill for Precast Minor Structures: Minor structures, as defined in Section [505.1.1](#), when furnished as precast structures, shall be placed on a compacted layer of Structure Backfill at least 6 inches in depth that conforms to the material requirements of Section [206.4.2](#). The layer shall be shaped to fit the bottom surface of the precast unit and compacted to not less than 100 percent maximum density. The Structure Backfill shall be at or near optimum moisture content, as approved by the Engineer. After the unit has been initially set in place and checked for line and grade, it shall be removed, and any defects in its bearing area or line and grade shall be corrected by trimming and by placing and compacting similarly moistened Structure Backfill and the unit reset in place. If in the opinion of the Engineer the bearing area or line or grade of a set precast unit is defective, the Contractor shall remove the unit, correct the bearing area and reset the unit at no additional cost to the Agency. Precast units shall be installed on compacted, shape-conformed Structure Backfill in reasonable conformity with the lines and grades shown on the project plans.

206.4.6 Relative Compaction: Unless otherwise provided in the plans and/or special provisions the maximum density shall be determined using procedures defined in Section [301](#).

206.5 PAYMENT:

Unless otherwise provided in the special provisions or proposal, no payment will be made for structure excavation and backfill as such; the cost thereof shall be included in the contract price for the construction or installation of the items to which such excavation and backfill are incidental or appurtenant.

When the Special Provisions identify Structure Excavation and/or Structure Backfill as pay items, the following methods of measurement and payment shall be used:

SECTION 206

206.5.1 Measurement

(A) **Structure Excavation:** Structure Excavation will be measured by the cubic yard, based on the volumes calculated from the measurement/pay limits shown on the Project Plans. If no limits are shown, the measurement for Structure Excavation shall be in accordance with the applicable details shown on the current Arizona Department of Transportation (ADOT) Standard Drawings B-19.30 and/or B-19.50.

No reduction in measurement for payment will be made when the Contractor elects to not excavate all material between the limits of the actual structure, and the pay limits shown on the Project Plans and/or the above referenced ADOT Standard Drawings.

No additional measurement for payment will be made for excavation resulting from lack of side support for structure excavations, nor due to carelessness of the Contractor.

(B) **Structure Backfill:** Structure Backfill will be measured by the cubic yard, based on the volumes calculated from the measurement/pay limits shown on the Project Plans. If no limits are shown, the measurement for Structure Backfill shall be in accordance with the applicable details shown on the current ADOT Standard Drawings B-19.40 and/or B-19.50.

206.5.2 Payment

Structure Excavation and Structure Backfill: The accepted quantities of Structure Excavation and the accepted quantities of Structure Backfill will be paid for at their respective contract unit prices.

Hauling, placing, and compacting surplus Structure Excavation in embankments, or otherwise disposing of the material, shall be included in the contract price paid for Structure Excavation.

- End of Section -

SECTION 210

BORROW EXCAVATION

210.1 LOCAL BORROW:

Local borrow shall consist of material excavated and used in the construction of fills or for use as selected material or for other construction purposes. Local borrow shall be obtained by widening cuts or by excavating from other sources outside the planned or authorized cross-section within the right-of-way and within the limits of the project. Local borrow shall be excavated to the lines and grades established by the Engineer.

210.2 IMPORTED BORROW:

Imported borrow shall consist of material required for construction and unless otherwise designated in the special provisions, the Contractor shall make arrangements for obtaining imported borrow and shall pay all costs involved. When designated sources for imported borrow are indicated on the plans, in the special provisions, the material shall be assumed approved by the Engineer.

Borrow material for fill within the roadway prism shall meet the following requirements:

The Plasticity Index (PI) (AASHTO T-90) and the percent passing the number 200 sieve (Minus 200) (ASTM [C136](#)) when used in the equation below, shall give a value of X that does not exceed 62.

$$X = (\text{Minus 200}) + 2.83 (\text{PI})$$

When the percentage of the Minus 200 material is greater than 30, the PI for the soil shall be at least 5 and at the same time in compliance with the X value requirement.

The material shall be free from wood, vegetation, or other deleterious matter. The maximum size of this material shall not be greater than 2/3 the compacted thickness of the course placed in the subgrade.

The Contractor shall notify the Engineer sufficiently in advance of opening any material sites so that cross-section elevations and measurements of the ground surface after stripping may be taken and sufficient time for testing and material will be allowed.

Borrow pits shall be excavated to regular lines to permit accurate measurement; depth of excavation throughout the area of borrow pits shall be as uniform as practicable and the side slope shall be dressed to such slope as may be directed, leaving the borrow pit area in a clean and safe condition.

210.3 PLACING AND COMPACTING:

Local borrow and imported borrow shall be placed and compacted as specified in Section [211](#).

The Contractor shall satisfy himself that there is sufficient space available in fill locations for placing any excavated material, before placing borrow. Any excess excavation which develops as a result of placing borrow in advance of completing excavations shall be disposed of by the Contractor at no additional cost to the Contracting Agency in accordance with the provisions in Section [205](#) and a corresponding reduction in the quantity of borrow to be paid for will be made, for which the Contractor will have no claim for compensation.

210.4 MEASUREMENT:

Quantities of borrow will be measured as specified for roadway excavation in Section [205](#).

Material excavated at the borrow site and not used on the work will be deducted from the computed quantities and will not be paid for.

SECTION 210

210.5 PAYMENT:

Quantities of borrow excavation will be paid for at the contract unit price per cubic yard. Such price shall include excavating, sloping and cleaning of borrow area, hauling, depositing, spreading and compacting the material complete in place, and disposal of surplus material, unless an alternate basis of payment is stipulated in the proposal.

- End of Section -

SECTION 211

FILL CONSTRUCTION

211.1 DESCRIPTION:

Fill construction shall consist of constructing embankments except as may otherwise be specified, including the preparation of the areas upon which they are to be placed; the construction of dikes; the placing and compacting of approved material within areas where unsuitable material has been removed; and the placing and compacting of material in holes, pits, and other depressions.

211.2 PLACING:

Rocks, broken concrete, or other solid material, which are larger than 4 inches in greatest dimension, shall not be placed in fill areas where piles are to be placed or driven.

When fill is to be made and compacted on hillsides or where new fill is to be compacted against existing fill or where embankment is built ½ width at a time, the slopes of original hillsides and old or new fills shall be benched a minimum of 4 feet horizontally as the fill is placed. A new bench shall be started where ever the vertical cut of the next lower bench intersects the existing ground. Material thus cut out shall be recompacted along with the new embankment material by the Contractor at no additional cost to the Contracting Agency, unless the width of the bench required exceeds 4 feet, in which case the excavated material in excess of 4 feet will be measured and paid for as excavation.

Clods or hard lumps of earth of 6 inches in greatest dimension shall be broken up before compacting the material in embankment, except as provided in the following paragraph:

When the fill material includes large rocky material, or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, such material shall be well distributed throughout the fill. Sufficient earth or other fine material shall be placed around the larger material as it is deposited so as to fill the interstices and produce a dense, compact fill. However, such material shall not be placed within 2 feet of the finished grade of the fill.

211.3 COMPACTING:

Fill shall be constructed in compacted layers of uniform thickness and each layer shall be compacted in accordance with the requirements herein specified with the following exception.

Where fills are to be constructed across low, swampy ground which will not support the weight of hauling equipment, the lower part of the embankment may be constructed by dumping successive loads of suitable materials in a uniformly distributed layer of thickness not greater than that necessary to support the equipment while placing subsequent layers, after which the remainder of the embankment shall be constructed in layers and compacted as specified.

Unless specified herein, or in the special provisions, the construction of dikes, the placing and compacting of approved material within the right-of-way where unsuitable material has been removed, and the filling of holes, pits and other depressions within the right-of-way, shall conform to all of the requirements herein specified for compacting fills. Trenches, holes, depressions and pits outside of areas where fills are to be constructed shall be graded to provide a presentable and well-drained area.

Areas over which fills are to be placed shall be cleared and scarified to a depth of 6 inches to provide a bond between the existing ground and the material to be deposited thereon. Unless otherwise specified, the original ground area upon which fills are to be constructed shall be compacted to a uniform density of not less than 95 percent.

The loose thickness of each layer of fill material before compacting shall not exceed 8 inches, except as provided in the following paragraph for rocky material. Each layer shall be compacted in accordance with the following requirements to a uniform density of not less than 90 percent, except that where a new or widened roadway and appurtenances are required, density of the upper 2 feet and when the fill is within 2 feet of the above shall be not less than 95 percent.

SECTION 211

When fill material contains by volume over 25 percent of rock larger than 6 inches in greatest dimension, the fill below a plane 3 feet below finished grade may be constructed in layers of a loose thickness before compaction not exceeding the maximum size of rock in the material but not exceeding 3 feet in thickness.

The interstices around the rock in each layer shall be filled with earth or other fine material and compacted. Broken Portland cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the fill with the following limitation:

- (A) The maximum dimension of any piece used shall be 6 inches.
- (B) Pieces larger than 4 inches shall not be placed within 12 inches of any structure.
- (C) Pieces larger than 2 ½ inches shall not be placed within 12 inches of the subgrade for paving.
- (D) Nesting of pieces will not be permitted.

At the time of compaction, the moisture content of fill material shall be such that the specified relative compaction will be obtained and the fill be firm and unyielding. Fill material which contains excessive moisture shall not be compacted until the material is dry enough to obtain the required relative compaction. Full compensation for any additional work involved in drying fill material to the required moisture content shall be considered as included in the contract price paid and no additional compensation will be allowed therefore.

Embankments shall be constructed so that each layer shall have a cross fall of at least 2 percent but no more than 5 percent.

211.4 TESTS:

Unless otherwise provided in the plans or special provisions the fill shall be thoroughly compacted to not less than the stated densities when tested and determined by AASHTO T-99, Method A, and T-191 or ASTM [D6938](#) with the percent of density adjusted in accordance with the rock correction procedure for maximum density determination, standard detail, to compensate for the rock content larger than that which will pass a No. 4 sieve.

211.5 MEASUREMENT:

The quantities of fill construction used to construct embankments or dikes will be those of the complete bid item, in place, within the limits of dimensions shown on the plans.

The Engineer will compute the quantities of fill by a method which in his opinion is best suited to obtain an accurate determination.

211.6 PAYMENT:

Quantities of fill construction will be paid for at the contract unit price per cubic yard of fill as stipulated in the proposal. Such price shall include placing and compaction and all related work as specified above, unless an alternate basis of payment is stipulated in the proposal.

Unless otherwise provided in the special provisions, no payment will be made for fill construction to replace unsuitable material or for fill for holes, pits, and other depressions. The cost thereof shall be included in the price bid for the construction of the items to which such fill is incidental or appurtenant.

- End of Section -

SECTION 215

EARTHWORK FOR OPEN CHANNELS

215.1 DESCRIPTION:

Earthwork for open channels shall consist of clearing, stripping, excavation, fill, backfill, grading and disposal of excavated and removed material.

Open channels for the purpose of this Section shall mean open rectangular concrete channels and lined or unlined trapezoidal channels.

215.2 STRIPPING:

When stripping is indicated on the plans or specified in the special provisions, the Contractor shall strip the soil from the designated areas to the depths shown or specified or as directed by the Engineer.

The material obtained from stripping operations shall be disposed of away from the site unless otherwise specified, shown on the plans or authorized by the Engineer.

Soil loosened below the stripping depth specified or designated by the Engineer, shall be compacted. Soil removed below stripping depth shall be replaced with approved material and compacted up to the designated grade. All such filling and compacting shall be done by the Contractor at no additional cost to the Contracting Agency.

215.3 EXCAVATION:

Excavation in open cut for lined channels may be made so as to place concrete directly against the excavated surfaces providing the faces of the excavation are firm and unyielding; are such as will stand or can be made to stand without sloughing and are, at all points outside the concrete lines shown on the plans.

Excavation to provide a subgrade for lined channels, or subdrainage material, shall be to the lines indicated on the plans; and, excavation made below subgrade shall be backfilled and compacted to a uniform density of not less than 90 percent or, if approved by the Engineer, with concrete or other materials being placed. However, no payment will be made for such over-excavation or material used for such backfill.

Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, the voids remaining after the removal of such boulders or interfering objects shall be backfilled as specified below, or as otherwise approved by the Engineer.

(A) When the void is below the subgrade for reinforced concrete channel, it shall be filled with suitable material, as approved by the Engineer, and compacted to a uniform density of not less than 90 percent. With the approval of the Engineer, concrete of the same mix as used in the concrete channel, may be used.

(B) When the void is in the side of the excavation, it shall be filled with suitable material as approved by the Engineer, placed in the manner and to the same uniform density as the backfill in the vicinity of the void. With the approval of the Engineer, concrete of the same mix as used in the concrete channel may be used. If concrete is placed prior to lining, a lower grade concrete may be used only if approved by the Engineer.

It shall be understood that the removal of boulders or other interfering objects and the backfilling of voids caused by such removals shall be done by the Contractor at no additional cost to the Contracting Agency. The cost of such work shall be included in the prices bid for the various items of work.

If during the progress of excavation, material is encountered, which, in the opinion of the Engineer, is unsuitable for subgrade for the channel to be constructed on, the Engineer may direct the Contractor to excavate beyond the pay lines shown on the plans. However, the suitability of subgrade shall be determined by the Engineer on the basis of its ability to withstand the load of the proposed channel and not upon the capacity to withstand the loads which may be placed upon it by the Contractor's equipment. Should the Contractor be directed to excavate beyond the pay lines shown on the plans, said pay lines will be extended to include such ordered excavation; and the pay lines for subdrainage material, if used, will be adjusted accordingly.

SECTION 215

Materials used or work performed by the Contractor, to stabilize the subgrade so it will withstand loads which may be placed upon it by his equipment shall be accomplished by the Contractor at no additional cost to the Contracting Agency.

215.4 FILL AND BACKFILL:

Unless otherwise specified in the special provisions, material obtained from the project excavations may be presumed to be suitable for use as fill or backfill provided that all organic material, rubbish, debris, and other objectionable material is first removed. However, stone, broken Portland cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the backfill or fill with the limitations as specified in Section [211](#).

Unless otherwise specified in the special provisions, the density of fills and backfills shall be at least 90 percent.

215.5 GRADING:

Grading of unlined channels, levees and access roads shall conform to the following tolerances:

(A) A vertical tolerance of none above and 3 inches below the specified grade will be allowed on:

- (1) Channel bottom
- (2) Channel side slopes in both cut and fill
- (3) Levee and access road side slopes in cut

(B) A vertical tolerance of none below and 3 inches above the specified grade will be allowed on:

- (1) Top surface of levee and access road in both cut and fill
- (2) Levee and access road side slopes in fill

Regardless of the construction tolerances specified, excavation and grading shall be performed so that finished surfaces are in uniform planes with no abrupt breaks in the surface.

Construction tolerances specified above for grading are solely for purposes of field control.

215.6 TESTS:

Density tests shall be made in accordance with Section [211](#).

215.7 MEASUREMENT:

If compensation for stripping is included in the price paid for other items of work the Contractor shall notify the Engineer sufficiently in advance of excavation or other work so that cross-section elevations and measurements of the ground surface may be taken upon completion of stripping.

The Engineer will compute the quantity of excavation by a method which in his opinion is best suited to obtain an accurate determination.

215.8 PAYMENT:

Earthwork for open channels will be paid for on a lump sum basis or at the contract unit price per cubic yard of excavation as stipulated in the proposal. Such price shall include clearing, stripping, excavation, fill, backfill, compaction, grading, hauling, removal and disposal of excess excavated material and debris unless an alternate method of payment is stipulated in the proposal.

- End of Section -

SECTION 220

RIPRAP CONSTRUCTION

220.1 DESCRIPTION:

Riprap construction shall consist of furnishing and placing stone, with or without grout, and underlain with filter material of granular filter blankets or erosion control geosynthetic fabric. The depth and type of riprap shall be as shown on the plans or in the special provisions.

220.2 MATERIALS

Riprap shall conform to the requirements of Section [703](#).

Erosion control geosynthetic fabric shall conform to the requirements of Table [796-3](#) in Section [796](#).

Waste or sacked concrete shall not be permitted for use as riprap.

The Contractor, at no additional cost, shall provide mechanical equipment, a sorting site, and labor needed to assist in checking riprap gradation.

Granular filter blankets shall consist of processed natural material conforming to the requirements of Section [701](#), with the gradation and thicknesses as specified on the plans or in the special provisions.

220.3 PREPARATION OF GROUND SURFACES

The bed for placement of riprap shall be shaped and trimmed to provide even surfaces.

220.4 PLACEMENT OF EROSION CONTROL GEOSYNTHETIC FABRIC:

Fabric shall be placed at the locations shown on the project plans. The Contractor shall provide a surface free of obstructions, depressions, debris, and soft yielding surfaces prior to the placement of fabric. The fabric shall be loosely laid (not in a stretched condition), aligned and placed with no fold over wrinkles.

The fabric shall be placed to provide a minimum 24-inch of overlap for each joint. On horizontal joints, the uphill fabric shall overlap the downhill fabric. On vertical joints, the upstream fabric shall overlap the downstream fabric.

Bedding material shall be placed uniformly on the fabric to the depth specified on the plans and shall be free of mounds, dips, and windrows. Bedding material shall not be compacted.

220.5 RIPRAP PLACEMENT:

Riprap shall be carefully placed on filter material consisting of a granular filter blanket or the bedding material on erosion control geosynthetic fabric. Placement shall not damage the underlying filter blanket or geosynthetic fabric. If the Engineer determines that the placement of stone has damaged or displaced the filter material to the extent that it cannot function as intended, the Contractor, at his expense, shall remove the placed riprap stone and properly correct the damage to, and/or the displacement of, the filter material. Such correction may include the removal of the filter material, re-grading the affected area, and subsequent replacement of the filter material and riprap stone as required by the Engineer.

Riprap shall be placed in a manner which will produce a dense, reasonably well-graded mass without segregation and with a minimum amount of voids. The larger stone shall be evenly distributed through the riprap mass. The individual placement of larger riprap stones may be required to obtain a uniform distribution of stone size. The riprap placement shall be supplemented by such hand methods as are required to obtain a uniform finished surface. Allowable tolerance from the slope lines and grades shown for the finished riprap surfaces shall not exceed a distance equal to 1/3 of the nominal D_{50} size above or below the design surfaces. The final surface elevations shall be lower than any adjacent apron or pipe invert elevations and shall not obstruct the operation of adjacent structures. The flow line within riprap shall provide positive drainage with minimal ponding. Individual stones shall depress below the finished grades no lower than a distance equal to 1/2 of the nominal D_{50} size. Special care shall be exercised in placing riprap within 3 feet of structures to avoid damage to such structures.

SECTION 220

220.6 GROUTED RIPRAP:

Place riprap as specified in Section [220.5](#), excluding the use of filter material and secure in place with Portland cement grout meeting the requirements of Table [220-1](#). Place grout to the depth as shown on the plan but in no case less than 70 percent of the depth of riprap. Consolidate grout into place with suitable spades, trowels or other approved means to provide a dense stone and mortar layer with all voids and interstices filled. After grout has been placed, the rocks shall be thoroughly brushed so that their top surfaces are exposed. If required, use water pressure to clean stone faces after the mortar has achieved sufficient strength. The outer rocks shall project 1/3 to 1/4 their diameter above the grouted surface.

TABLE 220-1			
Grout for Riprap			
Minimum Cementitious Material (lbs)	Maximum W/CM Ratio	Slump (in)	Air Content (%)
850	0.60	9 +/- 2	0 % - 8 %

The cementitious materials shall meet the requirements of Section [725.2](#). Up to 25 percent by weight of the Table [220-1](#) minimum cementitious materials requirements may be an approved fly ash or natural pozzolan. The aggregates shall meet the applicable requirements of ASTM [C33](#), #8 (3/8") coarse aggregate grading and fine aggregate (sand) grading. All Ready Mixed Grout volume calculations shall be based on "absolute volume" with the total volume per cubic yard equal to 27 cubic feet. Coarse aggregate volume shall be a maximum of 35% of the total aggregates volume. All mixing shall be in accordance with the applicable requirements of Section [725.7](#).

The amount of slump shall be the minimum amount needed to permit gravity flow into the interstices with limited spading and brooming. The consistency of the grout shall be as approved by the Engineer.

220.7 MEASUREMENT:

The completed, in place riprap construction within the limits of the dimensions shown on the plans shall be measured. Measurement will be in cubic yards rounded to the nearest cubic yard.

No separate measurement will be made for erosion control geosynthetic fabric, bedding material, or grout.

220.8 PAYMENT:

Payment for riprap will be made for the accepted complete in-place riprap construction at the contract unit price. Riprap construction shall include excavation, ground surface preparation, erosion control geosynthetic fabric (if used for the project), bedding material, riprap stone, grout (if used for the project) and backfilling.

Payment for riprap shall be full compensation for furnishing all material, labor and equipment for riprap construction.

- End of Section -

SECTION 230

DUST PALLIATIVE APPLICATION

230.1 DESCRIPTION:

This Section shall govern the application of dust control palliatives (agents) on unpaved roads, traffic surfaces, vacant lots, construction sites and road shoulders. Dust palliatives may also be used to protect erosion of slopes, embankments, sediment control and re-vegetated areas.

Dust palliatives may be applied as topical treatments to penetrate an undisturbed surface, or may be applied to larger areas using mixing methods that blend the product with surface material and then compact the mixture to provide a stabilized, dust resistant, surface course.

230.2 MATERIALS:

Materials to be used as dust palliatives shall conform to the requirements of Section [792](#). The specific dust palliative to be used shall be as shown on the plans or as directed by the Engineer.

Water used for diluting dust palliatives and for pre-wetting of treated subgrade shall be either potable or from a source compatible with dust palliative ingredients.

230.2.1 Product Verification: The Contractor, in the presence of the Engineer or his designee, shall obtain samples of the bulk, undiluted liquid dust palliative/stabilizer product as it is delivered to the job site. Samples shall be taken from each bulk tanker that delivers the liquid dust palliative/stabilizer for product verification testing purposes. If the bulk undiluted liquid dust palliative/stabilizer is delivered in containers, a sample must be taken from each container delivered to the job site. The Engineer will select the exact locations and times of sampling. The obtained liquid dust palliative/stabilizer samples will be split in three equal portions (minimum 2 ounce each), whereby the Contractor may retain one sealed portion for verification testing, and the Engineer will retain two sealed portions. One portion of the Engineer's samples will be provided to an AASHTO accredited test lab chosen by the Contractor. The other sample will be held for backup until the testing is completed. Sample containers will be labeled and sealed under the supervision of the Engineer.

The accredited lab will test the product in accordance with ASTM [D2834](#) to confirm that the liquid dust palliative/stabilizer meets the requirements of Section [792.2](#) for active solids. Contractor is responsible for the cost of product verification testing.

If the test reports indicate that the minimum acceptable active solids content value as specified in Section [792.2](#) is not met, the quality of the liquid dust palliative/stabilizer product shall be deemed deficient by the Engineer. The delivery and application of a deficient product shall be stopped. Work shall not resume until all product verification testing is complete or the Contractor replaces the product and initial tests on the new material show compliance.

The Contractor may perform additional verification testing on the split samples. In case of dispute where the verification tests produce different results by the Contractor than the Engineer, the Engineer will hire a different independent AASHTO accredited testing laboratory to perform a third round of testing. Such testing and the results of the testing shall be considered final by both the Engineer and Contractor for verification.

230.3 COMPLIANCE:

At least two weeks prior to the start of work, the Contractor shall provide the Engineer the following Applicator qualifications: (a) Information showing that the Applicator has at least three years of experience within the last five years serving as either a primary contractor or subcontractor in delivering and applying dust palliative/stabilizer product services, (b) A minimum 3 local references (including company/organization name, contact person and telephone number) to demonstrate that the Applicator is familiar with local environmental and permitting requirements associated with soil stabilization and dust palliative, and (c) Copy of the Applicator's State of Arizona Registrar of Contractors License.

SECTION 230

At least two weeks prior to the start of work, the Contractor shall provide the Engineer the proposed application methods and equipment for the project. The information provided shall include: (a) curing time for each application method required for the project, (b) application and dilution rates proposed for the project, and (c) equipment to be used during all phases of application that are in conformance with Section [230.4](#).

Prior to the commencement of any work, the Contractor shall provide copies of all required environmental/dust control permits, any required notices of intent, and the current Material Safety Data Sheet (MSDS) for the dust palliative/stabilizer product. The MSDS must include all chemical compounds present in concentrations greater than 1% for dust palliative/stabilizer product.

230.4 EQUIPMENT:

The Contractor shall provide all equipment necessary to complete the work. The equipment may include but not be limited to motorized graders, distribution trucks, mixing and pulverizing equipment, pneumatic-tired rollers, sprinkler systems, etc. All equipment used for this work is subject to approval by the Engineer. Equipment which fails to provide an acceptable application of properly diluted dust palliative/stabilizer product or does not perform satisfactorily shall be removed from the job and replaced with acceptable equipment meeting the requirement of this specification.

Distributor trucks shall be designed, equipped, maintained and operated so that dust palliative/stabilizer product may be applied uniformly on variable widths of surface up to 16 feet at readily determined and controlled rates from 0.03 to 1.0 gallons per square yard, with uniform pressure, and with an allowable transverse variation from any specified rate not to exceed 10% or 0.02 gallon per square yard, whichever is less. The maintenance and calibration of this vehicle shall be checked periodically. The record of maintenance and calibration shall be submitted to the Engineer for review upon request.

Distributor trucks proposed for use shall have been tested within 6 months from the date of spreading to determine the rate of the transverse spread. If requested, the Contractor shall furnish the Engineer with evidence that the transverse spread of the distributor truck, when the trucks were approved for use, was as uniform as practicable and under no condition was there a variance on any of the test pads greater than the allowable transverse variation; however, the Engineer may require that each distributor truck be tested to determine the rate of the transverse spread. The rate of the transverse spread shall be determined in accordance with the requirements of Arizona Test Method 411.

230.5 PREPARATION OF SURFACE:

All surface preparation shall be in conformance with Maricopa County Rule 310 and 310.01 as applicable.

230.5.1 Topical Preparation: Prior to the application of the dust palliative, the surface shall be graded to provide drainage.

Dust palliatives shall not be applied when the surface is excessively wet or saturated. Surfaces shall be pre-moistened only if required by the product manufacturer.

230.5.2 Surface Course Preparation: Areas to receive dust palliative shall be graded and scarified to at least the minimum depth and width shown on the plans. The soil shall be scarified/loosened by tilling, disking, ripping, or by other soil preparation methods, which achieves uniform results to the minimum depth shown on the plans. The material shall be damp at time of scarification to reduce dust and aid in pulverization. Soil clods shall be pulverized until all material, exclusive of gravel or stone, will pass a 2-inch sieve.

All debris, weeds, organic material, stone larger than 4 inches, etc., shall be removed from the site. Surface gravel or stones shall be removed or thoroughly mixed with the surrounding soils to obtain a homogeneous mixture.

If pre-wetting is required, ample amount of water shall be added and mixed with the in-place material to obtain a moisture content near optimum. This moisture content shall be established prior to and maintained until the application of the dust palliative. The methods to establish and maintain the moisture shall be done in accordance with manufacturer's recommendations. The moisture must be uniformly distributed throughout the surface course and over the underlying undisturbed soil. Dust palliatives shall not be applied when the soil is excessively wet or saturated. Moisture content shall be determined in accordance with either ASTM [D6938](#) or ASTM [D4944](#).

SECTION 230

230.6 APPLICATION:

230.6.1 General: The dust palliative shall be applied by a pressure type distributor vehicle equipped with a power unit for the pump, full circulation spray bars adjustable laterally and vertically, and computer controls. The distribution vehicle shall be calibrated to ensure a controlled application method. Spray bars and extensions shall be of the full circulating type. Valves which control the flow from nozzles shall be of a positive active design so as to provide a uniform, unbroken spread of dust palliative on the surface.

Corners or surface that cannot be accessed by the distributor truck shall be hand sprayed by means of hoses or bars pressurized by a gear pump or air tanks.

Distributor equipment shall be equipped with a tachometer and pressure gauge. To provide for accurate, rapid determination and control of the amount of dust palliative being applied, distributor equipment shall include one or more of the following: accurate volume measuring devices, a calibrated tank, and/or a certified meter or weight tickets and calibration charts relating to the specific gravity of the concentrate and/or dilution.

The dust palliative shall be applied at the dilution ratio and application rate specified in accordance with Section [792](#), unless otherwise directed by the Engineer. The Contractor shall dilute the dust palliative product as needed, with the dilution ratio adjusted within the ranges specified in Section [792](#), to bring the mixture to the desired moisture content. Products may be applied in multiple passes at reduced application rates to meet the total application rate specified and/or assure uniform coverage.

The Contractor shall notify the Engineer a minimum of 5 working days prior to any application of dust palliative.

230.6.2 Topical Application: Topical applications shall be rolled only when recommended by the manufacturer. Complete penetration of palliative will be required prior to the surface rolling. Complete penetration occurs when the compaction equipment will not track or pick up the dust palliative and/or the top layer of the surface material.

230.6.3 Surface Course Application: The stabilization product shall be applied, incorporated and thoroughly blended into the soil until the homogeneous mixture is obtained to the full depth of treatment. Mixing shall be done in-place using mixing equipment or by motorized grader (blade mixing). The blending methods utilized shall result in a uniformly treated mixture of soil and dust palliative at or near optimum moisture content (minus any post-compaction dust palliative top coat application quantity). The dilution ratio may be adjusted to bring the mixture to the desired moisture content. The amount of area treated each day shall be limited to that which the Contractor can thoroughly mix and compact within that work day.

Complete penetration of palliative will be required prior to compaction. Complete penetration occurs when the compaction equipment will not track or pick up the blended material.

The blended material shall be shaped to the required grade line and cross-section shown on the plans and be compacted at least 95% of maximum density in accordance with ASTM [D698](#), unless otherwise directed by the Engineer. The final surface shall be rolled to a smooth and even grade. Sufficient grading shall be done to provide reasonable drainage within the limits of existing drainage patterns. Immediately after the compaction, a top coat of dust palliative shall be applied.

230.7 CURING:

No equipment or traffic will be permitted on the treated surface for 24 hours unless otherwise approved by the Engineer. Once cured, the dust palliative final coat shall form a skin at the surface or a crusted surface. For purpose of this work, a “skin” on the surface will be a formation of any palliative on the surface of the soil that cannot be dislodged from the soil by winds. Any formation of the palliative on the soil surface must adhere to the underlying soil to a depth of 1/8th inch when applied topically.

230.8 WEATHER CONDITIONS:

Dust palliative/stabilizer product shall be applied only when the ambient temperature is above 50°F. Application should be avoided during high wind or when there is the chance of rain within the next 8 hours. The Contractor shall be responsible to retreat at no additional cost if the application is degraded by weather within the first 24-hours of placement.

SECTION 230

230.9 QUALITY CONTROL

The Contractor must provide manufacture-trained personnel for on-site technical assistance during initial delivery and application. This technical assistance is to assure that the dust palliative/stabilizer product is applied at proper dilution ratios and application rates on various soil, and subgrade types for optimum results.

At the start of each work day, the bulk tanker will be measured to verify the gallons of liquid dust palliative/stabilizer product brought to the job site. At the end of the day, the bulk tanker will be measured to verify the gallons of liquid dust palliative/stabilizer product remaining at the job site. The distributor truck shall be inspected to insure it is empty at the end of the day. The total gallons of liquid dust palliative/stabilizer product used for the day will be established by the start and end of day measurements of the bulk tanker.

A daily "Gallon Use Report" will be filled out by the distributor truck driver. The report will also identify the size of area treated for the day. It will be verified and signed by the Engineer or his designee. This report will be used to verify application rate and total product used. If the report indicates that the minimum application rate was not achieved, the work shall be deemed deficient by the Engineer.

230.10 DEFICIENCIES AND WARRANTY

If applied product active solids content is found deficient per Section [230.2.1](#), the Engineer may allow the Contractor to apply to any surfaces already treated by the deficient product additional topical coats of the dust palliative/stabilizer product to remedy the deficiency. Otherwise, the Contractor shall be required to repeat all work as directed by the Engineer with a different approved liquid dust palliative/stabilizer product that is compatible with the original product and will not result in adverse effects. The Contractor shall bear the cost of all remediation work for deficient product.

If the application rate as determined by the methods described in Section [230.9](#) or as agreed to in the contract documents is found to be deficient, the Contractor shall apply additional product within 24-hours of the original application to bring the total application rate to at least the minimum specified amount. If liquid dust palliative/stabilizer product was used as a soil stabilizer per Section [230.6.3](#), as directed by the Engineer, the Contractor shall re-scarify the stabilized section to its full depth and re-apply product at the original application rate. The Contractor shall bear the cost of all remediation work for deficient application rate.

For non-traffic areas (less than 150 vehicle trips per day), application of the dust palliative/stabilizer product placed in accordance with this Section shall provide a surface meeting the stabilization requirements of Maricopa County Rule 310 Section 302 and Maricopa County Rule 310.01 Section 302 for a minimum of 12 months from acceptance by the Engineer.

During the warranty period, the Contractor shall provide and install the product free of charge if the finished product fails to meet the performance requirement and specification/criteria outlined under this technical specification. The Contractor shall provide additional applications when within five working days of notification from the Engineer of performance failure.

230.11 MEASUREMENT:

Dust palliative surface course application shall be measured by the square yard, in place, treated, compacted, to the proper depth and accepted.

Dust palliative materials will be measured by the ton of undiluted material. Any conversion from volumetric quantities shall be done with Contractor-supplied calibration charts relating to the specific gravity of the concentrate and/or dilution.

230.12 PAYMENT:

Payment will be made for the applicable items at the Contract unit price and shall constitute full compensation for the item complete in place.

- End of Section -

This Page Reserved for Future Use

PART 300

STREETS AND RELATED WORK

Section	Last Revised	Title	Page
301	2014	Subgrade Preparation	301-1
306	2010	Mechanically Stabilized Subgrade-Geogrid Reinforcement	306-1
309	2014	Lime Slurry Stabilization or Modification of Subgrade	309-1
310	2015	Placement and Construction of Aggregate Base Course	310-1
311	2014	Placement and Construction of Cement Treated Subgrade	311-1
312	2012	Cement Treated Base	312-1
315	1998	Bituminous Prime Coat	315-1
317	2013	Asphalt Milling	317-1
320	1999	Road-mixed Surfacing	320-1
321	2016	Placement and Construction of Asphalt Concrete Pavement	321-1
322	2016	Decorative Asphalt	322-1
324	2015	Portland Cement Concrete Pavement (PCCP)	324-1
325	2016	Placement and Construction of Asphalt-Rubber Asphalt Concrete	325-1
327	2012	Hot In-Place Recycling	327-1
329	1998	Tack Coat	329-1
330	1998	Asphalt Chip Seal	330-1
331	2009	Microsurfacing Specifications	331-1
332	2013	Placement and Construction of Asphalt Emulsion Slurry Seal Coat	332-1
333	2012	Fog Seal Coats	333-1
334	2016	Preservative Seal for Asphalt Concrete	334-1
335	2012	Placement and Construction of Hot Asphalt-Rubber Seal	335-1
336	2016	Pavement Matching and Surfacing Replacement	336-1
337	2014	Crack Sealing	337-1
340	2015	Concrete Curb, Gutter, Sidewalk, Curb Ramps, Driveway and Alley Entrance	340-1
342	2016	Interlocking Concrete Paver Installations	342-1
343	1998	Exposed Aggregate Paving	343-1
345	2016	Adjusting Frames, Covers and Valve Boxes	345-1
350	2013	Removal of Existing Improvements	350-1
355	2015	Utility Potholes-Keyhole Method	355-1
360	1998	Telecommunications Installation	360-1

This Page Reserved for Future Use

SECTION 301

SUBGRADE PREPARATION

301.1 DESCRIPTION:

This Section shall govern the preparation of natural or excavated areas prior to the placement of sub-base material, pavement, curbs and gutters, driveways, sidewalks or other structures. It shall include stripping and disposal of all unsuitable material including existing pavement and obstructions such as stumps, roots, rocks, etc., from the area to be paved.

301.2 PREPARATION OF SUBGRADE:

With the exception of areas where compacted fills have been constructed as specified in Section [211](#), in the areas where new construction is required, the moisture content shall be brought to that required for compaction by the addition of water, by the addition and blending of dry, suitable material or by the drying of existing material. The material shall then be compacted to the specified relative density. If pumping subgrade should become evident at any time prior to paving, the Engineer may require proof rolling with a pneumatic-tire roller or other approved equipment in order to identify the limits of the unacceptable area. The proof rolling will be performed at no additional cost to the Contracting Agency.

Subgrade preparation shall also include preparing the subgrade to the required line and grade for paved or unpaved shoulders, tapers, turnouts, and driveways, and at all other project locations where aggregate base and/or select material courses are used in accordance with the Project Plans.

301.2.1 The Contractor may use removed existing asphalt concrete and other existing bituminous roadway surfacing materials originating on the project site, as embankment fill. All materials used shall be thoroughly crushed to sizes not exceeding four inches, or as approved by the Engineer. These asphalt/bituminous materials shall be placed not less than two feet below finished subgrade elevation.

Project earthwork quantities when included as separate contract pay items will include removed asphalt/bituminous material volumes, unless otherwise specified in the Special Provisions.

All unsuitable material and all excess material shall be disposed of in accordance with the requirements of Sections [205.2](#) and [205.6](#), respectively. When additional material is required for fill, it shall conform to Section [210](#).

301.3 RELATIVE COMPACTION:

The subgrade shall be scarified and loosened to a depth of 6 inches. Rock 6-inches or greater in size that becomes exposed due to scarification shall be removed from the scarified subgrade. When fill material is required, a layer of approximately 3 inches may be spread and compacted with the subgrade material to provide a better bond. The subgrade cut and fill areas shall be constructed to achieve a uniform soil structure having the following minimum compaction, measured as a percentage of maximum dry density when tested in accordance with AASHTO T-99, Method A, and T191 or ASTM [D6938](#) with the percent of density adjusted in accordance with the rock correction procedures for maximum density determination, ARIZ-227c¹ to compensate for the rock content larger than that which will pass a No. 4 sieve. Unless otherwise noted in the project plans or project specifications, compaction shall be performed within 2 percentage points of the optimum moisture content.

- | | |
|--|------------|
| (A) Below pavement, curb and gutter, attached sidewalk, roadway shoulders,
and other areas within right-of-way subject to vehicular traffic | 95 percent |
| (B) Below detached sidewalk not subject to vehicular traffic | 85 percent |

301.4 SUBGRADE TOLERANCES:

Subgrade upon which pavement, sidewalk, curb and gutter, driveways, or other structures are to be directly placed shall not vary more than 1/4 inch from the specified grade and cross-section. Subgrade upon which sub-base or base material is to be placed shall not vary more than 3/4 inch from the specified grade and cross-section. Variations within the above specified tolerances shall be compensating so that the average grade and cross-section specified are met.

⁽¹⁾Arizona Department of Transportation test method.

SECTION 301

301.5 GRADING OF AREAS NOT TO BE PAVED:

Areas where grade only is called for on the plan shall be graded to meet the tolerances for the subgrade where subbase or base material is to be placed. The surface shall be constructed to a straight grade from the finished pavement elevations shown on the plans to the elevation of the existing ground at the extremities of the area to be graded.

301.6 PROTECTION OF EXISTING FACILITIES:

The Contractor shall exercise extreme caution to prevent debris from falling into manholes or other structures. In the event that debris should fall into a structure it shall immediately be removed.

301.7 MEASUREMENT:

Measurement for Subgrade Preparation will be by the square yard. The area to be measured will be the total accepted area of new asphalt concrete pavement and new portland cement concrete pavement (PCCP), including paved shoulders, tapers, turnouts, and unpaved roadway shoulders. Subgrade Preparation area measured will also include the accepted surface area of driveways that are surfaced with aggregate base, or select materials and non-surfaced areas designated for vehicle traffic.

Except for PCCP, the area under portland cement concrete surfaces such as concrete curb and gutter, sidewalk, concrete driveways and driveway entrances, and concrete alley entrances will not be included in the Subgrade Preparation measurement.

Project earthwork quantities for Roadway Excavation, Borrow Excavation, and Fill Construction shall not be separately measured when they are not listed as separate line items on the fee proposal form. In such case, unless otherwise specified, payment for said earthwork items shall be included in the unit price for Subgrade Preparation.

301.8 PAYMENT:

Payment for Subgrade Preparation will be made only when it is performed for street or roadway paving projects.

Payment shall be compensation in full for stripping, scarifying, grading, excavating, hauling, filling, compacting, and disposing of excess or unsuitable materials, together with all costs incidental thereto.

- End of Section -

⁽¹⁾Arizona Department of Transportation test method.

SECTION 306

MECHANICALLY STABILIZED SUBGRADE - GEOGRID REINFORCEMENT

306.1 DESCRIPTION:

Mechanically stabilized subgrade shall consist of furnishing and placing a geogrid material within or below untreated base to provide a stabilized platform on which paving materials are placed. Geogrid type, fill thickness, pavement cross-section and associated details, shall be as shown on the contract drawings.

306.2 MATERIALS:

The geogrid material shall be supplied in accordance with and conform to the material requirements of Section [796](#) and Table [796-4](#).

306.3 SUBGRADE PREPARATION:

The geogrid shall not be placed when weather or surface conditions do not meet the manufacturer's recommendations for installation.

306.3.1 Placing Geogrid on Soft Subgrade: Prior to placement of geogrid material, soft subgrade shall be lightly proof rolled to provide a firm surface, brought to grade and shaped to conform to the typical sections, lines and grades as shown on the plans. The surface on which the geogrid will be placed shall be free of rock and other material that could damage the geogrid. The placement of the geogrid shall be approved by the Engineer before placement of overlaying materials.

Subgrade tolerances shall be in accordance with MAG Section [301.4](#).

306.3.2 Placing Geogrid Within Untreated Base: Subgrade shall be prepared in accordance with MAG Section [301](#).

306.4 EQUIPMENT:

Mechanical or manual laydown equipment shall be capable of laying the geogrid properly and smoothly, in compliance with the manufacturer's recommendations.

306.5 GEOGRID PLACEMENT:

The geogrid shall be installed in accordance with the installation guidelines provided by the manufacturer or as directed by the Engineer.

The geogrid may be temporarily secured in place with ties, staples, pins, sand bags or acceptable fill material as required by fill placement procedures, weather conditions, or as directed by the Engineer. A 12-inch minimum secured overlap is required at all joints (both transverse and longitudinal). At transverse joints, the preceding roll shall overlap the following roll in the direction that the aggregate base will be placed. The geogrid shall be rolled out along the alignment in the direction of advancing construction. All wrinkles and folds shall be removed.

The geogrid shall be tensioned by hand and anchored to the ground at the edges, including overlaps, and in the center of the roll at 30-foot intervals along the roll length, at the corners if applicable, or as directed by the Engineer. Securing locations may be reduced or eliminated if it can be shown to the satisfaction of the Engineer that an alternative installation process will provide satisfactory results.

Geogrid shall be placed to obtain full coverage of the indicated area. Placement of geogrid on irregular shaped areas and radii may require cutting of the geogrid material and the use of diagonal overlapping joints. Buckling of geogrid material will not be allowed.

SECTION 306

306.6 PLACING AND COMPACTING AGGREGATE FILL:

The aggregate shall be back dumped and spread in a uniform lift maintaining the design aggregate thickness at all times. The aggregate material shall be bladed on the geogrid in such a manner that the aggregate rolls forward onto the grid ahead.

When underlying substrate is trafficable with minimal rutting, rubber-tired equipment may pass over geogrid reinforcement at slow speeds (less than 10 mph). Sudden stops and turning by trucks shall be avoided on the geogrid. Traffic shall not be allowed onto coated geogrid materials. A minimum loose fill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid. Turning of tracked vehicles shall be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

Any ruts which develop during spreading or compacting aggregate fill shall have additional aggregate added rather than bladed from surrounding areas. Placing additional aggregate into the rutted areas limits disturbance to the underlying geogrid keeping it intact.

Untreated base shall be compacted as specified in Section [310](#). Untreated base material shall not be mixed or processed on the geogrid. Base materials will be uniformly blended and sampled for acceptance prior to placement on the geogrid material. Contamination and segregation of base materials during placement shall be minimized.

306.7 REPAIR:

Any geogrid material damaged before, during or after installation shall be replaced by the contractor at no additional cost to the Agency.

Replacement of geogrid reinforcement shall consist of removal and replacement of the geogrid and aggregate fill from the defective area. The aggregate fill shall be removed at least 3 feet beyond the limits of the defective area. The replacement geogrid shall be installed with proper overlaps. Aggregate fill replacement shall not commence until placement of the geogrid material has been inspection and approved.

306.8 PAYMENT:

The surface area of accepted in-place geogrid reinforcement will be measured to the nearest square yard.

Payment for geogrid reinforcement at the contract unit price shall be full compensation for furnishing all labor, material, equipment, and installing complete in place the geogrid as shown on the project plans.

- End of Section -

SECTION 309

LIME STABILIZATION OR MODIFICATION OF SUBGRADE

309.1 DESCRIPTION:

This section shall consist of constructing a mixture of soil, lime and water for the stabilization or modification of subgrade soils. The work shall be performed in conformity with the lines, grades thickness, and typical cross sections shown on the plans.

According to the National Lime Association, “Stabilization: When adequate quantities of lime and water are added, the pH of the soil quickly increases to above 10.5, which enables the clay particles to break down. Determining the amount of lime necessary is part of the design process and is approximated by tests such as the Eades and Grim test (ASTM [D3276](#)). Silica and alumina are released to react with calcium from the lime to form calcium-silicate-hydrates (CSH) and calcium-aluminate-hydrates (CAH). CSH and CAH are cementitious products similar to those formed in Portland cement. They form the matrix that contributes to strength of lime-stabilized soil layers. As this matrix forms, the soil is transformed from a sandy, granular material to a hard, relatively impermeable layer with significant load bearing capacity. The process begins within hours and can continue for years in a properly designed system. The matrix formed is permanent, durable, and significantly impermeable, producing a structural layer that is both strong and flexible.”

Lime modification may be used to “Dry-up of wet soil at a construction sites” or “include treating fine-grained soils or granular base materials to construct temporary haul roads or construction platforms.”

309.2 MATERIALS:

309.2.1 Soil or Subgrade: For lime stabilization applications, the soil or subgrade material used for this work shall consist of materials on the site or imported, and shall be free of roots, sod, weeds and stones larger than 3 inches and have a plasticity index (PI) greater than 10, when tested in accordance with AASHTO T-146 Method A, AASHTO T-89 Method A, and T-90. For lime modification applications, the allowable soil or subgrade properties will be determined by the Engineer.

309.2.2 Quicklime and Hydrated Lime: Lime used shall be either quicklime or hydrated lime and shall conform to the requirements of ASTM [C977](#). All lime shall come from a single source. If a source change is requested, a new mix design shall be submitted using lime from the proposed new source. The new design must be approved by the Engineer prior to use.

309.2.3 Lime Slurry: Lime slurry shall be a pumpable suspension of solids in water. The solids portion of the mixture, when considered on the basis of solids content, shall consist principally of hydrated lime of a quality and fineness sufficient to meet Section [309.2.2](#) requirements. A certificate of compliance shall be provided to the Engineer for each load of lime applied at the project.

309.2.4 Water: Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Water shall be tested in accordance with and shall meet the suggested requirements of AASHTO T-26. Water known to be of potable quality may be used without test.

309.3 COMPOSITION:

309.3.1 Lime Stabilization Mix Design: Before commencing lime treatment work, the Contractor shall submit for approval by the Engineer, a proposed mix design. The proposed mix design shall be prepared by a testing laboratory under the direction and control of a registered professional engineer. The mix design shall be determined using the soils or subgrade material to be stabilized and lime from the proposed supplier, and shall determine the following:

For soil stabilization applications, the mix design shall report and comply with the following requirements:

Untreated Soil:

- (a) Sulfates: Tested per ARIZ 733, AASHTO T-290, or ASTM [C1580](#).
- (b) Moisture-Density Relationship (Proctor): Tested per ASTM [D698](#) Method A.
- (c) Plasticity Index: Test method AASHTO T-146 Method A, AASHTO T-89 Method A, and T-90.
- (d) Sieve Analysis and Minus No. 200 Wash: Test methods ASTM [C136](#) and ASTM [D1140](#).

SECTION 309

Lime Treated Soil:

- (a) pH: Lime saturation content per ASTM [C977](#) APPENDIX or ASTM D6276.
- (b) Plasticity Index: Less than 3, per AASHTO T-146 Method A, AASHTO T-89 Method A, and T-90.
- (c) Swell Potential: Maximum expansive potential of 1.0 per ARIZ 249 using passing No. 4 sieve material. The maximum expansive potential shall be determined on a sample compacted to approximately 95 percent of the ASTM [D698](#) Method A maximum dry density at approximately 2% below optimum moisture content. The sample should be confined under a 100 psf surcharge and inundated.
- (d) Unconfined Compressive Strength: Minimum 160 psi per ASTM [D5102](#) Procedure A, after five days curing at 100°F, sealed in air-tight condition.
- (e) Mellowing time and mellowing moisture content for treated soil sections b and c to be determined by design engineer. Mellowing time and mellowing moisture content for treated soil section d determined by ASTM [D5102](#).
- (f) Hydrated Lime Content: The design engineer shall designate the minimum percentage of lime by dry weight of the dry soil to satisfy the criteria for Section [309.3.2](#) requirements. The percentage of lime specified shall be sufficient to allow for expected variations during the mixing process. A minimum of 5.0% hydrated lime by dry weight of the dry soil is required for all mix designs.

309.3.2 Lime Modification: For soil modification purposes only, the Engineer shall specify the minimum amount of hydrated lime or lime slurry required to meet the desired improved soil properties.

309.4 CONSTRUCTION:

309.4.1 General: It is the primary requirement of this specification to secure a completed subgrade containing a uniform lime mixture free from loose segregated areas, of uniform density and moisture content, well bound for its full depth, and with a smooth surface suitable for placing subsequent courses.

Prior to beginning any lime stabilization or modification, the subgrade shall be constructed and brought to grade and shall be shaped to conform to the typical sections, lines and grades as shown on the plans.

Lime shall be applied at the mix design rate for the depth of subgrade stabilization or modification shown on the plans or requested by the Engineer.

When the design requires treatment to a depth greater than 12 inches, the subgrade soil shall be treated in equal layers. The top layer(s) of soil shall be removed and stockpiled. The lower layer of soil to be treated shall then be treated and allowed to cure in place. After final mixing, the lower layer shall be compacted in maximum 12 inch thick compacted lifts. The stockpiled soil shall then be placed, treated, mixed and compacted in successive maximum 12 inch thick compacted lifts.

309.4.2 Weather Limitation: Lime treated subgrade shall not be constructed if the ambient temperature is below 40° F or when conditions indicate that temperatures may fall below 40° F within 24 hours.

309.4.3 Equipment: Contractor shall provide all equipment necessary to complete the work including grading and scarifying equipment, a spreader of the lime, mixing and pulverizing equipment, sheepsfoot and pneumatic rollers, sprinkling equipment and trucks. Gravity feed or tailgate spreading, defined as not having automatic controls, will not be permitted. The spreader shall demonstrate the ability to maintain a consistent spread rate over variable travel speeds. All equipment used for this work is subject to approval by the Engineer.

309.4.4 Application: Lime shall be spread only on that area where the mixing operation can be completed during the same working day. The lime application rate shall be at the design content to +0.5%, based on weight of dry soil. The Engineer reserves the right to vary the rate of application of lime from the mix design during the progress of construction as necessary to maintain a pH of the lime/soil mixture above 12.0 and the desired characteristics of the treated subgrade.

For all lime applications, the Contractor shall provide the Engineer with daily application quantities.

309.4.4.1 Quicklime Application: Quicklime shall only be applied by approved spreader trucks equipped with operating dust collectors to minimize dust issues while loading. Additionally, dust control measures must be utilized during the spreading and soil mixing of quicklime. Contractor shall exercise safety measures when mixing quicklime with water.

SECTION 309

309.4.4.2 Dry Hydrated Lime Application: Hydrated lime shall only be applied by approved spreader trucks equipped with operating dust collectors to minimize dust issues while loading. Additionally, dust control measures must be utilized during the spreading and soil mixing of dry lime.

309.4.4.3 Lime Slurry Application: Lime slurry shall be mixed in a portable mixing unit and spread with trucks equipped with an approved distribution system. Lime slurry shall be applied at a rate that will yield the required lime percentage determined by the mix design.

309.4.5 Mixing: The full depth of the treated subgrade shall be mixed with an approved mixing machine. The use of disc plows or blades are strictly prohibited except in areas specified by the Engineer. To insure a complete chemical reaction of the lime and soil or subgrade, water shall be used as required to maintain moisture content at optimum to +4% above the optimum of the lime treated mix design proctor, prior to beginning compaction. During the interval of time between application and mixing, lime that has been applied, unmixed and exposed to the open air for 10 hours or more will not be accepted. No traffic other than the mixing equipment will be allowed to pass over the spread of lime until after completion of mixing.

After mixing and prior to compaction, clay lumps shall meet the following criteria:

	<u>Percent</u>
Minimum of clay lumps passing 1-1/2 inch sieve	100
Minimum of clay lumps passing No. 4 sieve	60

309.4.6 Compaction: Compaction of the mixture shall begin after final mixing and shall be accomplished in accordance with the design specifications. Areas inaccessible to conventional rolling equipment shall be compacted to the required density by methods approved by the Engineer. Mellowing time and mellowing moisture content shall be specified by the mix design and performed prior to final compaction.

The material shall be aerated or watered as necessary to provide and maintain required moisture content. A composite of treated soil or subgrade materials from a minimum of five (5) random locations, per soil type, within the area to be stabilized shall be used to determine the maximum dry density and optimum moisture content in accordance with ASTM [D698](#). The field density of the compacted mixture shall be at least 95 percent of the maximum dry density of the field sampled proctor. The in-place compacted field density shall be determined in accordance with ASTM [D1556](#), sand cone, or ASTM [D6938](#), nuclear gauge. In the event of disputed results, the nuclear gauge density shall be correlated to the referee sand cone density while the nuclear water content shall be correlated to the referee ASTM [D2216](#) water content. The adjustment for rock larger than the no. 4 sieve shall be performed in accordance with ASTM [D4718](#).

After each section is completed, tests will be made by the Engineer. If the material fails to meet the density requirements and finished requirements, it shall be reworked to meet requirements at no additional cost to the Contracting Agency.

309.4.7 Thickness: The thickness of the lime treated subgrade shall be determined by visual inspection and/or by depth tests taken at intervals so that each test shall represent no more than 1000 square yards per layer. If more than one layer, the method used to remove material to determine the depth of lime treatment may be by shovel and/or pick, coring or other method approved by the Engineer. Phenolphthalein solution shall be used to detect the presence of lime. When the grade deficiency is more than 1 inch, the Contractor shall correct such areas in a manner satisfactory to the Engineer. Contractor shall replace, at no cost to the Contracting Agency, the material where depth tests are taken.

All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required, and reshaping and recompacting. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until other work is placed thereupon or the work is accepted. Compaction and finishing shall be done in such a manner as to produce a smooth dense surface free of compaction planes, cracks, ridges or loose materials.

Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion, shall be smooth and shall conform with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density, and finish before the next course is placed or the work is accepted, it shall be recompacted and refinished at no cost to the Agency.

309.4.8 Finishing and Curing: After the final layer or course of lime treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the plans. The completed section shall then be finished by rolling with a pneumatic or other suitable roller.

SECTION 309

Each layer of lime treated subgrade shall be maintained in a moist condition until the next layer of pavement structure is placed. If required, a fog seal for curing, in compliance with Section [333](#), shall be furnished and applied to the surface of the final layer of the lime stabilized material as soon as possible after the completion of final rolling and before the temperature falls below 40° F. Curing seal shall be applied at a rate between 0.10 and 0.20 gallons per square yard of surface. The exact rate will be determined by the Engineer.

After curing begins, all traffic, except necessary construction equipment shall be kept off the lime stabilized subgrade for a minimum of 7 days or until the final pavement structure layer(s) are placed. As an alternative, the Contractor may place a loose lift of aggregate base course over the curing subgrade. The aggregate base course should be kept moist during the curing process.

309.4.9 Maintenance: The Contractor shall maintain, at his/her own expense, the entire lime treated subgrade in good condition from the start of work until all the work has been completed, cured and accepted by the Engineer.

309.5 MEASUREMENT:

The quantity of lime slurry treated soils shall be measured by the square yard, measured in place, treated, compacted, to the proper depth, and accepted.

The quantity of curing seal shall be measured by the ton.

309.6 PAYMENT:

The lime treated soils measured as provided above, will be paid for at the contract price per square yard, which price shall be full compensation for the item complete, as herein described and specified.

The Owner or Engineer reserves the option to pay for the lime separately. Should this option be chosen, the lime treated soils measured as provided above will be paid for at the contract price per square yard which shall include full compensation for the item less lime, as herein described and specified. The lime materials will be paid for by the contract price per ton based on hydrated lime. If quicklime in slurry form is used there will be an additional pay factor of 1.3 applied to determine the actual amount of hydrated lime placed.

Payment for curing seal will be by the ton, based on the rate of application as requested by the Engineer.

- End of Section -

SECTION 310

PLACEMENT AND CONSTRUCTION OF AGGREGATE BASE COURSE

310.1 DESCRIPTION:

Aggregate base course shall comply with Section [702](#) unless the use of a different type of material is specifically authorized in the special provisions.

310.2 PLACEMENT AND CONSTRUCTION:

The compacted lift thickness shall not exceed 6 inches, unless approved by the Engineer. Based on the type of material, type of equipment and compaction methods used, the Contractor may propose a greater lift thickness to the Engineer for approval.

After distributing, the aggregate base course material shall first be uniformly watered and then graded to a uniform layer that will net, after compacting, the required thickness. The grading operation shall be continued to such extent as may be necessary to minimize segregation. The quantity of water applied shall be that amount which will assure proper compaction resulting in the density required by Section [310.3](#).

After placement, the aggregate base course surface shall be true, even and uniform conforming to the grade and cross-section specified. In no case shall the aggregate base course vary by more than ½ inch above or below required grade.

310.3 COMPACTION

The contractor is responsible for providing appropriate equipment and techniques to achieve the compaction results required by this specification. The aggregate base course shall be compacted in lift thicknesses as allowed by Section [310.2](#).

The laboratory maximum dry density and optimum moisture content for the aggregate base course material shall be determined in accordance with AASHTO T-99. (Note: when testing base materials – use method “C” or “D” as required based upon the gradation of the material.) Field ‘one-point’ maximum dry density and optimum moisture procedures shall only be allowed upon approval of the Engineer.

The in-place density shall be determined in the field by nuclear density testing in accordance with AASHTO T-310 or sand cone density testing in accordance with AASHTO T-191. In the event nuclear density testing is selected, and density results are in question, a sand cone correlation will be performed by the accepting agency at the contractor’s request, not to exceed one sand cone for each ten nuclear density tests.

A rock correction, to compensate for rock content larger than the #4 or ¾ inch sieves (as required by the laboratory maximum dry density and optimum moisture procedure selected), shall be performed in accordance with AASHTO T-224. Care should be taken to account for the specific gravity of the oversize particles particularly if recycled materials are utilized for aggregate base course. The specific gravity shall be determined in accordance with ARIZ-227c, as applicable.

For roadway construction, a minimum of one field density test shall be performed per lift per 660 feet per lane. For other aggregate base course applications, a minimum of one field density test shall be performed for each 800 square yards.

Unless otherwise noted in the project plans or project specifications, the moisture content of the aggregate base course at the time of compaction shall be the optimum moisture content +/- 3%.

The following percent compaction is required:

(A) Below asphalt concrete pavement	100%
(B) Below Portland cement concrete pavement, driveways, curb & gutter, sidewalks, and roadway shoulders	95%
(C) All other areas not subject to vehicular traffic	85%

SECTION 310

Areas which fail initial testing for density and/or moisture content shall be reworked until passing tests for density and/or moisture content are achieved. Lower moisture content percentages at the time of field density testing may be allowed if significant time has passed since the time of compaction and the required density has been achieved.

310.4 THICKNESS AND/OR PLASTICITY INDEX DEFICIENCY:

When in the opinion of the Engineer there is reason to believe that a deficiency in thickness, or an excess of plasticity exists, measurements or samples will be taken in the same pattern as that defined in Section [321](#). If the base has been covered or it is otherwise impractical to correct the deficiency, the corrective measures in Table [310-1](#) shall be taken by the Contractor at no additional cost to the Contracting Agency.

TABLE 310-1		
THICKNESS AND PLASTICITY DEFICIENCY		
Type	Deficiency	Corrective Measure
I	Less than 1/2 inch of the required thickness	No corrective measure required.
II	1/2 inch or more but less than 1 inch of the required thickness	(1) The contractor may choose to add additional material and rework the grade to meet the specification requirements. (2) The contractor may choose to increase the thickness of asphalt concrete by the amount of the aggregate base course thickness deficiency at no additional cost to the Owner. Required grade shall be met.
III	Thickness deficiency by greater than 1 inch	(1) The contractor will remove the aggregate base course and regrade the subgrade to allow the required aggregate base course layer thickness to be constructed. (2) If grades allow, the contractor may propose that the thickness of asphalt concrete be increased by the amount of the aggregate base course deficiency at no additional cost to the Owner.
IV	A plasticity index of 6 to 7 inclusive or gradation deficiency	(1) An Engineering Analysis (EA) that includes R-value testing may be prepared by the contractor to evaluate the expected performance of the aggregate base course layer. The EA may provide mitigation options for the Engineer to consider. If the Engineer accepts the plasticity index as a result of the EA, the material will be accepted at full payment. If the Engineer rejects the EA, the contractor will perform either option 2 or 3 below. (2) The contractor may choose to reprocess or treat the existing material to bring it within specification limits or remove deficient material from affected area and replace with material complying with the specifications. (3) If grades allow, the contractor may increase the thickness of asphalt concrete by 1/2-inch at no additional cost to the Owner.
V	A plasticity index of over 7	(1) The contractor may choose to reprocess or treat the existing material to bring it within specification limits or remove deficient material from affected area and replace with material complying with the specifications.

SECTION 310

310.5 PAYMENT:

Payment for aggregate base course will be made on the basis of the contract unit price per ton unless an alternate basis of payment is provided in the proposal.

- End of Section -

SECTION 311

PLACEMENT AND CONSTRUCTION OF CEMENT TREATED SUBGRADE

311.1 DESCRIPTION:

This item shall consist of a cement treated subgrade composed of a mixture of local soil, Portland cement, and water compacted at optimum moisture content.

311.2 MATERIALS:

Portland cement and water shall comply with Sections [725](#). The soil for the mixture shall consist of the material in the area to be paved. The material shall not contain more than 5 percent gravel or stone retained on a 3 inches sieve. It shall be demonstrated by laboratory tests that the plasticity and strength characteristics as defined in Section [311.4.5](#) of the soil will be adequately modified by the specified cement content.

311.3 EQUIPMENT:

An ample number of machines, combination of machines and equipment shall be provided and used to produce the complete soil cement treated layer meeting the requirements for soil pulverization, cement distribution, water application, incorporation of materials, compaction, finishing, and for application of the curing material as provided in these specifications.

Mixing shall be accomplished by means of multiple-pass soil-cement mixer, single-pass soil-cement mixer or central plant mixer.

Water may be applied through the mixer or with the water trucks equipped with pressure sprays. Water trucks providing fine fog-type sprays shall be furnished for finishing and curing. Properly adjusted garden type nozzles on a pressure bar may be used to produce fog spray if approved by the Engineer.

Cement spreader shall be a specially constructed device to distribute bulk cement at the specified rate. The spreader shall have the ability to maintain a consistent spread rate over variable travel speeds.

311.4 CONSTRUCTION METHODS:

Prior to construction, the contractor shall remove all deleterious material, organic material, and particles retained on the 3 inch sieve from the area to be treated. The soil shall be brought to a compacted condition, true to line and grade as directed by the Engineer or as shown on the plans. The compacted soil and surface shall be approved by the Engineer prior to proceeding with mixing.

The material shall be scarified, pulverized, mixed with water and cement, compacted, finished and cured in lengths permitting the full roadway width to be complete in not more than 4 hours from the time that cement is exposed to water. Such lengths will generally be not less than 600 feet or the length of one City block and preferably more. Where a gutter section exists the material shall be pulled back from the gutter face for the full depth of the course before processing.

311.4.1 Pulverizing: Prior to application of cement, soil to be processed shall be scarified to depth of base. The material shall be damp at time of scarifying to reduce the dust generation and to aid in pulverization. Soil shall be pulverized until not less than 80 percent, exclusive of gravel or stone, will pass a No. 4 sieve.

311.4.2 Application of Cement: The quantity of cement shall be by weight as a percentage of the dry weight of the soil as determined by the laboratory and/or as directed by the Engineer and shall be applied uniformly on the soil in a manner satisfactory to the Engineer. The allowable deviation in uniformity shall not exceed 10 percent. The entire operation of spreading and mixing shall be conducted in such a manner as will result in a uniform soil cement and water mixture for the full design width and depth.

The percentage of moisture in the soil, at the time of cement application, shall not exceed the quantity that will permit a uniform and intimate mixture of the soil and cement during mixing operations, and it shall not exceed the specified optimum moisture content for the soil cement mixture.

SECTION 311

311.4.3 Mixing: Mixing with addition of water as required shall be continued until the product is uniform in color and at optimum moisture content to +4% of optimum moisture content as determined in accordance with ASTM [D558](#). Any mixture of soil and cement which has not been compacted and finished shall not remain undisturbed for more than 30 minutes but shall be agitated by remixing.

311.4.4 Optimum Moisture: Optimum moisture requirements and field tests of moisture density shall be determined in accordance with ASTM [D558](#), and [D6938](#), with moisture content periodically corrected in accordance with AASHTO T-217 on representative samples of soil cement mixture obtained from the area being processed. At the time of compaction, the moisture content shall not be below optimum moisture, and shall be less than that quantity which will cause the base course to become unstable during the compaction and finishing process. Any area which becomes so unstable shall be removed and replaced with new cement stabilized material.

311.4.5 Compressive Strength: Laboratory compressive strength testing of the cement treated subgrade is required to evaluate the proposed amount of cement and/or verify the compressive strength achieved during construction. Laboratory compressive strength testing shall be done in accordance with ARIZ-241.

311.4.6 Compaction: After mixing is complete, the mixture shall be carefully placed in a uniform loose depth which will provide a surface true to grade and section when compacted. Unless otherwise directed by the Engineer, initial compaction shall be by means of a tamping, grid, or pneumatic roller. After the tamping roller has partially walked out, pneumatic rollers shall be used. Density of final product shall be not less than 95 percent as determined by ASTM [D6938](#) as specified above.

311.4.7 Finishing: As compaction nears completion, the surface of the base course shall be shaped to required lines, grades and cross-section. When required, the surface shall be lightly scarified with spike tooth harrows or other approved equipment to remove imprints left by equipment or to prevent slippage planes. During the finishing process the surface shall be kept moist by means of fog-type sprays. Surface finish and final compaction shall be completed in not more than 2 hours from the time the cement is exposed to water. The completed base course shall be true to line, grade, cross-section and shall not vary more than ½ inch in thickness and not more than 1 inch in surface tolerance when tested with a 10 foot straight edge. It shall be free of surface cleavage planes, cracks, or loose material. As a final operation, the surface shall be very lightly scalped with a motor grader, wet with a fog spray and rolled with a pneumatic roller as directed by the Engineer.

311.4.8 Thickness Deficiency: The Engineer may choose to have cores obtained to evaluate the thickness of the treated cement stabilized subgrade layer. Should the thickness of the treated layer not meet the project specifications, the Engineer may require the contractor to submit an Engineering Analysis (EA) to address the pavement section. The EA will provide an opinion as to the anticipated performance of the pavement section as a result of the reduced cement treated layer thickness and make recommendations on possible corrective actions. The Engineer shall determine what corrective actions, if any, are required.

311.4.9 Curing: Each layer of cement treated subgrade shall be maintained in a moist condition until the next layer of pavement structure is placed. If required, a fog seal for curing in compliance with Section [333](#), shall be furnished and applied to the surface of the final layer of the cement stabilized material as soon as possible after completion of final rolling and before the ambient temperature falls below 40° F. Curing seal shall be applied at a rate between 0.10 and 0.20 gallons per square yard of surface. The exact rate shall be determined by the Engineer.

After curing begins, all traffic, except necessary construction equipment shall be kept off the cement stabilized subgrade for a minimum of 7 days or until the final pavement structure layer(s) are placed. As an alternative, the contractor may place a loose lift of aggregate base course over the curing subgrade. The aggregate base course shall be kept moist during the curing process.

311.4.10 Construction Joints: At the end of each day's work, a construction joint shall be made transverse to the centerline of the road by cutting back into the work to provide a full depth vertical joint. Except where specifically authorized by the Engineer, no other construction joints will be permitted. Where authorized, such joints shall be full depth vertical joints.

311.4.11 Maintenance: The Contractor shall maintain the surface until it has been covered with the designated bituminous wearing course. In case it is necessary to replace any soil cement, it shall be for the full depth. No skin patches or soil cement will be permitted. Minor surface pits may be filled with compacted bituminous surfacing, if authorized by the Engineer. Immediately prior to the placing of the bituminous wearing course, the surface shall be broomed to remove all loosened material from the surface.

SECTION 311

311.5 MEASUREMENT:

Measurement of soil cement will be the number of square yards constructed to the required depth, completed and accepted.

Measurement of Portland cement will be the number of tons of cement mixed with local soil.

311.6 PAYMENT:

Payment will be made for the applicable items at the contract unit prices bid in the proposal, and shall constitute full payment for furnishing all material, equipment, tools, labor and incidentals necessary to complete the work and for carrying out the maintenance provisions.

No measurement or payment will be made for any imported earth materials.

- End of Section -

SECTION 312

CEMENT TREATED BASE

312.1 DESCRIPTION:

Cement treated base shall consist of a combination of base material and Portland cement as specified in Section [705](#).

312.2 GENERAL:

When the mixing of cement treated base in a stationary mixer is required, it will be so specified. Otherwise, cement treated base may be mixed in either a traveling plant or in a stationary plant, at the option of the Contractor.

If the cement treated aggregate is mixed in a central plant, it shall not contain moisture in excess of 1 percent above or below optimum at the time of delivery on the grade. Certain types of transit mixers will not discharge such material unless it is greatly in excess of optimum moisture. Use of such mixers will not be permitted.

If the material is mixed in place, the machine or combination of machines used shall be capable of thoroughly mixing the cement and aggregate, when using the granular material specified, in a single pass. No lift thickness shall exceed 8 inches. If the thickness required is in excess of 8 inches, it shall be mixed in 2 separate lifts of equal thickness.

312.3 CONSTRUCTION METHODS:

Mixing of materials, regardless of the type of mixer used or method employed shall be continued until the cement and water are evenly distributed throughout the aggregate, and a mixture of uniform appearance is obtained.

The amount of cement used shall conform to requirements of Section [705](#). Cement delivered in standard sacks from commercial producers will be assumed to weigh 94 pounds per sack and need not be weighed. Bulk cement or fractional sacks of cement shall be weighed.

The amount of water used shall be that required to give optimum moisture content. A portion of the required water may be added to the aggregate prior to the addition of the cement, if approved. Moisture content of the material delivered to the grade shall be checked for moisture content a minimum of four times per shift using AASHTO T-217. Batch adjustments shall be made as necessary to correct for deficiencies.

After spreading, the cement treated base shall be compacted to a density of at least 95 percent of the maximum density as determined by the mix design. Density testing shall be performed using ASTM [D6938](#), with moisture content periodically corrected in accordance with AASHTO T-217.

Compressive strength of the cement treated base material shall be tested a minimum of twice per shift using Arizona ARIZ-241. Strength specimens shall be compacted on site and protected from moisture loss or disturbance by any practical means. Specimens shall be kept in this manner on site for 18-24 hours inside a hard outer shelled container that will protect the specimens from external environmental elements. The specimens shall be carefully transported to the laboratory for moist curing after this initial 18-24 hour cure.

After compaction, the surface of the cement treated base course shall not deviate at any point more than 3/8 inch from the lower edge of a 10-foot straightedge laid parallel to the centerline of the roadway.

A construction joint shall be made at the end of each day's construction by trimming the end of the compacted mixture to a straight vertical plane, normal to the centerline of the roadway and with the vertical edge in thoroughly compacted material.

Cement shall not be added to more material than will be mixed, compacted and sealed the same day. Cement treated base shall not be mixed or placed when either the aggregate or subgrade is frozen. The air temperature shall be at least 40°F. in the shade and rising at the time of mixing.

In areas which are inaccessible to the mixing, spreading or compacting equipment designated herein, other methods and equipment acceptable to the Engineer may be utilized.

The mixed material shall not remain undisturbed on the subgrade for more than 30 minutes and not more than 3 hours shall elapse between the time water is added to the mixture and final compaction is accomplished.

SECTION 312

The mixed materials shall be spread for the full width of the base under construction, either by one spreader or by several spreaders operating in a staggered position across the subgrade, unless permission is granted to do part-width construction. Should permission be granted for part-width construction, not more than 30 minutes shall elapse between the times of placing the material in adjacent lanes at any location, and the longitudinal joint against which additional mixed material is to be placed shall be trimmed to a straight vertical plane parallel to the centerline of the roadway. Trimming shall be done in such a manner as to cause the least possible loosening of the compacted base material and to leave no loose material on the subgrade. The material cut away in trimming may be used in the construction of the shoulders or the adjacent lanes if approved, or shall be disposed of in a satisfactory manner.

During mixing, spreading and compacting and until the application of the curing seal, any moisture lost by evaporation shall be replaced by the addition of water by means of a light fog or fine spray.

The mixed base materials shall be covered as soon as possible after final compaction and shall be cured in accordance with this specification.

312.4 TRAVELING PLANT MIXING:

312.4.1 Placing Aggregate: The aggregate to be treated shall be placed on the roadway either as a uniform layer which, when compacted, will produce a base of the depth and width shown on the plans or as one or more windrows which, when spread, will yield a uniform layer which will compact to the prescribed dimensions. If the aggregate is placed in one or more windrows, a windrow sizer will be required. The number and size of the windrows may vary, depending on the width and depth of treatment and on the capacity of the machine, but regardless of size, the windrow shall be uniform in cross-section and shall not be larger than can be handled by the plant.

Care shall be exercised during the placement of the aggregate to prevent segregation of the fine and coarse portion of the aggregate.

312.4.2 Placing Cement: Cement shall be added to the uniform layer or windrow of aggregate by means of mechanized equipment which will spread the cement in correct and uniform quantities. For any section of roadway, the quantity of cement placed by mechanical spreaders shall not deviate more than 10 percent from the computed quantity for the section. When cement is applied to a windrow, the top of the windrow shall be slightly trenched to retain the spread of cement.

If storm winds cause a loss of spread cement, spreading operations shall be halted until such winds subside and, at the first indication of losses, prompt action shall be taken to avoid further losses. If cement losses are deemed excessive, the deficient quantity shall be furnished and added in the proper amount by the Contractor at no additional cost to the Contracting Agency.

312.4.3 Mixing: Mixing shall be accomplished by means of an approved single pass traveling continuous mixing machine, or combination of machines, of the pug or auger type. The machine shall be so constructed that the device for picking up or mixing the aggregate can be controlled and during the mixing operations it shall be set to mix the aggregate, cement and water to the design depth without cutting into or disturbing the subgrade or picking up any material other than that material to be processed. The machine shall be equipped so that water may be introduced at the time of mixing through a metering device which will accurately and uniformly control and measure the amount of water being used.

The cement and aggregate shall be mixed in the machine simultaneously with the adding, through the machine, of the additional amount of water required.

The material shall be spread immediately after mixing, in reasonably close conformity to the lines, grades and dimensions established or shown on the plans.

312.4.4 Stationary Plant Mixing: If the stationary plant method of mixing is employed, the aggregate, cement and water shall be mixed at a central plant using either a batch pug mill type or a continuous type mixer. Dead areas in the mixer, in which the material does not move or is not sufficiently agitated, shall be corrected, either by a reduction in the weight of materials or by other adjustments.

312.4.5 Batch Mixing: If a batch pug mill type mixer is used, the aggregate and cement shall be proportioned by batch weights. Cement shall be weighed on separate scales from the aggregate batching scales.

SECTION 312

The weight of the charge in a batch mixer shall not exceed that which will permit complete mixing of all materials. The period of mixing shall not be less than 30 seconds from the time all materials are in the mixer. Water may be proportioned by volume or by weight.

312.4.6 Continuous Mixing: If a continuous type mixer is used, the materials shall be proportioned by volume.

The continuous type mixer shall be equipped with metering devices and feeders which will introduce the cement, aggregate and water into the mixer in the specified proportions. The water pump shall be equipped with a means of varying the rate of delivery. The metering devices and feeders shall be interlocked and so synchronized as to maintain a constant ratio of cement and water to the aggregate.

The rate of feed to a continuous type mixer shall not exceed that which will permit complete mixing of all the material.

312.4.7 Spreading: The treated material shall be transported from the plant to the prepared subgrade in approved equipment.

The surface on which the material is to be placed shall be thoroughly moistened and kept moist, but not excessively wet, until covered by the material.

Plant mixed cement treated base shall be spread by approved spreader boxes or finishing machines. The machines shall be constructed and operated so as to produce a layer of uniform density and cross-section in sufficient quantity to provide a compacted base reasonably conforming to the lines, grades and cross-sections established or shown on the plans.

312.4.8 Compacting: Initial compaction shall begin immediately after mixing and spreading. Successive passes of compacting equipment shall overlap the previous adjacent pass by at least 25 percent of its width. Following initial compaction and before final compaction, the treated material shall be bladed with a motor grader or a Planning machine to obtain a surface reasonably true to the lines, grades and cross-sections established or shown on the plans. During and immediately following the shaping operations, if required, the Contractor shall lightly scarify the surface with a nail drag or other approved equipment to prevent the formation of surface compaction planes.

Extreme care shall be exercised by the Contractor during the blading operation so that no more material than is necessary is disturbed and so that this operation can be completed as quickly as possible. Material thus cut shall be wasted if so directed. Compaction shall proceed without interruption, except as stated above, until the required degree of compaction is obtained.

312.5 INVERTED SECTION:

Where the cement treated base is to be covered with an aggregate base material to prevent shrinkage crack reflection and overloading of the cement treated base, the minimum thickness of the aggregate base shall be 4 inches, unless otherwise specified in the special provisions. In order to provide for free internal drainage of the aggregate base course overlaying the cement treated material, it shall be non-plastic and the percentage of material passing the No. 200 sieve shall not exceed 8. The cement treatment shall be held back approximately 1 foot from each curb line so as to permit drainage of any water that may become trapped between the cement treated base material and the bituminous surfacing.

312.6 CURING:

The mixed cement treated base materials shall be covered as soon as possible after final compaction with a bituminous curing seal. Application shall be by means of a pressure distributor in accordance with the requirements of Section [330](#). The approximate quantity of bituminous material to be used shall be as specified; however, the exact amount will be determined by the Engineer at the time of application.

After the bituminous curing seal has been applied, the cement treated base course shall be kept free of equipment and traffic for a period of at least 7 days or until it will not pick up under traffic. Curing seal shall conform to the requirement of Section [712](#) or [713](#) for the type specified.

In lieu of the curing seal, the Contractor may, at his option, keep the surface of the compacted base continuously moist until overlaid with the aggregate base course. The aggregate base or the surfacing may be placed as soon as the cement treated base has been compacted. The spray equipment on the water truck shall be approved by the Engineer prior to the use of this equipment to spray the soil cement base course. The spray equipment must produce a fine, even spray to prevent washing of the

SECTION 312

surface of the base course. A cement treated section may be opened to all traffic immediately after placement and compaction of the surfacing.

312.7 DEFICIENCY:

When, in the opinion of the Engineer, there is reason to believe that a deficiency in thickness exists in the cement treated base, cores will be taken in the same pattern as that defined in Section [321](#). If the base has been covered or it is otherwise impractical to correct the deficiency of ½ inch or more in thickness, the corrective measure listed in Table [310-1](#) for Type II deficiency shall be taken by the Contractor at no additional cost to the Contracting Agency.

312.8 PAYMENT:

Payment for the Portland cement will be made by the tons of cement complete in place.

Payment for base material will be made by the tons of aggregate complete in place including mixing, spreading, and compacting.

No separate payment will be made for curing.

- End of Section -

SECTION 315

BITUMINOUS PRIME COAT

315.1 DESCRIPTION:

Bituminous prime coat shall consist of furnishing bituminous material and applying this bituminous material to a prepared base course, in accordance with these specifications.

315.2 MATERIALS:

Bituminous material shall conform to the requirements of Section [712](#) for the type and grade specified.

315.3 CONSTRUCTION METHODS:

315.3.1 Preparation of Surface: The surface on which the bituminous prime coat is to be placed shall be uniformly smooth and firm and reasonably true to grades and cross-sections as shown on the plans, and shall be so maintained throughout the period of placing the prime coat. In no event shall a prime coat be placed on a soft, uneven base. Any holes, depressions or irregularities shall be repaired by the removal of all loose and unsuitable material and replacement by suitable material, which shall be compacted to produce a dense surface conforming to the adjacent area. Uniformity of surface texture is of the utmost importance.

When required, the surface on which the prime coat is to be placed shall be lightly bladed and rolled immediately prior to the application of bituminous material.

315.3.2 Application of Bituminous Material: Bituminous material shall be applied only when the surface is either slightly damp or dry. For extremely dry areas, a light application of water may be required prior to the application of bituminous material.

The approximate quantity of bituminous material to be used will be specified; however, the exact amount used will be determined by the Engineer at the time of application. The bituminous material shall be uniformly applied to the prepared surface at the rate so designated and in one application.

The application of bituminous material and distributing equipment shall conform to the requirements of Section [330](#).

When it is deemed necessary, areas having excess bituminous material shall be blotted with material as directed.

When so directed, the surface of the complete prime coat shall be rolled with a pneumatic-tired roller.

315.3.3 Maintenance of Surface: Traffic shall be kept off the bituminous material until it has penetrated the base or subgrade and cured sufficiently.

The integrity of the prime coat shall be maintained at all times until the next course is placed or until the final acceptance. In the event traffic has caused holes or breaks in the surface, such holes or breaks shall be satisfactorily repaired by the Contractor.

315.4 MEASUREMENT:

The accepted quantities of bituminous material for bituminous prime coat will be measured by the ton undiluted for the bituminous material used.

No measurement or direct payment will be made for rolling.

Materials necessary for repair of holes or breaks in the surface after the prime coat has been accepted, when such holes or breaks are caused by traffic other than that of the Contractor, will be measured for payment under the respective contract item for the materials used.

SECTION 315

315.5 PAYMENT:

Payment for the bituminous material will be on the basis of the price bid per ton, undiluted, complete in place. Payment for furnishing, applying and removing blotter material will be paid for as an extra work item.

- End of Section -

SECTION 317

ASPHALT MILLING

317.1 DESCRIPTION:

The work under this section shall consist of milling existing asphalt concrete pavement where shown on the Plans or requested by the Engineer.

317.2 CONSTRUCTION REQUIREMENTS

Contractor is responsible for locating all milling hazards on and below the surface within the areas to be milled including areas requiring special milling. Special milling is not a separate pay item and shall be paid for as Asphalt Milling.

The milling cut depth shall be the depth indicated on the Plans plus or minus 1/8 inch. The milling machine shall have electronic grade controls. Contractor shall remove the milled material and sweep the roadway clean with a power pick-up broom to the satisfaction of the Engineer.

Asphalt pavement adjacent to manholes, valve boxes, small radius curbs and other fixed objects that produce confined area shall be removed with milling equipment specifically designed to operate in constricted areas. The equipment shall be capable of removing asphalt concrete of the specified thickness without damage to, or displacement of, the adjacent object(s).

The Contractor shall be responsible for continually checking the milling operation to determine that the proper depth of milling has been achieved, that the proper profile and cross slope are achieved, and that the surface texture is (a) free from longitudinal ridges, and (b) has a uniform pattern.

The Contractor shall immediately notify the Engineer when:

- The existing pavement thickness is found to be less than anticipated and breaking of the underlying material occurs.
- Delamination of underlying material occurs.

The work shall result in a clean milled surface to the specified depth for the area indicated by the construction documents including the areas immediately around and next to any individual hazard within the area to be milled. The edge of milled area shall form a straight clean cut line.

For milled surfaces on major streets (arterial and collector streets) that will be subject to traffic prior to overlay, a tack coat per Section [329](#) may, when authorized by the Engineer, be applied to the milled surface as a dust control measure. The tack coat shall be applied after sweeping and prior to allowing traffic on the milled surface. The tack coat application rate shall be half of the prescribed tack rate or contract amount or an alternate rate as prescribed by the Engineer. The Contractor shall be responsible for clean-up of any tack coat tracking that occurs.

317.3 MEASUREMENT AND PAYMENT:

Measurement for Asphalt Milling will be by the square yard and shall only include area milled to the required depth and cross-section.

Payment for Asphalt Milling at the contract unit price shall be full compensation for the work, complete-in-place, including all asphalt milling, milling around structures, removal and disposal of milled materials, and sweeping.

Engineer approved tack coat applied for dust control will be paid at the contract rate for tack coat. No additional payment for the application of dust control tack coat shall be made.

- End of Section -

SECTION 320

ROAD-MIXED SURFACING

320.1 DESCRIPTION:

Road-mixed surfacing shall consist of a mixture of mineral aggregate and bituminous binder mixed on the roadbed or other area, spread and compacted on a prepared subgrade or base course in conformity with the lines, grades, and dimensions shown on the plans or typical cross-section, or as specified in the special provisions.

320.2 MATERIALS:

Materials shall conform to the requirements of Sections [710](#) and [712](#) for the type and grade specified on the special provisions.

320.3 PRIME COAT:

When a prime coat is required, it shall be applied as specified in Section [315](#).

320.4 SPREADING AGGREGATE:

The mineral aggregate shall be deposited in a windrow along one side of the roadbed by means of approved spreader box equipped with a readily adjustable strike off device or other suitable equipment. The maximum lift for blade mixing and laying shall not exceed 1 cubic yard per running foot. If the mineral aggregate is delivered to the roadbed in separate sizes, each size of aggregate shall be spread in a windrow of the required quantity for that size of material, after which the windrows of various sizes shall be blended into one windrow alongside of the roadbed.

The aggregate shall be so spread that the windrows will be uniform and equal in size and will contain the proper quantity of material to provide surfacing of the required width and thickness. Care shall be exercised to prevent the aggregate from becoming mixed with earth or shoulder material. Preparatory to applying the liquid asphalt, a portion of the material from the windrow shall be spread uniformly over one-half the width of the roadbed.

Unless permitted by the Engineer, no more aggregate shall be spread on any one day than can be mixed with liquid asphalt within 72 hours. If traffic conditions require, the Engineer may require spread or flattened windrows.

320.5 APPLICATION OF LIQUID ASPHALT:

The temperature of the liquid asphalt, when applied, shall be in accordance with Section [712](#), and 16 to 22 gallons shall be applied for each cubic yard of road-mix material, in not less than 2 approximately equal applications.

Unless otherwise approved by the Engineer, no liquid asphalt shall be spread when weather conditions are unsuitable, or when the moisture content of the mineral aggregate exceeds 3 percent by weight of the dry aggregate. When the aggregate is unusually porous, the permissible moisture content may be increased and liquid asphalt spread at the discretion of the Engineer, when laboratory tests indicate that such increased moisture content will not produce an unstable mixture.

Liquid asphalt shall be prevented from spraying upon adjacent pavements, structure, guard rails, guide posts, culvert markers, trees and shrubbery, adjacent property and improvements, and other highway improvements or facilities not specifically mentioned herein, or that portion of the traveled way being used by traffic.

320.6 MIXING:

Immediately following each successive application of liquid asphalt, the surfacing material shall be thoroughly mixed by means of a blade. After the final application, the material shall be bladed into a windrow and the windrow bladed back and forth between the center and the edge of the area to be surfaced with a heavy blade grader having a wheel base not less than 16 feet long, until a satisfactory mixture of uniform appearance is obtained.

Should the mixture show an excess or deficiency of liquid asphalt, or uneven distribution thereof, prior to spreading and compacting, the condition shall be corrected by adding mineral aggregate or liquid asphalt, as the need may be, and remixing the material to produce a satisfactory mixture. If necessary, all compressed masses of material shall be broken up.

SECTION 320

After mixing, the material shall be placed in a windrow prior to spreading.

After the material has been mixed as above specified all of the mixed material shall be bladed into a single windrow in the center of the roadbed and the entire mass of treated material turned not less than 4 complete times by blading first to one side of the road and then to the other.

In lieu of mixing the material as above specified, a road-mixing machine or any equipment other than that required above may be employed which will produce a completed mixture equal to that which would be produced by means above specified. The Engineer reserves the right to order the use of any equipment discontinued which, in his opinion, fails to produce a satisfactory mixture.

Road-mixing machines shall be of the pug mill or auger type or other suitable equipment capable of picking up the loosened material completely from the roadbed, leaving practically no loose material on the ground, and which will introduce the liquid asphalt through a metering device at the time of mixing. The machine shall be equipped with the positive control of the amount of liquid asphalt introduced into the mix which can be readily adjusted to changes in grading of the road material.

The rate of movement of the machine along the roadway, the amount of material mixed and the amount of mixing shall be so regulated that a uniform mixture of unchanging appearance is obtained and all particles of aggregate are thoroughly coated with liquid asphalt. Before mixing on the roadbed the loosened material shall be placed in windrows or in a blanket of uniform cross-section and of such size that all the material in the windrow or blanket can be passed through the mixing machine at each mixing operation. Sufficient material, as determined by the Engineer, shall be placed in windrows or in a blanket in advance of mixing.

No mixed material shall be spread and compacted until the mixture has been approved by the Engineer.

The amount of material mixed on any one day shall not be more than can be spread and compacted on the following day, except that when directed by the Engineer mixed material shall remain in the windrow for a longer period.

Mixing the liquid asphalt with the mineral aggregate prior to delivery on the roadbed will be permitted, provided that the complete mixture is uniform in character and the same consistency with respect to grading, asphalt content and moisture as that specified for road-mixing.

Liquid asphalt added to mineral aggregate at a central mixing plant shall be accurately weighed by means of dial scales or other approved weighing devices. Liquid asphalt added to mineral aggregate in a traveling mixing plant shall be accurately measured by means of meters or other approved measuring device. Weighing or measuring liquid asphalt being added to mineral aggregate at mixing plants in accordance with the above specified methods shall be for the purpose of properly proportioning the material and not for determining the pay quantities of liquid asphalt.

320.7 SPREADING AND COMPACTION:

Spreading shall be in increments not exceeding 1 inch in thickness.

Rolling shall be continuous throughout the spreading operations until all the loose material has been laid and consolidated.

Segregation of coarse or fine particles shall be avoided and the surfacing as spread shall be free from lumps or pockets of coarse or fine material. Segregated materials or lumps shall be remixed by blading.

After spreading on the roadbed, should the moisture content of the mixture exceed 3 percent it shall be reduced by blading and reblading the mixture and allowing it to dry before the final spreading. Should blading and reblading of the mixture fail to reduce the moisture content below that above specified, the mixture shall be scarified, turned and respread until the moisture content does not exceed 3 percent by weight of the dry aggregate, with the exception, however, that in certain special cases, when the mineral aggregate is unusually porous the permissible moisture content may be increased at the discretion of the Engineer, when laboratory tests indicate that such increase will not result in an unstable mixture.

During blading and rolling, all lumps or compressed masses of the mixture shall be remixed and again rolled. On completion of the blading operations all loose stones shall be swept to the outside of the surfaced area and incorporated with the shoulder material or picked up and disposed of.

SECTION 320

The edges of the completed surfacing shall be trimmed uniformly to the required cross-section and width before the shoulders are finally rolled and shaped.

The completed surface, when ready for acceptance, shall be thoroughly compacted, smooth and even, true to grade and cross-section, and free from ruts, humps, depressions, or irregularities. When a 10 foot straightedge is laid on the finished surface and parallel with the center line of the road, the surface shall vary in no place more than 1/8 inch from the lower edge of the straightedge.

Should pneumatic-tired roller be used, the final finishing shall be done with a tandem roller. Sufficient blading and rolling equipment shall be furnished.

Where shown on the plans or specified in the special provisions, road-mixed material shall be placed and compacted around spillway assemblies, drop inlets and manholes outside the area to be surfaced, upon road approaches and connections, over gutter, ditch and dike areas, and over other areas, to the thickness shown on the plans or ordered by the Engineer.

At locations where the surfacing is to be placed over areas inaccessible to the required spreading and compacting equipment or over areas where the use of required spreading and compacting equipment would be impractical, the mixed material may be spread and compacted by other methods when approved or so ordered by the Engineer. Road-mixed surfacing placed on road approaches and connections shall be placed to the thickness and as specified for surfacing to be placed on the roadbed.

After final rolling the finished surface course shall have a density of at least 92 percent of the theoretical maximum density possible to obtain with the same materials in like proportions when computed without voids by specific gravity tests.

320.8 MEASUREMENT:

Measurements for determining the area to be paid for will be made horizontally unless otherwise specified.

320.9 PAYMENT:

Payment for road-mixed surfacing will be made on the basis of the price bid per square yard unless an alternate basis of payment is provided in the proposal. The price bid per square yard shall include the furnishing of all labor, materials, tools, compaction, asphalt and the dressing of the subgrade, or base course necessary to complete the work. Prime coat, when required, will be paid for by the ton, undiluted, complete in place.

- End of Section -

SECTION 321

PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

321.1 DESCRIPTION:

This section is to provide specifications for furnishing all materials, mixing at a plant, hauling and placing a mixture of aggregate materials, mineral admixture and asphalt binder to form a pavement course for placement upon a previously prepared base or sub base.

321.2 MATERIALS AND MANUFACTURE:

The materials shall conform to Section [710](#) for the type specified. Warm Mix Asphalt (WMA) technologies may be used within the mixture provided all requirements of the specifications are met, and the technology is on the ADOT approved product list. The specific required mix type shall be called out in the contract documents or as directed by the Engineer.

321.3 WEATHER AND MOISTURE CONDITIONS:

Asphalt concrete shall be placed only when the surface is dry, and when the atmospheric temperature in the shade is 40 degrees F. (50 degrees F for Asphalt Concrete lift less than 2 inch thick) or greater. No asphalt concrete shall be placed when the weather is foggy or rainy, or when the base or sub base on which the material is to be placed is unstable. Asphalt concrete shall be placed only when the Engineer determines that weather conditions are suitable.

321.4 APPLICATION OF TACK COAT:

A tack coat shall be applied to all existing and to each new course of asphalt concrete prior to the placing of a succeeding lift of asphalt concrete. If approved by the Engineer, the tack coat may be deleted when a succeeding layer of asphalt concrete is being applied over a freshly laid course that has been subjected to very little traffic.

The application of the tack coat shall comply with Section [329](#). The grade of emulsified asphalt shall be SS-1h or CSS-1h as specified in Section [713](#).

The same material that is specified above for the tack coat shall be applied to the vertical surfaces of existing pavements, curbs, and gutters, against which asphalt concrete is to be placed.

The surface to be covered may require repair or patching as directed by the Engineer. This shall be addressed in the project specifications prior to the bidding of the project.

321.5 MIX DESIGN:

The mix design shall be submitted to the Engineer at least five working days prior to the start of asphalt concrete production. Mix designs provided by the agency may be utilized on projects at the Engineer's discretion. The Engineer will review and approve the mix design to assure it contains all of the required information as outlined in Section [710.3.1](#). If WMA technologies are used within the mix design, the type of WMA technology used shall be indicated on the mix design. The target values for gradations, binder contents, and air voids will be established as the accepted Job Mix Formula (JMF) based upon the mix design. Mix designs not containing all of the information will be returned within five working days of receipt of all mix design information, for action and resubmission by the contractor.

Once the mix design has been approved by the agency and the mixing plant selected, the Contractor and/or his supplier shall not change plants nor utilize additional mixing plants without prior approval of the Engineer.

If the contractor elects to change its source of material, the contractor shall furnish the Engineer with a new mix design, which meets the requirements of Section [710](#), as amended by the Project Specifications.

SECTION 321

The contractor may make self-directed target changes to the approved mix design within the limits shown below. Requests for self-directed target changes shall be made in writing and acknowledged by the Engineer prior to the start of production of a lot and will remain in effect until such time as any additional changes are implemented. The self-directed target changes must meet the contract requirements for mix design criteria and gradation limits.

TABLE 321-1 ALLOWABLE SELF-DIRECTED TARGET CHANGES	
MEASURED CHARACTERISTICS	ALLOWABLE SELF-DIRECTED TARGET CHANGES
Gradation (Sieve Size)	
3/8 inch	$\pm 4\%$ from mix design target value
No 8	$\pm 4\%$ from mix design target value
No 40	$\pm 2\%$ from mix design target value
No 200	$\pm 0.5\%$ from mix design target value
Binder Content	$\pm 0.2\%$ from mix design target value
Effective Air Voids	None

The contractor may propose target changes, other than self-directed changes, to the approved mix design for the approval of the Engineer. The Engineer will determine if the proposed target change will result in mix production that meets the contract requirements for mix design criteria and gradation limits. The target changes will not be retroactive for the purpose of acceptance.

321.6 MIX PRODUCTION:

All materials shall be proportioned by weight in a hot mix asphalt plant in the proportions required by the mix design to provide a homogeneous and workable mass. Each hot mix asphalt plant shall be inspected in accordance with the provisions contained in the 'Hot Mix Asphalt Production Facilities' by the Arizona Rock Products Association and shall have a current inspection certificate. All measuring devices shall be calibrated at least annually by a technician licensed by the Arizona Bureau of Weights & Measures. Mixing plants shall conform to the requirements of AASHTO M-156, except as modified herein. If WMA technology is being used, any equipment associated with the production of hot mix asphalt shall be calibrated and in proper working order according to the WMA equipment specifications. If there are any deviations in the production or compacting temperatures of the hot mix asphalt with WMA technology, the mix design shall state the differences.

In drum mix plants the mineral admixture shall be added and thoroughly mixed with the mineral aggregate by means of a mechanical mixing device prior to the mineral aggregate and mineral admixture entering the dryer. The moisture content of the combined mineral aggregate shall be a minimum of three percent by weight of the aggregate during the mixing process.

For drum-mix plants, the mineral admixture shall be weighed across a weight belt, or other approved alternative weighing system, with a weight totalizer prior to entry into the mechanical mixing device. The mechanical mixing device shall be a pugmill type mixer that is in good working condition. The rate of the aggregate feed shall not exceed the mixing device's capacity in ton per hour. The mixer shall be constructed to minimize the loss of mineral admixture and shall be located in the aggregate delivery system at a location where the mixed material can be readily inspected. The mixing device shall be capable of effective mixing in the full range of the asphalt concrete production rates.

The hot plant and equipment shall be constructed and operated to prevent loss of mineral admixture through the dust collection system of the plant.

A positive signal system shall be provided and used during production whereby the mixing shall automatically be stopped if the mineral admixture is not introduced into the mineral aggregate. The plant will not be permitted to operate unless the signal system is in good working condition.

The introduction of bituminous material shall be controlled by an automated system fully integrated with the controls or the mineral aggregate and mineral admixture. The production of the plant shall be controlled by the rate required to obtain a uniform mixture of all components. Drying and heating shall be accomplished in such a manner as to preclude the mineral admixture from becoming coated with un-spent fuel. The completed asphalt concrete may be held in storage for up to 12 hours in insulated or heated silos, providing the minimum temperature noted herein for placement and compaction is met behind the

SECTION 321

placement device. If the Engineer determines that there is an excessive amount of heat, heat loss, drain down, segregation and/or oxidation of the mixture due to temporary storage, use of surge bins or storage bins will be discontinued.

The temperature of the asphalt concrete, with unmodified binders, upon discharge from the mixer shall not exceed 335 degrees F. The discharge temperature may be increased on the recommendation of the binder supplier, when approved by the Engineer. If the asphalt concrete is discharged from the mixer into a hopper, the hopper shall be constructed so that segregation of the asphalt concrete will be minimized.

321.7 TRANSPORTATION:

Petroleum distillates or other substances that will have a detrimental effect on the asphalt concrete shall not be used as a release agent.

The beds of all transportation units shall be clean and smooth to allow the free flow of material into the paving machine's hopper.

Tarpaulins shall be furnished on all trucks and used when weather condition warrant, or if directed by the Engineer.

321.8 PLACEMENT:

Placement of asphalt concrete pavement shall not commence until authorized by the Engineer. The Engineer's authorization to allow commencement of asphalt concrete paving will generally require all newly constructed valley gutters, curbing, and curb and gutters which new pavement is to be placed against to be in-place and in an acceptable condition. While it is preferred to have all newly constructed concrete items against which new pavement is to be placed be in an acceptable condition, the Engineer may allow paving to commence based on weather, the amount of defective concrete, or other considerations.

321.8.1 Placing: All courses of asphalt concrete shall be placed and finished by means of a self-propelled paving machine equipped with an automatically actuated control system, except under certain conditions or at locations where the Engineer deems the use of a self-propelled paving machine impracticable.

The control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other end indirectly either through controlling the transverse slope or alternatively when directed, by controlling the elevation of each end independently.

The control system shall be capable of working with one of the following devices:

- (a) Ski or non-contact device of not less than 30 feet in length, supported throughout its entire length
- (b) Taut stringline or wire set to grade
- (c) Short ski or sonar sensing units from curb control
- (d) Joint matching shoe

Failure of the control system to function properly shall be cause for the suspension of asphalt concrete production. In order to achieve a continuous operation, the speed of the paving machine shall be coordinated with the hot mix plant and transport units.

If the asphalt concrete is dumped from the hauling vehicles directly into the paving machine, care shall be taken to avoid jarring the machine or moving it out of alignment. No vertical load shall be exerted on the paving machine by the truck.

If asphalt concrete is dumped upon the surface being paved and subsequently loaded in the paving machine, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the asphalt concrete shall be picked up and loaded into the paving machine.

Self-propelled paving machines shall spread the mixture without segregation or tearing, true to line, grade and crown indicated on the project plans. Pavers shall be equipped with hoppers and augers that will distribute the mixture uniformly in front of an adjustable floating screed. The raising of the hopper wings must be minimized and the paving machine will not be operated when in an empty condition.

SECTION 321

Screeds shall include any strike-off device operated by tamping or vibrating action which is effective, without tearing, shoving or gouging the mixture and which produces a course with a uniform texture and density for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required. In the case of the screed, auger extensions and vibrators shall be installed wherever the screed is extended more than one (1) foot beyond the end of the base auger or auger extension. However, when placing material against an extremely uneven curb or edge over a short distance, the Engineer may waive the auger extensions and vibrators.

At any place not accessible to the roller, the mixture shall be thoroughly compacted with tampers to provide a uniform and smooth layer over the entire area compacted in this manner.

321.8.2 Joints: Transverse joints, before a surface course is placed in contact with a cold transverse construction joint, the cold existing asphalt concrete shall be trimmed to a vertical face for its full depth exposing a fresh face. The fresh face shall be tack coated prior to placement of the new asphalt concrete. After placement and finishing the new asphalt concrete, both sides of the joint shall be dense and the joint shall be smooth and tight. The surface in the area of the joint shall not deviate more than 1/4 inch from a 12-foot straightedge, when tested with the straightedge placed across the joint, parallel to the centerline.

Longitudinal joints of each asphalt course shall be staggered a minimum of 6 inches with relation to the longitudinal joint of the immediate underlying course's cold longitudinal construction joint.

Longitudinal joints with existing or cold (more than 32 hours old) asphalt concrete shall require the existing pavement to be trimmed to a vertical face for its full depth exposing a fresh face. The fresh face shall be tacked prior to placement of the adjacent course. Longitudinal joints with an existing asphalt pavement that is less than 32 hours old that has had its edge protected from damage may have adjacent new asphalt concrete placed after applying the required tack coat. After placement and finishing of longitudinal joints, both sides of the joint shall be dense and the joint shall be smooth and tight. The surface in the area of the joint shall not deviate more than 1/4 inch from a 12-foot straightedge, when tested with the straightedge placed across the joint, in any direction.

321.8.3 Asphalt Leveling Course: A leveling course shall be used when specified, or as directed in writing by the Engineer, to bring existing pavement to a uniform grade prior to placing an overlay or other course. If a leveling course is being applied on an asphalt surface, a tack coat shall be applied. The compaction requirements contained in Section [321.10](#) do not apply to leveling courses.

321.8.4 Compaction; Asphalt Base Course and Surface Course: It is the contractor's responsibility to perform Quality Control monitoring and/or testing during compaction operations to achieve the required compaction. The temperature of the asphalt concrete immediately behind the laydown machine shall be at least 265 degrees F, unless WMA technology is being used. If WMA technology is being used then the minimum requirements will be stated within the mix design recommended by the WMA manufacturer. A probe type electronic thermometer with a current calibration sticker attached will be used to measure the temperature of the asphalt concrete mixture. When measuring the temperature of the mat, the probe shall be inserted at mid-depth and as horizontal as possible to the mat. The contractor is responsible to achieve the required compaction.

Asphalt compaction equipment shall be of sufficient size and weight to accomplish the required compaction. All compaction equipment shall be operated and maintained in accordance with the manufacturer's recommendations and the project requirements. During the rolling operation, the speed of the roller shall not exceed three miles per hour, unless otherwise approved by the Engineer.

Pneumatic tired compactors shall be equipped with skirt-type devices mounted around the tires so that the temperature of the tires will be maintained during the compaction process.

The Engineer will determine the acceptability of the pavement compaction in accordance with Section [321.10](#).

321.8.5 Smoothness: The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than 1/4 inch from the lower edge of a 12-foot straightedge when the straightedge is placed parallel to the centerline of the roadway.

321.8.6 Asphalt Concrete Overlay: Asphalt concrete overlay consists of the placing and compacting plant mix asphalt concrete over existing pavement. The mix design and thickness of the overlay shall be as shown on the plans or as specified in the special provisions.

SECTION 321

Except when the existing asphalt surface is to be preheated and remixed, pavement surfaces shall be prepared as follows:

- (a) Areas designated for pavement repair by the contract documents (which may include severely raveled areas, severely cracked areas, over-asphalted areas, and other defects) shall be cut out and replaced. Pavement repairs shall be completed and approved before placing asphalt concrete overlay.
- (b) Before placing asphalt concrete overlay, raised pavement markers shall be removed, and milling shall be completed. Milling shall be as shown on the plans or specified in the special provisions and shall be in accordance with Section [317](#).
- (c) After pavement repairs and milling have been completed the entire surface shall be cleaned with a power broom.
- (d) After surfaces have been prepared to the satisfaction of the Engineer, they shall receive a tack coat per Section [321.4](#). Traffic will not be permitted to travel over surfaces which have received a tack coat, except when tack coat is applied to milled surfaces in compliance with Section [317.2](#) for dust control purposes. When the overlay is to extend onto a concrete surface, the concrete surface shall be thoroughly cleaned of loose dust and cement particles and shall be tack coated.

Asphalt concrete overlay shall be placed as specified in Section [321.8.1](#) and compacted as specified in Section [321.8.4](#). The surface smoothness shall meet the tolerances specified in Section [321.8.5](#).

Frames and covers of manholes, survey monuments, valve boxes, clean-outs and other existing structures shall be adjusted in accordance with Section [345](#) to set flush with the finished surface of the new pavement. During adjustment, if pavement or base materials are removed or disturbed, they shall be replaced with approved materials installed in a manner acceptable to the Engineer.

On roads without curb and gutter, the existing unpaved shoulder elevation shall be adjusted by the Contractor to match the elevation at the edge of the new overlay and slope away from the new pavement surface at a rate that the existing quantity of shoulder material will allow. Shoulder material shall be compacted to a minimum of 95% of maximum density, determined in accordance with Section [301.3](#). Shoulder adjustment to match the new pavement surface elevation shall not be measured. The cost of shoulder adjustment shall be included in the price paid for the asphalt concrete overlay or other related pay items. When the Engineer determines an insufficient amount of material is available for shoulder adjustment, the Engineer may require the Contractor to provide additional material. Acceptable material for shoulders includes the existing shoulder material, millings, untreated base materials, or a granular material approved by the Engineer. Engineer requested imported material for shoulder adjustment is not included in the price paid for the asphalt concrete overlay.

321.8.7 Pavement Fabric Interlayer: Pavement fabric interlayer shall be used only when specified on the plans or in the specifications.

Pavement fabric interlayer shall be in accordance with Table [796-1](#) and be the class designated on the plans or in the specifications.

Asphalt binder coat used to bond the fabric to the pavement shall be paving asphalt PG 70-10 asphalt cement conforming to the requirements of Section [711](#). The application and distributing equipment for the asphalt binder shall conform to the requirements of Section [330](#). The asphalt binder coat shall be uniformly spray applied to the prepared pavement surface at the rate of 0.20 gallons per square yard for Class B fabric or at the rate of 0.25 gallons per square yard for Class A fabric. Some underlying surfaces may require a higher or lower application rate. A test strip may be necessary to determine the proper application rate. The width of liquid asphalt cement application shall be the fabric width, plus six inches.

Neither the asphalt binder coat or fabric interlayer shall be placed when weather conditions, in the opinion of the Engineer, are not suitable. The asphalt binder and fabric interlayer shall only be placed when the pavement is dry, the ambient air temperature is 50 degrees F and rising, and pavement temperature is 40 degrees F and rising.

Equipment for placing the fabric shall be mechanized and capable of handling full rolls of fabric. The equipment shall be able to lay the fabric smoothly to maximize pavement contact and remove air bubbles. Stiff bristle brooms shall be used to smooth the fabric. The equipment used to place the fabric shall be in good working order and is subject to approval by the Engineer.

Pavement fabric interlayer shall not be placed if the in-place binder is hotter than 325 degrees F or has cooled to 180 degrees F or below (as determined by non-contact thermometer).

SECTION 321

Pavement fabric interlayer shall be placed onto the asphaltic binder with the heat bonded side up with a minimum amount of wrinkling or folding. Remaining wrinkles or folds 1-inch and larger shall be removed or slit and shingle-lapped in the direction of paving. Burning or torching of wrinkles is not allowed. Fabric shall overlap three to six inches to insure full closure of the joint. Transverse joints shall be shingle-lapped in the direction of paving to prevent edge pickup by the paver. A second application of hand-placed asphalt binder may be required at laps and repairs as determined by the Engineer to ensure proper binding of the narrow double fabric layer.

All areas where fabric has been placed shall be paved with asphaltic concrete during the same workshift. Placement of the asphaltic concrete shall closely follow fabric lay down. The temperature of the asphaltic concrete immediately behind the laydown machine shall not exceed 325 degrees F, unless modified by the WMA technology being used. If WMA technology is being used then the minimum requirements will be stated within the mix design recommended by the WMA manufacturer. In the event that the asphalt binder coat bleeds through the fabric causing construction problems before the overlay is placed, the affected areas shall be sanded with a sand blotter in compliance with Section [333](#). Excess sand shall be removed before beginning the paving operation. In the event of rainfall prior to the placement of the asphaltic concrete, the fabric shall be allowed to dry before the asphalt concrete is placed.

Turning of the paving machine or of other vehicles on the fabric shall be gradual and kept to a minimum to avoid damage to the fabric. Should equipment tires stick to the fabric during pavement operations, small quantities of paving asphalt concrete shall be broadcast on the fabric to prevent pick-up. Decrease of binder rate in order to minimize pick-up on tires is not allowed.

321.8.8 Thickened Edge: When the depth of the thickened edge extends four inches or more below the bottom of the asphalt pavement, the portion of the thickened edge extending below the asphalt pavement shall be placed and compacted prior to placement of the asphalt pavement. Placement of tack coat on the surface of the compacted thickened edge asphalt may be omitted when additional asphalt pavement is placed on the same day and the Engineer agrees that the surface of the thickened edge asphalt has remained clean.

When the depth of the thickened edge extends less than four inches below the bottom of the asphalt pavement, the portion below the asphalt pavement may be placed and compacted with the asphalt pavement in a single operation.

321.8.9 Safety Edge: The finished safety edge slope shall be planar forming a $30^{\circ} \pm 5^{\circ}$ angle with the adjacent roadway surface and extend a minimum of five inches (5") below the roadway pavement's finished surface.

The safety edge shall be constructed with the top or final paving lift of a new pavement or overlay using a device that is mounted to or is a part of the screed portion of the laydown machine. The safety edge device shall be capable of constraining the asphalt concrete material to increase density of the extruded profile by reducing the volume. A conventional single strike-off plate is not acceptable. Compaction obtained from the extruded safety edge shall be acceptable when the extruded shape conforms to the specified shape.

During laydown operations if the extruded safety edge does not conform to the specified shape, the Contractor shall take immediate actions to correct the deficiency and to repair all non-compliant sections of safety edge. The Contractor shall stop paving operations until corrections to the laydown operation have been made and resumption of paving is approved by the Engineer or his designated representative.

321.8.10 Protection for Asphalt Base Course: Arterial roadway traffic shall not be allowed on a new asphalt base course that is less than five inches (5") in thickness without the written consent of the Engineer.

321.9 QUALITY CONTROL:

It is the contractor's responsibility to perform Quality Control monitoring and/or testing during asphalt concrete production to achieve the required compaction and to perform Quality Control monitoring and/or testing during asphalt concrete production to achieve the required mix properties. The Engineer may obtain samples of any portion of any material at any point of the operations for his own use. Also, the Engineer may order the use of any drying, proportioning and mixing equipment or the handling of any material discontinued which, in his/her opinion, fails to produce a satisfactory mixture.

SECTION 321

The asphalt concrete produced shall conform to the requirements of the production tolerances established in Section [321.10](#). When the asphalt concrete does not conform to the production tolerances, it shall be reported to the Engineer, and corrective quality control measures shall be implemented, or production shall cease immediately at no additional cost to the contracting Agency.

Requests for referee testing as described in Section [321.11](#) will only be considered based on quality control test results performed by a laboratory accredited by the AASHTO Accreditation Program (AAP) for the tests being performed or a laboratory listed in the current ADOT Directory of Approved Materials Testing Laboratories for the set of tests in question. The laboratory shall use properly certified technicians in accordance with ASTM [D3666](#), Section 7 (Personnel Qualifications).

321.10 ACCEPTANCE:

321.10.1 Acceptance Criteria: Asphalt concrete will be divided into lots for the purpose of acceptance. A lot shall be one day's production. Each lot shall be divided into sublots of 500 ton or fraction thereof. Tests used to determine acceptance will be performed by a laboratory accredited by the AASHTO Accreditation Program (AAP) for the tests being performed. The contracting agency shall provide an appropriately accredited laboratory or laboratories to perform the acceptance testing. Laboratories shall use properly certified technicians in accordance with ASTM [D3666](#), Section 7 (Personnel Qualifications). The acceptance laboratory will take representative samples of the asphalt concrete from each sublot to allow for testing of gradation, binder content, air voids, pavement thickness, and compaction of base and surface courses. Acceptance of each sublot will be based on the test data from the sample(s) from that sublot. All acceptance samples shall be taken using random locations or times designated by the Engineer in accordance with ASTM [D3665](#).

321.10.2 Gradation, Binder Content and Air Voids: The acceptance laboratory will take a sample of the asphalt concrete in accordance with the requirements of Section 2 or 4 of Arizona Test Methods 104 or AASHTO T-168 from each sublot. The minimum weight of the sample shall be 45 pounds. Asphalt binder content and gradation shall be determined in accordance with AASHTO T-308 using the ignition furnace for each sublot. The acceptance laboratory is responsible for obtaining the necessary materials and performing an ignition furnace calibration as outlined in AASHTO T-308 for each asphalt concrete mixture utilized on the project. The correction factor used for each test shall be clearly indicated on the report. The bulk density for Marshall Mix designs shall be tested in accordance with AASHTO T-245. The bulk density for Gyratory mix designs shall be determined in accordance with AASHTO T-312. The maximum theoretical density shall be determined in accordance with the requirements of AASHTO T-209 including fan drying per AASHTO T-209 Section 15. Effective voids of the laboratory compacted specimens will be determined at a minimum of once per lot in accordance with the requirements of AASHTO T-269. Should the testing for effective air voids not meet the "Full Payment" or "No Corrective Action" requirements of Table [321-5](#), additional testing for laboratory air voids on the remaining sublots will be performed as necessary to determine the extent of the deficiency. Acceptance testing results will be furnished to the contractor and the supplier within five working days of receipt of samples by the acceptance laboratory.

During production, the allowable deviations from the mix design gradation targets are listed in the tables below. The allowable production tolerances may fall outside of the mix design gradation bands.

TABLE 321-3A				
GRADATION ACCEPTANCE LIMITS FOR MARSHALL MIXES				
Sieve Size	3/8 inch Mix	1/2 inch Mix	3/4 inch Mix	Base Mix
1 inch	---	---	---	±7%
3/4 inch	---	---	±7%	±6%
1/2 inch	---	±7%	---	---
3/8 inch	±7%	±6%	±6%	±6%
No. 8	±6%	±6%	±6%	±6%
No. 40	±4%	±4%	±4%	±4%
No. 200	±2%	±2%	±2%	±2%

SECTION 321

TABLE 321-3B			
GRADATION ACCEPTANCE LIMITS FOR GYRATORY MIXES			
Sieve Size	3/8 inch Mix	1/2 inch Mix	3/4 inch Mix
3/4 inch	---	---	±7%
1/2 inch	---	±7%	±6%
3/8 inch	±7%	±6%	---
No. 8	±6%	±6%	±6%
No. 40	±4%	±4%	±4%
No. 200	±2%	±2%	±2%

If the results from a single acceptance sample fall outside of the acceptance limits in Table [321-3A](#) or [321-3B](#) as applicable, a second sample shall be taken and if the second acceptance sample is also outside of the acceptance limits the Contractor shall cease production of asphalt concrete. Production shall not begin again until calibration test results verify that adjustments made to materials or proportions yield a gradation that falls within acceptance limits in Table [321-3A](#) or [321-3B](#) as applicable.

If the asphalt binder content is within $\pm 0.40\%$ of the mix design target value, the asphalt concrete will be paid for at the contract unit price. If the asphalt binder content deviates by more than $\pm 0.40\%$ from the mix design target value, the deficient area will be evaluated within the subplot by coring one additional location at a maximum interval of 100 feet on each side of the deficient sample. The asphalt content of the original deficient sample will be averaged with the asphalt binder content of the two additional cores to determine compliance with the acceptance requirements. If the resulting average of the asphalt binder content deviates by more than $\pm 0.40\%$ from the mix design target value, then Table [321-4](#) shall apply to the subplot. If approved by the Engineer, the Contractor may obtain additional cores to assist in formulation of an Engineering Analysis, but the additional cores shall not be used for re-evaluating acceptance.

TABLE 321-4		
ASPHALT BINDER CONTENT ACCEPTANCE AND PENALTIES		
Deviation from that permitted	When the contracting agency is the owner: Payment Reduction (\$ per ton of asphalt concrete)	When the contracting agency is not the owner (i.e. permits): Corrective Action
Over 0.2% <u>above</u> that permitted	Removal* or EA	Removal* or EA
Over 0.1% to 0.2% <u>above</u> that permitted	\$6.00	EA
Over 0.0% to 0.1% <u>above</u> that permitted	\$2.00	EA
Within permitted range	Full Payment	No Corrective Action
Over 0.0% to 0.1% <u>below</u> that permitted	\$2.00	EA
Over 0.1% to 0.2% <u>below</u> that permitted	\$6.00	EA
Over 0.2% <u>below</u> that permitted	Removal* or EA	Removal* or EA

NOTES: *The Contractor shall remove and replace the entire subplot that is deficient.
EA = Engineering Analysis per Section 321.10.6

If the laboratory air voids fall within a range of 2.8% to 6.2%, the asphalt concrete will be paid for at the contract unit price. If the laboratory air voids are outside of this range, the deficient area will be evaluated within the subplot by coring one additional location at a maximum interval of 100 feet on each side of the deficient sample. The laboratory air voids of the original deficient sample will be averaged with the laboratory air voids obtained from each of the two additional cores to determine compliance with the acceptance requirements. If the resulting average of the laboratory air voids is outside the indicated range, then Table [321-5](#) shall apply to the subplot. If approved by the Engineer, the Contractor may obtain additional cores to assist in formulation of an Engineering Analysis, but the additional cores shall not be used for re-evaluating acceptance.

SECTION 321

TABLE 321-5		
LABORATORY VOIDS ACCEPTANCE AND PENALTIES		
Laboratory Air Voids (Measured at N_{des} or 75 blows as applicable)	When the contracting agency is the owner: Payment Reduction (\$ per ton of asphalt concrete)	When the contracting agency is not the owner (i.e. permits): Corrective Action
Less than 1.5%	Removal* or EA	Removal* or EA
1.5-2.0%	\$5.00	EA
2.1-2.7%	\$2.00	EA
2.8-6.2%	Full Payment	No Corrective Action
6.3-6.9%	\$2.00	EA
7.0-8.0%	\$5.00	EA
Greater than 8.0%	Removal* or EA	Removal* or EA

NOTES: *The Contractor shall remove and replace the entire subplot that is deficient.

EA = Engineering Analysis per Section [321.10.6](#)

If an agency or Engineer is purchasing asphalt concrete directly from a commercial material supplier, the agency or Engineer will use Section [321.10](#), and specifically Tables [321-3A](#) or [321-3B](#) as applicable, [321-4](#) and [321-5](#) from Section [321.10](#), when determining the acceptance of the asphalt concrete with the material supplier.

321.10.3 Surface Testing: If directed by the Engineer surface drainage test shall be performed. The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than 1/4 inch from the lower edge of a 12-foot straightedge when the straightedge is placed parallel to the centerline of the roadway. The straightedge shall be furnished by the contractor and shall be acceptable to the Engineer.

All streets shall be water tested for drainage in the presence of the Engineer or designated representative before final acceptance. Any areas not draining properly shall be corrected to the Engineer's satisfaction at the Contractor's expense. Water for this testing shall be provided and paid for by the Contractor.

When deviations in excess of the above tolerance are found, humps or depressions shall be corrected to meet the specified tolerance. The defective pavement shall be cut out along neat straight lines or for multiple course pavements the surface course may be milled out, and the removed pavement replaced with fresh hot mixture and thoroughly compacted to conform with and bond to the surrounding area. Materials and work necessary to correct such deviations shall be at no additional cost to the Contracting Agency.

When pavement is cut out along neat straight lines, full depth longitudinal joints shall not be located within a lane wheel path or within forty-eight inches (48") of an asphalt pavement edge. Longitudinal joints shall comply with the restrictions for Type A Trench Repairs in Section [336.3](#).

321.10.4 Asphalt Pavement Thickness: Asphalt pavement thickness will be determined from cores secured from each lift of each subplot. Such cores will be taken and measured by the Asphalt Concrete Coring Method. This method can be found in Section [321.14](#). Each core location will be patched by the party responsible for the testing.

Acceptance or assessment of penalties for asphalt pavement thickness will be based on the combined total thickness of all asphalt concrete layers omitting all layers of asphalt-rubber asphalt concrete. If the final total pavement thickness exclusive of all ARAC layers is deficient from the target thickness by 0.25 inches or less, it will be paid for at the contract unit price.

SECTION 321

If the thickness deficiency of the pavement core exceeds 0.25 inch, the thickness deficiency shall be evaluated by coring at a maximum interval of 100 feet on each side of the deficient core. The thickness of the original deficient core will be averaged with the thicknesses of the cores taken from each side of it to determine compliance with the acceptance requirements.

If the pavement thickness deficiency is greater than 0.25 inches and the contracting agency is not the owner (i.e. permits) the following will apply:

- (1) If the pavement thickness deviates from the target thickness by more than 0.25 inch but not more than 0.50 inch, corrective action will be required. This corrective action shall consist of application of a Type II slurry seal coat in accordance to Section [715](#). The Contractor may present an Engineering Analysis outlining other proposed remedial measures for the consideration by the Engineer. The Engineer will review the engineering analysis and decide within 30 working days whether to accept the proposed remedial measures.
- (2) If the pavement thickness deviates from the target thickness by more than 0.50 inch, corrective action will be required. The deficient area shall be overlaid with no less than a 1 inch thick lift, for the full width of the pavement to meet or exceed the designed thickness, with appropriate end and edge milling, with a mixture approved by the Engineer. The Contractor may present an engineering analysis outlining other proposed remedial measures for the Engineer's consideration. The Engineer will review the engineering analysis and decide within ten working days whether to accept the proposed remedial measures. If the Engineer chooses to reject the Engineering Analysis, the indicated overlay shall be constructed by the Contractor at no additional cost to the Owner.

If the contracting agency is the owner and the pavement thickness deficiency is greater than 0.25 inches but less than 0.50 inches, Table [321-6](#) will apply. If the pavement thickness deficiency is greater than 0.5 inches, the deficient area shall be overlaid with no less than a 1-inch thick lift for the full width of the pavement to meet or exceed the designed thickness using an asphalt mixture approved by the Engineer. The Contractor shall provide appropriate end and edge milling. The overlay and milling shall be accomplished by the Contractor at no additional cost to the contracting agency.

TABLE 321-6	
ASPHALT PAVEMENT THICKNESS PAYMENT REDUCTION	
For Thickness Deficiency of More Than 0.25 inches and less than 0.50 inches	
Total Specified Asphalt Pavement Thickness exclusive of ARAC (if any)	Reduction in Payment Applied to asphalt concrete Except ARAC layers (if any)
Less than 1.5 inches	50%
1.50 inches to 1.99 inches	33%
2.00 inches to 2.49 inches	25%
2.50 inches to 2.99 inches	20%
3.00 inches and greater	17%

321.10.5 Density:

321.10.5.1 Pavement 1-1/2 Inches or Less in Nominal Thickness:

Compaction shall consist of a "Rolling Method Procedure" using an established sequence of coverage with specified types of compactors. A pass shall be defined as one movement of a compactor in either direction. Coverage shall be the number of passes as are necessary to cover the entire width being paved.

The rolling sequence, the type of compactor to be used, and the number of coverages required shall be as shown in Table [321-7](#).

SECTION 321

TABLE 321-7				
ROLLING SEQUENCE FOR LIFT THICKNESS 1½" OR LESS				
Rolling Sequence	Type of Compactor		No. of Coverages	
	Option No. 1	Option No. 2	Option No. 1	Option No. 2
Initial	Static Steel	Vibrating Steel	1	1
Intermediate	Pneumatic Tired	Vibrating Steel	4	2- 4*
Finish	Static Steel	Static Steel	1-3	1-3
* Based on the roller pattern which exhibits the best performance.				

The Contractor shall select the option for compaction and, when pneumatic-tired compactors are used will designate the tire pressure. Steel wheel compactors shall not be used in the vibratory mode for courses of one inch or less in thickness nor when the temperature of the asphaltic concrete falls below 180 degrees F. Initial and intermediate compaction shall be accomplished before the temperature of the asphaltic concrete falls below 200 degrees F.

Compaction will be deemed to be acceptable on the condition that the asphaltic concrete is compacted using the type of compactors specified, ballasted and operated as specified, and with the number of coverages of the compactors as specified.

321.10.5.2 Pavement Greater than 1-1/2 Inches in Nominal Thickness:

Achieving the required compaction is the responsibility of the contractor. The number and types of rollers is the contractor's responsibility and shall be sufficient to meet these requirements.

In-place air voids shall be determined in accordance with AASHTO T-269 utilizing cores taken from the finished pavement. The maximum theoretical density used in the determination of in-place air voids will be the average value from the acceptance samples determined for the lot as outlined in [321.10.1](#).

The Engineer will designate one random test location for each subplot and the acceptance laboratory will obtain one core from that location. Regardless of subplot quantities or boundaries, a minimum of one core will be obtained per residential street and a minimum of one core per travel lane for collector and arterial streets. The outside one foot of each pass of the pavement course or any unconfined edge will be excluded from testing. The Engineer may exclude areas from the compaction lot that are not accessible by normal compaction equipment.

The Contractor shall provide the traffic control to facilitate any coring operations necessary for compaction acceptance.

Cores will be taken per the Asphalt Concrete Coring Method. This method can be found in Section [321.14](#). Acceptance testing results will be furnished to the contractor within five working days of receipt of samples by the acceptance laboratory.

If the pavement density has in-place voids of between 4.0% and 8.0%, the asphalt concrete will be paid for at the contract unit price. If the acceptance core for a subplot indicates that the pavement density has in-place voids of less than 4.0% or greater than 8.0%, the deficient area will be evaluated by coring two additional locations at maximum intervals of 100 feet from the deficient core. The in-place voids of the original deficient core will be averaged with the in-place voids of the cores taken from 100 feet on each side of it to determine compliance with the acceptance requirements. If the resulting average of the in-place voids is outside the indicated range, then Table [321-8](#) shall apply to the subplot. If approved by the Engineer, the Contractor may obtain additional cores to assist in formulation of an Engineering Analysis, but the additional cores shall not be used for re-evaluating acceptance.

SECTION 321

TABLE 321-8		
PAVEMENT DENSITY PENALTIES		
Limits of In-place Air Voids for design lift thicknesses 1.5 inches and greater	When the contracting agency is the owner Payment Reduction (\$ per ton of asphalt concrete)	When the contracting agency is not the owner i.e. permits Corrective Action
Below 3.0%	Removal* or EA	Removal* or EA
3.0% to below 4.0%	\$10.00	EA and Type II Surry Seal
4.0% to 8.0%	Full Payment	No Corrective Action
Greater than 8.0% to less than 9.0%	\$6.00	EA
9.0% to 10.0%	\$10.00	EA and Type II Surry Seal
Greater than 10.0%	Removal* or EA	Removal* or EA

NOTES: *The Contractor shall remove and replace the entire subplot that is deficient.

EA = Engineering Analysis per Section [321.10.6](#)

321.10.6 Engineering Analysis (EA): Within 10 working days after receiving notice that a lot or subplot of asphalt concrete is deficient and is found to fall within the “Removal or EA” band per Table(s) [321-4](#), [321-5](#), and/or [321-8](#) the contractor may submit a written proposal (Engineering Analysis) to accept the material in place at the applicable penalties along with possible remediation(s) listed in the “Removal or EA” category. Engineering Analysis can also be proposed for non-removal categories of “Corrective Actions” when the contracting agency is not the owner (i.e. permits).

The Engineering Analysis shall contain an analysis of the anticipated performance of the asphalt concrete if left in place. The Engineering Analysis shall also detail the effect of any proposed corrective action to the material(s) in place as it relates to the in-place material’s performance. The Engineering Analysis shall be performed by a professional engineer experienced in asphalt concrete testing and mix designs.

If a lot or subplot is accepted for referee testing and the referee test results still show a deficiency, the contractor shall have ten working days to submit an Engineering Analysis beginning upon notification of referee test results.

When an Engineering Analysis recommends that a specific lot or subplot should not be removed, the Engineering Analysis will recommend that the following penalties (Table [321-9](#)) be paid when the contracting agency is the owner, for the specific criteria being reviewed by the EA.

TABLE 321-9		
ENGINEERING ANALYSIS PENALTIES for REMOVAL* LOTS/SUBLOTS LEFT IN-PLACE		
Acceptance Criteria	Acceptance Limits	Penalty When Contracting Agency is the Owner (\$/Ton)
Asphalt Binder Content	Over 0.2% points from that Permitted	\$9.00
Laboratory Air Voids (Measured at N_{des} or 75 blows as applicable)	Less than 1.5% or Greater Than 8.0%	\$7.50
Limits of In-place Air Voids	Less than 3% or Greater than 10.0%	\$15.00

Within 15 working days, the Engineer will determine whether or not to accept the contractor’s proposed Engineering Analysis.

SECTION 321

321.11 REFEREE:

If the Contractor has reason to question the validity of any of the acceptance test results, the Contractor may request that the Engineer consider referee test for final acceptance. Any request for referee testing must describe the contractor's reasons for questioning the validity of the original acceptance test results and must clearly describe which set of acceptance tests are in question. The engineer may either accept or reject the request for referee testing. When referee testing is accepted the Contractor (at the Contractors own expense) will engage an independent laboratory accredited by the AAP or a laboratory listed in the current ADOT Directory of Approved Materials Testing Laboratories as appropriate the acceptance tests that are being questioned. The independent referee laboratory shall use properly certified technicians in accordance with ASTM [D3666](#), Section 7 (Personnel Qualifications). For the set of test results in question the referee laboratory shall perform a new set of acceptance tests (as required by Section [321.10](#) representing the area for the set of tests in question). The referee tests will replace the original acceptance tests that were in question.

These tests may include asphalt binder content, aggregate gradation, Marshall or Gyratory unit weight, maximum theoretical unit weight, laboratory air voids and in-place air voids (compaction). Samples for referee testing shall come from representative samples obtained from the completed pavement, as directed by the Engineer.

The number of samples taken will be the same as specified in Section [321.10](#). The independent laboratory shall compile the test results and transmit them to both the Engineer and the contractor. The independent laboratory shall include a report sealed and signed by an Engineer registered in the State of Arizona, who is experienced in asphalt concrete testing and mix design development. The signed report shall give an opinion that the material evaluated does or does not comply with project specifications, shall clearly describe any deficiencies, and the results will be binding between all parties.

321.12 MEASUREMENT:

Asphalt concrete pavement will be measured by the ton, or by the square yard, for the mixture actually used as allowed above, which shall include the required quantities of mineral aggregates, asphalt binder, and mineral admixture. Measurement shall include any tonnage used to construct intersections, roadways, streets, or other miscellaneous surfaces indicated on the plans or as directed by the Engineer.

Measurement for safety edge preparation only applies to overlays of existing pavements that require the construction of a safety edge when none exists. Safety edge preparation will be measured by the linear foot. Safety edge preparation will not be measured when a safety edge is part of new pavement construction, pavement widening, or when overlaying an existing pavement that contains a safety edge. The asphalt concrete pavement measurement shall include the tonnage used to construct safety edges or the square yard measurement for asphalt concrete pavement will be increased by the horizontal extension of the safety edge beyond the roadway pavement edge.

321.13 PAYMENT:

The asphalt concrete measured as provided above will be paid for at the contract price per ton or square yard, as adjusted per Section [321.10](#), which price shall be full compensation for the item complete, as herein described and specified.

Payment for tack coat will be by the ton diluted, based on the rate of application, as directed by the Engineer.

No payment will be made for any overrun in quantity of asphalt concrete in excess of 10 percent for newly constructed pavement having a total thickness equal to or greater than 2.5 inches. The overrun quantity is excess tonnage above the tonnage calculated based on actual field measurement of area covered, design thickness, and the mix design unit weight. The calculations for overrun will be by individual pay item. To compensate or adjust for a thickness deficiency in an underlying asphalt concrete course, the Engineer may authorize a quantity increase in excess of 10 percent for a subsequent asphalt concrete course. In such cases, the quantity in excess of 10 percent will be paid for at the lowest unit price.

Removal of raised pavement markers, pavement repairs, and surface pavement replacements required prior to roadway overlay operations will be paid for by other pay items unless otherwise specified.

SECTION 321

Except as otherwise specified, no separate payment will be made for work necessary to construct thickened edges, safety edges, or other miscellaneous items or surfaces of asphalt concrete.

Payment for safety edge preparation will be at the contract unit price for the quantities measured as described above.

321.14 ASPHALT CORE METHOD: Core Drilling of Hot Mix Asphalt (HMA) for Specimens of 4" or 6" diameter

321.14.1 Scope: This method is to establish a consistent method of the use of a diamond bit core to recover specimens of 4 or 6 inch diameter for laboratory analysis and testing. The method will require the use of: water, ice (bagged or other suitable type), dry ice, and a water-soap solution to be utilized when coring asphalt rubber concrete. Individuals doing the specimen recovery should be observing all safety regulations from the equipment manufacturer as well as the required job site safety requirements for actions, and required personal protective equipment.

321.14.2 Core Drilling Device: The core drilling device will be powered by an electrical motor, or by an acceptable gasoline engine. Either device used shall be capable of applying enough effective rotational velocity to secure a drilled specimen. The specimen shall be cored perpendicularly to the surface of pavement, and that the sides of the core are cut in a manner to minimize sample distortion or damage. The machinery utilized for the procedure shall be on a mounted base, have a geared column and carriage that will permit the application of variable pressure to the core head and carriage throughout the entire drilling operation. The carriage and column apparatus shall be securely attached to the base of the apparatus; and the base will be secured with a mechanical fastener or held in place by the body weight of the operator. The core drilling apparatus shall be equipped with a water spindle to allow water to be introduced inside of the drill stem while operating. The cutting edge of the core drill bit shall be of hardened steel or other suitable material with embedded diamond chips in the cutting surface. The core barrel shall be of sufficient diameter to secure a specimen that is a minimum of four or six inches or whichever is prescribed for necessary testing. The core barrel shall not be missing more than one of the teeth used for cutting; if so it shall be discarded and another barrel shall be used. The core barrel shall also be a minimum of two inches longer than the anticipated depth of pavement in accordance with project paving plans.

321.14.3 Accessory Equipment: A sufficient supply of ice and dry ice shall be provided to sufficiently cool the pavement prior to securing the samples from the designated areas in the pavement. The ice should also be used to adjust the temperature of the water used to cool the core bit. A water supply (usually a plastic 35 – 55 gal drum) with sufficient hose to introduce the water into and through the spindle of the coring device by gravity feed. The drum should be white or light in color to minimize excessive thermal heating of the water (*for coring of asphalt rubber cores see Note 1*). At no time shall the water utilized in the coring operation exceed 65 degrees F during the coring operation. Ice shall be utilized to ensure the temperature control of the water being introduced during the cutting operation. An ice chest or other suitably insulated container that can maintain a temperature of less than 70 degrees F shall be used to secure the specimens during transport. The container will be equipped with flat shelving that will support the drilled cores throughout the entire specimen dimension during transport back to the testing facility.

Miscellaneous hand tools to remove the drilled specimen from the drill hole or the core barrel taking great care in not disturbing the specimen more than necessary (refer to fig. 1 in ASTM [D5361](#)).

321.14.4 Process: The pavement surface at the time of coring shall not exceed a temperature of 90 degrees F; the pavement shall be conditioned with ice or dry ice to ensure that this requirement is met. Immediately after it has been ensured that the pavement has dropped to the required temperature, core drilling shall begin. The operator will then apply an even and continuous pressure (Note 2) to penetrate through the full depth of the pavement. The operator will concurrently ensure that enough water is moving over the core surface as to adequately remove any and all cuttings that could damage the drilled core. After the pavement thickness has been penetrated the core shall be carefully removed from either the drill hole or the core barrel and be immediately transferred to an ice chest or other suitable container. Each individual core shall be placed on a shelf in the cooler with the exposed side of the specimen facing down, or the "top side" down. If the specimen is a two lift core, the only acceptable means of separating lifts is with a power or other acceptable wet saw type of equipment (conforming to ASTM [D5361](#)); however, at no time shall cores be split using a mallet and screwdriver or metal straight edge when being tested for bulk density. Perpendicularity of the specimen shall be checked in the field after the specimen has been extracted from the surface. The core operator shall hold the core up to eye level and place the core top side down in a "speed square" or small carpenter's square. The specimen placed in the square shall not depart from perpendicular to the axis more than 0.5° (approximately equivalent to 1/16 of an inch in 6 inches). If the specimen is outside of this distance from square it shall be discarded in the field and another sample cored that falls within tolerance. The cores upon arriving at the laboratory for testing shall be carefully cleaned and measured for thickness in accordance with ASTM [D3549](#). A speed square shall be utilized to

SECTION 321

measure perpendicularity as compared to a 90 degrees angle and shall not depart from perpendicular to the axis more than 0.5 degrees (approximately equivalent to 1/16 of an inch in 6 inches). All remaining testing shall be done within the parameters of the current project and/or agency required specification.

*Note 1 – It should be noted that when the material to be cored is a rubberized asphalt mixture a wetting agent such as liquid dish soap shall be added to the water barrel to hinder the material from sticking or allowing the binder to spread during coring.

*Note 2 – This refers to pressure exerted on the core barrel and machine during the coring process. Too much pressure can cause damage to the core barrel and the motor; and too little pressure can cause a glazing of the diamonds, reducing cutting efficiency and premature wear of the barrel.

-End of Section-

This Page is Reserved for Future Use

SECTION 322

DECORATIVE ASPHALT

322.1 GENERAL REQUIREMENTS:

Decorative asphalt is asphalt stamping that creates an imprinted surface pattern and/or installs color coatings to the surface of a newly constructed asphalt pavement. Mock ups may be required at the owner's discretion to ensure Contractor familiarity with product and installation procedures. Acceptance of colors and application procedures should be accepted in writing from the agency/owner prior to commencement of work. Payment for mock ups, if required in the contract documents, will be considered incidental to the stamping or coating item.

The Contractor shall submit for review and approval all manufacturer product and technical data for materials proposed to be installed. The Contractor shall submit for review and approval a sample of the stamped asphalt material prior to installation. These submittals shall be submitted to the Engineer.

322.2 MATERIALS:

All products used in the surfacing system shall meet the minimum physical and performance properties in Table [322-1](#). The Contractor shall submit a Certificate of Compliance to the Engineer indicating that the materials to be included in the work meet these specification requirements. The color used for painted asphalt shall be as per the contract documents or as approved by the Agency.

TABLE 322-1		
ASPHALT SURFACING SYSTEM PHYSICAL PROPERTIES		
CHARACTERISTIC	TEST SPECIFICATION	TEST RESULT – BASE
Solids by Volume (%)	ASTM D2697	68% Min
Solids by Weight (%)	ASTM D2369	78% Min
Density	ASTM D1475	13.7 lbs./gal Min
Dry-Time (To Recoat)	ASTM D5895	20 Min
Taber Wear Abrasion Dry H-10 Wheel	ASTM D4060 1 day cure	0.16 g/1000 cycles Max
Taber Wear Abrasion Wet H-10 Wheel	ASTM D4060 7 days cure	2.34 g/1000 cycles Max
QUV E Accel.	ASTM G154 Delta	0.53 Min
Hydrophobicity Water Absorption	ASTM D570	7.6% (9 Day Immersion) Max
Shore Hardness	ASTM D2240	67 Type D Min
Mandrel Blend	ASTM D522 -93A	1/4" @ 21 Degree C Pass Min
Permeance	ASTM D1653	3.77 g/m ² /hr. (52 mils) Max
VOC	Per MSDS	25 g/l Max
Adhesion to Asphalt	ASTM D4541	Substrate Failure
Friction Wet	ASTM E303 British Pendulum Tester	WP * Coated - 62 Min
		WP * Uncoated - 59 Min
		AC ** Coated - 70 Min
		AC ** Uncoated - 61 Min
Cure Time	Measured @ 77 Degrees Fahrenheit	Dry to touch – 20 Min Light Foot/Vehicle Traffic – 2-4 Hrs. Full Cure – 5 to 7 days

WP*= Wheel Path (Test conducted on asphalt pavement in wheel path.)

AC**= Adjacent to curb (Test conducted on asphalt pavement adjacent to curb.)

SECTION 322

322.3 INSTALLATION & SURFACE PATTERNING:

The patterning equipment shall be metal templates that shall correspond to the patterns shown in the project plans and specifications.

The Contractor shall obtain the Engineer's approval prior to beginning asphalt stamping.

When new asphalt is to be stamped, it shall have one overnight period to set prior to stamping for conventional mixes and ARAC mixes shall have 30 days to set prior to the stamping/coating process. Asphalt shall be fully compacted prior to positioning the patterning template and meet all the requirements set forth in Sections [321](#) or [325](#) as applicable.

For raised medians and other areas not subject to vehicular traffic, the surface course shall be at least 2-1/2" of 1/2" or 3/8" Marshall Low Traffic asphalt concrete mix in accordance with Section [710](#), or as approved by the engineer.

The asphalt to be stamped shall be uniformly heated using infrared technology to a temperature that shall not exceed 280 degrees Fahrenheit. Templates shall be set in place using a plate compactor and fully embedded into the asphalt.

The template imprint depth shall be 3/8" over 95% of the patterned area. Template print depth shall be inspected prior to coating to ensure compliance. All hand tooling shall be complete, full depth, aligned vertically, and shall extend to the edge of the asphalt pavement, common edge, concrete curb, gutter, or other border. There shall be no over print or shadowing of patterns and no remnants of excess print on surrounding unintended areas. Should overprinting or other imperfections occur, these areas shall be repaired by using the same process outlined in this section to return the asphalt to a smooth condition to that of the unstamped area(s).

322.3.1 Surfacing System (Painted Asphalt & Clear Coat Sealant): The air temperature shall be at least 45 degrees F and rising before the application of surface system products begins. There shall also be no precipitation expected within 24 hours of the anticipated surfacing completion. The surface shall be free from laitance, grease, deleterious oils, or any other foreign matter prior to placing any pavement coating.

The surfacing system products shall be spray-applied. Where required to cover small areas, the surfacing system may be applied using brooms or brushes. When complete, the entire asphalt surface shall be uniformly covered with the surfacing product with no exposed asphalt present.

The Contractor shall use sufficient masking to ensure that the surface system products are applied only where specified. Masking shall be complete and no overspray, or other imperfections, onto surfaces not designated as coated surfaces shall be allowed.

The Contractor shall apply the surface system products per the manufacturer's recommendations. After the colorant has had sufficient time to set, a clear coat sealant, if required, shall be applied per the manufacturer's recommendations.

Total thickness of the surfacing product shall be per the manufacturer's recommendations or greater including the sealant.

After the surfacing system products have been applied, the treated asphalt shall not be exposed to vehicular traffic for eight (8) hours, or per the manufacturer's recommendations.

322.4 MEASUREMENT:

Approved and accepted decorative asphalt installations shall be measured by the square foot for asphalt surface patterning with color coating or for asphalt surface color coating without surface patterning. The measurement for asphalt stamping specialty design shall be the number of approved and accepted installations of each specialty design. Asphalt coloring shall be measured by the square foot.

322.5 PAYMENT:

Payment for specialty designs, for asphalt surface patterning with color coating, and for asphalt surface color coating without surface patterning shall be at the contract unit price and shall be full compensation for furnishing all labor, material, tools, equipment and incidentals, and doing all work involved in the installation of asphalt stamping complete in place, in compliance with the contract documents.

SECTION 322

322.6 WARRANTY:

Asphalt color coating shall have a two year warranty from flaking, premature wearing and like defects. Color changes shall not be part of the warranty.

Warranty repair shall be at the expense of the Contractor. Areas that require recoating shall receive a light scuffing to remove the clear coat sealant prior to reapplication of the color coating and sealant.

- End of Section -

SECTION 324

PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

324.1 DESCRIPTION:

This item shall consist of construction of a pavement composed of plain jointed portland cement concrete on a prepared subgrade. The Contractor shall furnish all labor, materials and equipment necessary for the construction of the pavement in accordance with these specifications and in reasonably close conformity to the lines, grades, thicknesses and details indicated by the plans or as established by the Engineer. All tests shall be performed by a laboratory approved by the Engineer.

324.2 MATERIALS:

324.2.1 Portland Cement Concrete: Portland cement concrete shall conform to the applicable requirements of Section 725 and the additional requirements of this section.

Concrete shall comply with Table [725-1](#) for Class AA, 4000 psi unless otherwise specified by the Engineer.

The maximum concrete slump shall be as determined by the approved mix design in accordance with Section [725.9\(A\)\(1\)](#).

324.2.2 Reinforcement: Tie bars shall be deformed billet steel reinforcing bars conforming to the requirements of ASTM [A615](#), Grade 40.

Dowel or load transfer bars shall conform to the requirements of ASTM [A615](#), Grade 40. An approved support system shall be used to hold bars in position.

324.2.3 Curing Materials: Materials for curing concrete shall conform to the requirements of Section [726](#).

324.2.4 Joint Materials: Joint sealant shall be poured type, conforming to the requirements of Section [729.2](#) or as approved by the Engineer. Preformed expansion joint filler shall conform to the requirements Section [729.1](#) or as approved by the Engineer.

324.3 CONSTRUCTION METHODS:

324.3.1 General: Pavement shall be constructed with mechanical equipment utilizing stationary side forms or by the use of slipform paving equipment without stationary side forms. Manual methods of placing and finishing concrete with stationary side forms may be permitted by the Engineer for areas inaccessible for mechanical equipment.

All curb and gutter shall have the same class of concrete as the adjacent PCCP. Gutter sections shall have the same thickness as the PCCP section. All curbs or combined curb and gutter joints shall align with roadway joints.

324.3.2 Equipment: Design, capacity, and mechanical condition of equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer. Equipment shall be at the jobsite sufficiently ahead of the start of concrete paving operations to permit thorough examination and approval by the Engineer prior to start of concrete paving.

Equipment used to place concrete may consist of one or more machines, shall be capable of uniformly distributing and consolidating the concrete as it is placed without segregation and shall be capable of producing concrete pavement which will conform to the required cross-section with a minimum of hand work. The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to the concrete delivery rate.

Vibrators shall be used to consolidate concrete; the rate of vibration shall be not less than 3,500 cycles per minute for surface vibrators and not less than 8,000 cycles per minute for internal vibrators. Power to vibrators mounted on mechanical equipment shall be so connected that vibration ceases when forward or backward motion of the machine is stopped. Contractor shall furnish a tachometer or other suitable device for measuring and indicating the frequency of vibration.

Slipform pavers shall be equipped with high frequency internal vibrators mounted with axes either parallel or normal to pavement alignment for the full paving width. Vibrators mounted with axes parallel with pavement alignment shall be spaced at intervals not to exceed 24 inches, measured center-to-center. Vibrators mounted with axes normal to pavement alignment shall be spaced so that lateral clearance between individual vibrating units does not exceed 6 inches.

SECTION 324

Slipform paving equipment which will be wholly or partially supported on subgrade shall be equipped with traveling side forms of sufficient dimensions, shape and strength to support the concrete at free edges laterally for a sufficient length of time during placement to produce pavement of the required cross-section, and shall be equipped and operate with automatic sensing and control devices such that the machine automatically senses deviations from the established guideline and performs the necessary corrective maneuvers to overcome variations from correct grade and alignment.

When concrete will be placed adjacent to existing pavement or curb and gutter, that part of the equipment supported on the existing pavement or curb and gutter shall be equipped with protective pads on crawler tracks or rubber-tired wheels with bearing surfaces offset a sufficient distance from the edge of the pavement or curb and gutter to avoid edge damage, or the surface of the existing pavement or curb and gutter shall be otherwise protected against such damage in a manner approved by the Engineer.

324.3.3 Subgrade and Base Preparation: Subgrade and base shall conform to the applicable compaction requirements of Section [601](#) and elevation tolerances specified for the material involved, shall be kept smooth and compacted, and shall be free of all loose and extraneous material when concrete is placed.

The surface of the subgrade shall be uniformly moist when concrete is placed. The surface of the subgrade shall be moistened immediately prior to placement of concrete, if necessary to produce a uniformly moist condition. Any excess water standing in pools or flowing on the surface shall be removed prior to placing concrete.

324.3.4 Stationary Side Forms and Setting of Forms: Side form sections shall be straight, free from warps, bends, indentations or other defects. Side forms shall be of metal, have a base width of at least four inches and a minimum depth equal to the thickness of the pavement. No section shall show a variation from a true plane greater than 1/8 inch in ten feet on the top of the form or more than 1/4 inch in ten feet on the inside face. Flexible or curved forms of proper radius shall be used for curves of 100 feet radius or less. Suitable materials other than metal may be used to form end closures or at other locations where use of metal forms is not practical. Forms shall be thoroughly cleaned and oiled each time they are used.

Forms shall be of such cross section and strength and so secured and supported on the subgrade as to resist the pressure of the concrete when placed and the impact and vibration of any equipment they are to support without springing or settlement. The method of connection between sections shall be such that the joints shall not move in any direction.

Subgrade under forms shall be compacted and cut to grade so that the form when set will be uniformly supported for its entire length at the specified elevation. Forms shall be so supported and secured during the entire operation of placing and finishing that they will not deviate vertically at any point more than 1/8 inch from the proper elevation. Forms shall be set to the required lines and grades well in advance and for a distance sufficient to prevent delay in placing concrete, and shall be approved by the Engineer prior to placing concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

Side forms shall remain in place until the day after placing concrete, and in all cases until the edge of the pavement no longer requires the protection of the forms. Forms shall be carefully removed in such a manner as to avoid damage to the pavement. Use of pry bars between the pavement and the forms will not be permitted.

324.3.5 Placing, Spreading and Compacting: Construction equipment shall not operate on the subgrade in the paving lane when conditions of the job will permit operation from outside the lane. When job conditions make it necessary to operate equipment on the subgrade in the paving lane, suitable runways or other precautions shall be taken to prevent rutting or displacement of subgrade material. The grade shall be checked and corrected immediately ahead of concrete placement and all disturbed grade shall be properly recompact. Except when otherwise approved by the Engineer, concrete shall be deposited on the subgrade and spread full width using mechanical methods that result in minimal handling and segregation. Necessary hand spreading shall be done with shovels, not rakes. Placement shall be continuous between transverse joints without the use of intermediate bulkheads.

The Contractor shall make adequate advance arrangements for preventing delay in delivery and placing of concrete. An interval of more than 15 minutes between placing of any two consecutive batches shall constitute cause for stopping operations, and Contractor shall remove all concrete placed beyond the last scheduled joint or install a joint of the type and at the location as directed by the Engineer.

Concrete shall be deposited as near to expansion and construction joints as possible without disturbing them but shall not be dumped onto a joint assembly. Concrete shall be thoroughly consolidated against and along the faces of all forms, adjacent

SECTION 324

pavement or curb and gutter, and on both sides of all joint assemblies. Vibrators shall not be permitted to come in contact with joint assemblies, the grade, or side forms, and shall not be operated longer than 15 seconds in any one location.

Manual methods of placing, spreading, and compacting may be used in the construction of pavement lanes of irregular width or widths less than 10 feet, and sections of intersections or other locations with complex variable surface configurations when permitted by the Engineer. Workmen shall not be allowed to walk in the freshly placed concrete.

324.3.6 Shaping and Initial Finishing: Concrete shall be struck off, consolidated, and float-finished with a slipform paver, mechanical finishing machine, vibrating screed, or by hand finishing methods when approved by the Engineer so that the complete pavement will conform to the thickness and cross section requirements of the plans and specifications. When the pavement being constructed is contiguous to existing parallel concrete pavement or curb and gutter, the elevation of the new pavement surface shall conform as closely as possible to the elevation of the existing pavement or gutter surface in a manner which will prevent ponding. The difference in elevation shall not exceed 1/4 inch.

Water shall not be applied to the pavement surface during screeding and finishing operations in excess of the amount lost by evaporation. Adding water to the surface of the concrete to assist in finishing operations shall not be permitted. When applications of water to the surface are required to prevent rapid evaporation of water from the surface during finishing operations, it shall be applied as a fog spray and with approved spray equipment.

(A) Slipform Supported on Subgrade Method: When concrete pavement will be placed with slipform paving equipment which will be supported and operate on the subgrade, the subgrade and slipform paver track area shall be brought to proper grade and cross section by means of a properly designed and operated machine. The equipment shall spread, consolidate, screed and float-finish the concrete in one complete pass of the machine. The machine shall be operated with as nearly a continuous forward movement as possible and all paving operations shall be so coordinated as to provide uniform progress with stopping and starting of the paver held to a minimum. Sliding side forms shall be rigidly held together to prevent spreading. Any edge slump of the pavement, exclusive of edge rounding, in excess of 1/4 inch shall be corrected.

No abrupt changes in longitudinal alignment of the pavement will be permitted. The horizontal deviation shall not exceed one inch from the alignment established by the Engineer.

While concrete is being spread, compacted and shaped, vibrating units shall be operated within fresh concrete so that the longitudinal axis, at the center of each unit, is not more than 6 inches above the top of the subgrade. Amplitude of vibration shall be sufficient to be perceptible on the surface of concrete along the entire length of vibrating units and for a distance of at least one foot.

(B) Mechanical Equipment Supported on Fixed Form Method: When concrete is spread without the use of internal vibration, the finishing machine shall be equipped with vibrating equipment that will internally vibrate the concrete for the full paving width and with not less than two oscillating or reciprocating screeds. Concrete shall be struck off and consolidated so that the surface will conform to the finished grade and cross section shown on the project plans and with sufficient material on the surface for floating operations.

After the concrete has been struck off and consolidated, it shall be floated with a longitudinal float of a type approved by the Engineer.

A slipform paver or a single machine which will effectively spread, consolidate, screed, and float in one operation may be used in lieu of separate finishing and floating equipment.

(C) Manual Methods with Fixed Forms: Concrete shall be deposited, spread and struck off to such an elevation that, when properly consolidated, the surface will conform to the required lines and grades. Concrete shall be consolidated by internal vibration as it is struck off with a screed. A slight excess of concrete shall be kept in front of the screed at all times during the strike-off operation.

After consolidation and screeding, concrete shall be tamped to the proper surface elevation and cross section using either a heavy plank with a length in excess of the width of pavement being placed by one foot or more, or with a mechanical vibrating unit spanning the full width between forms. The tamping plank, if used, shall be stiffened as necessary to prevent sag and shall have the lower tamping edge shod with metal. The tamping plank shall be moved forward with a combined vertical tamping and longitudinal screeding motion so that the concrete will be thoroughly consolidated and the surface screeded to the required elevation. A small surplus of concrete shall be kept in front of the tamper or vibrating unit.

SECTION 324

Tamping or vibrating shall continue until the specified cross section is obtained and the mortar flushed slightly to the surface. On grades in excess of 5 percent a second strike board shall follow from 25 to 50 feet behind the tamper or vibrating unit and shall be used in the same manner to remove waves caused by the flow of concrete behind the first strike board.

Methods other than the tamping plank may be utilized for screeding when approved by the Engineer.

Pavement shall be finished smooth and true to grade with suitable manually operated floats or powered finishing equipment.

324.3.7 Final Finishing: After the pavement has been float-finished, it shall be scraped with a 10-foot long straightedge equipped with a handle to permit operations from the edge of the pavement, and excess water and laitance shall be removed from the surface. The straightedge shall be operated parallel to the centerline of the pavement and shall be moved forward one-half length after each pass. Irregularities shall be corrected by adding or removing concrete, and disturbed places shall be again straight-edged.

Long-handled floats shall be used only in areas not accessible to finishing equipment and in emergencies, and use of such floats shall be confined to a minimum.

The addition of water to the surface of the concrete to assist in finishing operations shall not be permitted unless approved by the Engineer. When the evaporation rate on the concrete surface exceeds the rate of bleeding of the concrete, measures shall be taken to prevent the rapid evaporation of water from the surface during finishing operations. When allowed by the Engineer, the addition of water to the surface may be permitted when applied as a fog spray with approved spray equipment immediately after screeding and/or between finishing operations. A commercial evaporation reducer that forms a monomolecular film may also be sprayed onto the concrete surface in accordance with the Manufacturer's recommendations. When either of these methods is approved and used it does not take the place of proper curing methods per Section [324.3.8](#).

Pavement edges and joints shall be edged in accordance with details shown on the project plans or as directed by the Engineer.

In advance of curing operations, pavement shall be textured. Texturing shall be performed with an artificial turf drag with a board added to assure the weight needed to obtain an approved surface. Artificial turf shall be a molded composite structure with polyethylene face, nylon and polyester backing, a pile height of 0.85 inches, and total weight of 75 oz./sq. yd. The surface obtained during initial surface texturing shall be subject to approval by the Engineer. The texturing approved on the initial construction shall not be changed without the Engineer's approval. Each time the construction is stopped or causes the texturing to stop, the artificial turf must be shaken clean before continuing.

324.3.8 Curing: Curing shall begin immediately following surface texturing and edging. Before concrete placement begins, Contractor shall have at hand and ready to install the materials and equipment needed for adequate curing.

After finishing operations have been completed, the newly placed concrete shall be cured by moist curing methods, by application of a white pigmented liquid membrane compound conforming to the requirements of Section [726](#), or by a combination of these methods. All surfaces not covered by reasonably waterproof forms shall be kept damp by applying water with a nozzle that so atomizes the flow of water that a fog mist and not a spray is formed until the surface is covered with liquid membrane compound, the surface has hardened sufficiently to permit sprinkling of the surface, or moist curing by covering with wet burlap or other approved materials can be initiated. Moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow and erode the surface. Moist curing shall be continued until liquid membrane curing compound or other type of curing membrane is applied.

Membrane curing compound shall be applied to all pavement by automatic mechanical method from a construction bridge.

The edges of concrete slabs exposed by the removal of forms shall be protected immediately to provide these exposed surfaces with continuous curing treatment equal to the method selected for curing the pavement surface.

The membrane method of curing may be applied behind the final finishing operation after all free water has disappeared from the surface. Complete and uniform coverage at the rate of one gallon per 100 square feet, or as otherwise recommended by the manufacturer, shall be required. Compound shall be kept agitated to prevent pigment from settling.

324.3.9 Joints: Joints shall be provided in the pavement of the type, dimensions and at the locations as indicated in the plans or as specified herein.

SECTION 324

Joints in concrete pavement will be designated as transverse expansion joints, longitudinal or transverse construction joints, longitudinal or transverse weakened plane joints, or isolation joints. The faces of all joints shall be perpendicular to the pavement surface. Joints shall be constructed in accordance with the details shown or referenced in the plans and in accordance with the following provisions.

At all times prior to acceptance of the construction, joints shall be maintained clean and free of soil, gravel, and other foreign material except approved types of joint filler materials.

(A) Longitudinal Joints: Longitudinal joints shall be weakened plane or construction joints. Longitudinal weakened plane joints shall be constructed by sawing or by insertion of a parting strip in the plastic concrete to be left in place. Longitudinal construction joints shall be constructed with tie bars or keyways as indicated in the plans.

(B) Transverse Joints: Transverse joints shall be weakened plane, construction or expansion joints. All transverse weakened plane joints will be constructed by sawing and in accordance with the details shown in the project plans. Transverse construction joints shall be constructed in accordance with the details shown or referenced in the project plans. Transverse expansion joints shall be constructed in accordance with the details shown or referenced in the project plans.

Dowel bars when required shall be supported with an approved support system.

(C) Joint Location: Longitudinal and transverse joints shall be constructed at locations as indicated in the project plans.

Isolation joints shall be provided around manholes, catch basins, or other elements which extend into or project through the pavement and act as point of restraint to horizontal or vertical movement of the pavement. Isolation joints shall be located in accordance with Detail 224 or as directed by the Engineer.

324.3.9.1 Construction of Joints:

(A) Sawed Joints: Sawed joints shall be constructed by cutting a groove in the pavement using a single or multiple-blade power saw. The groove shall be cut to the dimensions shown on the project plans. Suitable guidelines or devices shall be used to ensure joints are cut true to the lines as shown on the project plans.

If joints are sawed in stages, the initial saw cut shall be of the minimum width specified and sawed to the required depth. The depth of the initial saw cut in the construction of weakened plane joints shall be a minimum of 1/4 of slab thickness.

Sawing of weakened plane joints shall be done before uncontrolled cracking takes place, and after the concrete has hardened to the extent that tearing or raveling of the edges of the saw cut is not excessive. The exact time for all sawing shall be determined by the Contractor when not otherwise specified.

Any procedure for sawing joints that result in premature, uncontrolled cracking shall be revised immediately. The Contractor shall be responsible for replacing or repairing areas containing uncontrolled cracking and for repairing spalled or chipped concrete along the edges of sawed joints to the satisfaction of the Engineer.

After saw cutting of the joint and just prior to sealing the joint, the internal joint surfaces shall be cleaned of all dirt, curing compound residue, laitance and other foreign materials. The internal joint surface shall be defined as the sawed portion of the joint and the resultant crack for the full depth of the pavement.

Sealing of sawed joints where required shall be completed prior to the opening of the pavement to traffic unless otherwise approved by the Engineer. When delayed sealing of sawed joints is permitted, saw cuts and formed recess to be filled with sealant shall be protected to ensure thorough curing of the concrete along the edges of the joint recesses and to prevent entry of foreign materials into the joint. At the Contractor's option, inert compressible joint filler material such as plastic backer rod or upholstery cord may be inserted into joints immediately after sawing or forming of the joint recess to provide curing protection and prevent entry of foreign material. If absorptive filler material is used, it shall be thoroughly moistened either before or immediately after installation in the sawed groove. When filler material is rope, or similar material which does not fill the entire depth of sawed groove, it shall be depressed not less than 1/2 inch below the pavement surface before the pavement is opened to traffic.

(B) Expansion and Construction Joints: Longitudinal and transverse expansion and construction joints shall be as required by the project plans.

SECTION 324

(C) Isolation Joints: Isolation joints unless otherwise detailed in construction documents shall be 1/2 inch wide expansion joints in accordance with Detail 224 or as directed by the Engineer.

(D) Sealing of Joints: Sealant shall be applied in accordance with the sealant manufacturer's recommendations. A primer shall be furnished and applied after the joint has been cleaned and prepared to receive sealant when indicated in the manufacturer's recommendations.

Prior to the application of the sealant, an approved type of inert, compressible joint filler material such as plastic backer rod or upholstery cord, or an approved type of bond breaker, shall be inserted along the joint in accordance with the details shown on the project plans. The joint shall then be filled with sealant to a level not less than 1/8 inch or more than 1/4 inch below the elevation of the pavement surface adjacent to the joint edge.

The equipment used to apply sealant shall be as recommended by the sealant manufacturer. Sealant shall not be spilled on the surface of the concrete pavement, and Contractor shall remove any sealant inadvertently spilled on the pavement surface.

(E) Repair of Cracks, Spalls, Raveling and Tearing: Contractor shall be responsible for replacing or repairing all areas of pavement containing uncontrolled cracking, surface spalls, or other types of surface. Repairs when authorized shall be made and completed by methods acceptable to the Engineer.

324.4 TESTS OF FINISHED PAVEMENT:

324.4.1 Smoothness: The pavement surface including pavement in intersections will be tested with a ten-foot straight-edge placed parallel to the centerline of the pavement in each lane. Ordinates measured from the face of the straight-edge to pavement surface shall at no place exceed one-quarter inch. Areas that do not meet the required surface accuracy as determined by straight-edge testing shall be marked, and Contractor shall at his own expense and as required by the Engineer either:

- (1) Grind down areas higher than 1/4 inch but not more than 1/2 inch above the correct surface.
- (2) Correct areas lower than 1/4 inch but not lower than 1/2 inch below the correct surface by grinding down the adjacent areas.
- (3) Remove and replace pavement when the deviation exceeds 1/2 inch from the correct surface. Area replaced shall be of a length, width and depth as required to allow formation of a new slab of the required quality. The area replaced shall be compatible with the joint layout shown on the project plans as determined by the Engineer.

After grinding, the finished surface of the ground area shall be provided with a uniform texture acceptable to the Engineer. The method of texturing shall be approved by the Engineer.

324.4.2 Pavement Thickness: Concrete pavement shall be constructed in accordance with the thickness requirements of the plans and specifications. Tolerances for base and subgrade construction and other provisions of these specifications which may affect thickness shall not be construed to modify such thickness requirements.

Pavement thickness testing shall begin after achieving pavement smoothness compliance. For the purpose of determining acceptability for thickness, cores shall be drilled by the Contractor at the locations specified by the Engineer. Cores shall have a minimum diameter of four inches. Length of cores will be determined in accordance with the requirements of AASHTO T-148.

In calculating average length, cores which have a length in excess of the thickness specified by more than 0.25 of an inch will be deemed to have a length of the specified thickness plus 0.25 of an inch. Field length measurements will be acceptable in lieu of average length measurement in accordance with the requirements of AASHTO T-148, provided the original core in any secondary unit meets or exceeds the specified thickness. Measurements in accordance with the requirements of AASHTO T-148 will be required on any questionable thickness measurements and on the three cores used to determine the average length for payment, regardless of length.

A primary unit of pavement shall be the area of pavement placed in each day's paving operation. Each intersection or special section shall be considered as a primary unit.

Revised 2015

SECTION 324

A secondary unit of pavement shall consist of 1,000 linear feet, or fraction thereof, of each traffic lane. Each 1,300 square yards of pavement in intersections, etc., shall be considered a secondary unit regardless of when the concrete was placed.

One core shall be drilled in each secondary unit. If the length of that core is not deficient by more than 0.25 of an inch, that secondary unit will be measured for payment at 100 percent. If the length of that core is deficient by more than 0.25 of an inch but less than 1.0 inch, two additional cores shall be drilled within that secondary unit and the length of the three cores averaged. If the average length is not deficient by more than 0.25 of an inch, that secondary unit will be measured for payment at 100 percent. If the average length of the three cores is deficient by more than 0.25 of an inch, that secondary unit will be measured for payment in accordance with the requirements of Table [324-1](#).

If the core in the secondary unit is deficient by more than 1.00 inch, that core will not be used in determining the average thickness of that secondary unit. Additional cores shall be drilled at intervals not to exceed ten feet in each direction from the deficient core, parallel to the main-line centerline, until one core is obtained in each direction which is not deficient by more than 1.00 inch. The pavement between these two cores will be evaluated separately from the balance of the pavement in that secondary unit. The limits for evaluation shall be between the longitudinal weakened plane or construction joint on each side of the core and between the next transverse weakened plane, construction, or expansion joint beyond each of the last two cores. Unless the Engineer allows the pavement to remain, it shall be removed and replaced with pavement of the specified thickness and no payment will be made for the removed pavement.

If the pavement in the deficient area is removed, either by the order of the Engineer or at the option of the Contractor, it shall be removed between the limits of the evaluation. After the pavement has been replaced, one core shall be drilled at random in that secondary unit after deducting the area of the replaced pavement and one core shall be drilled in the new pavement. Pavement represented by the core drilled in the secondary unit, less the replaced pavement, will be measured for payment as hereinbefore specified. The core drilled in the replaced pavement shall be not less than the specified thickness; otherwise that pavement will not be measured or paid for.

At all locations where cores have been drilled, the resulting holes shall be filled with concrete in a manner satisfactory to the Engineer.

324.5 PROTECTION OF PAVEMENT:

The Contractor shall be responsible for taking adequate steps to protect concrete placed during rain, or hot or cold weather as defined in ACI Standards. Any concrete damaged by rain or extreme temperatures shall be removed and replaced at the Contractor's expense.

When ordered by the Engineer, pavement crossings shall be constructed for the convenience of public traffic. Where motor vehicles are encountered, a temporary bridge to span the newly placed concrete will be provided.

No traffic or Contractor's equipment, except as hereinafter provided, will be permitted on the pavement until the concrete has developed a compressive strength of 3500 psi.

Equipment for sawing joints will be permitted on the pavement when, in the Contractor's judgment, the concrete has developed sufficient strength to support the equipment without damage to the concrete. In case of visible cracking or other damage to the pavement, operation of the equipment on the pavement shall be immediately discontinued.

Any damage to the pavement resulting from early use of pavement by the Contractor's equipment shall be repaired by the Contractor at his expense.

324.6 METHOD OF MEASUREMENT:

Portland Cement Concrete Pavement will be measured by the square yard. Any opening in excess of one square yard will not be measured for payment.

324.7 BASIS OF PAYMENT:

The accepted quantities of Portland Cement Concrete Pavement, measured as provided for herein, will be paid for at the contract unit price complete in place, except that where the average length of cores indicates pavement deficient in thickness by more than 0.25 of an inch but not more than 1.00 inch, payment will be made as specified in Table [324-1](#). Payment will be made to the nearest cent.

SECTION 324

No additional payment will be allowed for pavement constructed in excess of the thickness specified on the project plans.

TABLE 324-1	
PAVEMENT THICKNESS PAYMENT REDUCTION (PCCP)	
Core Thickness, Less Than Specified Thickness, Inches	Percent of Contract Unit Price Allowed
0.00 to 0.25	100
0.26 to 0.35	93
0.36 to 0.45	85
0.46 to 0.55	75
0.56 to 0.75	63
0.76 to 1.00	50

End of Section -

SECTION 325

PLACEMENT AND CONSTRUCTION OF ASPHALT-RUBBER ASPHALT CONCRETE

325.1 DESCRIPTION:

Asphalt-rubber asphalt concrete (ARAC) consists of supplying, placing and compaction of plant-mixed, gap-graded ARAC over asphalt surfaces. The thickness of the finished ARAC overlay shall be within the range of one to two inches as shown on the plans or as specified in the special provisions.

325.2 MATERIALS:

ARAC shall consist of a mixture of aggregate, mineral admixture and asphalt-rubber binder (ARB) as specified in Section [717](#).

325.2.1 Mixing of Asphalt-Rubber Binder: Mixing of asphalt-rubber binder (ARB) may take place in a dedicated blending and storage unit connected to the hot plant or at the asphalt binder supplier's facility. In either case, the temperature of the asphalt cement shall be between 375° F and 425° F prior to the addition of crumb rubber. No agglomerations of crumb rubber particles in excess of 2 inches in the least dimension shall be allowed in the mixing chamber. The crumb rubber and asphalt cement shall be accurately proportioned in accordance with the ARB design as identified in [717.2.14](#) and thoroughly mixed prior to the beginning of the one hour reaction period. Reaction time may be decreased to 45-minutes if documentation is provided that the physical properties of the mix design requirements are consistently met using a 45-minute reaction period. The Contractor or supplier shall document that the proportions are accurate and that the crumb rubber has been uniformly incorporated into the mixture. Additionally, the Contractor or supplier shall demonstrate that the crumb rubber particles have been thoroughly mixed into the base asphalt cement. The occurrence of crumb rubber floating on the surface or agglomerations of crumb rubber particles shall be evidence of insufficient mixing. The temperature of the ARB immediately after mixing shall be between 350° F and 400° F. Reaction time shall start after all of the material for the batch has been mixed and the minimum reaction temperature of 350° F has been achieved.

Prior to use, the viscosity of the ARB shall be tested by the use of a rotational viscometer, which is to be furnished by the Contractor or supplier. The Contractor or supplier shall provide a qualified person to perform the testing.

325.2.2 Handling of ARB: Once the ARB has been mixed, it shall be kept thoroughly agitated during periods transport and use to prevent settling of the crumb rubber particles. During the production of ARAC the temperature of the ARB shall be maintained between 325° F (163°C) and 400° F (204°C). However, in no case shall the ARB be held for more than 10 hours at these temperatures. It may be allowed to cool to a temperature of 250° F (121°C) or lower and held at that temperature for not more than four days. The process of cooling and reheating shall not be allowed more than one time for a batch of ARB.

For each load or batch of ARB, the Contractor or supplier shall provide the Engineer with the following documentation:

- (A) The source, grade, amount and temperature of the asphalt cement prior to the addition of crumb rubber.
- (B) The source, type and amount of crumb rubber and the rubber content expressed as percent by the weight of total ARB.
- (C) Times and dates of the crumb rubber additions, resultant viscosity test, and the elapsed reaction time at which the viscosity test was taken.
- (D) A record of the temperature, with time and date reference for each load or batch. The record shall begin at the time of the addition of crumb rubber and continue until the load or batch is completely used. Readings and recordings shall be made at every temperature change in excess of 20° F, and as needed to document other events which are significant to batch use and quality.

325.3 WEATHER AND MOISTURE CONDITIONS:

ARAC shall be placed only when the surface is dry, and when the atmospheric temperature in the shade is 55° F or higher. No ARAC shall be placed when the weather is foggy or rainy. ARAC shall be placed only when the Engineer determines that weather conditions are suitable.

SECTION 325

325.4 APPLICATION OF TACK COAT:

A tack coat shall be applied to all existing and to each new course of ARAC prior to the placing of a succeeding lift of ARAC. The tack coat may be deleted when a succeeding layer of ARAC is being applied over a freshly laid course that has been subjected to very little traffic when approved by the Engineer.

The application of the tack coat shall comply with Section [329](#). The grade of emulsified asphalt shall be SS-1h or CSS-1h as specified in Section [713](#).

The same material that is specified above for the tack coat shall be applied to the vertical surfaces of existing pavements, curbs, and gutters, against which asphalt concrete is to be placed.

The surface to be covered may require repair or patching as directed by the Engineer. This shall be addressed in the project specifications prior to the bidding of the project.

325.5 MIX PRODUCTION:

All materials shall be proportioned by weight in a hot mix asphalt plant in the proportions required by the mix design to provide a homogeneous and workable mass. Each hot mix asphalt plant shall be inspected in accordance with the provisions contained in the 'Hot Mix Asphalt Production Facilities' by the Arizona Rock Products Association and shall have a current inspection certificate. All measuring devices shall be calibrated at least annually by a technician licensed by the Arizona Bureau of Weights & Measures. Mixing plants shall conform to the requirements of AASHTO M-156, except as modified herein.

In drum mix plants the mineral admixture shall be added and thoroughly mixed with the mineral aggregate by means of a mechanical mixing device prior to the mineral aggregate and mineral admixture entering the dryer. The moisture content of the combined mineral aggregate shall be a minimum of three percent by weight of the aggregate during the mixing process.

For drum-mix plants, the mineral admixture shall be weighed across a weigh belt, or other approved alternative weighing system, with a weight totalizer prior to entry into the mechanical mixing device. The mechanical mixing device shall be a pugmill type mixer that is in good working condition. The rate of the aggregate feed shall not exceed the mixing device's capacity in ton per hour. The mixer shall be constructed to minimize the loss of mineral admixture and shall be located in the aggregate delivery system at a location where the mixed material can be readily inspected. The mixing device shall be capable of effective mixing in the full range of the ARAC production rates.

The hot plant and equipment shall be constructed and operated to prevent loss of mineral admixture through the dust collection system of the plant.

A positive signal system shall be provided and utilized during production whereby the mixing shall automatically be stopped if the mineral admixture is not introduced into the mineral aggregate. The plant will not be permitted to operate unless the signal system is in good working condition.

The introduction of ARB shall be controlled by an automated system fully integrated with the controls for the mineral aggregate and mineral admixture. The production of the plant shall be controlled by the rate required to obtain a uniform mixture of all components. Drying and heating shall be accomplished in such a manner as to preclude the aggregate or mineral admixture from becoming coated with un-spent fuel. The completed ARAC may be held in storage for up to 12 hours in insulated or heated silos, providing the minimum temperature noted herein for placement and compaction is met behind the placement device. If the Engineer determines that there is an excessive amount of heat, heat loss, drain down, segregation and/or oxidation of the mixture due to temporary storage, use of surge bins or storage bins will be discontinued.

The temperature of the ARAC, with unmodified binders, upon discharge from the mixer shall not exceed 350° F. The discharge temperature may be increased, when approved by the Engineer. If the ARAC is discharged from the mixer into a hopper, the hopper shall be constructed so that segregation of the ARAC will be minimized.

SECTION 325

325.6 TRANSPORTATION:

Petroleum distillates or other substances that will have a detrimental effect on the asphalt concrete shall not be used as a release agent.

The beds of all transportation units shall be clean and smooth to allow the free flow of material into the paving machine's hopper.

Tarpaulins shall be furnished on all trucks and used when weather condition warrant, or if directed by the Engineer.

325.7 PLACEMENT:

325.7.1 Surface Preparation:

The provisions for preparation of pavement surfaces in Section [321.8.6](#) (Asphalt Concrete Overlay) shall apply to ARAC overlays. Placement compaction, and surface smoothness shall be as specified in this section.

After surfaces have been prepared to the satisfaction of the Engineer, they shall receive a tack coat as specified in Section [325.4](#).

Traffic will not be permitted over surfaces which have received a tack coat. When the overlay is to extend onto a concrete surface, the concrete surface shall be thoroughly cleaned of loose dust and cement particles and shall be tack coated.

325.7.2 Placing and Construction Methods:

All courses of ARAC shall be placed and finished by means of a self-propelled paving machine equipped with an automatically actuated control system, except under certain conditions or at locations where the Engineer deems the use of a self-propelled paving machine impracticable. Safety edge construction, when required, shall comply with Section [321.8.9](#).

The control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other end indirectly either through controlling the transverse slope or alternatively when directed, by controlling the elevation of each end independently.

The control system shall be capable of working with one of the following devices:

- (A) Ski or non-contact device of not less than 30 feet in length, supported throughout its entire length
- (B) Taut stringline or wire set to grade
- (C) Short ski or sonar sensing units from curb control
- (D) Joint matching shoe

Failure of the control system to function properly shall be cause for the suspension of asphalt concrete production. In order to achieve a continuous operation, the speed of the paving machine shall be coordinated with the hot mix plant and transport units.

The ARAC shall be dumped from the hauling vehicles directly into the paving machine, unless otherwise approved by the Engineer.

Care shall be taken to avoid jarring the machine or moving it out of alignment. No vertical load shall be exerted on the paving machine by the truck.

SECTION 325

If ARAC is dumped upon the surface being paved and subsequently loaded in the paving machine, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the ARAC shall be picked up and loaded into the paving machine. If ARAC is placed in a windrow during paving, the windrow shall not exceed a distance greater than 150 feet in front of the paving machine.

Self-propelled paving machines shall spread the mixture without segregation or tearing, true to line, grade and crown as indicated on the project plans. Pavers shall be equipped with hoppers and augers that will distribute the mixture uniformly in front of an adjustable floating screed. The raising of the hopper wings shall be minimized and the paving machine shall not be operated when in an empty condition.

Screeds shall include any strike-off device operated by tamping or vibrating action which is effective, without tearing, shoving or gouging the mixture and which produces a course with a uniform texture and density for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required. In the case of the screed, auger extensions and vibrators shall be installed wherever the screed is extended more than one (1) foot beyond the end of the base auger or auger extension. However, when placing material against an extremely uneven curb or edge over a short distance, the Engineer may waive the auger extensions and vibrators.

325.7.3 Compaction: It is the contractor's responsibility to perform any desired Quality Control monitoring and/or testing during compaction operations to achieve the required compaction. The temperature of the ARAC immediately behind the laydown machine shall be at least 275° F. A probe type electronic thermometer with a current calibration sticker attached will be used to measure the temperature of the asphalt concrete mixture. When measuring the temperature of the mat, the probe shall be inserted at mid-depth and as horizontal as possible to the mat. When the pavement lift is less than 1.5-inches, the temperature of the material shall be measured in the truck by inserting a calibrated probe type electronic thermometer, or other approved measuring device, to a point at least 6" below the surface of material.

Asphalt compaction equipment shall be of sufficient size and weight to accomplish the required compaction. All compaction equipment shall be operated and maintained in accordance with the manufacturer's recommendations and the project requirements. Pneumatic tired compactors shall not be used.

The Engineer will determine the acceptability of the pavement compaction in accordance with Section [325.9](#). At any place not accessible to the roller, the mixture shall be thoroughly compacted with tampers to provide a uniform and smooth layer over the entire area compacted in this manner.

325.7.4 Lime Water: An application of lime water shall be applied by the Contractor to the compacted ARAC surface after final compaction, prior to opening the roadway to traffic, or when requested by the Engineer to cool the pavement to prevent tracking and pick-up. The lime water solution shall be applied at the rate of approximately ½ gallon/square yard. The lime shall be mixed using a minimum of one (1) 50-pound bag per 3,000 gallons of water.

325.7.5 Adjustments: After installation of an overlay course all necessary frame and cover adjustments for manholes, valve boxes, survey monuments, sewer clean-outs, etc., shall be completed by the Contractor within the given segments being surfaced.

On roads without curb and gutter, the existing shoulder elevation shall be adjusted by the Contractor to match the elevation at the edge of new overlay and slope away from the new pavement surface at a rate that the existing quantity of shoulder material will allow. Shoulder material includes the existing shoulder, millings, untreated base materials, or a granular material approved by the Engineer. Shoulder material shall be compacted to a minimum of 95% of maximum density, determined in accordance with Section [301.3](#).

325.8 QUALITY CONTROL:

It is the contractor's responsibility to perform Quality Control monitoring and/or testing during ARAC production to achieve the required compaction and the required mix properties. The Engineer may obtain samples of any portion of any material at any point of the operations for his own use. Also, the Engineer may order that the use of any drying, proportioning or mixing equipment or the handling of any material be discontinued which, in his/her opinion, fails to produce a satisfactory mixture.

The ARAC produced shall conform to the requirements of the production tolerances established in Section [325.9](#). When the ARAC does not conform to the production tolerances, it shall be reported to the Engineer, and corrective quality control

SECTION 325

measures shall be implemented, or production shall cease immediately at no additional cost to the contracting Agency or Engineer.

325.9 ACCEPTANCE:

325.9.1 Acceptance Criteria: The ARAC will be divided into lots for the purpose of acceptance. A lot shall be one day's production. Each lot shall be divided into sublots of 500 tons or fraction thereof. Tests used to determine acceptance will be performed by a laboratory accredited by the AASHTO Accreditation Program (AAP), for the tests being performed. The contracting agency shall provide an appropriately accredited laboratory or laboratories to perform the acceptance testing. The acceptance laboratory will take representative samples of the ARAC from each subplot to allow for determination of gradation, binder content, and air voids. Each subplot will be accepted based on the test data from the sample(s) from that subplot. All acceptance samples shall be taken using random locations or times designated by the Engineer in accordance with ASTM [D3665](#). The laboratory shall use properly certified technicians in accordance with ASTM [D3666](#), Section 7 (Personnel Qualifications).

325.9.2 Gradation and Binder Content: Acceptance testing for gradation and binder content will be performed in one of the following ways; A) Plant-based testing of the mineral aggregate and binder content using cold feed samples and a nuclear asphalt content gauge or B) End-product testing of the ARAC using an ignition furnace with the gradation being performed on the resulting aggregate. The specifics of these methods are detailed in the following subsections.

During production, the allowable deviations from the mix design gradation targets are listed in Table [325-1](#) below. The allowable production tolerances may fall outside of the mix design gradation bands.

TABLE 325-1		
GRADATION ACCEPTANCE LIMITS FOR ASPHALT-RUBBER MIXES		
Sieve Size	1" & 1 1/2" Lift Thickness	2" Lift Thickness
1 inch	100%	100%
3/4 inch	100%	92-100%
1/2 inch	92-100%	±6%
3/8 inch	±6%	±6%
No. 4	±6%	±6%
No. 8	±6%	±6%
No. 30	±4%	±4%
No. 200	±2%	±2%

325.9.2.1 Plant-Based Sampling and Testing

325.9.2.1.1 Mineral Aggregate Gradation: The acceptance laboratory will take a sample of the mineral aggregate in accordance with the requirements of Arizona Test Method 105 on a random basis for each subplot. For batch plants, the sample shall be taken from the hot bins. For plants other than batch plants, the sample shall be taken from the cold feed belt. Samples will be taken by means of a sampling device which is capable of obtaining representative samples. The device, which shall be approved by the Engineer, shall be furnished by the contractor. In any shift that the production of ARAC is less than 500 tons, at least one sample will be taken.

Samples will be tested for conformance with the mix design gradation, with or without mineral admixture as appropriate, in accordance with the requirements of Arizona Test Method 201. If the results from a single acceptance sample fall outside of the acceptance limits in Table [325-1](#) a second sample shall be taken and if the second acceptance sample is also outside of the acceptance limits in Table [325-1](#) the Contractor shall cease production of asphalt concrete. Production shall not begin again until calibration test results verify that adjustments made to materials or proportions yield a gradation that falls within acceptance limits in Table [325-1](#).

325.9.2.1.2 Binder Content: During production of ARAC, the contractor shall maintain at the plant site a nuclear asphalt content gauge calibrated and operated in accordance with Arizona Test Method 421. At the discretion of the Engineer, the

SECTION 325

Owner may choose to prepare the calibration samples for use by the contractor. Under the observation of the Engineer, the contractor shall determine the ARB content by means of the nuclear asphalt content gauge a minimum of four times per full shift. The Engineer shall determine the times that the samples are taken. The contractor's technicians performing the testing, including the calibration of the nuclear gauge, shall meet the technician requirements given in the Arizona Department of Transportation (ADOT) System for the Evaluation of Testing Laboratories. The requirements may be obtained from ADOT Materials Group, 1221 North 21st Avenue, Phoenix, AZ 85009.

Production of ARAC shall cease immediately and the plant and/or the nuclear asphalt content gauges re-calibrated if any single test result varies by an amount greater than $\pm 0.60\%$, or the average of three consecutive test results varies by an amount greater than $\pm 0.40\%$, from the mix design target. Material that has already been produced may be used on the project if the single test value representative of that material varies by an amount from $\pm 0.61\%$ to $\pm 0.75\%$, inclusive, from the mix design target. Material that has already been produced may not be used on the project if the single test value representative of that material varies by an amount greater than $\pm 0.75\%$ from the mix design target unless, by retesting, the material is found to be acceptable.

When there is cause to question the ARB content being obtained via nuclear asphalt content gauge, or if approved by the Engineer, the ARB content may be determined using inventory data provided by the supplier as detailed in the following paragraphs. This will only apply for plants providing ARAC exclusively for the subject project or if an asphalt cement tank is dedicated for the shift of ARAC production.

The determination of the actual ARB content by inventory methods may include weighing of asphalt cement deliveries, invoice quantities, volumetric tank measurements using a calibrated rod (tank stickings) corrected for temperature, computerized mass-flow meter, and accounting for wasted materials. If a computerized mass-flow meter is used, documentation of its calibration shall be submitted to the Engineer prior to ARAC production. At any time during ARAC production, the Engineer may require that a new calibration of the mass-flow meter be performed.

If there is a difference of greater than 0.2% ARB between the ARB content measured by nuclear asphalt content gauge testing and the actual ARB content as determined by inventory, the contractor may request that the ARB content be determined by inventory. The contractor must make such a request in writing within two working days after receiving the test results for the first day of ARAC production.

325.9.2.2 End Product Sampling and Testing

325.9.2.2.1 Mineral Aggregate Gradation and Binder Content: The acceptance laboratory will take a sample of the asphalt concrete in accordance with the requirements of Section 2 or 4 of Arizona Test Methods 104 or AASHTO T-168 from each subplot. The minimum weight of the sample shall be 45 pounds. Asphalt binder content and gradation shall be determined in accordance with AASHTO T-308 using the ignition furnace for each subplot. The acceptance laboratory is responsible for obtaining the necessary materials and performing an ignition furnace calibration as outlined in AASHTO T-308 for each asphalt concrete mixture utilized on the project. The correction factor used for each test shall be clearly indicated on the report.

During production, the allowable deviations from the mix design gradation targets are listed in Table [325-1](#) above. The allowable production tolerances may fall outside of the mix design gradation bands.

If the results from a single acceptance sample fall outside of the acceptance limits in Table [325-1](#) a second sample shall be taken and if the second acceptance sample is also outside of the acceptance limits in Table [325-1](#) the Contractor shall cease production of asphalt concrete. Production shall not begin again until calibration test results verify that adjustments made to materials or proportions yield a gradation that falls within acceptance limits in Table [325-1](#).

If the asphalt binder content is within $\pm 0.60\%$ of the mix design target value, the asphalt concrete will be paid for at the contract unit price. If the asphalt binder content deviates by more than $\pm 0.60\%$ from the mix design target value, the deficient area will be evaluated within the subplot by coring at maximum intervals of 100 feet from the deficient sample. The asphalt content of the original deficient sample will be averaged with the asphalt binder content of the cores taken for re-evaluation to determine compliance with the acceptance requirements. If the resulting average of the asphalt binder content deviates by more than $\pm 0.60\%$ from the mix design target value, then Table [325-2](#) shall apply to the subplot. Additional cores may be required to define the limits of the deficient area, and shall not be used for re-evaluating acceptance.

SECTION 325

TABLE 325-2

ARB CONTENT ACCEPTANCE AND PENALTIES

Deviation from that permitted	(\$ per ton of asphalt concrete)
Over 0.2% <u>above</u> that permitted	Removal* or EA
Over 0.1% to 0.2% <u>above</u> that permitted	\$6.00
Over 0.0% to 0.1% <u>above</u> that permitted	\$2.00
Within permitted range	Full Payment
Over 0.0% to 0.1% <u>below</u> that permitted	\$2.00
Over 0.1% to 0.2% <u>below</u> that permitted	\$6.00
Over 0.2% <u>below</u> that permitted	Removal* or EA

NOTES: *The Contractor shall remove and replace the entire sublot that is deficient.

EA = Engineering Analysis per Section [325.9.6](#)

325.9.3 Marshall Air Voids: For purposes of determining Marshall air voids, the acceptance laboratory will designate one sample of the ARAC in accordance with the requirements of Section 2(h) of Arizona Test Methods 104 or AASHTO T-168 for each day's production or as directed by the Engineer's. The minimum weight of the sample shall be 45 pounds. The bulk density shall be tested in accordance with AASHTO T-245. The maximum theoretical density shall be tested in accordance with the requirements of AASHTO T-209, including fan drying per AASHTO T-209 Section 11. Effective voids determined on the laboratory compacted specimens will be determined in accordance with the requirements of AASHTO T-269. Should the testing for effective air voids not meet the "Full Payment" or "No Corrective Action" requirements of Table [325-3](#), additional testing for laboratory air voids on additional samples will be performed as necessary to determine the extent of the deficiency.

TABLE 325-3

LABORATORY VOIDS ACCEPTANCE AND PENALTIES

Marshall Air Voids (Measured at 75 blows) Deviation from Mix Design Target	When the contracting agency is the owner: Payment Reduction (\$ per ton of asphalt concrete)	When the contracting agency is not the owner (i.e. permits): Corrective Action
± 0% to 2.0%	Full Payment	No corrective action
± 2.1% to 2.9%	\$1.00	EA (see 325.9.5)
± 3.0% to 4.0%	\$2.50	EA (see 325.9.5)
± Greater than 4.0%	Removal* or EA per 325.10.4	Removal* or EA per 325.9.5

325.9.4 Requests for Referee Testing as described in 325.10 will only be considered based on quality control test results performed by a laboratory accredited by the AASHTO Accreditation Program (AAP) for the tests being performed or a laboratory listed in the current ADOT Directory of Approved Materials Testing Laboratories for the set of tests in question. The laboratory shall use properly certified technicians in accordance with ASTM [D3666](#), Section 7 (Personnel Qualifications).

325.9.5 Density: The temperature of ARAC just prior to compaction shall be at least 275° F. The Engineer may change the rolling procedure if in the Engineer's judgment the change is necessary to prevent picking up of the ARAC.

325.9.5.1 Equipment: Asphalt compaction equipment shall be of sufficient size and weight to accomplish the required compaction. All compaction equipment shall be operated and maintained in accordance with the manufacturer's

SECTION 325

recommendations and the project requirements. The compactors shall be self-propelled and shall be operated with the drive wheel in the forward position. The compactors shall weigh not less than eight tons. Compactors shall not be used in the vibratory mode for courses of one inch or less in nominal thickness. The wheels of compactors shall be wetted with water, or if necessary soapy water, or a product approved by the Engineer to prevent the ARAC from sticking to the steel wheels during rolling

325.9.5.2 Compaction Procedures

325.9.5.2.1 Pavement Lift Thickness 1½ Inches or Less: Achieving the required compaction is the responsibility of the contractor. A minimum of three static steel-wheel compactors shall be provided; however, sufficient compactors must be provided so that the drums of the compactors when staggered will cover the entire width of the paving machine on the initial forward pass while a static compactor remains to complete final rolling. The roller(s) for final compaction shall follow as closely behind the initial breakdown as practical, such that a uniformly smooth surface is achieved. As many passes as are possible shall be made with the compactors before the temperature of the ARAC falls below 220° F.

At the Engineer's discretion, cores may be taken and used to evaluate thickness.

325.9.5.2.2 Pavement Lift Thickness Greater than 1½ Inches: Achieving the required compaction is the responsibility of the contractor. The number and types of rollers is the contractor's responsibility and shall be sufficient to meet these requirements. Initial breakdown rollers shall follow as closely behind the paving machine as practical. The roller(s) for final compaction shall follow as closely behind the initial breakdown as practical, such that a uniformly smooth surface is achieved.

Compaction will be determined using a correlated nuclear density gauge and will be monitored for acceptability continuously during construction. The density of the compacted mixture shall not be less than 95% of the laboratory unit weight composed of the same mixture compacted by the 75 blow method of AASHTO T-245 at the job mix design specified compaction temperature. The outside one foot of each pass of the pavement course or any unconfined edge will be excluded from testing. The Engineer may exclude areas from the compaction lot that are not accessible by normal compaction equipment.

Nuclear Density Gauge Correlation - During placement of the test strip or on the first day of paving, the pavement surface shall be tested with a nuclear density gauge at a minimum of four locations. These same locations shall then be cored, using a 4-inch diameter core barrel, and tested for bulk density (AASHTO T-166A, or T-275) and a correlation value developed between the nuclear density gauge and the asphalt cores.

At the Engineer's discretion, cores may be taken and used to evaluate density and/or thickness.

325.9.5.3 Compacting Miscellaneous Items and Surfaces: ARAC used in the construction of miscellaneous items and surfaces shall be compacted using compactors, hot-hand tampers, smoothing irons, mechanical vibrating hand tampers, or with other devices to the extent considered necessary by the Engineer.

325.9.6 Engineering Analysis (EA): Within 10 working days after receiving notice that a lot or subplot of ARAC is deficient and is found to fall within the "Removal or EA" band per Table(s) [325-2 or 325-3](#), the contractor may submit a written proposal (Engineering Analysis) to accept the material in place at the applicable penalties along with possible remediation(s) listed in the "Removal or EA" category. An Engineering Analysis can also be proposed for non-removal categories of "Corrective actions" when the contracting agency is not the owner (i.e. permits).

The Engineering Analysis shall contain an analysis of the anticipated performance of the ARAC if left in place. The Engineering Analysis shall also detail the effect of any proposed corrective action to the material(s) in place as it relates to the in-place material's performance. The Engineering Analysis shall be performed by a professional engineer experienced in asphalt concrete testing and mix designs. If the lot or subplot is submitted for referee testing by the contractor, the ten working days allowed to prepare an engineering analysis will begin upon notification of referee test results.

When an Engineering Analysis recommends that a specific lot or subplot should not be removed, the Engineering Analysis will recommend that the following penalties (Table [325-4](#)) be paid when the contracting agency is the owner, for the specific criteria being reviewed by the EA.

SECTION 325

TABLE 325-4		
ENGINEERING ANALYSIS PENALTIES for REMOVAL* LOTS/SUBLOTS LEFT IN-PLACE		
Acceptance Criteria	Acceptance Limits	Penalty When Contracting Agency is the Owner (\$/Ton)
Laboratory Air Voids (Measured at 75 blows)	Deviation from Target Greater Than $\pm 4.0\%$	\$3.75

Within 15 working days, the Engineer will determine whether or not to accept the contractor's proposed Engineering Analysis.

325.10 REFEREE:

In the event the contractor elects to question the acceptance test results for laboratory air voids, the Contractor may make a written request for additional testing of the affected material. Any request for referee testing must describe the contractor's reasons for questioning the validity of the original acceptance results and must clearly describe which set of acceptance tests are in question. The Contractor will engage an independent laboratory (at the Contractor's own expense) who is accredited by AAP in all of the acceptance test methods. The independent laboratory shall be acceptable to the Engineer and shall perform a new set of acceptance tests as required by Section [325.9.2.3](#) representing the area or set of tests in question. The results of these determinations will be binding on both the contractor and the agency.

These tests will include Marshall unit weight, maximum theoretical unit weight, and laboratory air voids. Samples for referee testing shall come from representative samples obtained from the completed pavement, as directed by the Engineer.

The number of samples taken will be the same as specified in Section [325.9.2.3](#). The independent laboratory shall compile the test results and transmit them to both the Engineer and the contractor. The independent laboratory shall include a report signed by an Engineer registered in the State of Arizona, who is experienced in asphalt concrete testing and mix design development. The signed report shall give an opinion that the material evaluated either does or does not comply with project specifications, shall clearly describe any deficiencies, and the results will be binding between all parties.

325.11 MEASUREMENT:

ARAC shall be measured by the ton, for the mixture actually used, which shall include the required quantities of mineral aggregates, filler material, asphalt-rubber binder and admixture.

Application of lime water shall be measured by the square yard. The measured area shall be the area of ARAC pavement to which the lime water is applied. The measured area shall only be counted one time regardless of the number of applications applied to the ARAC pavement section.

Except as otherwise specified, no separate measurement will be made for work required for the construction of safety edges or for the grading and compaction for shoulder adjustment to match the new pavement surface elevation. The cost of this work shall be included in the price paid for ARAC or other related pay items. Engineer requested imported material for shoulder adjustment is not included in the price paid for the ARAC.

Measurement for safety edge preparation only applies to overlays of existing pavements that require the construction of a safety edge when none exists. Safety edge preparation will be measured by the linear foot. Safety edge preparation will not be measured when a safety edge is part of new pavement construction, pavement widening, or when overlaying an existing pavement that contains a safety edge.

325.12 PAYMENT:

Payment for asphalt milling will be as specified in Section [317](#).

Removal of raised pavement markers, pavement repairs, and surface pavement replacements required prior to roadway overlay operations, will be paid for by other pay items unless otherwise specified.

SECTION 325

Payment for safety edge preparation will be at the contract unit price for the quantities measured as described above.

Payment for tack coat will be by the ton diluted, based on the rate of application, as directed by the Engineer.

Payment for ARAC will be at the contract unit price, complete in place.

Application of lime water as approved by the Engineer will be paid at the contract unit price.

Payment for frame and cover adjustments will be at the contract unit prices specified in the proposal.

- End of Section -

This Page is Reserved For Future Use

SECTION 327

HOT IN-PLACE RECYCLING

327.1 DESCRIPTION

This work shall consist of rehabilitating the surface layer of existing asphalt concrete pavement. Rehabilitation shall be accomplished with specially designed equipment in a simultaneous multistep process of heating, scarifying, applying an asphalt recycling agent and thoroughly remixing and reshaping the old asphalt concrete surface to an average depth of 1", and then placing an overlay of new hot mix asphalt concrete in compliance with the lines, grades, thickness and typical cross-sections shown on the plans (typically 1" to 2"). NOTE: This work shall be performed with a single machine that heats, scarifies, recycles and spreads new asphalt concrete hot mix, all in one continuous pass. Additional preheaters may be utilized to achieve specified depth and temperature.

327.2 MATERIALS:

Asphalt Recycling Agent used to restore the existing pavement shall be approved by the Engineer prior to use. A manufacturer's certification shall be submitted for each load of recycling agent delivered to the project.

Hot Mix Asphalt Concrete (HMAC) shall meet the requirements of Section [710](#) or Section [717](#).

327.3 EQUIPMENT

The Contractor shall specify, in the bid proposal, the type of equipment intended for use. The equipment shall be on the project in operating condition a minimum of 2 days before beginning operations to allow evaluation by the Engineer. The Engineer reserves the right to reject equipment deemed not suitable for the intended purpose, at no additional cost to the Agency.

The recycling equipment shall meet the following minimum requirements:

Repaver: The equipment for this work shall be a self-contained, self-propelled, automated unit capable of heating, scarifying (or milling), mixing, redistributing and leveling the existing asphalt concrete pavement to the specified depth, all in a single pass.

It shall have a means of automatically applying an asphalt recycling agent at a uniform rate as shown on the plans, special provisions, or as requested by the Engineer. It shall be capable of applying a new HMAC layer over the hot, partially compacted recycled mixture.

Heating Unit: This unit shall be hooded to prevent damage to adjacent property, including trees and shrubs. It shall be capable of heating the pavement surface to a temperature high enough (375° - 400° F.) to allow scarification to the required depth without breaking aggregate particles or charring the pavement surface.

Scarifying or Milling Units: The scarifiers or rotary millers shall be able to penetrate the pavement surface to a depth shown, up to a maximum of one inch in one pass. Scarifiers or millers shall be equipped with separate, automatic height adjustments which allow clearance over manholes and other obstructions.

Recycling Agent Applicator: This system shall automatically add recycling agent to the scarified material at a uniform rate as shown on the plans, special provisions or as requested by the Engineer. The application rate shall be synchronized with the machine's forward speed to maintain a tolerance, within 5% of the specified rate.

Conveying System: Shall consist of a receiving hopper and conveying system to collect and transport new hot mix asphalt concrete material to the finishing unit.

Recycling Unit: A system that mixes, distributes and levels the scarified material over the width processed to produce a uniform cross-section of recycled material.

Finishing Unit: This unit shall have automatic screed controls to produce a surface conforming to that shown on the plans. The unit shall be capable of producing a uniform slope, grade and texture.

Revised 2012

SECTION 327

327.4 CONSTRUCTION METHODS:

The contractor shall be responsible to clean the pavement to be treated shall be cleaned of trash, debris, earth or other deleterious substances present in sufficient quantity to interfere with the work to be performed.

The heating shall be sufficient to soften the pavement to the extent that it can be scarified or milled to the depth specified. Due to the varying properties of the existing asphalt pavement, depth of the scarification material may be varied, if requested by the Engineer. Heating shall be done in a manner that will assure uniform softening and will not char the asphalt.

The Contractor shall be responsible for protecting the area adjacent to the work from heat damage. If damage occurs, the Contractor shall replace all damaged areas, landscape, curb, parked vehicles, etc. at no cost to the Agency.

To provide a welded longitudinal joint, the standing edge of the adjoining asphalt pavement shall be fully heated to a width at least 2 inches beyond the width to be scarified and recycled.

Immediately following heating, the pavement surface shall be scarified (or milled) to the specified depth. The scarified material shall have a temperature between 225° F. and 265° F. unless otherwise requested by the Engineer. The material shall be leveled, mixed and treated with a recycling agent. The application rate shall be as shown on the plans, special provisions or as requested by the Engineer. Application rate for the recycling agent may be adjusted as necessary to maintain a uniform mixture.

The reclaimed material shall be gathered by a leveling device and spread to a uniform depth over the width being processed. After it is placed and while it still has a residual temperature of at least 190° F., a layer of new HMAC conforming to the job mix formula shall be placed over it. The application rate of new material shall be sufficient to provide the required pavement thickness.

Construction, compaction and smoothness of the surface shall be in accordance with Section [321](#) except as modified in this Section.

327.5 WEATHER CONDITIONS:

This work shall not be done when it is raining or if there is a threat of rain. The ambient temperature shall be at least 50° F. and rising and the application shall cease when the temperature reaches 55° F. and falling.

327.6 AIR QUALITY:

The equipment and process shall meet all Arizona Department of Environmental Quality (ADEQ) and County air quality regulations and the Contractor shall have the appropriate ADEQ air quality control permit prior to the issuance of the notice to proceed.

327.7 MEASUREMENT:

Pavement Recycling will be measured by the square yard completed and accepted. Recycling Agent will measure by the gallon of actual material used in place. Hot Mix Asphalt Concrete (HMAC) will be measured by the ton in place.

327.8 PAYMENT:

The accepted quantities of pavement recycling will be paid at the contract unit price per square yard. Payment shall include cleaning the existing pavement surface and heating, scarifying, redistributing, leveling and compacting HMAC pavement. Asphalt Recycling Agent will be paid for by the gallon used in place. Hot Mix Asphalt concrete (HMAC) will be paid for by the ton in place.

- End of Section -

SECTION 329

TACK COAT

329.1 DESCRIPTION:

Tack coat for bituminous paved surfaces shall consist of the application of emulsified asphalt as specified in Section [713](#).

329.2 PREPARATION OF SURFACE:

Surfaces to be treated shall be cleaned of all loose material as specified in Section [330](#).

329.3 APPLICATION:

Tack coat shall be diluted in the proportion of 50 percent water and 50 percent emulsion and applied at the rate of 0.05 to 0.10 gallons per square yard. Application shall be made in advance of subsequent construction as ordered by the Engineer.

329.4 EQUIPMENT:

Tack coat shall be applied by distributor trucks designed, equipped, maintained and operated in accordance with Section [330](#). Hand spray by means of hose or bar through a gear pump or air tank shall be acceptable for resurface work, corners or tacking of vertical edges. Care shall be taken to provide uniform coverage. Equipment that performs unsatisfactory shall be removed from the job.

329.5 PROTECTION FOR ADJACENT PROPERTY:

According to Section [333](#).

329.6 MEASUREMENT:

Bituminous emulsion that is diluted prior to application will be measured by the ton of diluted material. Any conversion from volumetric quantities shall be in accordance with Section [713](#).

329.7 PAYMENT:

Payment for the emulsified bituminous tack coat will be by the ton, diluted.

- End of Section -

SECTION 330

ASPHALT CHIP SEAL

330.1 DESCRIPTION:

This work shall consist of the application of a bituminous material followed by the application of a cover material.

330.2 MATERIALS:

330.2.1 Asphalt: The type of grade of the bituminous material will be specified in the contract documents.

Paving grade asphalt shall meet the requirements to Section [711](#).

Liquid Grade asphalt shall meet the requirements of Section [712](#).

Emulsified asphalt shall meet the requirements of Section [713](#).

330.2.2 Aggregate: The cover material (chips) shall meet the requirements of Section 716. Gradation of the chips shall be as specified in Table [716-1](#) or Table [716-2](#).

330.3 TIME OF APPLICATION AND WEATHER CONDITIONS:

Chip seal shall not be applied for at least 7 days after completion of new bituminous paving.

The chip seal shall be placed only when the roadway surface is dry and there is no imminent threat of rain. The ambient temperature must be at least 60°F. and rising.

Caution should be exercised in the placement of asphalt chip seal between the dates of Oct. 1 and April 1.

330.4 CONSTRUCTION METHODS:

330.4.1 Preparation of surfaces: Immediately before applying the bituminous material, the area to be surfaced shall be cleaned of dirt and other objectionable material. In urban areas, the surface shall be cleaned with a self-propelled pickup sweeper. In rural areas, power brooms may be used. When necessary, cleaning shall be supplemented by hand brooms.

The bituminous material shall not be applied until an inspection of the surface has been made by the Engineer and he has determined that it is suitable.

For chip seals using paving grade asphalt as the binder, a bituminous tack coat shall be applied prior to sealing. The tack coat shall comply with Section [329](#). The exact rate shall be determined by the Engineer.

330.4.2 Application of Bituminous Material: The bituminous material shall be applied as soon as possible after preparation of surfaces. At the time of application, temperatures of the asphalt shall be within the ranges specified in Table [330-1](#) and Table [330-2](#) or in Sections [711](#), [712](#) and [713](#) for each specified asphalt type. The Engineer may require a specific temperature within the ranges.

The quantity of liquid or emulsified asphalts will be between the range of 0.20 and 0.40 gals. /sq. yd. The quantity of paving grade asphalt will be between the range of 0.17 and 0.31 gals. /sq. yd. The exact rate of application will be determined by the Engineer.

The bituminous material shall be placed using a distributor as specified in Section [330](#). Application methods shall insure that a uniform distribution is obtained over the area to be sealed.

The chips shall be spread before the bituminous material sets. The maximum distance that the bituminous material is applied in advance of the chips will be determined by the Engineer.

SECTION 330

TABLE 330-1		
APPLICATION TEMPERATURES OF LIQUID ASPHALTS		
All types of Liquid Asphalt	Distributor Application Temperature, Degree F.	
	Min.	Max.
70	105	175
250	140	225
800	175	255
3000	215	290

TABLE 330-2		
APPLICATION TEMPERATURE OF EMULSIFIED ASPHALTS		
Grade of Emulsified Asphalts	Distributor Application Temperature, Degree F.	
	Min.	Max.
RS-1, CRS-1, CRS-1h	75	140
RS-2, CRS-2, CRS-2h	125	185
SS-1, CSS-1	75	130
SS-1h, CSS-1h	75	130

The surfaces of structures, trees and shrubbery adjacent to the areas being seal coated shall be protected in such manner as to prevent their being spattered with bituminous material or marred. The Contractor shall be responsible for all damage to such structures or landscaping.

330.4.3 Application of Cover Material: Immediately following the application of the bituminous material, the chips shall be spread with a self-propelled mechanical spreader. The chip spreading equipment shall be capable of applying a uniform application of cover material. The self-propelled requirement may be waived for projects under 10,000 sq. yds.

At the time of application, precoated aggregate shall be within the temperature range of 250 degrees F. and 350 degrees F. measured at a point 6 to 12 inches below the top of the load.

At the time of application, uncoated chips shall not contain moisture in excess of a saturated, surface dry condition when liquid or paving grade asphalt are used as the seal coat binder.

At the time of application, chips shall be surface wet but free from running water when emulsified asphalt is used as the seal coat binder.

The precise application rate for cover material will be determined by the Engineer within the ranges of 15 to 25 pounds per square yard for the 1/4 in. size and 20 to 30 pounds per square yard for the 3/8 in. size.

When so directed by the Engineer and within 48 hours after application of the precoated chips, all chipped surfaces on major streets shall receive a flush coat in accordance to Section [333](#). The exact rate of application shall be as directed by the Engineer.

330.4.4 Rolling: Immediately following the application of the cover material, the surface shall be rolled with self-propelled pneumatic-tired rollers. Three coverages shall be made with a pneumatic roller. Each roller shall carry a minimum of 2,000 pounds on each wheel and a minimum of 60 psi in each tire. The roller shall not travel in excess of 12 miles per hour. A minimum of 3 self-propelled pneumatic rollers shall be required for projects over 10,000 sq. yds. On projects under 10,000 sq. yds. one roller may be used provided it performs the same number of coverages.

330.4.5 Joints: All joints shall be constructed as approved by the Engineer such that there will be a uniform application of cover material and bituminous material.

SECTION 330

330.4.6 Surplus Aggregate Removal: Surplus aggregate shall be removed from the surface using methods specified in Subsection [330.4.1](#) and stockpiled in the location indicated on the plans or as directed by the Engineer. In no event shall surplus aggregate be left on the pavement for more than one day (24 hours).

330.4.7 Distributing Equipment: Distributor trucks shall be of the pressure type with insulated tanks. Gravity distributors will not be permitted.

Spray bars and extensions shall be of the full circulating type. The spray bar shall be adjustable to permit varying height above the surface to be treated.

The nozzle spacings, center to center, shall not exceed 6 inches. The valves shall be operated so that one or all valves may be quickly opened or closed in one operation. The valves which control the flow from the nozzles shall be of a positive acting design so as to provide a uniform, unbroken spread of bituminous material on the surface.

The distributor shall be equipped with devices and charts to provide for accurate, rapid determination and control of the amount of bituminous material being applied. The distributor shall be equipped with a tachometer of the auxiliary wheel type registering speed in feet per minute. The distributor shall also be equipped with pressure gauges and an accurate thermometer for determination of the temperature of bituminous material. The spreading equipment shall be designed so that uniform application of a bituminous material can be applied in controlled amounts ranging from 0.05 to 2.0 gallons per square yard. Transverse variation rate shall not exceed ten (10) percent of the specified application rate. The distributor shall be equipped with a hose and nozzle attachment to be used for spotting skipped areas and areas inaccessible to the distributor. Distributor and booster tanks shall be maintained as to prevent dripping of bituminous material from any part of the equipment.

Equipment that fails to perform satisfactorily shall be removed from the job.

330.5 TRAFFIC:

Traffic will not be permitted on the surface until the cover aggregate has set. Traffic control shall be in accordance with Section [401](#) as supplemented by the Contracting Agency.

When using paving grade or liquid grade asphalt chip seal, the speed limit must be maintained at 25 mph for all equipment and traffic until the cover material is swept.

When using emulsified asphalt chip seals, only emergency or local access traffic will be allowed until the seal coat has had time to set.

330.6 MEASUREMENT:

Certified weight slips of all material shall be delivered to the Engineer before the materials are applied. Certified weight slips of any material being weighed back in for credit shall be delivered to the Engineer the next day.

330.7 PAYMENT:

Quantities of materials for this work will be paid for at the contract unit price.

(A) Asphalt Cement, Liquid Asphalt, Emulsion, Diluted Emulsion	Ton
--	-----

(B) Chips	Ton
-----------	-----

There will be no payment for materials not placed in accordance with this specification.

- End of Section -

SECTION 331

MICROSURFACING SPECIFICATIONS

331.1 GENERAL:

The work covered by this specification consists of furnishing all labor, equipment, and materials for the application of a "quick traffic solid/polymer microsurface."

This specification covers the equipment and construction procedures for rut filling and/or resurfacing of existing paved surfaces. The microsurface shall be a mixture of cationic polymer modified asphalt emulsion, mineral aggregates, mineral filler, water and other additives properly proportioned, mixed and spread on the pavement surface.

331.2 MATERIALS:

The Contractor shall supply all materials necessary for the performance of the work in accordance with the specifications. The asphalt emulsion, aggregate, and mineral filler shall be as specified in Section [714](#). Materials shall be approved by the Engineer prior to the start of construction. Certificates of Compliance shall accompany each delivery of emulsion.

The Contractor shall be responsible for the safety of all materials of which he has taken delivery until they are in place on the road, and shall take all necessary precautions to avoid loss by fire or theft, or damage by water, and shall bear the cost of replacing any such material that is lost, spilt, destroyed or damaged after delivery.

331.3 PROPORTIONING:

The microsurface shall be proportioned in accordance with the mix design. Calibrated sign flowmeters shall be provided to measure both the addition of water and additives to the pugmill. Emulsion and cement flow shall be tied directly to aggregate flow. All additive flows shall be calibrated.

331.3.1 Performance: The microsurface mixture shall be proportioned per the mix design to ensure:

(A) Trafficability - the material will permit controlled traffic without damage to the surface within thirty (30) minutes and uncontrolled traffic without damage within sixty (60) minutes, per Section [331.4.2.2](#).

(B) Prevent development of bleeding, raveling, separation or other distress for seven (7) days after placing the microsurface.

331.4 MIX DESIGN:

331.4.1 General:

331.4.1.1: The Contractor shall provide a job mix formula from an approved laboratory and present certified test results for the Engineer's approval. Compatibility of the aggregate and polymer modified emulsion shall be certified by the emulsion manufacturer. All the materials used in the job mix formula shall be representative of the materials proposed by the Contractor for use in the project.

331.4.1.2: All the products used in the construction shall have certifications from the suppliers and they shall be given to the Engineer upon delivery to the project.

331.4.1.3: Mix design and proportioning will be approved by the Engineer prior to the start of the project.

331.4.2: Specifications:

331.4.2.1: The Engineer shall approve the mix design prior to use. The specification limits are as follows:

Residual Asphalt	(ASTM D244)	6% - 11.5% by dry weight of aggregate
Mineral Filler	(ASTM C136)	0.1% - 1% by dry weight of aggregate
Polymer Content/Type		4% min. (see Section 714.4)

SECTION 331

Additive	As required for mix properties
Water	As required for mix properties
Aggregate Grading	Meets Section 331.4.2.4
Consistency (ISSA T-106)	2.5 to 3.0 cm
Traffic Time	See Section 331.4.2.2
Abrasion Loss (ISSA TB-100)	75 g/ft ² maximum
Adhesion (ISSA TB-114)	90% minimum
Loaded Wheel Sand Adhesion	See Section 331.4.2.3

331.4.2.2 Modified Cohesion Test (ISSA TB-139): Furnish laboratory test data showing the mix design to be trafficable thirty (30) minutes after application at 77 F conforming to the following criteria in accordance with test methods described in the applicable specifications.

Set Time Test: 30 minutes 12 kg-cm minimum.

Early Rolling Traffic Time: 60 minutes 20 kg-cm minimum.

331.4.2.3 Loaded Wheel Sand Adhesion Test (ISSA TB-109): Furnish laboratory test data showing the mix design conforming to the following criteria in accordance with test methods described in the appropriate specifications.

<u>Vehicles/day</u>	<u>Minimum Sand Adhesion</u>
0-30	70 g/ft ²
250-1500	60 g/ft ²
1500-3000	55 g/ft ²
greater than 3000	50 g/ft ²

331.4.2.4 The laboratory shall further report the quantitative effects of moisture content in the unit weight of the aggregate (bulking effect). The report must clearly show the theoretical recommended proportion of aggregate, mineral filler (Min. & Max.), water (Min. & Max.), additive(s), and asphalt, and how the proportions are based (dry aggregate weight, total mix, etc.).

331.5 TESTING: Samples for quality assurance will be taken throughout the project per ISSA TB101 for testing by an approved laboratory as required by the Engineer. Materials with test results not meeting these specifications shall be corrected immediately. Testing shall be at the expense of the Agency for the following:

- (A) Asphalt content
- (B) Aggregate gradation
- (C) Percent polymer content and type—certified by supplier

331.6 EQUIPMENT:

331.6.1 General: All equipment, tools and machines used in the performance of this work shall be maintained in satisfactory working condition at all times to ensure a high quality product.

SECTION 331

331.6.2 Mixing Equipment: The mixing machine shall be a self-propelled or truck mounted mixing machine which shall be able to accurately deliver and proportion the aggregate, mineral filler, water, additive, and polymer-modified asphalt emulsion to a revolving multi-blade mixer capable of minimum speeds of 200 RPM and discharge the product on a continual flow basis. The machine shall have sufficient storage capacity for aggregate, polymer modified asphalt emulsion, mineral filler, water, and additive to maintain an adequate supply to the proportioning controls.

331.6.3 Material Control:

331.6.3.1 Calibration: Each mixing unit to be used in the performance of the work shall be calibrated prior to construction. Calibration data, if done within the calendar year, using the same material, may be used, providing a verification of the aggregate feed agrees.

Individual volume or weight controls for proportioning each material to be added to the mix shall be provided, and shall be accessible to the Engineer. Each material control device shall be calibrated prior to work and documented for inspection by the Engineer.

331.6.3.2 Aggregate Feed: The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time.

331.6.3.3 Emulsion Pump: The emulsion pump shall be the positive displacement type with a jacketed housing for uniform heating. A revolution counter or similar device shall be fitted so that the amount of emulsion used may be determined at any time.

331.6.3.4 Fines Feeder: An approved fines feeder is required that will provide a uniform, positive, accurately metered range of 0 to 1 percent by dry aggregate weight. The fines feeder shall have a counter so the amount of mineral filler can be determined at any time.

331.6.3.5 Liquid Additive: The mixing machine shall be equipped with a liquid additive system that provides a pre-determined amount of additive to the mixing chamber. This additive system must be equipped with a counter that can determine the amount used at any time.

331.6.3.6 Water System: The mixing machine shall be equipped with a water system that provides a pre-determined amount of water to the mixing chamber. This water system must be equipped with a counter that can determine the amount used at any time.

331.6.4 Operator Controls: Controls will allow the operator to sequence and proportion the material per the mix design.

331.6.5 Spray Bars: The mixing machine shall be equipped with a water pressure system that provides a water spray immediately ahead of and outside the spreader box.

331.6.6 Spreading Equipment:

331.6.6.1: The paving mixture shall be spread uniformly by means of mechanical type laydown box attached to the mixer, equipped with agitation, to spread the materials throughout the box without any dead zones. The paddles shall be designed and operated so all the fresh mix will be agitated. Flexible seals, front and rear, shall be in contact with the road surface to prevent loss of mixture from the box. The spreader box shall be equipped with hydraulic cylinders for controlling the thickness of the spread mixture.

331.6.6.2: The rut filling spreader box shall have 6 to 8 skids to provide for leveling and filling uneven depressed areas. Two adjustable steel strike-off plates are required. The rear flexible seal shall act a final strike-off and shall be adjustable. The steel strike-offs shall be controlled by hydraulic cylinders placed at the rear of the spreader box.

331.6.6.3 The spreading equipment shall be maintained free from build-up of the mixture on the paddles or side walls. Skips, lumps, or tears will not be allowed in the finished product.

SECTION 331

331.7 APPLICATION:

331.7.1 General: The microsurface shall be of the desired consistency when deposited in the spreader box and nothing more shall be added to it. The mixing time shall be sufficient to produce a complete and uniform coating of the aggregate and the mixture shall be chuted into the moving spreader box at a sufficient rate to maintain an ample supply across the full width of the strike-off squeegee at all times.

331.7.2 Weather: Microsurfacing shall not be placed if either the pavement or air temperature is below 50 degrees F and falling, but may be applied if both the air and pavement temperature are at least 45 degrees F and rising, and it is not raining.

331.7.3 Protection of Existing Surfaces: The Contractor shall take all necessary precautions to prevent microsurface or other material used from entering or adhering to gratings, hydrants, valve boxes, manhole covers, bridge or culvert decks, and other road fixtures. Immediately after resurfacing, the Contractor shall clean off any such material and leave any grating, manholes, etc. in a satisfactory condition.

331.7.4 Fogging Pavement: The surface shall be pre-wetted by Fogging ahead of the spreader box. The rate should be adjusted as dictated by the pavement temperature, surface texture, humidity, and dryness of existing pavement.

331.7.5 Mix Stability: The mix shall possess sufficient stability so that premature breaking of material in the spreader box does not occur. The mixture shall be homogeneous during mixing and spreading; it shall be free of excess water or emulsion, and free of segregation of the emulsion and aggregate fines from the coarser aggregate.

331.7.6 Application Rate: The application rates, pounds per square yard of mix specified, are average rates; the surface texture variation throughout the work will dictate the actual spreading rates. The strike-off squeegee shall be adjusted to provide a microsurface thickness which will completely fill the surface voids and provide an additional thickness not exceeding one and one-half times the largest top-size stone. The requirement of 1-1/2 stone depth does not apply to rut filling operations as these depths vary greatly according to the surface irregularities.

331.7.7 Joints: No excessive build-up or unsightly appearance shall be permitted on longitudinal or transverse joints. A maximum of 4.0" overlap will be permitted on longitudinal joints. The Contractor shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the work. Half passes and odd width passes will be used in minimal amounts. If half passes are used, they cannot be the last pass on any area. Care shall be taken to ensure straight lines along curbs and shoulders. No runoff will be permitted on these areas. Construction joints shall be neat in appearance and shall be tapered or feathered to conform to the existing surface. All excess material shall be removed from the surface upon completion of each run.

331.7.8 Handwork: Approved squeegees and lutes shall be used to spread the mixture in areas inaccessible to the spreader box and in other areas where hand spreading may be required.

331.7.9 Protection of the Microsurface: Adequate means shall be provided by the Contractor to protect the uncured product. Any damage done to the product shall be repaired at the Contractor's expense.

331.7.10 Damage to the Microsurface: The Contractor's responsibility to replace microsurface damaged by unexpected rain after spreading shall be limited to the period within four (4) hours of placement of the microsurface.

331.8 PAYMENT:

The micro-surfacing shall be paid for by the weight of the aggregate and weight of emulsified asphalt, as shown on certified weight tickets from the supplies delivered to the project, less weigh backs. The price shall be full compensation for furnishing, mixing and applying all materials; and for all labor, equipment, tools, design tests, and incidentals necessary to complete the job as specified herein.

- End of Section -

SECTION 332

PLACEMENT AND CONSTRUCTION OF ASPHALT EMULSION SLURRY SEAL COAT

332.1 DESCRIPTION:

The work covered by this specification consists of furnishing all labor, equipment, and materials necessary to perform all operations required for the application of an asphalt emulsion slurry surface.

NOTE: THESE SPECIFICATIONS DO NOT COVER THE APPLICATION OF COAL TAR SLURRY SEALS.

332.2 MATERIALS:

The asphalt emulsion material, mineral aggregate and mineral filler shall be as specified in Section [715](#).

332.3 EQUIPMENT:

332.3.1 General: When requested by the Engineer, descriptive information on the slurry seal mixing and applications equipment to be used will be submitted for approval no less than 7 days before the work starts.

332.3.2 Self Contained Slurry Machine: The mixing machine will be a continuous flow type. It will be capable of accurately delivering a predetermined proportion of pre-wetted aggregate, mineral filler, water and asphalt emulsion to the mixing chamber and discharging the thoroughly blended mixture on a continuous basis. The mixing machine will be equipped with a mineral filler feeder. The feeder will have an accurate metering device or method to introduce a predetermined proportion into the mixer. The filler will be introduced into the mixing chamber at the same time and location as the aggregate.

The mixing machine will be equipped with a water pressure system and fog-type spray bar, adequate for complete water fogging of the surface to be sealed.

The mixing machine will be mounted on a truck or other vehicle capable of producing evenly controlled low rates of speed throughout the operation to ensure the slurry is spread evenly and all cracks are filled.

332.3.3 Slurry Spreading Equipment: Attached to the mixer machine shall be a mechanical type squeegee spreader equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. It shall be maintained to prevent loss of slurry on varying grades and crown by adjustments to assure uniform spread. There shall be a steering device and a flexible strike-off. The spreader box shall have an adjustable width. The box shall be kept clean. Build-up of asphalt and aggregate on the box shall not be permitted. The use of burlap drags or other drags shall be approved by the Engineer.

332.3.4 Rollers: Rollers shall be approved by the Engineer.

332.3.5 Cleaning Equipment: Power brooms, pick-up brooms, air compressors, water flushing equipment, and hand brooms shall be suitable for cleaning the surface and cracks of the old surface.

332.3.6 Auxiliary Equipment: Hand squeegees, shovels, and other equipment shall be provided as necessary to perform the work.

332.4 PREPARATION OF THE SURFACE:

332.4.1 Immediately before applying the slurry, the area to be surfaced shall be cleaned of dirt, loose material, and other objectionable material. In urban areas, the surface shall be cleaned with a self-propelled pick-up sweeper. In rural areas, power brooms may be used. When necessary, cleaning shall be supplemented by hand brooms. Water flushing will not be permitted in areas where cracks are present in the pavement surface.

The slurry shall not be applied until an inspection of the surface has been made by the Engineer and he has determined that it is suitable.

SECTION 332

332.4.2 Tack Coat: When specified, a tack coat shall be applied in accordance with Section [329](#) using the same type and grade of asphalt emulsion as specified for the slurry seal.

332.4.3 Water Fogging: When required by local conditions, the surface, directly ahead of the slurry box, shall be pre-wetted by fogging. The fogging shall be accomplished in such a manner that the entire surface is damp with no apparent flowing water or puddles.

332.5 WEATHER LIMITATIONS:

The slurry seal shall not be applied unless the pavement temperature is at least 45°F. and rising. The mixture shall not be applied during unsuitable weather.

332.6 PROTECTION OF UNCURED SURFACE:

Adequate means shall be provided by the Contractor to protect the uncured product. Any damage done to the product shall be repaired at the Contractor's expense.

332.7 MIXING AND APPLICATION:

The mixing time shall not exceed four minutes. Excessive mixing will not be allowed. The resulting mixture shall have the desired consistency, when placed on the surface. If breaking, hardening, segregation, balling or lumping occurs during the mixing process, the batch will be discarded.

A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that a complete coverage is obtained.

No streaks caused by oversized aggregate shall be left in the finished surface. Build-up on longitudinal and transverse joints will be kept to a minimum. Approved squeegees shall be used to spread slurry in areas nonaccessible to the slurry mixer.

332.8 ROLLING:

As soon as the asphalt slurry has been set sufficiently to prevent any material from being picked up, it shall be rolled until all ridges have been ironed out and a uniform surface is obtained.

332.9 MEASUREMENT:

Quantities and materials for this work will be paid for at the contract price per unit of measurement for each of the following pay items as indicated in the proposal.

(A) Bituminous tack coat if specified	Ton (Diluted)
(B) Emulsified asphalt for slurry	Ton (Undiluted)
(C) Aggregate for slurry	Ton (Surface Dry)

- End of Section -

SECTION 333

FOG SEAL COATS

333.1 DESCRIPTION:

Fog seal coats on bituminous paved surfaces shall consist of the application of emulsified asphalt and a sand blotter when necessary.

333.2 TIME OF APPLICATION AND WEATHER CONDITIONS:

Fog seal coats on new pavements shall be applied within 24 hours. This time restriction may be extended by the Engineer.

Emulsified asphalt shall not be applied when the surface is wet or when there is a threat of rain. The ambient temperature shall be at least 50 degrees F. and rising and the application shall cease when the temperature is 55 degrees F. and falling.

333.3 MATERIALS:

333.3.1 Emulsified Asphalt: Unless otherwise specified in the special provisions, emulsified asphalt may be a grade SS-1h, CSS-1h, or CQSH, as specified in Section [713](#). The emulsified asphalt shall be diluted in proportions of 50% water and 50% emulsified asphalt.

333.3.2 Sand Blotter: The sand shall be as specified in Section [701.3](#) and shall be graded in accordance with Table [333-1](#).

TABLE 333-1	
SAND BLOTTER GRADATION	
Sieve Size	Percentage Passing (by weight)
3/8 inch	100%
No. 4	90-100%
No. 200	0-12%

333.4 TESTS, TEST REPORTS AND CERTIFICATIONS:

Asphalt emulsion shall meet requirements of Section [713](#).

Test reports and certifications shall be as specified in Section [711](#).

333.5 PREPARATION OF SURFACES:

Immediately before applying the emulsion, the area to be surfaced shall be cleaned of dirt and loose material by means of power brooms, or pick-up brooms supplemented by hand brooms if necessary. The fog seal shall not be applied until an inspection of the surfaces has been made by the Engineer and he has determined that the surfaces are suitable.

333.6 APPLICATION OF ASPHALT EMULSION:

The diluted material shall be well mixed before application. It shall be applied by a distributor truck equipped with fog nozzles at the approximate rate of 0.10 gallon per square yard. The exact rate shall be as directed by the Engineer. The distributor truck shall be as specified in Section [330](#).

333.7 SAND BLOTTER:

A sand blotter shall be applied as directed by the Engineer where there is an excess of asphalt emulsion. After the treated area has been opened to traffic, any excess asphalt emulsion that comes to the surface shall be immediately covered with additional sand.

SECTION 333

333.8 PROTECTION FOR ADJACENT PROPERTY:

Care shall be taken to prevent the spraying of asphalt emulsion on adjacent pavements, including that portion of the pavement being used for traffic, on structures, guard rails, guide posts, markers, trees, shrubs, and property of all kinds.

333.9 PROTECTION OF TREATED SURFACE:

The treated surface shall be protected by barricades until the asphalt emulsion will not be picked up by traffic.

333.10 PAYMENT:

Payment for asphalt emulsion in place will be by the ton, diluted.

Payment for furnishing and applying sand blotter in place will be paid for by the ton.

- End of Section -

SECTION 334

PRESERVATIVE SEAL FOR ASPHALT CONCRETE

334.1 DESCRIPTION:

The asphalt concrete preservative seal shall be composed of an emulsified asphalt or asphalt rejuvenate, or an asphalt sealant to preserve the asphalt concrete pavement.

Preservative seals are applicable for asphalt pavements as directed on the plans, special provisions, or the Engineer.

334.2 MATERIALS:

The preservative seal shall be one of the following materials as specified by the Engineer:

<u>Type</u>	<u>Description</u>	<u>Material Conformance</u>
A	Rejuvenating emulsion	Section 718
B	Petroleum hydrocarbon emulsion	Section 718
C	“Filled” asphalt sealer such as TRMSS or equal	Section 718
D	Acrylic polymer emulsion	Section 718
E	Polymer modified rejuvenating emulsion (PMRE)	Section 718
Other	Diluted asphalt emulsion, CSS-1 or SS-1h	Section 713

334.3 CONSTRUCTION METHOD:

The material shall be approved by the Engineer in accordance to this specification. The application rates, dilution and curing shall be directed by the Engineer in accordance with this specification.

The contractor shall be responsible to clean the pavement to be treated free of trash, debris, earth or other deleterious substances present in sufficient quality to not interfere with the work to be performed.

The application rate will be based upon a typical surface condition test site with application rate trials to determine the needed rate. All application rates specified in Section [718](#) shall be a diluted 50-50 emulsified asphalt and water, except as recommended by the manufacturer for Type B and C. Any over applied seal will be sanded as directed by the Engineer. Application equipment shall be in accordance with Section [330](#).

Before opening a treated area to traffic, the surface shall be checked for slipperiness and/or tackiness. If the treated portion of the roadway must be opened to traffic prior to the disappearance of slipperiness and/or tackiness, the surface shall be sanded with a minimum of 1 ½ pounds per square yard or as directed by the Engineer. Sand Blotter shall comply with Section [333](#).

334.4 MEASUREMENT:

Preservative seal for asphalt concrete will be measured by the gallon or ton applied.

334.5 PAYMENT:

Payment will be made on the basis of the unit price bid in the proposal. Payment shall be full compensation for preservative seal complete and in place.

- End of Section -

SECTION 335

PLACEMENT AND CONSTRUCTION OF HOT ASPHALT-RUBBER SEAL

335.1 DESCRIPTION:

This work shall consist of applying an application of asphalt-rubber binder, a combined mixture of hot paving grade asphalt and crumb rubber modifier. It shall be immediately covered with a cover material.

The work involves furnishing and placing all materials on existing pavement surfaces in accordance with this specification.

335.2 MATERIALS:

The asphalt-rubber binder shall comply with Section [717](#). Sand Blotter shall comply with Section [333](#). Cover material shall be precoated and comply with Section [716](#). Fog seal coats shall comply with Section [333](#).

335.2.1 Certification and Quality Assurance: Prior to application, the Contractor shall submit certification of compliance to the Engineer at least 7 days prior to application for all materials to be used in the work. For example: Asphalt-rubber binder designs (Section [717](#)), cover material test results (Section [716](#)), sand blotter material (Section [333](#)), fog seal coats (Section [333](#)), and any additional materials used on the project.

335.3 EQUIPMENT:

335.3.1 General: The method and equipment for combining the crumb rubber modifier and hot paving grade asphalt shall be so designed and accessible that the Engineer can readily determine the percentage by weight of each of two materials being incorporated into the mixture.

All equipment shall meet requirements of Section [330](#) with the following modifications:

(A) Pneumatic-tired rollers: At least three pneumatic-tired rollers shall be used. Each roller shall carry a minimum of 5,000 pounds on each wheel and a minimum of 90 psi in each tire. Rollers shall not travel in excess of 12 mph.

(B) Distributor: The distributor must be equipped with a mechanical mixing device.

335.3.2 Mechanical Pre-Blender: Crumb rubber modifier and the hot paving grade asphalt for the asphalt-rubber binder may be pre-blended prior to introduction of the blend into the distributor.

The mechanical pre-blender shall be equipped with an asphalt totalizing meter in gallons and a flow rate meter in gallons per minute.

335.4 MIXING:

Mixing shall be done in accordance with Section [717](#). Application shall proceed immediately upon the asphalt-rubber binder requirements being met.

335.5 CONSTRUCTION:

Prior to placing the hot asphalt-rubber binder, soil and other objectionable materials shall be removed from the pavement surface.

The application rate of the hot asphalt-rubber binder shall be 0.55 to 0.70 gallons per square yard or as directed by the Engineer based on field conditions. Material shall be applied at temperatures of 350 degrees F. to 400 degrees F. The application of the cover material shall follow as close as possible behind the distributor truck.

The cover material shall be preheated immediately prior to application and precoated as specified in Section [716](#) - PRECOATED. The temperature of the precoated chips shall be in accordance with Section [330](#).

SECTION 335

Hot asphalt-rubber binder with hot precoated cover aggregate shall be placed only when the ambient temperature is at least 60 degrees F. and rising, on a dry surface and there is no imminent threat of rain.

The rate of application of the cover material shall be from 18 to 25 pounds per square yard for the Low Volume Chip or 28 to 35 pounds per square yard for the High Volume Chip, or as directed by the Engineer.

The rolling of the cover material shall proceed immediately after application in order to insure maximum embedment of the aggregate. Sufficient rollers shall be used for the initial rolling to cover the width of the aggregate spread with one pass. The first pass shall be made immediately behind the aggregate spreader. If the spreading is stopped for an extended period, the spreader shall be moved ahead or off to the side so that all cover material may be immediately rolled. Three (3) complete passes with rollers shall be made with all rolling completed within one (1) hour after the application of the cover material.

The Contractor shall sweep all joint edges clean of overlapping cover material prior to the adjacent application of asphalt-rubber binder. Transverse joints shall be made by placing building paper over the ends of the previous applications. The joining application shall start on the building paper. Once the application process has progressed beyond the paper, the paper shall be removed and disposed of to the satisfaction of the Engineer. All reasonable precautions shall be taken to avoid skips and overlaps at joints and to protect the surfaces of adjacent structures, trees and shrubs, etc., from being spattered or marred. Correction of any such defects will be required at no additional cost to the Contracting Agency.

Traffic will not be permitted on the surface until after sweeping operations have finished and the cover aggregate has set. Traffic control shall be in accordance with Section [401](#) as supplemented by the Contracting Agency.

At signalized intersections, an application of 2 to 5 pounds of sand blotter per square yard shall be applied through the intersection and for a distance of 200 feet each way from the near curb returns after rolling and before opening a lane to traffic. Sand Blotter shall meet requirements of Section [333](#).

After sweeping and prior to striping, a fog seal coat shall be applied to the asphalt-rubber seal consisting of 0.05 to 0.10 gallons per square yard according to Section [333](#). The application of the fog seal coat may be delayed to facilitate curing or to avoid placement under unfavorable high temperature conditions.

Note: The fog seal coat shall not be applied to the area 200 feet either side of and through signalized intersections.

335.6 MEASUREMENT:

Certified weight slips of all materials shall be delivered to the Engineer before the materials are applied.

Certified weight slips of any bituminous material being weighed back in for credit shall be delivered to the Engineer for the next day.

Quantities of materials for this work will be paid for at the contract price per unit of measurement for each of the following pay items actually used on the project.

(A) Cover Material (Precoated)	Ton
(B) Asphalt Rubber Binder	Ton
(C) Emulsified Asphalt (Fog Seal)	Ton (diluted)
(D) Sand Blotter	Ton (surface dry)

335.7 PAYMENT:

Payment will be full compensation for furnishing and placing all materials specified and used, with no allowance for waste, and shall include labor, equipment, tools, and incidentals necessary to complete the work as prescribed in the specifications and as directed by the Engineer.

Revised 2012

SECTION 335

Asphalt cement for precoating chips will be included in the price per ton for hot precoated chips.

No payment will be made for materials rejected due to improper placing, improper proportions of materials, or materials found to be defective.

- *End of Section* -

SECTION 336

PAVEMENT MATCHING AND SURFACING REPLACEMENT

336.1 DESCRIPTION:

This specification identifies requirements for removing and replacing or widening pavement and replacing other surfacings within public rights-of-way.

Asphalt concrete roadway trench repairs shall be constructed in accordance with Type A, B, or T-Top trench repair of Detail 200-1 and as indicated on the plans or in the special provisions.

Trench repairs for unpaved alleys, roadways, and designated future roadway prism shall be constructed in accordance with Type E trench repair of Detail 200-1.

Trenching into portland cement concrete pavement, sidewalk, or other concrete flatwork shall require complete joint to joint replacement of damaged panels unless an alternative repair is required by contract documents or is authorized in writing by the Engineer.

Surface replacement in the right-of-way not in paved roadways shall be constructed in accordance with Type D trench repair of Detail 200-1 and as indicated on the plans or in the special provisions.

Temporary pavement replacement shall be constructed as required herein.

Asphalt pavements to be matched by construction of new pavements adjacent to or at the ends of a project shall be milled or saw cut in accordance with these specifications and where shown on the plans.

Pavement and surfacing replacement within ADOT rights-of-way shall be constructed in accordance with their permits and/or specification requirements.

336.2 MATERIALS AND CONSTRUCTION METHODS:

Materials and construction methods used in the replacement of pavement and surfacing shall conform to the requirements of all applicable standard details and specifications, latest revisions.

336.2.1 Pavement Widening or Extensions: Existing pavements which are to be matched by pavement widening or pavement extension shall be trimmed to a neat true line with straight vertical edges free from irregularities with a device specifically designed for this purpose.

Existing asphalt pavement shall be cut and trimmed after placement of required ABC and just prior to placement of asphalt concrete for pavement widening or extension, and the trimmed edges shall have tack coat applied to the vertical edges immediately prior to constructing the new abutting asphalt concrete pavement. No extra payment shall be provided for these items and all costs incurred in performing this work shall be incidental to the pavement widening or extension.

The location of longitudinal match points shall depend on the type of asphalt joint being constructed (full depth or offset) and the location of the pavement lane striping to be in place at completion of construction. Full depth longitudinal joints shall be located within one foot of a post construction lane line stripe or within the center two feet of a post construction travel lane. The location restriction for full depth longitudinal joints does not apply to multi-layer pavements when a vertically offset joint with the existing pavement is constructed. An acceptable offset joint shall have at least a six-inch horizontal offset with the nearest joint in the underlying asphalt layer. An offset joint may be obtained by edge milling to a depth that meets the minimum lift thickness identified in Section [710](#) for the asphalt surface course to be placed.

The exact point of matching, termination, and overlay may be adjusted in the field by the Engineer or designated representative.

336.2.2 Pavement to be Removed: Existing asphalt pavement to be removed for trenches or for other underground construction or repairs shall be cut by a device capable of making a neat, straight and smooth cut without damaging adjacent pavement that is not to be removed. The Engineer's decision as to the acceptability of the cutting device and manner of operation shall be final.

In lieu of cutting trenches across driveways, curbs and gutters, sidewalks, alley entrances, and other types of pavements, the

SECTION 336

Contractor may, when approved by the Engineer, elect to tunnel or bore under such structures and pavements.

When installations are within the street pavement and essentially parallel to the center-line of the street, the Contractor, with approval of the Engineer, may elect to bore or tunnel all or a portion of the installation. In such installations, the seal coat requirements, as discussed in Section [336.2.4](#), will be modified as follows:

- (A) If the pavement cuts (bore pits, recovery pits, etc.) are 300 feet or more apart, the bore or tunneled distance will not be considered as part of the open trench and the seal coat will not be required.
- (B) If the pavement cuts (bore pits, recovery pits, etc.) are less than 300 feet apart, the distance between the cuts will be considered the same as a trench cut and the distance will be added to any trench cut distances.

Pavement removal limits when replacing existing curb or gutter shall be as follows. For curb or gutter replacement adjacent to a designated bike lane or paved shoulder area wider than three feet, the asphalt pavement removal and replacement shall extend to within 6 inches of the travel lane edge stripe. For curb or gutter replacement when no travel lane edge stripe exists, the asphalt pavement match point shall extend two feet or less from the pavement edge into the vehicle travel lane.

Asphalt pavement damaged by the Contractor during trenching or other activities shall be removed after adjacent aggregate base has been placed and compacted and prior to placement of the adjacent permanent pavement. The replacement of the damage asphalt pavement shall occur at the same time as the permanent pavement replacement is constructed.

336.2.3 Temporary Pavement Replacement: Temporary pavement replacement, as required in Section [601](#), may be with cold-mix asphalt concrete, with a minimum thickness of 2 inches, using aggregate grading in accordance with Marshall mix design of Section [710](#). Permanent pavement replacement shall replace temporary repairs within 5 working days after completion of temporary work.

Temporary pavement replacement shall be used in lieu of immediate placement of single course permanent replacement or the first course of two course pavement replacement only on transverse lines such as spur connections to inlets, driveways, road crossings, etc., when required by the Engineer, by utilities or others who subcontract their permanent pavement replacement, under special prior arrangement; or for emergency conditions where it may be required by the Engineer. Temporary pavement replacement shall be placed during the same shift in which the backfill to be covered is completed.

Rolling of the temporary pavement replacement shall conform to the following:

- (A) Initial or breakdown rolling shall be followed by rolling with a pneumatic-tired roller. Final compaction and finish rolling shall be done by means of a tandem power roller.
- (B) On small areas or where equipment specified above is not available or is impractical, the Engineer will approve the use of small vibrating rollers or vibrating plate type compactors provided comparable compaction is obtained.

The surface of the temporary pavement shall be finished flush with the adjacent pavement.

336.2.4 Permanent Pavement Replacement and Adjustments:

336.2.4.1 Permanent Asphalt Pavement Replacement: All asphalt pavement replacement shall match gradation and thickness of the existing pavement. Immediately preceding the placement of permanent pavement the density of the base material shall comply with requirements of Table [601-2](#). Asphalt concrete pavement shall be compacted to the same density specified in Section [321](#). The compacted thickness of all courses shall conform to the recommended thicknesses of Table [710-1](#).

Unless otherwise noted, asphalt concrete pavement replacement shall comply with the following:

- (A) Single course pavement replacement shall consist of a 1/2" or 3/4" mix in accordance with Section [710](#).
- (B) The base course(s) of a multi-course pavement replacement shall consist of a 3/4" mix in accordance with Section [710](#).
- (C) The surface course of a multi-course pavement replacement shall consist of a 3/8" or 1/2" mix in accordance with Section [710](#) to match the existing surface.
- (D) Where the base course is to be placed with non-compactive equipment, it shall be immediately rolled with a

SECTION 336

pneumatic-tired roller.

(E) Pavement replacement over trenches where the pavement replacement width is 6 feet or more, all courses shall be placed with self-propelled spreading and compacting equipment. When the pavement replacement width is from 6 to 8 feet, self-propelled spreading and compacting equipment shall not be wider than 8 feet.

(F) Placement of the surface course is to be by means which will result in a surface flush with the existing pavement. The pavement replacement surface shall not vary more than 1/4 inch from the lower edge of a straightedge placed across the replacement pavement surface between edges of the existing matched surfaces. When the pavement replacement includes replacement of the roadway crown, the surface smoothness shall comply with requirements of Section [321](#).

(G) Pavement replacement extending to the edge of asphalt pavement not abutting concrete shall have a safety edge or thickened edge constructed per Detail 201 as deemed appropriate by the local jurisdiction.

For trench cuts, pavement widening, or other partial pavement installations greater than 300 feet in length the entire area shall be slurry seal coated in accordance with Section [332](#) or as otherwise specified. The seal coat shall extend from the edge of pavement or lip of gutter to the street centerline except that on residential streets less than 36 feet face to face of curb and where the pavement patch straddles the centerline, the entire width of street shall be seal coated.

In lieu of placing the seal coat as required previously, and with approval of the local jurisdiction, the Contractor may deposit with the Street Maintenance Department for credit, a negotiated agreed upon amount. The Street Maintenance Department will incorporate this work into their street maintenance program.

336.2.4.2 Adjustments: When new or existing manholes, valves, survey monuments, clean outs, etc. fall within the limits of the permanent pavement replacement as discussed in this Section, the Contractor shall be responsible for adjusting the various items to the new pavement surface.

The Contractor shall coordinate with the Engineer and with representatives of the various utilities regarding the adjustment and inspection of the work. The Contractor shall be responsible for obtaining and complying with all specifications, special requirements, and details for the adjustment of utility company facilities. When adjusting the Agency's utilities, survey monuments, etc., the adjustment will comply with these specifications and details.

The work will be done in compliance with OSHA standards and regulations regarding confined space entry. The Contractor shall remove all material attached to the lids and/or covers including that of prior work. The method of removal shall be approved by the Engineer and/or the Utility Representative.

336.3 TYPES AND LOCATIONS OF TRENCH SURFACE REPLACEMENT:

Trench backfill shall be in place and compacted to the density required in Table [601-2](#) prior to the placement of the asphalt concrete structural section or other surfacing.

Laying a single course or the base course(s) of the asphalt concrete pavement replacement for trenches shall never be more than 1320 feet behind the ABC placement for the pavement replacement.

Type of surface replacement required for trenches shall be as noted on the plans or special provisions and construction shall be in accordance with Detail 200-1 and 200-2. If a trench repair type is not noted on the plans or specified in the special provisions, the following criteria will govern:

Type A trench repair will be used for all asphalt concrete paved streets where the excavation is essentially longitudinal or parallel to traffic. Full depth longitudinal joints shall not be located within forty-eight inches (48") of an asphalt pavement edge or within a lane wheel path. The lane wheel path for a traffic lane is the entire lane width except the area within one foot of a traffic lane line stripe and except the center two feet of the lane. The lane wheel path for a designated bike lane is the entire lane width except the area within six inches (6") of a bike lane edge stripe. When the surface match point is located within 48" of an asphalt pavement edge, all asphalt surfacing shall be removed to the asphalt edge, the replacement surfacing shall extend to the asphalt edge. The traffic lane wheel path restrictions for full depth longitudinal joints do not apply for offset joints that provide at least a six-inch horizontal offset between the surface course joint and the joint in the underlying asphalt layer. The depth of the asphalt surface course shall be equal to or greater than the minimum thickness recommended in Table [710-1](#).

SECTION 336

T-Top trench repair will be used where the excavation is essentially transverse or not parallel to traffic, including trenches that go through an intersection.

Type B trench repair shall only be used when specified by the local jurisdiction.

Type D trench repair will be used to repair surfaces other than asphalt concrete or portland cement concrete pavement. The surface replacement shall be of a like type and depth as the existing material, compacted to the densities required in Section [601](#).

Where a longitudinal trench is partly in pavement, the pavement shall be replaced to a neat straight line located at the outer limits of the existing pavement.

Where asphalt pavement replacement extends to an uncurbed asphalt edge, the agency designated edge treatment shown in Detail 201 (Type A, Type B, or Safety Edge) shall be installed.

Where a trench is in a landscaped or graded area outside of pavement, no special surface treatment is required except as indicated by plans or specifications.

336.4 MEASUREMENT:

Measurement for surface replacement shall be by the square yard, based on actual field measurement of the area covered except as noted below.

(A) In computing pay quantities for surface replacement of Type B trench repair, the default pay width will be based on the dimension calculated from Table [601-1](#) for the “Maximum Width at Top of Pipe Greater Than O.D. of Barrel.” The pay width will be adjusted to the minimum required field width when relocation of the pavement match point is due to the remnant requirement or when pavements less than 4” thick are required to be adjusted outside of a wheel path.

(B) In computing pay quantities for surface replacement of a T-Top or Type A trench repair, the default widths will be based on the dimension calculated from Table [601-1](#), for the “Maximum Width at Top of Pipe Greater Than O.D. of Barrel” plus 24 inches. The pay width will be adjusted to the minimum required field width when relocation of the pavement match point is due to the remnant requirement or when pavements less than 4” thick are required to be adjusted outside of a wheel path. In all cases, the minimum pay width for T-Top or Type A surface replacement shall be 48 inches.

(C) In computing pay quantities of surface replacement for Type D trench repair, pay widths will be based on the dimension calculated from Table [601-1](#) for the “Maximum Width at Top of Pipe Greater Than O.D. of Barrel.” In all cases, the minimum pay width for Type D surface replacement shall be 48 inches.

(D) Where a longitudinal trench is partly in asphalt pavement, pay quantities shall not exceed actual pavement replacement quantities. The measurement shall be the area as allowed for the respective Type A or Type B trench repair limited to that portion located within the existing pavement. The minimum 48 inch pay width for the Type A pavement replacement does not apply when the trench is partially in pavement.

(E) The length of pavement and surfacing replacement shall be measured through any manhole, valve box, or other structure constructed in the pipe line, and any pavement or surface replacement and/or seal treatment in excess of the trench repair width shall be considered and included in the bid item for such structure.

(F) Any pavement replacement in excess of the specified pay widths necessitated by the installation of valves, tapping sleeves and valves, valve by-passes, and concrete thrust blocks shall be included in the bid price for these items.

(G) Measurement of pavement and surfacing replacement shall be made along the finished surface excluding any extra replacement required due to Contractor caused damage. The measured quantity shall be computed to the nearest square yard.

(H) No separate measurement or payment will be made for the required construction of a Detail 201 edge treatment.

SECTION 336

336.5 PAYMENT:

Direct payment for pavement or other surface replacement will be made for replacement over all pipe trench cuts except as otherwise noted in the special provisions. Payment for surface replacement over other work shall be included in the cost of constructing that work.

Payment for temporary pavement replacement shall be included in the cost of the pipe.

Payment for pavement replacement shall include the replacement cost of any existing pavement markings that have been degraded, obscured, obliterated or removed.

When a Contractor has the option of jacking and/or boring or open cut construction, and elects to construct a pipeline by the jacking and/or boring method, the Contractor will be paid for the replacement of such items of work as pavement, curb and gutter, sidewalk, driveway, and alley entrances, as allowed for open cut construction.

- End of Section -

This Page is Reserved For Future Use

SECTION 337

CRACK SEALING

337.1 DESCRIPTION:

This work consists of furnishing and placing sealant material in Contractor prepared cracks and joints of asphalt concrete or Portland cement concrete pavements. All cracks and joints, including the space between asphalt concrete pavement and the curb and gutter, which have a clear opening of one-quarter inch ($\frac{1}{4}$ ") or greater, shall be sealed for the length of the crack that equals or exceeds one-eighth inch ($\frac{1}{8}$ ") in width. The Contractor shall notify the Engineer when cracks are encountered that have an opening greater than one inch (>1 "). The Engineer shall specify the treatment requirements for cracks having an average clear opening greater than one inch (>1 ").

337.2 MATERIALS:

Sealant materials shall be a premixed, single component mixture of asphalt cement, aromatic extender oils, polymers, and granulated rubber in a closely controlled manufacturing process. Materials shall conform to the following specifications when heated in accordance with ASTM [D5078](#) and the manufacturer's maximum safe heating temperature.

TEST	REQUIREMENT
Cone Penetration (ASTM D5329)	20-40
Resilience (ASTM D5329)	30% Minimum
Softening Point (ASTM D113)	210°F (99°C) Minimum
Ductility, 77°F (25°C) (ASTM D113)	30 cm Minimum
Flexibility (ASTM D3111 *Modified)	Pass at 30°F (-1°C)
Flow 140°F (60°C) (ASTM D5329)	3 mm Maximum
Brookfield Viscosity 400° (204°C) (ASTM D2669)	100 Poise Maximum
Asphalt Compatibility (ASTM D5329)	Pass
Bitumen Content (ASTM D4)	60% Minimum
Tensile Adhesion (ASTM D5329)	400% Minimum
Maximum Heating Temperature	400°F (204°C)
Minimum Heating Temperature	380°F (193°C)
Flash Point (ASTM D92)	450°F Minimum

*Specimen bent 90° over a 1-inch mandrel within 10 seconds.

337.2.1 Certification and Quality Assurance: Prior to application, the Contractor shall submit certification of compliance to the Engineer for all materials to be used in the work.

337.3 EQUIPMENT:

The melter applicator unit shall be a self-contained double boiler device with the transmittal of heat through heat transfer oil. It must be equipped with an on board automatic heat controlling device to permit the attainment of a predetermined temperature, and then maintain that temperature as long as required. The unit shall also have a means to vigorously and continuously agitate the sealant to meet the requirements of Appendix X1.1 of ATSM [D6690](#). The sealant shall be applied to the pavement under pressure supplied by a gear pump with a hose and wand and direct connecting applicator tip. The pump shall have sufficient pressure to apply designated sealant at a rate of at least three (3) gallons (11.4 L) per minute. Melter applicators shall be approved for use by the sealant manufacturer.

337.4 CLEANING AND PREPARING CRACKS OR JOINTS:

Immediately prior to application of sealant, all cracks and joints shall be cleaned of debris and dust. Cracks and joints shall be vacuumed during final cleaning.

SECTION 337

337.4.1 Routing: Routing, when specified, shall create a sealant reservoir. Cutting should remove at least 1/8" from each side and produce vertical, intact surfaces with no loosely bonded aggregate. Routing of joints and cracks shall produce a reservoir having a nominal size of 3/4" wide x 3/4" deep. Variations from the nominal size are subject to acceptance or rejection at the engineer's discretion.

337.4.2 Vacuuming: Final cleaning shall thoroughly clean cracks and joints to a minimum depth of 1". The vacuum unit shall use high pressure 90 psi minimum, dry oil free compressed air to remove remaining dust. The high pressure tool shall be integral with a vacuum unit to collect the dust and residue. Both sides of the crack or joint shall be cleaned. Surfaces will be inspected to assure adequate cleanliness and dryness.

337.5 APPLICATION:

337.5.1 Weather: In no case shall sealant be placed during damp roadway conditions such as wet roadway surfaces or damp material inside the cracks. Operations stopped by the Engineer, due to weather, shall be at no additional cost to the contracting Agency. If installing at night, ensure that dew is not forming on the pavement surface.

Sealant material shall only be applied when pavement temperature exceeds 40°F (4°C). If pavement temperature is lower than 40°F (4°C), it may be warmed using a heat lance that puts no direct flame on the pavement.

337.5.2 Temperature: Sealant temperatures should be maintained at the maximum heating temperature recommended by the manufacture.

337.5.3 Placement of Sealant: The sealant shall be applied in cracks, joints, and sealant reservoirs uniformly from bottom to top and shall be filled without formation of entrapped air or voids.

Cracks and joints shall be slightly overfilled then leveled with a 3" sealing disk or v-shaped squeegee to create a neat band extending approximately 1" on each side of the crack or joint for surface waterproofing. The band shall be as thin as possible and shall not extend more than 1/8 inch above the pavement surface.

If the pavement is to be overlaid with Hot Mix Asphalt within six months of sealant application, cracks shall be routed, and sealant placement shall be recessed 1/4" in the crack or joint reservoir with no over band. If routing is not used, the sealant over band thickness and width should be kept as narrow and thin as possible.

During and after placement of the sealant, the Contractor shall protect against harm to persons or animals that may be exposed to the hot material.

337.5.4 Unacceptable Work: The Contractor, at no additional cost to the contracting Agency, shall correct unacceptable work. Unacceptable work shall include, but not be limited to, unsealed cracks, material wastage on the sides of the roadway, and excess quantities of material on the roadway that adversely affects driving.

Correction of unacceptable work shall be accomplished within five working days after notification from the Engineer of the unacceptable work. The Contractor shall not progress to a new area until the unacceptable work is corrected to the satisfaction of the Engineer.

337.5.5 Reporting Requirements: The Contractor shall meet with the Engineer or the Engineer's designated representative on a daily basis and supply a signed daily report indicating the amount of crack sealant material applied for the day in total pounds and total square yards of pavement sealed. In addition, the Contractor shall supply the Engineer with the dates of completion of each road segment.

337.6 OPENING TO TRAFFIC:

Sealant material shall not be exposed to traffic until fully cured. If the sealed area must be open to traffic, blotter material shall be applied to the surface of all uncured sealant material.

All sealed cracks that have an average clear opening of 1 1/2 inches or greater shall have blotter material applied prior to opening to traffic.

SECTION 337

337.6.1 Blotter: On two lane roads or where traffic may come in contact with the hot sealant before it cures, a blotter or specialized bond breaking material shall be used to prevent asphalt bleeding and/or pickup of sealant by vehicular traffic. Blotter material shall be compatible with the crack sealant and any surface treatment being used.

337.7 MEASUREMENT:

Accepted pavement crack sealing shall be measured as indicated in the fee proposal by one of the following methods: square yards of pavement surface area sealed, pounds of sealant placed, or linear feet of cracks sealed.

337.8 PAYMENT:

Payment for pavement crack sealing at the contract unit price shall be full compensation for all labor, materials, equipment, tools, and incidentals used for surface preparation, placement of crack sealant and blotter materials, and cleanup.

- End of Section -

SECTION 340

CONCRETE CURB, GUTTER, SIDEWALK, CURB RAMPS, DRIVEWAY AND ALLEY ENTRANCE

340.1 DESCRIPTION:

The various types of concrete curb, gutter, sidewalk, curb ramps, driveways and alley entrances shall be constructed to the dimensions indicated on the plans and standard detail drawings.

340.2 MATERIALS:

Concrete shall conform to the requirements of Section [725](#). Concrete class shall be as noted on the standard details.

Expansion joint filler shall be ½-inch thick preformed bituminous material in compliance with Section [729](#), unless otherwise noted.

340.2.1 Detectable Warnings: Truncated dome dimensions and spacing for detectable warnings are defined by the Americans with Disabilities Act Accessibilities Guidelines (ADAAG) for optimal detect-ability and public safety. Detectable warnings shall consist of raised truncated domes aligned in a square grid pattern in conformity to the ADAAG. Truncated domes shall have the following nominal dimensions: base diameter of 1.0 inches (0.9 inches minimum) top diameter of 50 percent of the base diameter minimum to 65 percent of the base diameter maximum, and height of 0.2 inches. Dome center-to-center spacing of 2.35 inches, measured between the most adjacent domes on the square grid. Dome center-to-center spacing for radial installations shall be 1.6 inches minimum and 2.4 inches maximum with a base-to-base spacing of 0.65 inches minimum. Detectable warning edges shall be sized and installed so that dome spacing is maintained across adjoining edges. Each dome shall have a minimum static friction of coefficient of 0.8 as tested per ASTM C1028.

340.2.1.1 Color and Contrast: Detectable warnings shall contrast visually with adjoining surfaces, either light-on-dark or dark-on-light. Specific colors to be used shall be approved by the local jurisdictional agency prior to installation. Detectable warnings shall have integral color throughout.

340.2.1.2 Materials: Detectable warning materials shall be durable with a non-slip surface not subject to spalling, chipping, delamination, or separation. All detectable warnings shall be approved by the local jurisdictional agency prior to installation.

340.2.1.3 Attachment System: Detectable warnings shall be either placed in freshly poured concrete (wet-set) or recessed into pre-formed concrete. Detectable warnings using wet-set placement shall have an anchoring method that assures constant contact of the detectable warning bottom surface with the concrete as it cures, thus rendering the ramp a single monolithic structure. The thicker and heavier detectable warnings lowered into pre-formed recesses in the concrete substrate must demonstrate a firm fitting into metal reinforced frames without gaps along the edges that can channel water, sand, or debris. They must also be able to resist movement (i.e. sliding, rocking, or lifting) once in service. All attachment systems shall be approved by the local jurisdictional agency.

340.3 CONSTRUCTION METHODS:

Existing concrete shall have a clean vertical edge where it is to be joined by new construction. Sawcutting is required when the existing matching edge is not a straight vertical edge.

340.3.1 Subgrade Preparation: The subgrade shall be constructed and compacted true to grades and lines shown on the plans and as specified in Section [301](#). All soft or unsuitable material shall be removed to a depth of not less than 6 inches below subgrade elevation and replaced with material satisfactory to the Engineer. Removal and replacement of soft or unsuitable materials will be paid for as extra work.

Subgrade classified as marginally expansive or expansive as defined in Table [340-1](#) shall be treated as follows unless the construction documents require alternative measures for mitigation of expansive soils. The upper 6 inches of marginally expansive soils shall be compacted per Section [301.3](#) at a moisture content between 0% to 3% above optimum moisture per ASTM [D698](#). Expansive soils shall be considered unsuitable and shall be treated or removed and replaced with material as directed by the Engineer. Alternate corrective measures contained in an existing geotechnical report or new site analysis can be submitted to the Engineer for approval. The submittal of alternative corrective measures must be a recommendation of an

SECTION 340

Arizona registered engineer and have the professional seal affixed.

Table 340-1			
Description	Percent Fines (– #200 sieve) ⁽¹⁾	Plasticity Index ⁽²⁾	Additional Testing
Non-expansive	> 20%	≤ 15	None
Potentially expansive		> 15	Perform Swell Test ⁽³⁾
Description	% Swell ⁽³⁾		
Non-expansive	< 1		
Marginally expansive	1 – 3		
Expansive	> 3		

(1) Tested in accordance with ASTM [C117](#)

(2) Tested in accordance with AASHTO T-90 (wet prep per AASHTO T-146)

(3) Swell Test: Samples for swell tests shall be re-molded in accordance with ARIZ 249 (ADOT Materials Testing Manual) to 95% of maximum dry density at optimum moisture as determined by ASTM [D698](#) and tested for one-dimensional expansion in accordance with the applicable portions of ASTM [D4546](#) applying a surcharge of 144 psf.

Material removed for construction shall not be placed on the base and/or surfacing material already in place on the roadway nor shall the excavated material be placed in such a manner as to interfere with access to property or traffic flow in the street.

340.3.2 Formwork: Concrete curbs, gutters and sidewalks shall be constructed by the conventional use of forms, or may be constructed by means of an appropriate machine when approved by the Engineer.

If machines designed specifically for such work and approved by the Engineer are used, the results must be equal to or better than that produced by the use of forms. If the results are not satisfactory to the Engineer, the use of the machine shall be discontinued and the Contractor shall make necessary repairs at his own expense. All applicable requirements of construction by use of forms shall apply to the use of machines.

Forms conforming to the dimensions of the curb, gutter, sidewalk, curb ramps, driveway, and alley entrance shall be carefully set to line and grade, and securely staked in position. The forms and subgrade shall be watered immediately in advance of placing concrete.

Forms shall be thoroughly cleaned each time they are used, and shall be coated with a light oil, or other releasing agent of a type which will not discolor the concrete.

340.3.3 Concrete Placement: The concrete shall be thoroughly spaded away from the forms so that there will be no rock pockets next to the forms. The concrete may be compacted by mechanical vibrators approved by the Engineer. Tamping or vibrating shall continue until the mortar flushes to the surface, and the coarse aggregate is below the concrete surface. The surface shall then be struck off and worked to grade and cross section with a float.

If machine placement is used, the machine shall place, consolidate and finish the concrete in one complete pass, requiring a minimum of hand finishing producing a dense and homogeneous section. A form shall trail behind the machine for such a distance that no appreciable concrete slumping will occur. Final finishing shall be as specified in Section [340.3.7](#), Form Removal and Finishing.

340.3.4 Joints: Shall be constructed in a straight line, vertical plane and perpendicular to the longitudinal line of the sidewalk, curb and gutter, single curb, etc., except in cases of curved alignment, where they shall be constructed along the radial lines of the curve.

Curb and gutter joints shall match the location of concrete pavement joints when abutting concrete pavement.

The space between joints in curbs and gutters (space between contraction joints or between contraction and expansion joints) shall not exceed ten feet.

Sidewalk that abuts curb or gutter shall have joints that match the curb or gutter joints.

SECTION 340

The space between sidewalk joints shall not exceed 125% of the sidewalk width (for example: maximum joint spacing for 5 foot wide sidewalk is 6.25 feet).

340.3.4.1 Expansion Joints: Expansion joints shall be constructed to the full depth and width of the concrete. The expansion joint material shall extend fully through the concrete and one inch into the subgrade with the top of the expansion joint material one-quarter inch below the top surface. Expansion joint material shall be secured in place prior to placement of concrete.

Expansion joints shall be installed along all abutting structures to provide complete separation from the structure.

Sidewalk, curb, and gutter expansion joints shall be installed at all radius points, at both sides of each driveway, at both sides of each alley entrance. The maximum distance between expansion joints shall be 50 feet.

340.3.4.2 Contraction Joints: Unless otherwise specified, the large aggregate in contraction joints shall be separated to either side of the joint for a minimum depth equal to 25% of the concrete thickness; the finished depth shall be a minimum of 3/4 inch.

340.3.5 Edges: All exposed edges shall be shaped with a suitable tool to form edges having the shape as indicated on the referenced detail.

340.3.6 Detectable Warnings: Detectable warnings shall be installed perpendicular to the direction of pedestrian/wheelchair travel and have a minimum width of 24 inches measured perpendicular to the edge of the roadway or rail crossing. The base surface of detectable warnings shall be installed flush with the adjacent walkway surface; the truncated domes shall extend above the walkway surface. The boundary between detectable warnings and the adjacent walkway shall provide a flush uniform surface that will not cause ponding of water nor present a tripping hazard. Partial domes at the edge of the detectable warning shall be made flush to match the base surface of the detectable warning. Detectable warnings installed on curb ramps shall extend the full width of the ramp depression.

Detectable warnings installed on curb ramps shall modify the sidewalk concrete thickness at the detectable warning to provide a minimum concrete thickness of four-inches (4"). When detectable warnings are modules inset into the curb ramp, the bottom surface of the sidewalk shall be lowered a distance equal to or greater than the module thickness to maintain the minimum sidewalk thickness. The sidewalk bottom surface shall have a minimum transition taper length of 12" between the thickened and normal depth sections of sidewalk. The detectable warning surface shall be located so that the edge nearest the curb line is 6 inches minimum and 8 inches maximum back from the face of curb.

Detectable warning surfaces for pedestrian at-grade rail crossings not located within a street or highway shall be installed on each side of the rail crossing, located as shown on plans. Detectable warnings shall extend the full width of the pedestrian walkway.

340.3.7 Form Removal and Finishing: The front face form shall not be removed before the concrete has taken initial set and has sufficient strength to carry its own weight. Gutter forms and rear forms shall not be removed until concrete has hardened sufficiently to prevent damage to the edges. Any portion of concrete damaged while stripping forms shall be repaired or replaced at no additional cost to the Contracting Agency.

After the forms are removed, the joints shall be tooled and the surface finished with a float to remove all imperfections. As needed, retool joints after finishing to prevent groove bonding. In all cases, the resulting surface shall be smooth and of uniform color with all rough spots, projections, and form stakes removed. No plastering of the concrete will be allowed. The concrete work shall have a true surface; shall be free from sags, twists, or warps; have a uniform appearance; and be true to the lines, grades, and configurations indicated on the drawings.

Surfaces shall be light broom finished; flow lines shall be troweled for a smooth finish.

If the evaporation rate on the concrete surface exceeds the rate of bleeding of the concrete due to weather conditions, materials used, or for any other reason, and there is any likelihood of the fresh concrete checking or cracking before the curing operation, measures shall be taken to prevent the rapid evaporation of water from the surface during finishing operations. When allowed by the Engineer, the addition of water to the surface may be permitted as an indirect fog spray with approved spray equipment immediately after screeding and/or between finishing operations. A commercial evaporation reducer that forms a monomolecular film may also be sprayed onto the concrete surface in accordance with the manufacturer's recommendations. At no time will free water/evaporation reducer be worked into the concrete surface. Approved measures shall continue until curing operations per Section [340.3.8](#), Curing, are started in the particular area affected.

SECTION 340

The Contractor shall stamp the company name and year on each end of the sidewalk or curb ramp constructed. The letters shall not be less than 3/4 inch in height and the depth of the stamped impression shall be between 1/8-inch and 1/4-inch.

340.3.8 Curing: As soon after the completion of the finishing operation as the condition of the concrete will permit, all exposed surfaces shall either be sprayed with a pigmented curing compound or sealed with a material conforming to Section [726](#). Curing compound shall be applied under pressure through a spray nozzle in such manner and quantity as to entirely seal all exposed concrete surfaces with a uniform film. The membrane shall be applied in two applications for a total coverage of 150 square feet per gallon. Concrete surfaces shall be kept damp until the curing compound is applied. Should the curing compound seal be broken or damaged before the expiration of 10 days after the placing of the concrete, the break shall be immediately repaired by the application of additional curing compound over the damaged area.

The need for adequate curing is greatest during the first few hours after placement of the concrete.

340.3.9 Tolerances: The face, top, back, and flow line of the curb and gutter shall not deviate in excess of 1/4-inch over 10 feet, as tested with a 10-foot straightedge or curve template, longitudinally along the surface.

The surface of concrete sidewalk or curb ramp shall not deviate in excess of 1/8-inch over 5 feet as tested with a 5-foot straightedge except for the 1/4-inch recess of the preformed material in expansion joints.

All finished concrete elevations shall not deviate from the elevations shown on the plans, or indicated by typical sections or standard details referenced within the construction documents, by more than 1/2 inch.

When required by the Engineer, gutters shall be water tested. The Contractor shall establish flow in the length of gutter to be tested by supplying and distributing water from a hydrant, tank truck or other source. After the supply of water is shut off and water has stopped flowing, the gutter shall be inspected for evidence of ponding or improper shape. The work shall be deemed deficient if water is found ponded in the gutter to a depth greater than 1/2 inch or ponding extends onto the adjacent asphalt pavement.

Areas between elevations shown on the plans shall be straight graded or smoothly transitioned through a vertical curve in a manner approved by the Engineer or as otherwise indicated on the construction documents.

340.3.10 Deficiencies: Any section of the work deficient in depth or not conforming to the plans or specifications shall be removed and replaced by the Contractor at no additional cost to the Contracting Agency. Replacement or reconstruction shall be from joint to joint.

Concrete work that does not comply with tolerance requirements of Section [340.3.9](#), Tolerances, shall be removed and replaced. Remove and replace gutters that exceed the ponding tolerance. Grinding shall only be allowed if approved by the Engineer.

340.4 BACKFILLING:

Unless otherwise specified the Contractor shall backfill behind the curbs, sidewalk or curb ramps with soil native to the area to the lines and grades shown on the plans.

340.5 MEASUREMENT:

Concrete curbs and gutters of the various types shown on the plans and in the proposal will be measured along gutter flow line through inlets, catch basins, driveways, curb ramps, etc., by the lineal foot to the nearest foot for each type, complete in place. Measurement for curb terminations and transitions shall be included with the linear measurement of the various types of curb or curb and gutter as shown on the plans and in the proposal.

Curb and gutter type shall be based on the configuration of the final exposed surfaces. The increased curb and gutter depth required at valley gutter aprons or driveways shall not be measured as a separate pay item; any additional Contractor cost shall be included in the unit cost associated with the valley gutter, driveway or other associated item.

Concrete sidewalks, driveways, alley intersections, valley gutters and aprons will be measured to the nearest square foot complete in place.

SECTION 340

Detectable warnings shall not be measured for payment. Detectable warnings are considered integral to the walking surface that they form a part of and the cost is included in the related pay item.

- Curb ramp installations shall be measured as complete installed units and shall include the ramp curb and the walking surfaces between the ramp curb and back of curb and gutter or single curb. Single curb or curb and gutter located at the edge of roadway
- shall be measured and paid for separately. The surface area of curb ramps shall not be included in the measured quantity for sidewalk.

340.6 PAYMENT:

Payment will be made in accordance with the unit prices or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, material, tools and equipment and accomplishing all work in conformance with the contract documents.

Over-excavation of soft, expansive or unsuitable materials and installation granular materials will be paid as a separate pay item, not included with the above measured pay items.

- End of Section -

SECTION 342

INTERLOCKING CONCRETE PAVER INSTALLATIONS

342.1 GENERAL:

The Contractor shall furnish all necessary labor, material, tools and equipment to complete the proper installation of interlocking concrete pavers used in medians, crosswalks, intersections and other locations noted in Contract Documents. This includes furnishing a 10-foot straightedge to accomplish the testing required by this specification.

342.2 MATERIALS:

342.2.1 Aggregate Base Course: Aggregate Base Course shall be per Table [702-1](#).

342.2.2 Portland Cement Concrete: For installations subject to vehicular traffic, portland cement concrete used for headers or underlying base slabs for pavers shall be Class A per Section [725](#). At locations not subject to vehicle traffic loads, the portland cement concrete shall be a minimum of Class B per Section [725](#).

342.2.3 Sand: Sand used for laying course shall conform to ASTM [C33](#) except for the gradation. The gradation shall comply with Table [342-1](#).

TABLE 342-1								
SAND GRADATION								
Sieve Size	3/8 inch	No. 4	No. 8	No. 16	No.30	No. 50	No. 100	No. 200
Percent Passing	100	95-100	85-100	15-85	25-60	10-30	2-10	0-1

342.2.4 Concrete Pavers: Pavers shall have a minimum thickness of 80 mm (3.15 inches) when installed in vehicular traffic bearing areas and 60 mm (2.36 inches) when installed in non-traffic bearings areas. Pavers shall be of an interlocking design conforming to ASTM [C936](#). Pavers shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. The Contractor shall submit two samples of each type of pavers used on the project for review and approval by the Engineer prior to any work. The pavers and materials used in their manufacture shall conform to the following:

(A) Compressive Strength: Pavers shall have a minimum compressive strength of 8,000 psi in accordance with ASTM [C140](#).

(B) Absorption: The average absorption shall not be greater than 5 percent, with no individual unit absorption greater than 7 percent.

(C) Portland Cement: Cement shall comply with Section [725.2](#), Type II.

(D) Aggregates: Aggregates shall conform to ASTM [C33](#) (washed, graded sand and rock, no expanded shale or lightweight aggregates).

(E) Other Constituents: Coloring pigments shall be applied integrally to the concrete. Air entraining admixtures, coloring pigments, integral water repellents, and finely ground silica shall be previously established as suitable for use in concrete and either shall conform to ASTM standards where applicable, or shall be shown by test or experience not to be detrimental to the concrete.

(F) Physical Properties: The size, shape, design and color of the pavers shall be as noted in the Contract Documents.

342.2.5 Expansion Joint Filler: Expansion joint filler material shall be 1/2-inch premolded joint filler that complies with Section [729](#) and ASTM [D1751](#).

342.2.6 Joint Sealant: Joint sealant shall be elastomeric joint sealant conforming to ASTM [C920](#), Type S, Grade NS, Class 25.

342.3 CONSTRUCTION PROCEDURES:

342.3.1 Subgrade: The subgrade shall be constructed true to grades and lines shown on the plans in compliance with subgrade tolerances and compaction requirements as specified in Section [301](#).

SECTION 342

342.3.2 Aggregate Base Course: When aggregate base course is specified, the aggregate base course shall be constructed true to grades and lines shown on the plans in compliance with grade and cross-section tolerances and compaction requirements of Section [310](#).

342.3.3 Concrete Header and Base Slab: Forms shall be thoroughly cleaned each time they are used, and shall be coated with a light oil or other releasing agent of a type which will not discolor the portland cement concrete.

The portland cement concrete shall be thoroughly spaded away from the forms so that there will be no rock pockets next to the forms. Compacted by mechanical vibrators may be used when approved by the Engineer. Tamping or vibrating shall continue until the mortar flushes to the surface, and the coarse aggregate has been tamped below the surface.

All edges shall be shaped with a suitable tool to form a rounded edge of radius as shown on the referenced detail.

The portland cement concrete header face form shall not be removed before the concrete has taken the initial set and has sufficient strength to carry its own weight. The concrete header outer form shall not be removed until the concrete has hardened sufficiently to prevent any damage to the concrete. Any porting of concrete damaged while stripping forms shall be repaired or if the damage is severe, replaced at no additional cost to the Contracting Agency. The face and top of the concrete header shall be tested with a 10-foot straightedge or curve template, longitudinally along the surface. Any deviation in excess of 1/4-inch in 10-feet shall be corrected at no additional cost to the Contracting Agency.

Any section of the work deficient in depth or not conforming to the plans or specifications shall be removed and replaced by the Contractor at no additional cost to the Contracting Agency.

Finishing and curing of the concrete shall be done in the manner specified in Section [340](#).

342.3.4 Expansion Joints: Expansion joints in the concrete base slab shall be constructed to the full depth and width of the concrete base slab with the top of the filler material recessed one-half inch below the top surface of the concrete base slab unless otherwise specified. After the concrete is cured, the top one-half inch shall be filled to the surface of the concrete with joint sealant.

Expansion joints in the concrete base slab and header shall be aligned. Joints shall be constructed in a straight line and vertical plane perpendicular to the longitudinal line of the concrete header, except in cases of curved alignment when they shall be constructed along the radial lines of the header. Expansion joints shall be located at 50-foot maximum intervals. Pavers shall be placed continuously over the expansion joints.

342.3.5 Contraction Joints: Contraction joints in the base slab and header shall be aligned. Joints shall be constructed in a straight line and vertical plane perpendicular to the longitudinal line of the concrete header, except in cases of curved alignment when they shall be constructed along the radial lines of the header. Contraction joints in the concrete base slab shall be constructed one-half inch in width to a depth of one inch and located at 10-foot maximum intervals. Contraction joints shall be filled to the top surface of the concrete base slab with joint sealant.

342.3.6 Sand Laying Course: The maximum thickness of the sand course shall be one-inch. Screeding boards shall be used to ensure a uniform thickness. The sand shall not be compacted, walked on or wet down.

342.3.7 Concrete Pavers: The concrete pavers shall be clean and free of foreign materials before installation. Paving work shall be true to line and grade and shall be installed to properly coincide and align with adjacent work and elevations. All edges shall be fixed or retained to secure the perimeter pavers and the sand laying course. The pavers shall be laid in such a manner that the desired pattern is maintained and joints between the pavers are as tight as possible.

The Contractor shall lay the pavers starting from the longest straight line and from a true 90 degrees corner. The pavers shall be installed hand-tight and level on the undisturbed sand course in a manner that eliminates gaps between pavers and between pavers and headers. The maximum gap between pavers shall not exceed 3/16 inch. String lines or other approved methods shall be used to hold all pattern lines true. Gaps between pavers at headers exceeding 3/8-inch shall be filled with pavers cut to fit. Cutting shall be accomplished using a masonry saw. The cut paver shall be placed with the clean surface edge exposed to the traffic (vehicular or pedestrian).

SECTION 342

After the pavers are in place, they shall be vibrated into the sand laying course. After vibration, approximately 1/4 inch of clean masonry sand shall be placed over the paver surface, allowed to dry, and vibrated into the joints with additional vibrator passes and brushing so as to completely fill joints. Excess sand shall be swept from the surface.

The finished paver surface shall be tested longitudinally and transverse to the concrete header or curb with a 10-foot straightedge along the surface. Any deviation in excess of 1/8-inch shall be corrected at no additional cost to the Contracting Agency.

Any broken or damaged pavers shall be removed and replaced. Replacement pavers shall be tamped into place and the joints filled with masonry sand as specified herein. The completed installation shall be cleaned of all debris, surplus material and equipment.

342.4 MEASUREMENT:

Concrete paver installations of the various types as shown on the plans will be measured to the nearest square foot. Separate measurements shall be made for areas subject to vehicle traffic and areas not subject to vehicle traffic.

Headers of the various types as shown on the plans will be measured by the linear foot to the nearest foot.

342.5 PAYMENT:

Payment for concrete pavers in areas subject to vehicle traffic will be at the contract unit price set forth in the proposal. Payment shall be full compensation for all labor, materials, tools and equipment required for the subgrade preparation, construction of the concrete base slab, and installation of concrete pavers.

Payment for concrete pavers in areas not subject to vehicle traffic will be at the contract unit price set forth in the proposal. Payment shall be full compensation for all labor, materials, tools and equipment required for the subgrade preparation, installation of aggregate base and concrete pavers.

Payment for each type of header will be at the contract unit price set forth in the proposal. Payment shall be full compensation for all labor, materials, tools and equipment required for the construction complete in place in conformance with the contract documents.

- End of Section -

SECTION 343

EXPOSED AGGREGATE PAVING

343.1 DESCRIPTION:

Exposed aggregate paving consists of placing a concrete slab with exposed aggregate in the surface of the finished concrete. This exposed aggregate paving is designed for decorative or pedestrian use only. It should not be used in areas subject to vehicular traffic.

343.2 MATERIAL:

343.2.1 Concrete: Concrete shall be Class A per Section [725](#) with a maximum slump of 3 inches.

343.2.2 Exposed Aggregate: The exposed aggregate shall be uncrushed river-run rocks. The Contractor shall provide at least a 10-pound sample for approval by the Engineer prior to any aggregate paving.

(A) When the paving is for decorative use only, no pedestrian traffic, the aggregate shall not be larger than 3 inches or smaller than 1 ½ inches.

(B) When the paving is to be used for pedestrian traffic, the aggregate shall be not larger than 2 inches or smaller than 1 inch.

343.3 CONSTRUCTION PROCEDURE:

The Contractor shall construct a sample panel 3 feet by 3 feet for inspection and approval by the Engineer, prior to actual construction. When approved, this panel shall be used as a standard for the remainder of the work.

After the slab has been placed, screeded and darbied, the aggregate shall be hand-scattered so that the entire surface is evenly covered. The surface shall be reworked so that the aggregate will be embedded just beneath the surface. The concrete shall completely surround and lightly cover the aggregate leaving no holes or voids.

A non-staining surface retarder will be applied to provide a surface penetration of at least 1/8-inch and the surface will be lightly screed to ensure penetration. The surface will be covered with a protective material for the period of time recommended by the retarder manufacturer. After this time has elapsed, the upper, retarded layer of concrete will be removed using a water jet stream and a brush. The protective cover will be replaced and the concrete allowed to cure. After curing, the surface shall be cleaned and a silicone seal applied.

343.4 MEASUREMENT AND PAYMENT:

Measurement will be by the square foot. Payment will be made at the unit bid price per square foot. This price shall be full compensation for all labor, material, tools, and equipment required to complete the work.

- End of Section -

SECTION 345

ADJUSTING FRAMES, COVERS AND VALVE BOXES

345.1 DESCRIPTION:

The Contractor shall furnish all labor, materials, and equipment necessary to adjust all frames, covers and valve boxes as indicated on the plans or as designated by the Engineer. The frames shall be set to grades established by the Engineer.

The Contractor may elect to remove old frames, covers, and valve boxes and then install new frames and/or boxes in accordance with standard detail drawings at no additional cost to the Contracting Agency.

The Contractor shall be responsible for maintaining an accurate description and location of all items to be adjusted. The locations shall be referenced with map documentation by the use of swing ties or GPS locations. This information shall be supplied to the Engineer and utility owner(s) prior to taking any action that would hide or restrict access to the items to be adjusted.

Any missing or defective frames, covers, valve boxes or related hardware shall be reported to the Engineer in writing during the initial location process to allow for timely replacement. The Engineer shall be responsible for providing replacement items to the contractor. The contractor is responsible for providing items required to accomplish the required adjustments such as additional adjusting rings, valve box extensions, meter box extensions, and pull box extensions.

345.2 LOWERING PROCEDURE:

If required, manholes, valve boxes, or survey monuments located within the paved areas to be milled or reconstructed shall be lowered to an elevation that will allow required work to be accomplished without damaging the facilities. Care shall be taken to prevent entrance of any material into the lowered facilities. Lowering shall be to a depth that will prevent damage to the utility during the construction activities.

All manhole frames, valves boxes, survey hand hole frames and related items removed by the contractor during the lowering process shall be maintained in a secure area, and the contractor shall bear full responsibility for the material. Any hardware items lost or damaged by the contractor shall be replaced in kind, at no additional cost to the Contracting Agency.

Preparation for Milling: Temporary asphalt concrete shall be placed over the steel plate filling the excavated area. The temporary pavement shall be maintained until removed during the adjustment to final grade. For manholes located on major streets that are to be kept opened to vehicular traffic, hot mix asphalt shall be used to backfill the excavated areas and compacted flush with the existing pavement prior to opening up to traffic. In residential or low volume streets with minimal traffic, cold mix or other approved product may be used for temporary pavement. No measurement or payment shall be made for temporary pavement placement or removal.

345.3 ADJUSTING FRAMES:

The Contractor shall loosen frames in such a manner that existing monuments, cleanouts, manholes, and valve boxes will not be disturbed or damaged. Debris shields shall be used to prevent debris from entering sanitary or storm sewers. All loose material and debris shall be removed from the excavation and the interiors of structures prior to resetting frames. If dirt or debris enters the sewer system the contractor shall be responsible for cleaning the sewer system for a minimum of one reach (the next downstream structure from the contamination point.)

Frames shall be set to match finished grade or the elevations and slopes established by the Engineer. Manhole frames shall be firmly blocked in place with masonry or metal supports. Spaces between the frame and the facility shall be sealed on the inside to prevent any concrete from entering the hand hole or manhole. A Class AA concrete collar shall be placed around and under the frames to provide a seal and properly seat the frame at the required elevation and slope. Concrete shall be struck off flush with the top of the existing pavement.

Adjustments of utilities, if located within the asphalt pavement, shall be made after placing the final surface course when there is only a single lift of pavement required. When there are multiple lifts of pavement required, adjustments may be made before the final surfacing or as directed by the Engineer.

SECTION 345

After removal of the temporary asphalt pavement in the area of adjustment, and prior to placement of the final concrete collar ring (as shown on Details 270 and 422) the asphalt pavement in proximity of the adjustment shall be rolled with a self-propelled steel wheel roller if requested by the Engineer.

345.4 ADJUSTING VALVE BOXES:

Valve boxes shall be adjusted to the new elevations indicated on the plans, or as established by the Engineer.

Adjustable valve boxes shall, if possible, be brought to grade by adjustment of the upper movable section. Any excavated area shall be filled with Class AA concrete to the level of the existing pavement, or as directed by the Engineer.

Concrete pipe valve boxes in areas not subject to vehicular traffic shall be adjusted to grades by installing a suitable length of metal or concrete pipe, of the same inside diameter as the present valve box, and reinforcing the outside with a concrete collar extending from at least 2 inches below the joint up to and flush with the top of the valve box extension. This collar shall be of Class AA concrete. The dimension from the outside of the box to the outside of the collar shall not be less than 2 inches. This adjustment will be known as Type B.

In areas subject to vehicular traffic and where the existing valve box is a Type B, the adjustment to the new elevation shall be made using the old cover and installing a new 8 inch frame in accordance with the standard detail for installation of valve boxes in vehicular traffic areas. This adjustment shall be known as Type BA.

Adjustment of existing Type A valve boxes to the new elevations shall be as described in Subsection 345.2. This adjustment shall be known as Type A.

345.5 ADJUSTING MANHOLE AND VALVE COVERS WITH ADJUSTMENT RINGS:

Adjusting rings may be used to raise manhole covers in asphalt pavements when deemed acceptable by the Engineer. The amount of adjustment, thickness of seal or overlay, and cross slope will be considered when using adjusting rings. Each location where an adjusting ring is used must have a sufficient depth of asphalt to assure the proper installation and operation of the ring. The rings shall be made of a concrete, non-metallic, polypropylene or fiberglass material and installed per the manufacturer's specifications. The rings shall be approved by the Engineer.

The concrete collar ring around the frame or valve box shall be circular, and shall be a minimum of eight (8) inches thick, placed flush with the adjacent new pavement surface. Concrete shall be a minimum of Class AA on all paved streets. All concrete shall be obtained from plants approved by the Engineer.

If required by the Contracting Agencies specifications or details, a single No. 4 rebar hoop will be placed in each adjustment collar. The hoop diameter shall be such that its placement is centered between the edge of the manhole frame or valve box, and the outer edge of the concrete collar, the depth of the hoop shall be centered in the thickness of the collar. Each concrete ring shall be scored radially at quarter-circle points. Score lines shall be ¼ -inch wide by ½ - inch deep. The concrete collar surface shall be rough broom finished. (See Details 270 and 422).

Traffic shall not be allowed on the concrete collars until the concrete had reached a minimum compressive strength of 2500 psi on residential and 3000 psi on collector and major streets. On major streets the contractor shall use "high-early" in the concrete mix, approved by the Engineer, to minimize delay in reopening the street(s) to traffic.

345.6 MEASUREMENT:

The quantities measured will be the actual number of frames, covers and valve boxes of each type, adjusted and accepted.

345.7 PAYMENT:

Accepted quantities, will be paid for at the contract unit price. Payment shall be compensation in full for all materials, labor, equipment and incidentals necessary to complete the work.

- End of Section -

SECTION 350

REMOVAL OF EXISTING IMPROVEMENTS

350.1 DESCRIPTION:

This work shall consist of removal and disposal of various existing improvements, such as pavements, structures, pipes, conduits, curbs and gutters, and other items necessary for the accomplishment of the improvement.

350.2 CONSTRUCTION METHODS:

350.2.1 Utilities

The removal of existing improvements shall be conducted in such a manner as not to injure active utilities or any portion of the improvement that is to remain in place.

A utility may be abandoned in place below a new major structure that is part of the work only if approved by the Agency and solidly filled with grout using methods approved by the Agency. All abandoned utilities to remain and the approved abandonment method shall be noted on the installation record drawings.

Utilities to be removed by the Contractor shall be disconnected and taken out in accordance with the requirements of the utility owner to the limits shown on the plans. Utility removal shall not be performed until a release has been obtained from the utility stating that their respective service connection and appurtenant equipment have been disconnected, removed or sealed and plugged in a safe manner.

The Engineer shall be notified when utilities are encountered that are not shown on the plans.

350.2.2 Others

Sidewalks shall be removed to a distance required to maintain a maximum slope for the replaced portion of sidewalk, for one inch per foot and all driveways shall be removed to a distance as required by standard details.

Portland cement concrete pavements, curbs and gutters and sidewalks designated on the plans for removal shall be saw-cut at match lines, in accordance with Section [601](#) and removed.

Portions of asphalt concrete pavements designated on the plans for removal shall be done in accordance with Section [336](#).

Removal of trees, stumps, roots, rubbish, and other objectionable materials in the right-of-way shall be done in accordance with Section [201](#).

350.2.3 Backfill and Disposal

Backfill of all excavated areas below structures shall be in accordance with Section 206.4. Backfill and compaction of all other excavated areas shall be compacted to the densities as prescribed in Section [601](#) (trenches) or Section 211 (holes, pits or other depressions).

All surplus materials shall be immediately hauled from the jobsite and disposed of in accordance with Section [205.6](#).

350.3 MISCELLANEOUS REMOVAL AND OTHER WORK:

This work shall include, but not be limited to the following, where called for on the plans:

- (A) Relocate existing fence and gate.
- (B) Remove and reset mail boxes.
- (C) Remove signs and bases in right-of-way.
- (D) Remove planter boxes, block walls, concrete walls, footings, headwalls, irrigation structures, and storm water inlets.

SECTION 350

(E) Install plugs for pipes and remove existing plugs as necessary for new construction.

(F) Remove wooden and concrete bridges.

(G) Remove median island slabs.

(H) Remove pavements and aggregate base where called for outside the roadway prism.

350.4 PAYMENT:

Payment for removals will be made at the unit proposal price which price shall be full compensation for the item complete, as described herein or on the plans.

- End of Section -

SECTION 355

UTILITY POTHOLES-KEYHOLE METHOD

355.1 DESCRIPTION:

This specification covers the requirements for coring, vacuum excavation, backfilling, and reinstatement of the asphalt core into asphalt pavement.

355.2 EXCAVATION:

Excavation requires coring a circular hole through asphalt pavement using drilling/coring equipment and removal of the intact asphalt pavement core. The vertical alignment of the coring operation shall be perpendicular to the horizon and cutting shall be extended the full depth of the existing pavement section.

Pavement cores shall not be greater than 24 inches in diameter, shall not be spaced closer than 3 feet between cores (edge to edge), shall not contain a joint or any pavement cracks greater than 1/8-inch wide, and shall only be obtained from pavements where the asphalt concrete section is at least 4 inches thick.

Contractor shall place a temporary mark (paint or chalk) on the pavement core and adjacent pavement prior to cutting to insure that the pavement core when replaced will have the same orientation as found in the original pavement.

Pavement cores shall be either removed from the work site or stored in a safe and secure on-site location. The cores shall be made readily available for reinstatement into the pavement.

Soil shall be removed by air/vacuum extraction methods to expose utilities. The zone of soil removal shall remain essentially within a vertical plane extending below the edges of the core hole.

The Contractor shall dispose of all excess materials.

355.3 BACKFILL AND COMPACTION:

355.3.1 Backfill Using Mechanical Compaction: Backfill shall be aggregate base per Section [702](#) or native backfill material per Section [601](#), placed in maximum 6 to 8-inch loose lifts.

Backfill compaction shall be determined by use of a compression wave amplitude monitoring device manufactured specifically for the purpose of measuring soil compaction. This device shall measure the compression wave amplitude as compaction progresses using below grade piezoelectric transducer wave sensors and an above-grade electronic monitor. The device shall signal the operator of successful compaction (the compaction wave amplitude becomes asymptotic for continued compaction effort) for each lift.

At time of compaction backfill material shall have sufficient available moisture to be compacted based on the physical appearance (soil ball) method as specified in USDA Soil Conservation Service Agricultural Information Bulletin 199, described as follows:

Firmly squeeze a palm-size sample of soil into a ball by hand. Granular soils with sufficient available moisture will tend to ball under pressure, but seldom holds together for long. Cohesive soils with sufficient available moisture will form a ball that can be rolled into approximate 1/4" wide ribbons between the palms of the hands without breaking apart, leaving no free water on the hand.

A compaction sensor shall be placed at the bottom of the first loose lift. A new sensor shall be placed for every 48 inches of compacted fill depth.

Pneumatic compaction equipment (pneumatic rammers or equivalent) shall be used for compaction of the backfill material. The size of the compactor shall not exceed one-half the diameter of the hole.

SECTION 355

Mechanical compaction on each lift shall be continued until the electronic monitor signals that compaction is complete. A new lift shall not be placed until a positive signal has been received. Remove backfill soil and sensor if the monitor does not give a positive compaction signal after repeated compaction efforts. Repeat backfilling and compaction with a new sensor.

Contractor shall provide compaction documentation to the Agency upon request.

355.3.2 Slurry Backfill: If mechanical compaction is not used, the Contractor shall use ½-sack CLSM as backfill in accordance with Section [728](#).

355.3.3 Leveling Course: A 1-1/2-inch to 2-inch thick leveling course of compacted crushed gravel meeting the requirements of ASTM [C33](#), No. 8 coarse aggregate shall be placed above the backfill and directly below the asphalt concrete pavement section.

355.4 PAVEMENT RESTORATION

The pavement surface shall be restored to its original condition by setting the reinstated pavement core flush with and in its original orientation.

Bonding agent meeting the requirements of Section [708](#) shall be used for pavement core reinstatement. Excess bonding material shall be removed from the restored pavement surface. A "patched" appearance shall be avoided in surface restoration wherever possible.

The contractor shall reinstate the pavement core within 24 hours of cutting the pavement. Holes left open longer than 24 hours after cutting shall be covered with an approved steel road plate capable of supporting traffic loads. The steel plate must be rounded with a fitted collar that, when inserted into the hole, will prevent the steel plate from tipping, tilting, bouncing or spinning out of the hole under traffic conditions. An asphalt mix shall be used to ramp pavement up to the steel plate along all edges.

355.5 SURFACE TOLERANCES

The reinstated core shall be flush and level with the adjacent pavement. Gaps attributable to the positioning of the core shall be less than 1/16-inch between the bottom of a minimum 3-foot long straightedge and the surface of the pavement in any direction on the surface of the keyhole core, except across the pavement crown or drainage gutters.

355.6 DEFICIENCIES

Where the pavement core is found to be fractured or defective upon removal, or becomes damaged after removal and prior to reinstating, the defective or damaged core shall not be used to reinstate the pavement. Pavement repair shall be performed in accordance with Detail 212, Type A Pavement Repair.

A pavement core is considered unacceptable when one of the following conditions exist:

- (a) The core contains any vertical cracks wider than 1/8-inch extending full depth or partial depth through the core; or
- (b) Any deteriorated piece of the core is larger than 10 percent of the overall area of the core.
- (c) Two or more successive layers of asphalt concrete in the core become horizontally delaminated and cannot be rebounded to each other with the bonding compound.

All unacceptable pavement cores shall be removed from the job site.

355.7 MEASUREMENT

Each acceptable utility pothole repair shall be counted. No distinction shall be made based on size of the utility pothole or method of repair.

SECTION 355

355.8 PAYMENT

Payment at the contract price for utility pothole repair complete in place shall be full compensation for all labor, equipment and material required for a complete in place installation. Payment includes traffic control and disposal of all excess materials.

- *End of Section* -

SECTION 360

TELECOMMUNICATIONS INSTALLATION

360.1 DESCRIPTION:

This work shall consist of the installation of underground telecommunications facilities within the public right-of-way.

360.2 TRENCHING, BACKFILL AND RESTORATION:

All work shall be done in accordance with Section [601](#).

360.3 CABLE INSTALLATION:

(A) "Trunk Lines" Cable providing telecommunications service by connecting regions or states or by connecting central offices within a metropolitan area. Such cable shall be installed as described below:

(1) If the cable is to be installed within an open trench, the cable shall be placed within schedule 40 PVC conduit or equal with a minimum inside diameter of 4 inches. The conduit shall be buried at a minimum depth of 48 inches below finished grade measured to the top of the conduit. A color coded plastic warning tape with a minimum thickness of 5 mil and a minimum width of 3 inches shall be installed in the trench and centered over the PVC conduit at a depth of from 18 to 30 inches below finish grade.

(2) Cable crossings under existing paved streets shall be accomplished by jacking or boring unless open trenching is authorized by the Engineer or Agency. The cable shall be placed within a schedule 40 PVC conduit or better at a minimum depth of 48 inches.

(B) Telecommunications cables other than "trunk lines" shall be installed as described below.

(1) If a cable is to be installed within the right-of-way of an arterial or collector street, it shall be placed at a minimum depth of 36 inches below finished grade. A color coded plastic warning tape as described in "A" shall be placed 18 inches below the surface.

(2) If a cable is to be installed within the right-of-way of a local/residential street it shall be placed at a minimum depth of 24 inches below finished grade.

(3) Cable crossings under existing, paved streets shall be accomplished by jacking or boring unless open trenching is authorized by the Engineer or Agency.

360.4 CABLE LOCATING (FIBER OPTIC):

If a cable which is to be installed is fiber optic a tracing or locating wire shall be installed with the cable.

360.5 PAYMENT:

Payment will be made at the contract unit price bid per lineal foot.

- End of Section -

PART 400

RIGHT-OF-WAY AND TRAFFIC CONTROL

Section	Last Revised	Title	Page
401	1998	Traffic Control	401-1
405	2015	Survey Monuments	405-1
410	1998	Precast Safety Curbs	410-1
415	2014	Flexible Metal Guardrail	415-1
420	1998	Chain Link Fences	420-1
424	1998	Parkway Grading	424-1
425	1998	Topsoils	425-1
430	2014	Landscaping and Planting	430-1
440	1999	Sprinkler Irrigation System Installation	440-1

This Page Reserved for Future Use

SECTION 401

TRAFFIC CONTROL

401.1 DESCRIPTION:

Traffic control shall consist of traffic control devices and flagmen or pilot cars. All traffic control devices, the application of traffic control measures, and traffic regulation in these specifications are to supplement and are not intended to delete any of the provisions of the Contracting Agency's Traffic Barricade Manual, the Uniform Manual on Traffic Control Devices or any agency's Supplements to these Uniform Standard Specifications.

401.2 TRAFFIC CONTROL DEVICES:

Traffic control devices shall consist of providing, erecting, and maintaining necessary and adequate devices for the protection of the work, the workmen and the traveling public as approved by the Engineer.

(A) Temporary traffic control devices shall be used to guide traffic through construction areas. They include traffic cones to channelize traffic, portable barricades for warning, vertical panel channelizing devices to divert traffic, and lighting devices between the hours of sunset and sunrise.

(B) Advance warning devices shall be used to alert the motorist of an obstruction in the roadway. They include diamond-shaped signs, flags, and flasher type high level warning devices mounted 8 feet above the roadway.

401.3 FLAGMEN OR PILOT CARS:

Flagmen or pilot cars shall consist of providing sufficient flagmen, uniformed off-duty law enforcement officers or pilot cars to expedite the safe passage of traffic.

401.4 TRAFFIC CONTROL MEASURES:

The application of all traffic control measures shall be based primarily upon the conditions existing at the time that such measures are deemed necessary. Prior to the start of any work that would interrupt the normal flow of traffic; sufficient and adequate devices and measures shall be provided and erected as directed by the Engineer. These devices shall be immediately removed when no longer needed.

401.5 GENERAL TRAFFIC REGULATIONS:

A traffic lane shall be a minimum of 10 feet of clear street width with a safe motor vehicle operating speed of at least 25 miles per hour.

An intersection shall be all of the area within the right of way intersection streets plus 300 feet beyond the edge of the intersected right of way on all legs of the intersection.

A minimum of two traffic lanes, one for each direction, shall be maintained open to traffic at all times on all major streets.

(A) On Bond Issue and Budget Projects: All existing traffic lanes on major streets shall be maintained open to traffic at signalized intersections between the hours of 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. weekdays unless otherwise specified in the special provisions.

(B) On Improvement District Projects: All existing traffic lanes on major streets shall be maintained open to traffic between the hours of 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. weekdays. All work that enters or crosses a major street must be done at times other than 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. unless otherwise specified in the special provisions.

Local access shall be maintained to all properties on the project at all possible times. When local access cannot be maintained, the Contractor must notify the affected property owner at least 24 hours in advance and restore access as soon as possible.

SECTION 401

A traffic lane shall not be considered as satisfactorily open to traffic unless it is paved with hot mix or cold mix asphalt paving if surrounded by or adjacent to existing pavement. Where pavement did not previously exist or where all of the existing pavement has been removed, a traffic lane shall not be considered as satisfactorily open to traffic unless it is graded reasonably smooth and maintained dust free as directed by the Engineer.

Arrangements for partial or complete street closure permits shall be handled through the Engineer on local projects or the Arizona Highway Department, Resident Engineer on Federal Aid Projects, to the Contracting Agency's Traffic Engineering Department. An advance notice of 48 hours for major streets and 24 hours for local streets and alleys is required from the Contractor.

The Contractor shall provide and maintain all necessary traffic controls to protect and guide traffic for all work in the construction area.

The Contractor shall maintain all existing STOP, YIELD, and street name signs erect, clean, and in full view of the intended traffic at all times. If these signs interfere with construction, the Contractor shall temporarily relocate the signs away from construction but still in full view of the intended traffic.

The Traffic Engineering Department will reset all STOP, YIELD, and street name signs to permanent locations.

Existing traffic signs other than STOP, YIELD, and street name signs shall be maintained by the Contractor until such time as construction renders them obsolete. At that time the Contractor shall remove signs and posts without damage and deliver them as directed by the Engineer. The Traffic Engineering Department will reinstall all traffic signs.

Subject to the approval of the Traffic Engineer, the Contractor shall furnish and install the 25 MPH Construction Zone Speed Limit Signs. The Contractor shall maintain the signs erect, clean and in full view of the intended traffic at all times. Should the signs interfere with construction, the Contractor shall relocate the signs as necessary.

At any time project construction shall require the closure or disruption of traffic in any roadway, alley, or refuse collection easement such that normal refuse collection will be interfered with, the Contractor shall prior to causing such closure or disruption, make arrangements with the Contracting Agency's Sanitation Department in order that refuse collection service can be maintained.

Special traffic regulation will be listed in the special provisions.

401.6 MEASUREMENT:

No measurement will be made for traffic control devices.

Flagmen, uniformed off-duty law enforcement officers or pilot cars, with driver, will be measured by the hour for each individual, including vehicle and equipment, required to perform traffic control. When an officer is used less than 3 hours, a minimum of 3 hours will be charged. Anything over 3 hours will be measured by the hour.

401.7 PAYMENT:

Payment will be made at the contract bid price in the proposal for uniformed, off-duty law enforcement officer. If the officer is utilized in excess of 8 hours in any calendar day or in excess of 40 hours in any calendar work week, payment shall be at the rate of 1 1/2 times the contract bid price for all hours worked in excess in either of the above time periods.

- End of Section -

SECTION 405

SURVEY MONUMENTS

405.1 DESCRIPTION:

This work shall consist of furnishing and installing survey monuments at the locations shown on the plans or directed by the Engineer. The work also includes the preparation and recording of a corner record or results of survey in accordance with the Arizona State Board of Technical Registration requirements.

Monuments shall conform to the standard details or details shown on the plan.

405.2 MATERIALS:

The concrete portion of monuments shall be constructed in accordance with the provisions in Sections 725 and 505. Concrete shall be Class B.

Brass caps for survey monuments shall be furnished by the Contractor unless otherwise specified.

405.3 CONSTRUCTION:

Monuments may be cast in drilled holes without the use of forms.

Survey monuments shall be set vertically in the ground.

The brass cap assembly shall be firmly embedded in the concrete cylinder before the concrete has acquired its initial set. The concrete cylinder shall be so located that, the reference point will fall within a 1 inch circle in the center of the brass cap.

The tops of survey monument covers shall be set flush with the pavement surface.

405.4 MEASUREMENT:

Survey monuments will be measured by the number of units of each type of monument constructed and accepted.

405.5 PAYMENT:

Payment for monuments will be at the contract unit price and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in constructing the monuments, complete in place, as shown on the plans or as directed by the Engineer including preparing and recording a corner record or results of survey.

– End of Section –

SECTION 410

PRECAST SAFETY CURBS

410.1 DESCRIPTION:

This work shall consist of furnishing and installing precast safety curbs as shown on standard details or as detailed on the plans, or as directed by the Engineer.

410.2 MATERIALS:

Portland cement concrete shall be Class A, conforming to the applicable requirements of Section [725](#).

Steel reinforcing shall conform to the requirements of Section [727](#). The dimensions of the precast curb shall be as indicated on the plans and standard details.

Dowels shall conform to ASTM [A615](#) plain, intermediate grade, 1/2 inch round by 24 inches.

Mastic may be either a fiberized mastic cement or an epoxy cement. The Contractor shall submit to the Engineer, the type of mastic and manufacturer's recommended procedures for use, within 10 days after the date of award of contract which will enable the Engineer to determine that the proposed material is acceptable.

410.3 CONSTRUCTION METHOD:

Back of safety curbs shall be set at the property line unless otherwise shown on the plans. Curbs shall be kept a minimum distance of 5 feet from driveways.

Precast safety curb installed on natural earth or gravel surfaces shall be secured in place with a minimum of 2 steel dowels through each curb. A minimum 12 inches diameter by 12 inches deep Class B concrete cylinder or approved equal shall be poured in place around each dowel.

Precast safety curb installed on Portland cement concrete or asphalt concrete surfaces shall be bedded in a continuous layer of mastic cement under its complete base area and secured with a minimum of 2 steel dowels driven through the safety curb.

Dowels shall extend into the sub-surface and/or concrete cylinder a minimum of 18 inches. When installed, the top of each dowel shall be flush with the top of the safety curb.

The Engineer will verify locations of all safety curbs in the field at time of construction.

410.4 MEASUREMENT:

Measurement will be the number of safety curbs furnished and installed, complete in place.

410.5 PAYMENT:

Payment will be made at the unit price bid each in the proposal for the following:

- (A) Safety curbs installed on natural earth or gravel.
- (B) Safety curbs installed on Portland cement concrete.
- (C) Safety curbs installed on asphalt concrete.

- End of Section -

SECTION 415

FLEXIBLE METAL GUARDRAIL

415.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials, constructing new guardrail, and delineating guardrail sections at the locations shown on the plans.

Guard rail end treatments shall be as specified on the plans or special provisions.

415.2 MATERIALS:

The rail elements, bolts, nuts and other fittings shall conform to the specifications of AASHTO M 180, except as modified in this section. The rail metal shall conform to AASHTO M 180, Type I, Class A and in addition to the requirements of AASHTO M 180, shall withstand a cold bend, without cracking of 180 degrees around a mandrel of a diameter equal to 2 1/2 times the thickness of the plate.

Three certified copies of mill test reports of each heat from which the rail element is formed shall be furnished to the Engineer.

All materials shall be new, except as otherwise noted on the plans or special provisions.

Railing Parts furnished under these specifications shall be interchangeable with similar parts regardless of source. All surfaces of guardrail elements that are exposed to traffic shall present a uniform, pleasing appearance and shall be free of scars, stains or corrosion.

Nails shall be 16 penny common galvanized.

Bolts shall have shoulders shaped to prevent the bolts from turning.

Unless otherwise specified the rail elements, terminal sections, bolts, nuts, and other fittings shall be galvanized in accordance with Section [771](#). Where galvanizing has been damaged, the coating shall be repaired in accordance with Section [771](#).

Guardrail reflector tabs shall be either 3003-H14 Aluminum strip 0.063 ± 0.004 inches thick, or steel strip 0.078 ± 0.008 inches thick galvanized in accordance with ASTM [A653](#) coating designation G 90. The reflector material shall be high-reflectivity sheeting, either silver-white or yellow and shall conform to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction. Adhesive for sheeting attachment to the metal tab shall be of the type and quality recommended by the sheeting manufacturer. Reflector tabs shall conform to the Reflector Tab Detail of Maricopa County Department of Transportation Standard Detail 3002.

Timber for posts and blocks shall be rough sawn (unplanned) or S4S with the nominal dimensions indicated. Any species or group of woods graded in accordance with the requirements for Timber and Posts of the Western Wood Products Association may be used. Timber shall be No. 1 or better, and the stress grade shall be as follows:

6" by 8" Post and Block	1200 psi
8" by 8" Post and Block	900 psi
10" by 10" Post and Block	900 psi

When the plans show guardrail systems using 8" by 8" timber posts and blocks, the Contractor may use 8 1/4" nominal size posts and blocks with a stress grade of 825 pounds per square inch.

At the time of installation, the dimensions of timber posts and blocks shall vary no more than plus or minus 1/2" from the nominal dimensions as specified on the project plans. The size tolerance of rough sawn block in the direction of the bolt holes shall vary no more than plus or minus 3/8".

All timber shall have a preservative treatment as per the requirements of AASHTO M 133.

Structural steel shapes shall conform to the requirements of ASTM [A36](#) and be galvanized in conformance with the appropriate requirements of AASHTO M 111. Dimensions shall meet the dimensional requirements of the American Institute of Steel Construction.

SECTION 415

Steel tubes shall conform to the material requirements of ASTM [A500](#) or [A501](#) and be galvanized in conformance with the requirements of AASHTO M 180, Type 1.

415.3 CONSTRUCTION REQUIREMENTS:

415.3.1 General: The construction of the various types of guardrail shall include the assembly and erection of all component parts complete at the locations shown on the project plans or as directed by the Engineer.

Posts shall be as indicated by plans, standard details, or special provisions. Only one type and size of post and block shall be used for any one continuous length of guardrail.

Terminal sections shall be installed in accordance with the manufacturer's recommendations.

Workmanship shall be equivalent to good commercial practice and all edges, bolt holes and surfaces shall be free of torn metal, burrs, sharp edges and protrusions.

The various types of guardrail shall be constructed with wood posts and wood blocks, except as otherwise noted on the plans.

The bolted connection of the rail element to the post shall withstand a 5,000 pound pull at right angles to the line of the railing. All metal work shall be fabricated in the shop. No punching, cutting or welding shall be done in the field, except as provided for by the project plans. All metal cut in the field shall be cleaned and the galvanizing repaired in accordance with Section 771.

Where field cutting or boring of wood posts and blocks is permitted, the affected areas shall be thoroughly swabbed with at least two passes of the same type of wood preservative as initially used.

Where wood posts with rectangular sections are used, the posts shall be set so that the longest dimension is perpendicular to the rail.

All bolts shall extend beyond the nuts a minimum of two threads, except that all bolts adjacent to pedestrian traffic shall be cut off flush to the nut.

Bolts extending more than 2" beyond the nut shall be cut off to less than ½" beyond the nut.

Unless otherwise shown on the plans, bolts shall be torqued as follows:

Diameter of Bolt	Torque, Foot/Pounds
5/8"	45-50
3/4"	70-75
7/8" and larger	120-125

All bolts, other than those specified to be torqued, shall be securely tightened.

When guardrail is being constructed under traffic, the work shall be conducted so as to constitute the least hazard to the public. Guardrail work shall be performed in the direction of traffic flow when feasible.

Any section of guardrail that is removed for modification shall be replaced within five calendar days of the date the guardrail is removed, unless otherwise directed by the Engineer. At the end of each day, incomplete guardrail sections having an exposed end toward oncoming traffic shall have an appropriate temporary protective end treatment acceptable to the Engineer set securely in place together with approved overnight traffic control devices set in place.

415.3.2 Delineation: The maximum spacing between reflector tabs shall not exceed six posts. The slotted part of the tab shall be installed under the mounting bolt head so that the Reflectorized surface of the tab faces oncoming traffic. The exposed ends of the slotted part of the tab shall be bent up against and then over the top of the bolt head. The color of the reflective portion of the barrier markers shall conform to the color of the adjacent edge line. Silver-faced reflector tabs shall be installed on the right

SECTION 415

hand side of all roadways, and yellow-faced tabs shall be installed on the left-hand side of one-way, or median divided roadways.

415.3.3 Roadway Guardrail: Wood posts shall be used for new guard rail installations unless otherwise indicated by plans or special provisions. Wood posts shall either be driven or placed in manually or mechanically dug holes; however, driven posts will not be permitted at locations where damage to the curb, gutter, sidewalk, buried items, shoulders or pavement might occur. The Engineer will be the sole judge as to whether driving of posts will be allowed. Driving of posts shall be accomplished in a manner that will prevent battering, burring, or distortion of the post. Any post which is damaged to the extent it is unfit for use in the finished work, as determined by the Engineer, shall be removed and replaced at no additional cost to the Agency.

The posts shall be firmly placed in the ground. The space around posts shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted to the density of the surrounding material.

Where pavement is disturbed in the construction of guardrail, the damaged surfacing shall be repaired as approved by the Engineer.

Where a culvert or other obstacle is at an elevation which would interfere with full depth post placement, guardrail installation shall comply with requirements of Section [415.3.4](#) Bolted Guardrail Anchors or Section [415.3.5](#) Nested Guardrail.

Wood blocks shall be toe nailed to the wood post with one 16 penny galvanized nail on each side of the top of the block. Wood blocks shall be set so that the top of the block is no more than ½" above or below the top of the post, unless otherwise shown on the project plans.

Rail elements shall be spliced at 25 foot intervals or less. Rail elements shall be spliced at posts unless otherwise shown on the project plans and shall be spliced by lapping in the direction of traffic in the nearest adjacent lane. Rail elements at joints shall have full bearing. When the radius of curvature is 150 feet or less, the rail elements shall be shop curved.

The Contractor shall dispose of surplus excavated material remaining after the guard railing has been constructed.

415.3.4 Bolted Guardrail Anchors: Where the elevation of the top surface of a concrete box culvert or other similar installation prevents the placement of a post of the specified length, the posts shall be shortened and anchored in accordance with Maricopa County Department of Transportation Standard Detail 3010.

415.3.5 Nested Guardrail: This work shall consist of furnishing and constructing nested guardrail, Type 1, 2, or 3, as shown in Maricopa County Department of Transportation Standard Details 3008-1 through 3008-3.

415.3.6 Guardrail to Structure Transitions: Guardrail transitions shall be constructed in accordance with requirements shown on the plans and special provisions.

415.4 MEASUREMENT:

The limits of measurement for roadway guardrail shall be as detailed in Maricopa County Department of Transportation Standard Detail 3016, except as otherwise noted on the plans or special provisions. Guardrail, of the type shown on the project plans, will be measured by the linear foot along the face of the rail element from center to center of posts, exclusive of guardrail terminals, guardrail end terminal assemblies, nested guardrail (Types 1, 2 and 3) and guardrail transitions.

Delineation is considered a part of installation of guardrail and hence will not be measured as a separate item.

The accepted quantities of guardrail posts secured with bolted guardrail anchors will be measured by the unit each.

Nested guardrail, Types 1, 2, or 3, and guardrail transitions will be measured by the unit each, complete in place and accepted as shown on the plans.

SECTION 415

415.5 PAYMENT:

Payment for accepted quantities of each type of guardrail will be made at the contract unit price. Payment shall be full compensation for furnishing materials and installing guardrails, complete in place including excavation, backfill, and disposal of surplus material.

Payment for Bolted Guardrail Anchors will be at the contract unit price, and shall be full compensation for the work, complete in place, including steel brackets, hardware, excavation, backfill, removing and replacing surfacing, cutting and fitting steel beam posts or timber posts, drilling anchor bolt holes in steel posts, timber posts, and box culverts, and disposal of surplus materials.

Payment for guardrail transitions will be at the contract unit price. Payment shall be full compensation for furnishing materials and installing guardrail transitions, complete in place including excavation, backfill, and disposal of surplus material.

- *End of Section* -

SECTION 420

CHAIN LINK FENCES

420.1 DESCRIPTION:

This work shall consist of constructing chain link fences at the locations and in accordance with the details shown on the plans, and as provided in these specifications and the special provisions. When installation procedures are not covered within these specifications, standard details, special provisions, plans or other documents, installation will comply with ASTM [F567](#).

420.2 MATERIALS:

Chain link fence material shall conform to the requirements of Section [772](#). Portland cement concrete shall conform to the requirements of Section [725](#).

420.3 CONSTRUCTION METHODS:

420.3.1 Fence Construction: Before any fence is installed, the Contractor shall submit to the Engineer for approval, shop drawings showing the details of all fittings and gates proposed to be furnished.

Posts shall be spaced at not more than 10 foot intervals, measured from center to center of posts, and shall be placed in a vertical position.

Changes in line or grade where the angle of deflection is 30 degrees or more shall be considered as corner and slope points, respectively, and corner or slope posts shall be installed at these points.

All posts shall be set in Class C concrete footings, which footings shall be crowned at the top to shed water. Footings for line posts for 72 inch fabric or less shall not be less than 30 inches deep and 8 inches in diameter, and footings for line posts for fabric more than 72 inches shall be shown on plans. All other footings, unless otherwise indicated on the plans or in the special provisions, shall be not less than 36 inches deep and 12 inches in diameter.

End, corner, slope and gate posts shall be braced to the midpoint of the nearest line post or posts with horizontal braces used as compression members and the said line posts trussed from the brace back to the bottom of the end, corner, slope or gate post with 3/8 inch steel truss rods with turnbuckles used as tension members.

Unless otherwise specified all fence shall be installed with a top rail and a bottom tension wire and the post tops shall be secured to the post by bolts or rivets. When top rail is omitted, a top and bottom tension wire shall be used.

The fabric shall be placed on the outward facing side of the posts and shall be installed so that the top edge projects above the top rail of the fence to form a knuckled or barbed projection. The fabric shall be stretched taut and securely fastened to the posts, the top rail, and the bottom tension wire. The tension wire shall be installed on a straight grade between posts by excavating the high points of ground and in no case will filling of depression be permitted. Unless otherwise specified the bottom of the fence shall be on a line approximately 2 inches above the ground surface.

The fabric shall be fastened to end, corner, slope and gate posts with 3/16 inch \times 3/8 inch high carbon steel tension bars and not less than 12 gage \times 1 inch steel tension bar bands spaced at 16 inch intervals; and to line posts, top rail and tension wire with 11 gage or heavier tie wires or metal bands. Tie wires or metal bands shall be placed on line posts at intervals of approximately 16 inches, and on top rail and tension wire at intervals of approximately 18 inches.

Barbed wire shall be installed on the fence only when specifically required by the plans or special provisions. When required, it shall be installed on extension arms of a type specified under Section [772](#).

420.3.2 Construction of Gates: The widths of any gates to be installed will be indicated on the plans or in the special provisions. Gates in which the width of the leaf is greater than 6 feet shall be constructed with an internal horizontal or vertical stiffener of the same diameter as the frame; the frame shall be trussed with a 3/8 inch adjustable tension rod. Gates in which the width of the leaf is 6 feet or less will not require a stiffener and will require only 1 truss rod.

SECTION 420

The corners of gate frames shall be fastened together and reinforced with a fitting designed for the purpose or by welding. All welds shall be ground smooth.

Chain link fence fabric shall be attached to the gate frame by the use of tension bars and tie wires as specified for fence construction, and suitable tension connectors spaced at approximately 16 inch intervals.

The swing gates shall be hung by at least 2 steel or malleable iron hinges, so designed as to securely clamp to the gate post and permit the gate to be swung back against the fence.

Semi-cantilever gates shall be provided with a combination steel or malleable iron catch and locking attachment of approved design, and shall be subject to approval of the Contracting Agency. Stops to hold gates open and a center rest with catch shall be provided on all double drive gates and on all other gates where required.

420.3.3 Repair of Damaged Coating: Welds made after galvanizing shall be ground smooth, then wire brushed to remove loose or burned zinc coating, after which the cleaned areas shall be repaired to the satisfaction of the Engineer in accordance with Section [771](#). Repairs to abraded or otherwise damaged zinc coating shall be made in a similar manner.

420.4 MEASUREMENT:

Chain link fence shall be measured on the fence line along the bottom strain wire from center to center of end posts, deducting the widths of gates and openings.

420.5 PAYMENTS:

The price bid and paid per linear foot for chain link fence shall include full compensation for furnishing all labor, materials, tools, and equipment, and doing all the work involved in constructing the fence complete in place as specified on the plans, and in the special provisions, except for furnishing and installing gates.

Gates will be paid for at the unit price bid for each size of gate required by the plans or special provisions, which price shall include full compensation for furnishing the gates, together with all necessary gate posts, fittings and hardware, and doing all the work involved in installing the gates complete in place as specified. If double gates are required, each double gate will be paid for at the unit price bid and such unit price shall include furnishing and installing both leaves.

Full compensation for clearing the line of the fence and disposing of the resulting material, excavating high points in the existing ground between posts, excavating and furnishing and placing concrete footings, connecting new fences to structures and existing fences, and any other related work shall be considered as included in the price bid per linear foot of fence and no additional allowance will be made therefore.

- End of Section -

SECTION 424

PARKWAY GRADING

424.1 DESCRIPTION:

This grading shall include all work necessary to bring the surface of the parkway, between the back of curbs and sidewalks and/or the parkway between sidewalks and the right-of-way line, to the grade and cross-section shown on the plans or as directed by the Engineer. It shall also include median islands between divided roadways.

424.2 ROUGH GRADING:

- (A) Fill material shall contain no rocks over 3 inches in diameter, broken concrete, or debris of any nature.
- (B) Backfill behind curbs and along the edges of the sidewalk shall be made immediately upon the completion of those items.

424.3 FINE GRADING:

- (A) The finished surface shall be free from stone and all debris and be true to grade and cross-sections after compaction to not less than 80% of maximum density, as determined by test methods specified in Section [301](#).
- (B) Where existing parkways are planted in grass, flowers, or shrubs and the level is somewhat above the top of the curb, or sidewalk, the parkway shall be graded back on a 4:1 slope from the edge of curb or sidewalk, with the least possible damage to the planted area.

424.4 PAYMENT:

Unless otherwise provided in the special provisions or proposal, no payment will be made for parkway grading as such; the cost thereof shall be included in the price bid for construction or installation of the items to which such grading is incidental or appurtenant.

- End of Section -

SECTION 425

TOPSOILS

425.1 DESCRIPTION:

This work shall consist of furnishing and hauling topsoil from an approved source and placing the topsoil as shown on the plans, in accordance with this specification and special provisions.

425.2 MATERIALS:

Topsoil shall conform to the requirements of Section [795](#).

425.3 CONSTRUCTION METHODS:

Prior to the excavation of topsoil, all grass, weeds, brush, stumps, loose rocks and other objectionable material shall be removed from the surface of the area from which the topsoil is to be removed.

The topsoil source shall be excavated in such a manner that all material excavated will be of the same composition and structure throughout.

Topsoil shall be spread over the areas and to the depths as specified, and shall be water settled.

After the topsoil has been spread, stumps, roots and other objectionable matter shall be removed from the surface of the area and disposed of in a manner satisfactory to the Engineer.

425.4 MEASUREMENT:

Unless otherwise specified, topsoil shall be measured by the cubic yard in place and loose after watering and settling.

425.5 PAYMENT:

The quantities measured as provided above, will be paid for at the contract price per cubic yard for furnishing and placing topsoil, which price shall be full compensation for the item complete, as described and specified.

- End of Section -

SECTION 430

LANDSCAPING AND PLANTING

430.1 DESCRIPTION:

This section shall govern the preparation and planting of landscape areas required in the Plans or Specifications. Materials will be in accordance with Section [795](#).

Existing utilities and improvements not designated for removal shall be protected in place. Any damages will be repaired by the Contractor at no additional cost to the Contracting Agency.

Unless otherwise provided, walls, curbs, planter boxes, irrigation systems, and other improvements shall be constructed after rough grading has been completed and prior to finish grading.

430.2 GENERAL:

Landscape or planting areas shall not be cultivated when they are so wet as to cause excessive compaction or so dry as to cause excessive dust or the formation of large clods.

Prior to any grading the areas shall be cleared and grubbed in accordance with Section [201](#), Clearing and Grubbing.

Finish grade for these areas shall not vary more than 1 inch from the specified grade and cross-section and shall be a smooth uniform surface, free of any abrupt grade changes or depressions. Unless otherwise specified, finish grade below adjacent paving, curbs, or headers shall be 1 inch for lawn and granite areas and 3 inches for planting areas.

Unless otherwise specified, in-place soil will be prepared and conditioned for utilization as topsoil. If imported topsoil is specified or has to be used, the existing soil, before subgrade, shall be scarified to a depth of 6 inches prior to placing the topsoil and the thickness of the topsoil layer shall be at least 6 inches.

All landscape and planting areas, except those intended for lawns, shall be treated with a pre-emergence control, such as "Surflan" or equal, applied in accordance with the manufacturer's recommendations.

430.3 LAWN AREAS:

430.3.1 Preparation of In-Place Soil: After clearing and grubbing has been completed, the existing surface shall be scarified and cultivated to a minimum depth of 8 inches; then brought to finish grade. During the operation, debris, including all stones over 1 inch in any dimensions, shall be removed and disposed of offsite.

After clearing and grubbing and initial cultivation has been completed, chemical fertilizer, 16-20-0 composition, shall be mechanically spread over the entire area at an average rate of 10 pounds per 1000 square feet. After spreading, the fertilizer shall be cultivated into the top six inches of soil using suitable equipment. The resulting soil shall be in a friable condition, suitable for planting.

The Engineer shall inspect and approve these areas prior to seeding.

430.3.2 Seeding: If a Bermuda summer lawn has not been established during its normal planting season, April through September, then rye grass (*Solium Multi-folium*) seed will be planted.

The rate of seeding shall be 3 1/2 pounds of Bermuda seed or 15 pounds of rye seed per 1000 square feet.

After seeding has been completed, the entire area shall be rolled with a lawn roller for leveling and seed retention. Immediately after rolling, the area shall be watered with a mist type spray until the soil is wet to a depth of 2 inches.

The Contractor shall provide the necessary safeguards to protect the planted areas from damage by erosion or trespass. Any damaged areas or any areas, greater than 6 inches in diameter, which fail to show a good stand shall be repaired and replanted until an acceptable stand of grass is obtained.

SECTION 430

430.3.3 Maintenance: The Contractor shall be responsible for maintenance of the lawn areas until they are accepted by the Contracting Agency. This shall include watering, mowing, weeding and removal of all debris.

430.4 DECOMPOSED GRANITE AREA:

Decomposed granite shall be in accordance with Section [795](#). The Contractor shall confirm that a sufficient quantity is available so that the entire area will be of the same composition and appearance, and shall furnish a sample to the Engineer for approval as to color.

After preliminary grading is completed and the area has been cleared and grubbed, a pre-emergence control, such as Surflan, or equal, shall be applied over the entire area, in accordance with the manufacturer's recommendations. The decomposed granite shall be evenly distributed over the area with a minimum depth of 2 inches. Finish grading will be accomplished and the granite will be lightly watered and then compacted to an extent satisfactory to the Engineer. After compaction, a second treatment with the pre-emergence control will be accomplished.

430.5 TREE, SHRUB, AND GROUND COVER PLANTING:

The species, sizes, the manner in which to be furnished, and the approximate number are as shown in the plant list. The quantities, as listed, are approximate and the Contractor shall furnish and install all plant material necessary to complete the plantings as shown on the landscape plan. Change order adjustment will be made for unit price proposals, but not for lump sum proposals.

430.5.1 Substitutions: All requests for substitutions must be submitted in writing to the Contracting Agency prior to commencement of work on the project. The Contractor shall not take any further action concerning his request until a written approval or denial is received from the Contracting Agency. Plants of kinds other than those indicated on the plant list will be considered by the Contracting Agency only upon submission of proof that the specified plant is not reasonably procurable in the local region. Substitutions will resemble the specified plant in regards to appearance, ultimate height, shape, habit of growth, and general soil requirement.

Substitution of a larger size of the same species may be made by the Contractor without written approval. However, the Contracting Agency will not be responsible for any additional costs incurred by the Contractor, either for the additional cost of the plants or for any additional planting costs.

430.5.2 Plant Inspection Prior to Delivery to the Project Site: Prior to delivery of any species to the project site, the Contractor shall make the necessary arrangement with the Engineer for an inspection of the plant material at the offsite location. Any plants found to be unsuitable in growth or condition or which are not true to name shall be removed and replaced with acceptable plants.

430.5.3 Plant Protection after Delivery to the Project Site: Plants transported to the site shall be planted as soon as possible. During any interim storage period, they shall not be exposed to excessive sun or drying winds. Any stock, that in the opinion of the Engineer has deteriorated due to exposure or has been damaged during transporting, will be removed and replaced at the Contractor's expense.

430.5.4 Plant Location: The Contractor shall stake out the location of planting areas and plantings pit prior to any excavation. Subject to the Engineer's approval, minor relocations may be accomplished at this time to avoid unsuitable conditions, such as utilities, rocky areas, poor soil, etc. If major relocations are necessary, the Engineer will provide revised plans.

430.5.5 Ground Cover Areas: The planting beds shall be brought to finish grade before spreading the fertilizer or conditioning material specified. Fertilizing and conditioning material shall be mechanically spread at a uniform rate over the entire bed area. After spreading, this material shall be uniformly cultivated into the upper 6 inches of soil using suitable equipment. The resulting soil shall be in a friable condition suitable for planting. A pre-emergence control application is required prior to planting.

SECTION 430

Ground cover shall be planted in moist soil with the spacing as indicated on the plans. Each plant shall be planted with its proportionate amount of soil so as to minimize root disturbance. After planting, the area shall be raked to restore a smooth finish grade and to provide drainage. Watering will begin immediately.

The Contractor is responsible for maintaining these areas until acceptance by the Contracting Agency. Maintenance will include protection from trespass or damage, weeding, watering, and removal of all debris. It may be necessary to install a protective fence or barrier around these areas until growth is assured.

430.5.6 Shrub and Tree Pits: Planting pits shall be approximately circular with a diameter and depth at least twice the size of the plant ball or container. It must be large enough to permit handling and planting without injury or breakage of the root ball or root system. Unless otherwise specified, the excavated soil will be conditioned and used as prepared soil mix for backfill. Plants will not be allowed to stand in these pits without watering.

Prepared soil mix shall consist of one part organic soil conditioner (Section [795](#)), two parts excavated soil and one pound of gypsum and four ounces of soil sulphur per tree or one-half pound of gypsum and two ounces of soil sulphur per shrub. The backfill shall be produced by thoroughly combining these components into a homogeneous mixture. The Contractor shall notify the Engineer prior to mixing prepared soil so that he may observe the mixing process. In addition, during backfilling, slow release fertilizer tablets, Agriform 21 gram tablets with a 20-10-5 analysis, shall be added in the following quantities:

For one-gallon container	1 tablet
For five-gallon container	2 tablets
For fifteen-gallon container	4 tablets
For twenty-four inches or larger box	6 tablets

All containers shall be opened and removed in such a manner that the roots of the plant are not damaged. Balled plants wrapping shall be loosened or cut back after the plant is positioned in the pit.

A layer of prepared soil mix shall be placed in the pit and the plant shall be set approximately in the center of the hole with the root crown at its natural growing depth with respect to finish grade. The plant shall be faced so as to present the best appearance and relationship to adjacent plants or structures. It shall be rigidly constrained until backfilling with prepared soil mix and slow release fertilizer tablets is completed. The backfill will be thoroughly settled by tamping and watering so that all voids are filled.

Trees shall be supported by two tree stakes (Section [795](#)) with a top tie placed for maximum support and a second tie placed midway between top tie and ground level.

After planting, the plants shall be pruned as directed by the Engineer.

430.6 HEADER INSTALLATION:

Headers shall be installed at the location and grades as shown on the plans prior to planting operations. Stakes shall be located at corners and at intervals not to exceed 5 feet and shall be driven to slightly below the top of the header. Headers shall be nailed to the stakes with two nails, clinched 1/2 inch. Splice plates shall be used at butt joint; centered on the joint and nailed with four nails.

430.7 CLEAN UP:

Any debris or other material dropped onto paved or graded area during excavation or hauling operation shall be promptly removed and these areas shall be kept neat and clean at all times. Upon completion of planting operation, all remaining soil, stones, and other debris shall be removed from the site and disposed of to the satisfaction of the Engineer.

430.8 PLANT GUARANTEE AND MAINTENANCE:

The Contractor shall insure that all plant materials are in a sound, healthy, vigorous condition free from insects, bark abrasions, or other objectionable disfigurements and shall immediately replace any plant which is unacceptable at any time up to and including final acceptance of the project or completion of the plant establishment period whichever occurs later. When the termination of the plant establishment period extends beyond the final acceptance date for the project, this additional period of

SECTION 430

time for plant establishment may be considered as a special warranty period within the standard 1-year guarantee period and the Engineer may authorize final payment in accordance with Section [109](#). Unless otherwise authorized by the Engineer, the Contractor shall maintain all landscaped areas on a continuous basis as they are completed during the course of work and until final project acceptance or the termination of the plant establishment period, whichever occurs later.

Maintenance shall include keeping the landscape areas free of debris and weeding and cultivating the planted areas at intervals acceptable to the Engineer. The Contractor shall provide adequate personnel to accomplish the required maintenance. Pruning and restaking of plants shall be as directed by the Engineer.

430.9 PLANT ESTABLISHMENT PERIOD:

The Contractor shall request an inspection by the Engineer whenever substantial completion of the planting and related work has been accomplished. After this initial inspection, and subject to his approval of the work, the Engineer will issue a written field notification to the Contractor setting the effective, beginning date for plant establishment. The plant establishment period shall be for a period of 60 calendar days, but is subject to extension by the Engineer if the landscape areas are improperly maintained, appreciable plant replacement is required, or other corrective work becomes necessary.

At final project acceptance or at the end of the plant establishment period, a final acceptance inspection of the planted areas will be made by the Engineer.

430.10 MEASUREMENT AND PAYMENT:

Measurement and payment shall be in accordance with Section [109](#).

The lump sum or unit prices established on the proposal sheet shall be full compensation for furnishing all labor, material, tools, and equipment and for performing all work necessary to complete the landscaping operation to include planting of trees, shrubs, and ground cover.

- End of Section -

SECTION 440

SPRINKLER IRRIGATION SYSTEM INSTALLATION

440.1 DESCRIPTION:

The Contractor shall furnish all the necessary labor, materials, and equipment required to complete the installation of the automatic sprinkler irrigation system providing full coverage to all plants and shrubs.

440.2 GENERAL:

Unless otherwise specified, the automatic sprinkler irrigation system layout as shown on the plans shall be considered schematic. The Contractor shall lay out the entire system using stakes to indicate the location of the various components. Preliminary adjustments to conform to actual site condition shall be accomplished at this time and the approval of the Engineer obtained prior to any actual work being performed. Utility connections, both water and electrical, shall be as shown on the plans or as designated by the utility concerned. Unless specifically exempted in the plans or specifications, the Contractor shall pay all costs concerned in providing these services.

Prior to the acceptance of the project, the Contractor shall furnish the Engineer 4 copies of the manufacturer's instruction and maintenance manual for each component or group of components to include parts listings and source of supply.

Prior to final inspection, the Contractor shall submit one set of corrected, as-built drawings showing the location of all pipe, valves, wiring, and utility services.

All permits for installation or construction of any of the work included under this section, which are required by legally constituted authorities having jurisdiction, shall be obtained and paid for by the Contractor, each at the proper time. He shall also arrange for and pay all costs in connection with any inspections and examinations required by these authorities.

440.3 MATERIALS:

Prior to the start of construction, the Contractor shall submit shop drawings per Section [105](#) on all material for approval of the Engineer. All materials shall conform to Section [757](#).

440.4 LANDSCAPE IRRIGATION SYSTEM REMOVAL AND RESTORATION

When construction encroaches into an existing landscaped irrigation system, the Contractor shall remove the conflicting portion of the system within the right-of-way and/or easements and any portion which may remain under the proposed improvements, whether shown or not shown on the plans. If the removals affect other areas of the system not in conflict with the construction, the Contractor shall permanently or temporarily restore or modify the existing system to provide water to the unaffected areas. The restoration or modifications shall be completed within 24 hours after the disruption occurs or notification by the Engineer.

The Contractor shall restore the affected landscape irrigation system to an operational condition equal to or better than the existing system. When necessary, bubbler and/or sprinkler heads shall be reinstalled at the edge of the new improvements. The reconstructed or modified system shall provide completed irrigation coverage without overspray onto walks, pavement, walls, buildings, etc.

The Contractor shall have the option to salvage and reuse existing materials. In the event that it is not feasible to reinstall the salvaged materials, new materials shall be installed.

To provide ample notification for owners who desire to remove and restore their own system, the Contractor shall notify the affected property owners at least fourteen (14) days prior to the scheduled removal of the irrigation system.

When determined by the Engineer that the existing sprinkler system cannot be practically restored, the existing system shall be plugged and removed as directed.

Unless specified by the agency and called out in the bid documents, this work shall be considered incidental to the contract and no separate payment shall be made to comply with these provisions.

SECTION 440

440.5 TRENCH EXCAVATION AND BACKFILL:

Trenches and other excavations shall be sized to accommodate the irrigation system components, conduit, and other required facilities. Additional space shall be provided to assure proper installation and access for inspection. Unless otherwise specified, the minimum depth of cover over pipelines and conduits shall be as follows:

- (A) Electrical conduit - 18 inches
- (B) Waterlines continuously pressurized - 18 inches
- (C) Lateral sprinkler lines - 12 inches
- (D) Plastic lines under pavement - 24 inches

The bottom of trenches shall be true to grade and free of protruding stones, roots or other matter which would prevent proper bedding of pipe or other facilities.

Trenches and excavations shall be backfilled so that the specified thickness of topsoil is restored to the upper part of the trench. Compaction shall be in accordance with Section [301](#).

Water settling of trench backfill will not be permitted unless approved by the Engineer.

440.6 PIPE INSTALLATION:

(A) General: Pipe fittings shall be installed in accordance with the manufacturer's recommendations and these specifications. When requested by the Engineer, the Contractor shall furnish the manufacturer's printed installation instructions before pipe installation.

Pipe shall be bedded in at least 2 inches of finely graded native soil or sand to provide a firm, uniform bearing. After laying, the pipe shall be surrounded with additional finely graded native soil or sand to at least 2 inches over the top of the pipe. Trench backfill, sufficient to anchor the pipes, may be deposited before the pipeline pressure testing, except that joints shall remain exposed until satisfactory completion of testing.

When two or more pipelines are installed in the same trench, they shall be separated by a minimum horizontal clear distance of 6 inches and they shall be installed so that each pipeline, valve, or other pipeline component may be serviced or replaced without disturbing the other.

Piping under concrete or asphalt shall normally be installed by jacking, boring, or hydraulic driving. When any cutting or removal of asphalt and/or concrete work is necessary, it shall be saw cut in accordance with Section [601](#). Permission to cut asphalt and/or concrete shall be obtained from the Engineer. Where piping on the drawings is shown under paved areas, but running parallel and adjacent to planted areas, the intent of the drawings is to install the piping in the planted area.

When plastic to steel pipe connectors are required, these connections shall be accomplished first. A non-hardening, non-oil base pipe compound or liquid teflon shall be used on the male threads only. The joint shall be hand-tightened with final tightening as necessary to prevent leaks accomplished with a strap wrench.

Threads shall be cut with clean sharp dies and shall conform to American Standards Association Specification B2.

Joints shall be made with a non-toxic non-hardening joint compound applied to the male threads only.

(B) When wrapped pipe is specified, joints and connectors shall not be wrapped until completion of the pressure test.

(C) Plastic Pipe: Plastic pipe shall be cut square, externally chamfered approximately 10-15 degrees, and all burrs and fins removed. It shall be joined utilizing threaded fittings or socket type, solvent welded fittings. Schedule 80 pipe only will be used for threaded joints. Field threading will be accomplished in the same manner as specified for steel pipe, except that a plug will be installed in the bore of the pipe prior to threading to prevent distortion. Threaded pipe joints shall be made using teflon tape on the male threads. Solvent will not be used for threaded joints. Threaded joints shall be hand tightened with final tightening as necessary to prevent leaks with a strap wrench. Solvent welded joints shall be made in accordance with ASTM [D2855](#), and the

SECTION 440

type of solvent recommended by the pipe manufacturer shall be used. Solvent shall be applied to the pipe ends in such a manner that no material is deposited on the interior surface or forced into the interior of the pipe during insertion. Excess solvent on the exterior of the joint shall be wiped clean immediately after assembly.

The pipe shall be protected from damage during assembly. All vises shall have padded jaws and only strap wrenches shall be used. Any plastic pipe which has been nicked, scarred, or otherwise damaged shall be removed and replaced. Care shall be exercised so that stresses on the previously made joints are avoided. Movement of the pipe following assembly, such as lowering the pipe into the trench, shall not occur prior to the set time recommended by the manufacturer of the solvent cement used.

The plastic pipe will be snaked from side to side within the trench so as to provide approximately 1 foot of slack per each 100 feet of pipe.

The pipeline will not be exposed to water for at least 12 hours after the last solvent welded joint has been made.

440.7 VALVES, VALVE BOXES, AND SPECIAL EQUIPMENT INSTALLATION:

Valves, backflow preventers, pressure regulators and related accessories shall be furnished and installed as specified.

All valves and other equipment shall be installed in a normal upright position unless otherwise recommended by the manufacturer, and shall be readily accessible for operation, maintenance and replacement. Sectional control valves shall not be located within range of sprinklers they control.

Gate valves and sectional control valves shall be installed below ground. Gate valves shall be housed in a covered concrete or plastic box that will permit access for servicing. Sectional control valves shall be equipped with a sleeve and cap centered on the valve stem.

Quick-coupler valves and garden valves projecting above grade shall be installed a minimum of 3 feet from curbs, pavement and walks. In non-irrigated areas, quick-coupler valves shall be set flush with finish grade, and in irrigated areas at or just above water level. They shall be installed on a double swing joint riser assembly. Garden valves shall be set 12 inches above finish grade, and shall be installed on a galvanized riser. In non-irrigated areas all valve boxes, valve access sleeves, and caps shall be set to finish grade, and in irrigated areas set adjacent to curbs, sidewalks or pavement at or just above water level. Valves shall be set at sufficient depth to provide clearance between the cover and the cap, valve handle, or key when the valve is in the fully open position. Backflow preventers shall be provided with pipe supports and the accessories necessary to properly secure the assembly. All backflow preventers shall be assembled with pipe, fittings, and risers of an approved material by the contracting agency.

440.8 SPRINKLER HEAD INSTALLATION AND ADJUSTMENT:

In accordance with the requirements of Subsection [440.7](#) all mains and laterals, including risers, shall be flushed and pressure tested before installing sprinkler heads. A water coverage test shall be performed after the sprinkler heads are installed.

(A) Location, Elevation and Spacing: Sprinkler head spacing shall not exceed the maximum shown on the drawings or recommended by the manufacturer. They shall be installed with at least 4 inches clearance from adjacent vertical elements projecting above grade such as walls, planter boxes, curbs and fences. Bubbler heads shall be installed a minimum of 2 inches above finish grade. The Engineer will notify the Contractor in writing when the planted beds are sufficiently planted and settled to make the necessary adjustments to the bubbler heads. Any adjustments are to be made within sixty (60) calendar days after this notification is received and at no additional cost to the Contracting Agency.

(B) Riser Assembly: A top outlet riser assembly shall consist of a pipe riser threaded into a top outlet ell or tee installed in the lateral supply line. Double-swing joint and single-swing joint riser assemblies shall utilize a horizontal 6 inches pipe nipple threaded into a side outlet ell or tee installed in the lateral supply line. For a double-swing joint, 3 ells shall be used in the remaining assembly ahead of the vertical riser pipe. For a single-swing joint, one ell shall be used.

(C) Sprinkler Head Adjustment: After all sprinkler heads are installed and the irrigation system is operating, each section or unit shall be adjusted and balanced, with all section control valves fully open to obtain uniform and adequate coverage. Sprinkler heads having adjustable pin nozzles or orifices shall have the pins adjusted to provide adequate distribution of

SECTION 440

water over the coverage pattern. The Contractor shall substitute larger or smaller nozzle cores in non-adjustable sprinkler heads as necessary.

440.9 AUTOMATIC CONTROL SYSTEM INSTALLATION:

The Contractor shall install a complete automatic irrigation control system including the automatic controller, remote control valves and wiring, and all necessary accessories and utility service connection including the junction box and any work required from the stubout provided by the power company.

The automatic controller shall be installed outside of the coverage pattern of the irrigation system at the location designated in the contract documents. The foundation for the controller shall be Class C concrete of the size shown on the plan or recommended by the manufacturer. The control components in the controller shall be fused and the chassis shall be grounded. The controller shall be installed in a steel security cabinet with metal hasp and padlocks unless the controller is to be placed with a building or walled enclosure.

Remote control valves shall be compatible with the automatic controller. The valve is to be housed in a plastic box with locking cover, and it shall be installed with at least a 6 inches clearance below the plastic cover. The box shall be set to finish grade in non-irrigated areas and adjacent to curbs, sidewalks or pavement at or just above high water elevation in irrigated areas.

All service wiring shall be installed in rigid conduit from the service point to the controller at the minimum depth specified in Subsection [440.2](#). A separate disconnect switch or combination meter socket, as required, shall be installed between the source of power and the controller. The minimum service wire shall be No. 12 AWG copper 600 volt type, TWH or larger as required by the contract documents or controller manufacturer. Wire splices shall be located only in specified pull boxes and shall be made with a packaged kit approved for underground use. Pull boxes shall be plastic with locking covers set to proper elevations on a 12 inches layer of crushed rock or washed gravel.

All wiring issuing from the controller shall be direct burial installed in main or lateral waterline trenches wherever practicable. The wiring shall be bundled and secured to the lower quadrant of the irrigation pipeline at 10 foot intervals with plastic electrical tape. Sufficient slack shall be left in the wiring or tubing to provide for expansion and contraction. When the control wiring or tubing cannot be installed in a pipe trench, it shall be installed a minimum of 18 inches below finish grade. All pilot or "hot" wires are to be of one color and all common wires are to be of another color.

Unless otherwise required, all control wiring shall be direct burial Type UF, No. 14 AWG copper. Splices in control wire shall be made in accordance with the requirements for service wire. Sufficient slack shall be left at each splice and point of connection in pull boxes and valve boxes so that in case of repair the valve bonnet or splice may be brought to the surface without disconnecting the wire. No splices shall be permitted under pavement.

All wiring shall be tested for continuity, open circuits, and unintentional grounds prior to connecting the equipment.

Upon completion of the work the control system shall be in operating condition with an operational chart mounted within the controller cabinet.

440.10 FLUSHING AND TESTING:

After completion and prior to the installation of any terminal fittings, the entire pipeline system shall be thoroughly flushed to remove all foreign material. After flushing, the following tests shall be conducted in the sequence listed below. All equipment, materials, and labor necessary to perform the tests shall be furnished by the Contractor and all tests shall be conducted in the presence of the Engineer.

(A) Pipeline Pressure Test: A water pressure test shall be performed on all pressure mains and laterals before any couplings, fittings, valves, and the like are concealed. All open ends shall be capped after the water is turned into the lines in such a manner that all air will be expelled. Pressure mains shall be tested with all control valves to lateral lines closed. After the pressure main test, all valves shall be opened to test lateral lines. The constant test pressure and the duration of the test are as follows:

Mains	6 hours at 125 psi
Laterals	2 hours at 100 psi

SECTION 440

(B) Sprinkler Coverage Test: The coverage test shall be performed after sprinkler heads have been installed and shall demonstrate that each section or unit in the irrigation system is balanced to provide uniform and adequate coverage of the areas serviced. The Contractor shall correct any deficiencies in the system.

(C) Operational Test: The performance of all components of the automatic control system shall be elevated for manual and automatic operation.

During the maintenance period specified and at least 9 days prior to final acceptance, the Contractor shall set the controller on automatic operation and the system shall operate satisfactorily during this period. All necessary repairs, replacement and adjustment shall be made until all equipment, electrical work, controls and instrumentation are functioning in accordance with the contract documents.

440.11 MEASUREMENT AND PAYMENT:

Measurement and payment shall be in accordance with Section [109](#). The lump sum or unit prices established in the proposal sheets shall be full compensation for furnishing all labor, materials, tools and equipment, and performing all work necessary to complete the sprinkler irrigation system described or specified in the contract documents.

- End of Section -

This Page Reserved for Future Use

PART 500

STRUCTURES

Section	Last Revised	Title	Page
505	2014	Concrete Structures	505-1
506	2012	Precast Prestressed Concrete Members	506-1
510	1998	Concrete Block Masonry	510-1
511	1998	Brick Masonry	511-1
515	1998	Steel Structures	515-1
520	2012	Steel and Aluminum Handrails	520-1
525	1998	Pneumatically Placed Mortar	525-1
530	2000	Painting	530-1

This Page Reserved for Future Use

SECTION 505

CONCRETE STRUCTURES

505.1 DESCRIPTION:

Concrete bridges, culverts, catch basins, manholes, retaining walls, abutments, piers, footings, foundations and similar structures shall be constructed in conformity with the plans and specifications. Concrete for use in work constructed under this specification and testing thereof shall conform to the requirements of Section [725](#). Reinforcing shall conform to the requirements of Section [727](#).

Safe and suitable ladders shall be provided to permit access to all portions of the work.

505.1.1 Minor Structures: Concrete structures such as cattle guards, catch basins, median barriers, headwalls, and other miscellaneous structures as defined by the Engineer are hereby defined as Minor Structures. Such Minor Structures, at the option of the Contractor, may be either constructed of cast-in-place concrete, or furnished as precast units. Precast units shall be fabricated in accordance with shop drawings submitted by the Contractor and approved by the Engineer, in accordance with the requirements of Section [105.2](#). All structures not defined as Minor Structures shall be classified as Major Structures.

505.2 SUBGRADE FOR CONCRETE STRUCTURES:

Each subgrade upon which concrete is placed shall be firm and free from water. Ground water shall be kept several inches below subgrade until the concrete has set. When the subgrade is in dry earth, it shall be moistened with water from a spray nozzle immediately before concrete is placed.

When the design details for the project provide for the construction of filter or drain material consisting of gravel or combination of gravel and sand, which material becomes subgrade for concrete, the placing of steel reinforcement and placement of concrete shall follow the placing of the filter or drain material as closely as practical. The filter or drain material shall be kept dewatered to the extent necessary to prevent any portion of concrete materials being carried away before the concrete has attained its final set. No payment will be made for the work required to keep such materials dewatered, other than such costs as may be included in the prices bid for various items of work or amount bid for dewatering when the schedule provides an item for same.

When concrete is to rest on rock, the rock shall be fully uncovered. The surface of the rock shall be removed to a depth sufficient to expose sound rock. Bedrock shall be roughly leveled off or cut to approximately horizontal and vertical steps. Seams in the rock shall be grouted as directed by the Engineer and the base for structures shall be slush grouted or otherwise treated as the Engineer may direct.

Precast Concrete Minor Structures shall be founded in accordance with the requirements of Section [206.4.5](#).

505.3 FORMS:

Forming plans for cast-in-place bridge decks and cast-in-place bridge superstructures shall be prepared in accordance with the requirements of Section [105.2](#).

Forms shall be of suitable material and of type, size, shape, quality, and strength to enable construction as designed. The forms shall be true to line and grade, mortar tight, and sufficiently rigid to resist any appreciable amount of springing out of shape during placing of the concrete. The responsibility for their adequacy shall rest with the Contractor. All dirt, chips, sawdust, nails, and other foreign matter shall be completely removed from forms before any concrete is deposited. The surfaces of forms shall be smooth and free from irregularities, dents, sags and holes that would appreciably deface the finished surface. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being reused, and the reuse of forms shall be subject to the approval of the Engineer. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent that will leave no objectionable film on the surface of the forms that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete.

Forms for all surfaces that will not be completely enclosed or hidden below the permanent surface of the ground shall be made of surfaced lumber, or material which will provide a surface at least equally satisfactory. Any lumber or material which becomes badly checked or warped prior to placing concrete may be rejected.

SECTION 505

Forms for all exposed surfaces of bridges, viaducts, overcrossings and similar structures shall be constructed of plywood or an approved equal. Plywood for forms shall be exterior type, of the grade Concrete-Form Exterior, conforming to the specifications of the NBS, Commercial Standards latest edition. Plywood shall be furnished and placed in 48 inches widths and in uniform lengths of not less than 96 inches, except where the dimension of the member formed is less than the specified panel dimension. Plywood shall be placed with the grain of the outer plies in the direction of the span. Where plywood is attached directly to the studding or joints, the panels shall be not less than 5/8 inch thick, and the studdings or joints shall be spaced not more than 12 inches, center to center. Plywood less than 5/8 inch thick, otherwise conforming to the requirements specified, may be used with a continuous backing of 5/8 inch sheathing. All form panels shall be placed in a neat, symmetrical pattern with the horizontal joints level and continuous.

Wood forms for copings and curbs shall have a thickness of not less than 1 5/8 inches and a width of not less than the full depth of coping or curb.

Unless otherwise shown on the plans, all sharp edges shall be chamfered with 3/4 inch triangular fillets. Forms for curved surfaces shall be so constructed and placed that the finished surface will not deviate appreciably from the arc of the curve.

Forms shall be so constructed that portions, where finishing is required, may be removed without disturbing portion of forms to remain.

Forms for girders and slabs shall be cambered as may be required by the Engineer.

Forms shall, as far as practicable, be so constructed that the form marks will conform to the general lines of the structure.

Form clamps or bolts, approved by the Engineer, shall be used to fasten forms. The use of twisted wire loop ties to hold forms in position will not be permitted, nor shall wooden spreaders be used unless authorized by the Engineer. Clamps or bolts shall be of sufficient strength and number to prevent spreading of the forms. They shall be of such type that they can be entirely removed or cut back 1 inch below the finished surface of the concrete. Forms for outside surfaces shall be constructed with stiff wales at right angles to the studs and all form clamps shall extend through and fasten such wales, all based on the rate of concrete placement.

The Contractor may at his own option, place such portions of the concrete for the structure directly against the side of the excavation or sheathing without the use of outside forms, provided that the following conditions are met.

(A) If concrete is placed directly against the sides of the excavation, the faces of the excavation must be firm and compact, and be able to stand without sloughing off and be at all points outside the concrete lines shown on the plans.

(B) If concrete is placed against sheathing, such sheathing shall be closely fitted and shall be outside of the concrete lines shown on the plans. Those surfaces against which the concrete is to be placed shall be faced with building paper. Except as otherwise specified all sheathing shall be removed, but not until either at least 7 days after placing concrete or until the concrete has attained a strength in compression of not less than 2,000 psi. Care should be used in pulling sheathing so as to avoid damaging the concrete. Voids left by the removal of sheathing, piles and/or similar sheathing supports shall be backfilled with material having a sand equivalent of not less than 30 and consolidated by jetting as directed by the Engineer. When, in the opinion of the Engineer, field conditions or the type of sheathing or methods of construction used by the Contractor are such as to make the removal of sheathing impracticable, that portion of the sheathing against which concrete has been placed may be left in place.

Regardless of the method used in the placement of concrete without outside forms the following stipulations shall hold:

(A) The reinforcing steel shall be accurately set and held firmly in place, to the satisfaction of the Engineer.

(B) No direct payment will be made for building paper, sheeting, gunite or concrete placed outside of concrete lines shown on the plans. The cost thereof shall be absorbed in the prices bid for the various items of work.

(C) The Contractor shall assume all risks of damage to the work or to existing improvements due to any reason whatsoever that may be attributable to the method of construction outlined above.

SECTION 505

505.3.1 Removal of Forms: The falsework supporting any span of a continuous or rigid frame structure subject to bending stress shall not be released until after the last concrete placed in the span and in the adjoining spans, excluding concrete above the deck slab, has attained a compressive strength of not less than twice the design unit stress, or 21 days after the concrete is placed, whichever occurs first.

Stairway riser forms shall be removed and the finish of the steps completed on the day the concrete is placed. Metal stairway treads, if required by the plans, shall be installed immediately after the steps have been placed.

Side forms for beams, girders, columns, railings, or other members wherein the forms do not resist dead load bending shall be removed not more than 24 hours after placing concrete, where finishing is required, unless otherwise directed by the Engineer, provided that satisfactory arrangements are made to cure and protect the concrete thus exposed.

Side forms for arch rings, columns, and piers shall be removed before the members of the structure which they support are placed so that the quality of the concrete may be inspected. Such forms shall be so constructed that they may be removed without disturbing other forms which resist direct load or bending stress.

Forms and shoring for box and arch sections of sewers and storm drains may be removed as follows:

- (A) Forms for open channel walls — 16 hours.
- (B) Outside forms of box sections and inside wall forms of box sections which do not support the slab forms — 16 hours.
- (C) Arch sections in open cut — 12 hours.
- (D) Slab forms for box sections:
 - (1) Type II Cement — 48 hours or 6 hours per foot of span between supports, whichever is greater.
 - (2) Type III Cement — 24 hours or 3 hours per foot of span between supports, whichever is greater.
 - (3) Type V Cement — 56 hours or 7 hours per foot of span between supports, whichever is greater.

The periods of time at which the Contractor may remove forms, as set forth above, are permissive only and subject to the Contractor's assuming all risks that may be involved in such removals. At his option, except for surfaces to be finished, the Contractor may leave the forms in place for such longer periods as are, in his opinion, required.

505.4 FALSEWORK:

Falsework construction and erection shall not commence until the Contractor has received written approval of the sealed final falsework shop drawings.

All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure concrete were placed at one time.

All falsework, staging, walkways, forms, ladders, cofferdams, and similar accessories shall equal or exceed the minimum applicable safety requirements of Section [107](#). Compliance with such requirements shall not relieve the Contractor from full responsibility for the adequacy and safety of said items.

Falsework shall be founded upon a solid footing safe against undermining and protected from softening. When the falsework is supported on timber piles, the piles shall be driven to a bearing value as determined by the Contractor's Engineer.

Falsework and forms shall be so constructed as to produce in the finished structure the lines and grades indicated on the plans. Suitable jacks or wedges shall be used in connection with the falsework to set the forms to grade or camber shown on the plans, or to take up any settlement in the form work either before or during the placement of concrete. Single wedges for this purpose will not be permitted; it being required that all such wedges be in pairs to insure uniform bearing. Dead load deflection in stringers and joints will be compensated for by varying depths of the joists or by using varying depth nailing strips.

Arch centering shall be removed uniformly and gradually, beginning at the crown and working toward the springing, to permit the arch to take its load slowly and evenly. Centering for adjacent arch spans shall be struck simultaneously.

Falsework under any continuous unit or rigid frame shall be struck simultaneously; the supporting supports being released gradually and uniformly, starting at the center and working both ways towards the supports.

SECTION 505

505.4.1 Falsework Design: Falsework design shall be in accordance with the requirements of Section [105.2](#).

Falsework shall be designed by the Contractor to carry all loads and pressures which may be applied to it. The construction loads to be applied are as follows:

Tunnel centering – 100 percent of the concrete load where concrete is placed by pumping. Forms shall be so constructed to provide adequate relief for excessive pump pressure.

All other structures – a live load of 30 pounds per square foot of horizontal area.

Transverse and longitudinal bracing – a horizontal force equal to 2 percent of the vertical load.

The unit stresses for wood falsework shall be those recommended in the West Coast Lumbermen's Association's standard grading and dressing rules increased 25 percent for short time loading.

Falsework may be bolted or spiked at the option of the Contractor, but the use of bolts and spikes shall not be combined in the same connection. The allowable spacings and connection values of bolts and spikes shall be in accordance with the national design specifications for stress-grade lumber and its fastenings as recommended by National Lumber Manufacturers Association except that an additional allowance of 25 percent for temporary use shall be added to the connection values for bolts and spikes.

Ends of columns bearing on wedges shall be tied in both direction by girts.

Unit stresses for steel falsework shall be in accordance with the requirements of the specifications for design, fabrication and erection of structural steel for buildings of the AISC.

505.5 PLACING REINFORCEMENT:

Reinforcing bars shall be accurately placed as shown on the plans and shall be firmly and securely held in position by wiring at intersections with wire not smaller than No. 16 gage and by using concrete or metal chairs, spacers, metal hangers, supporting wires and other approved devices of sufficient strength to resist crushing under full load. Wooden supports shall not be used.

Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted. Before placing in the forms, all reinforcing steel shall be thoroughly cleaned of mortar, oil, dirt, loose mill scale, loose or thick rust and coatings of any character that would destroy or reduce the bond. No concrete shall be deposited until the placing of the reinforcing steel has been inspected and approved.

Bundle bars shall be tied together at not more than 6 foot centers.

The Contractor will be allowed the following tolerances when placing, tying and supporting reinforcing steel:

- (1) In slabs and beams, horizontal bars shall be within ¼ inch measured vertically, of the position indicated on the plans.
- (2) In vertical walls, columns, wings, and similar members, clearance from the forms shall be within ¼ inch of the clearance shown on the plans.
- (3) In slabs or walls, long runs of bars may vary up to 2 inches in spacing; however, the specified number of bars shall be placed.

505.5.1 Splicing: Splices of bars shall be made only where shown on the plans or as approved by the Engineer. Where bars are spliced they shall be lapped at least 30 diameters, unless otherwise shown on the plans.

Welding of reinforcing steel will not be permitted unless specifically authorized by the Engineer.

505.5.2 Bending Reinforcement: Bending of reinforcing steel shall conform to the requirements of the AASHTO LRFD Bridge Construction Specifications Section 9.4.

SECTION 505

Bars shall not be bent nor straightened in a manner that will injure the material. Bars with kinks or unspecified bends shall not be used.

505.5.3 Welded Wire Fabric: Welded wire fabric shall be held firmly in place and spliced not less than 2 meshes.

505.5.4 Dowels:

505.5.4.1 Dowel Placement: Dowel placement shall consist of drilling or coring dowel holes in concrete, furnishing and placing anchoring materials, and placing reinforcing steel dowels in accordance with the details shown on the Project Plans, and the requirements of the project Special provisions and these Specifications.

Dowel holes shall be cored where dowels are to be placed:

(A) in bridge decks and other thin concrete sections, and the depth of the dowel hole shown on the project plans projects to 3 inches or less from the opposite face of the concrete section, or

(B) within 4 inches from an existing concrete edge.

Cored holes shall be intentionally roughened after coring.

All holes shall be blown clean with compressed air, prior to applying the anchoring material.

The diameter of the holes for the dowels shall be 1/8" larger than the diameter of the dowels to be placed. The depth of the holes for the dowels shall be as shown on the Project Plans.

The anchoring materials for the dowels shall be an epoxy adhesive conforming to the requirements of Section [505.5.4.2](#), unless otherwise specified on the Project Plans and/or the project Special Provisions, or as approved by the Engineer.

505.5.4.2 Anchoring Materials: Epoxy materials shall be used for anchoring dowels. The Contractor shall submit Certificates of Compliance or Analysis, complete with supporting documentation, to the Engineer for all epoxy materials to be used for anchoring dowels on a specific project, in accordance with the requirements of Section [106.2](#). The epoxy materials shall be provided by the Contractor in general conformance with the requirements of Section 1015 – General Requirements of Section 1015 – EPOXY MATERIALS of the current Arizona Department of Transportation (ADOT) Standard Specifications for Road and Bridge Construction, amended to date.

Epoxy resin base anchoring adhesive shall be used for anchoring dowels in concrete. High viscosity, or non-sag epoxies in the form of a gel, shall be used for horizontal or near-horizontal applications, where flow out of the anchoring hole is a problem. Low and medium viscosity epoxies may be used in vertical anchoring holes that open upward. The anchoring product shall specifically be designed for the designated application, according to the manufacturer's product literature.

Epoxy resin base anchoring adhesive shall provide the specified minimum tensile pullout resistance, when tested in accordance with Arizona Test Method 725, as modified in accordance with Section [505.5.4.3](#) of these specifications. The pot life of the anchoring material shall be determined in accordance with AASHTO T-237, Part I. The determined pot life shall be within 25 percent or 10 minutes of the pot life specified by the manufacturer, whichever is greater.

505.5.4.3 Dowel Strength Requirements: The epoxy resin base anchoring adhesive shall provide the following minimum pullout resistances:

#4 dowels:	12.0 Kips
#5 dowels:	18.6 Kips
#6 dowels:	26.4 Kips
#7 dowels:	36.0 Kips

Arizona Test Method (ATM) 725 is a Tensile Proof Dowel Test, developed by ADOT to specifically test #6 reinforcing steel dowels anchored in Portland cement concrete with an epoxy adhesive. When testing reinforcing steel dowel sizes, the anchoring hole (ATM 725: PREPARATION – 4. (a)) shall be modified as follows; the rotary hammer drill bit size (ATM 725: APPARATUS – 2. (a)) shall be modified accordingly:

SECTION 505

#4 dowels:	5/8" diameter x 8" long
#5 dowels:	3/4" diameter x 10" long
#6 dowels	7/8" diameter x 12" long
#7 dowels	1" diameter x 14" long

The Contractor may opt to conduct pullout tests with hole lengths other than those required above, based on the adhesive manufacturer's product literature and recommendations; however, test results shall demonstrate that the tested system provides the required pullout resistances.

505.6 PLACING CONCRETE:

No concrete shall be placed in any forms supported by falsework until the Contractor's Professional Engineer has inspected the completed falsework, and has issued a properly sealed and signed certificate that the falsework has been constructed according to the approved falsework drawings.

Where a schedule for placing concrete is shown on the plans, no deviation will be permitted therefrom unless approved in writing by the Engineer.

The placing of concrete for a given pour shall start at the low point and shall proceed upgrade, unless otherwise permitted by the Engineer.

With the exception of concrete placed in slope paving and aprons, and concrete placed under water, all concrete shall be compacted by means of high frequency internal vibrators of a type, size and number approved by the Engineer. The number of vibrators employed shall be ample to consolidate the incoming concrete to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least 2 vibrators shall be available at the site of the structure in which more than 25 cubic yards of concrete is to be placed. The vibrators shall not be attached to or held against the forms or the reinforcing steel. The locations, manner and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without causing segregation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface. Fresh concrete shall be spread in horizontal layers insofar as practicable and the thickness of the layers shall not be greater than can be satisfactorily consolidated with the vibrators. If additional concrete is to be placed, care shall be taken to remove all laitance and to roughen the surfaces of the concrete to insure that fresh concrete is deposited upon sound concrete surfaces. Layers of concrete shall not be tapered off in wedge-shaped slopes, but shall be built with square ends and level tops.

Mixed concrete, after being deposited, shall be consolidated until all voids are filled and free mortar appears on the surface. The concrete shall be placed as nearly as possible in its final position and the use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted.

Fresh concrete shall not be permitted to fall from a height greater than 6 feet without the use of adjustable length pipes or elephant trunks.

The use of approved external vibrators for compacting concrete will be permitted when the concrete is inaccessible for adequate compaction provided the forms are constructed sufficiently rigid to resist displacement or damage from external vibration.

During the placing of concrete, care shall be taken that methods of compaction used will result in a surface of even texture free from voids, water or air pockets, and that the coarse aggregate is forced away from the forms in order to leave a mortar surface. Spades or broad-tined forks shall be provided and used to produce the desired results if required by the Engineer.

The use of chutes in conveying or depositing concrete will be allowed only at the discretion of the Engineer, and wherever they are used they shall be laid at such inclination as will permit the flow of concrete of such consistency as is required. The use of additional water in mixing the concrete to promote free flow in chutes of low inclination will not be allowed. Where necessary in order to prevent segregation, chutes shall be provided with baffle boards or a reversed Section at the outlet.

Concrete for columns shall be placed using pipes of adjustable length and not less than 6 inches in diameter.

Horizontal members or sections shall not be placed until the concrete in the supporting vertical members or sections has been consolidated and a minimum 2 hour period has elapsed to permit shrinkage to occur.

SECTION 505

Walkways shall be provided along each side and for the full length of bridge structures outside the deck area. These walkways shall be of sufficient width, and so constructed as to provide for the support of the bridges from which the longitudinal floats specified are to be operated. Inspection walkways and access thereto shall be provided under the deck forms between each pair of girders and outside of each outside girder for the full length of the bridge structure. The walkways shall be not more than 8 feet below the concrete to be inspected.

505.6.1 Construction Joints in Major Structures: The work shall be so prosecuted that construction joints will occur at designated places shown on plans unless specifically permitted otherwise by the Engineer. The Contractor shall complete, by continuous depositing of concrete, section for the work comprised between such joints. The joints shall be kept moist until adjacent concrete is placed.

All construction joints at the bottom of walls or arches, at the top of walls, and all longitudinal construction joints having a keyed, stepped or roughened surface shall be cleaned by sandblasting prior to placing the adjacent concrete. Any quality of sand may be used which will accomplish the desired results.

The sandblasting operations shall be continued until all unsatisfactory concrete, and all laitance, coatings, stains, debris, and other foreign materials are removed. The surface of the concrete shall be washed thoroughly to remove all loose material. The method used in disposing of waste water employed in washing the concrete surfaces shall be such that the waste water will not stain, discolor, or affect exposed surfaces of the structures. The method of disposal will be subject to the approval of the Engineer.

All horizontal construction joints or those on slight slopes, shall be covered with Class D mortar as specified in Section [776](#).

Expansion and contraction joints in the concrete structures shall be formed where shown on the plans and as directed. In general, such joints shall have smooth abutting surfaces, painted or separated and sealed as detailed on the plans. No reinforcement shall be extended through the joints, except where specifically noted or detailed on the plans. Concrete or mortar shall not be permitted to lap these joints in such a manner as to effect a tie or bond that would later promote spalling.

Asphalt paint or premolded asphalt filler used in joints shall be as specified in Section [729](#).

No direct payment will be made for furnishing and placing asphaltic paint, premolded asphaltic filler or other types of joint separators; their costs shall be included in the price bid for the item of work of which they are a part.

505.6.2 Adverse Weather Concreting:

(A) Hot Weather Concreting: Hot weather is defined as any combination of high ambient temperature, low relative humidity, and wind velocity which would tend to impair the quality of fresh concrete. These effects become more pronounced as wind velocity increases. Since last minute improvisations are rarely successful, preplanning and coordination of all phases of the work are required to minimize these adverse effects.

As an absolute minimum, the Contractor shall insure that the following measures are taken:

- (1) An ample supply of water, hoses, and fog nozzles are available at the site.
- (2) Spare vibrators are on hand in the ratio of one spare vibrator for each three in use.
- (3) Preplanning has been accomplished to insure prompt placement, consolidation, finishing, and curing of the concrete.
- (4) Concrete temperature on arrival should be approximately 60°F. and in any event shall not exceed 90°F. The use of cold water and ice is recommended.
- (5) The subgrade is moist, but free of standing water.
- (6) Fog spray is utilized to cool the forms and steel. Under extreme conditions of high ambient temperature, exposure to the direct rays of the sun, low relative humidity, and wind, even strict adherence to these measures may not produce the quality desired and it may be necessary to restrict concrete placement to early morning only. If this decision is made, then particular attention must be directed to the curing process since the concrete will be exposed to severe thermal stresses due to temperature variation; heat of hydration plus midday sun radiation versus nighttime cooling.

(B) Cold Weather Concreting: Concrete shall not be placed on frozen ground, nor shall it be placed when the ambient temperature is below 40°F. unless adequate means are used to heat the aggregate and/or water and satisfactory means have been taken for protecting and heating the concrete during the curing period.

SECTION 505

(C) Wet Weather Concreting: Placing of concrete shall be discontinued when the quantity of rainfall is such as to cause a flow or wash to the surface. Any concrete already placed and partially cured shall be covered to prevent dimpling. A construction joint will be installed prior to shut down.

(D) Replacement of Damaged or Defective Concrete: Upon written notice from the Engineer, all concrete which has been damaged or is defective, shall be replaced by the Contractor at no cost to the Contracting Agency.

(E) Recommended Reference:

- (1) ACI-305 Hot Weather Concreting
- (2) ACI-306 Cold Weather Concreting
- (3) ACI-308 Recommended Practices for Curing Concrete

505.6.3 Bridge Deck Joint Assemblies:

505.6.3.1 Description: This work shall consist of furnishing and installing expansion devices including the seals, anchorage system, and hardware in accordance with the project plans and these specifications.

505.6.3.2 Materials: Elastomer Seals shall be of the Compression Seal or Strip Seal type, and shall conform to the requirements of the Arizona Department of Transportation Standard Specifications for Road and Bridge Construction Section 1011-5.

Steel shapes and plates shall conform to the requirements of ASTM [A36](#), or ASTM [A588](#).

505.6.3.3 Construction Requirements:

(1) General: Deck joint assemblies shall consist of elastomer and steel assemblies which are anchored to the concrete at the deck joint. The seal armor shall be cast in the concrete. The completed assembly shall be properly installed in the planned position, shall satisfactorily resist the intrusion of foreign material and water, and shall provide bump-free passage of traffic. For each size of seal on a project, one piece of the seal material supplied shall be at least 18 inches longer than required by the project Plans. The additional length will be removed in the presence of the Engineer and used for materials testing. Certificates of Compliance conforming to the requirements of Section [106.2](#) shall also be submitted by the Contractor.

(2) Shop Drawings: Prior to fabrication, the Contractor shall submit shop drawings to the Engineer for approval, in accordance with the requirements of Section [105.2](#). The shop drawings shall show complete details of the method of installation to be followed, including a temperature correction chart for adjusting the dimensions of the joint according to the ambient temperature, and any additions or rearrangements of the reinforcing steel from that shown on the project plans.

(3) Elastomer Seals: Seals shall conform to the requirements specified.

(4) Armor: All steel for cast-in-place deck joint assemblies shall conform to the requirements specified.

(5) Galvanizing: All steel parts of strip seal assemblies shall be galvanized after fabrication, in accordance with the requirements of ASTM [A123](#) and [A153](#), unless ASTM [A588](#) steel is used. Bolts shall be high strength, conforming to the requirements of ASTM [A325M](#), with a protective coating of zinc, followed by a chromate and baked organic coating conforming to the requirements of ASTM F1135, Grade 3, 5, 6, 7, or 8 and Color Code A.

Steel parts of compression seal assemblies do not require galvanizing, plating, or painting.

(6) Joint Preparation and Installation: At all joint locations, the Contractor shall cast the bridge decks and abutment backwalls with a formed blockout, sized to accommodate the pre-assembled joint assembly. The joint assembly will be anchored in the concrete to be placed with the secondary pour in the blockout. Prior to the secondary pour, the surface of the existing concrete in the blockout shall be coated with an approved adhesive specifically formulated for bonding new concrete to old concrete.

(7) Welding: All welding and inspection of welding for structural steel shall be performed in accordance with the requirements of the latest revision of the AASHTO/AWS D1.5M/D1.5 Bridge Welding Code. The use of electro-slag welding process on structural steel will not be permitted.

SECTION 505

Installed armor assemblies shall be covered or otherwise protected at all times prior to installing the elastomer portion of the joint assembly. The elastomer shall be installed at such time and in such manner that it will not be damaged by construction operations.

Immediately prior to the installation of the seal element, the steel contact surfaces of the joint armor shall be clean, dry, and free of oil, rust, paint, or foreign material. Any perforation or tearing of the seal element due to installation procedures or construction activities will be cause for rejection of the installed seal element.

During the installation of all proprietary deck joint assemblies, the manufacturer's representative shall be present. As a minimum, the representative shall be present during the placement of the joint assembly in the deck blockout, prior to the secondary concrete pour, and shall also be present during the installation of the seal element.

505.6.4 Water Stops: Water stops of rubber or plastic, shall be placed in accordance with the details shown on the project plans. Where movement at the joint is provided for, the water stops shall be of the type permitting such movement without damage. Water stops shall be mechanically spliced, vulcanized, or heat-sealed to form continuous watertight joints, in accordance with the manufacturer's recommendations, and as approved by the Engineer.

505.6.5 Longitudinal Joints between Precast Bridge Deck Units: After erection of the units and at the time requested by the Engineer, the longitudinal shear key joints between units shall be thoroughly packed with a pre-packaged non-shrink grout or a sand-cement grout with an expansion agent approved by the Engineer. The Contractor shall then transversely connect the deck units with the connection rods, stressing and anchoring them as shown on the project plans.

505.7 CONCRETE DEPOSITED UNDER WATER:

When conditions render it impossible or inadvisable in the opinion of the Engineer to dewater excavation before placing concrete, the Contractor shall deposit under water, by means of a tremie or underwater bottom dump bucket, a layer of concrete of sufficient thickness to thoroughly seal the cofferdam. To prevent segregation the concrete shall be carefully placed in a compact mass and shall not be disturbed after being deposited. Water shall be maintained in a still condition at the point of deposit.

A tremie shall consist of a water tight tube having a diameter of not less than 10 inches with a hopper at the top. The tube shall be equipped with a device that will close the discharge end and prevent water from entering the tube while charging the tube with concrete. The tremie shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering, when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of the work to prevent water entering the tube and shall be entirely sealed at all times, except when concrete is being placed. The tremie tube shall be kept full of concrete. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed and the resulting concrete seal shall be monolithic and homogeneous.

The underwater bucket shall have an open top and the bottom doors shall open freely and outward when tripped. The bucket shall be completely filled and slowly lowered to avoid back wash and shall not be dumped until it rests on the surface upon which the concrete is to be deposited. After discharge, the bucket shall be raised slowly until well above the concrete.

Concrete deposited in water shall have 10 percent extra cement added.

505.8 CURING:

As soon after the completion of the specified finishing operations as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surface shall either be sprinkled with water, covered with earth, sand or burlap; sprayed with a curing compound or sealed with a material conforming with Section [726](#). All concrete for bridge structures shall be water cured unless otherwise permitted by the Engineer. The Contractor shall use the wet burlap method for the water cure of all concrete in bridge decks and approach slabs, unless otherwise authorized by the Engineer.

Concrete that is water cured must be kept continuously wet for at least 10 days after being placed; preferably being covered, if possible, with at least 2 layers of not lighter than 7 ounce burlap, except that handrail, baserail, railing posts, tops of walls, and similar parts of the structure, if water cured, must be covered with burlap as above prescribed, immediately following the

SECTION 505

finishing treatment specified therefore, and such covering shall not be removed in less than 4 days. Roadway areas, floors, slabs, curbs, walks, and the like, that are water cured may be covered with sand to a depth of at least 2 inches, in lieu of the burlap as specified above, as soon as the condition of the concrete will properly permit, and such covering must remain wet and in place until the concrete so covered is at least 10 days old unless otherwise directed by the Engineer or provided by special provisions.

When a sprayed impervious membrane is used, it shall be applied under pressure through a spray nozzle in such manner and quantity as to entirely cover and seal all exposed surfaces of the concrete with a uniform film. To insure complete coverage, membrane shall be applied in two applications for a total coverage of 150 square feet per gallon. The membrane, however, shall not be applied to any surface until all of the finishing operations have been completed; such surfaces being kept damp, until the membrane is applied. All surfaces on which a bond is required, such as construction joints, shear planes, reinforcing steel, and the like, shall be adequately covered and protected before starting the application of the sealing medium in order to prevent any of the membrane from being deposited thereon; and any such surface with which the seal may have come in contact shall immediately thereafter be cleaned. Care shall be exercised to avoid and prevent any damage to the membrane seal during the curing period. Should the seal be broken or damaged before the expiration of 10 days after the placing of the concrete, the break shall be immediately repaired by the application of additional impervious membrane over the damaged area.

Should any forms be removed sooner than 10 days after the placing of the concrete, the surface so exposed shall either be immediately sprayed with a coating of the membrane seal, or kept continuously wet by the use of burlap or other suitable means until such concrete has cured for at least 10 days.

When tops of walls are cured by the membrane sealing method the side forms, except metal forms, must be kept continuously wet for the 10 days following the placing of the concrete.

If due to weather conditions, materials used, or for any other reason, there is any likelihood of the fresh concrete checking or cracking prior to the commencement of the curing operations, it shall be kept damp, but not wet, by means of an indirect fine spray of water until all danger of such checking or cracking is past, or until the curing operations are started in the particular area affected.

Since hot weather leads to more rapid drying of concrete, protection and curing are far more critical than in cool weather. Water curing shall be used wherever it is practical and shall be continuous to avoid volume changes due to alternation of wetting and drying. The need for adequate continuous curing is greatest during the first few hours after placement of concrete in hot weather.

505.9 FINISHING CONCRETE:

Immediately after the removal of forms as provided above, all concrete surfaces shall be finished in accordance with the requirements specified below.

All surfaces scheduled to be covered with backfill shall be finished so as to be free of open and rough spaces.

All surfaces that will remain exposed in the completed work shall be finished so as to be free of open and rough spaces, depressions or projections. All angles and fillets shall be sharp and true and the finished surface shall present a pleasing appearance of uniform color.

All top surfaces of walls, abutments, piers, etc., shall be finished to a smooth surface and shall be cured by an approved method.

If rock pockets or honeycomb are of such an extent and character as to affect materially the strength of the structure and to endanger the steel reinforcement the Engineer may declare the concrete defective and require the removal and replacement of that portion of the structure affected by the Contractor at no additional cost to the Contracting Agency.

If finishing operations are not carried out as set forth below, all placing of concrete shall stop until satisfactory arrangements are made by the Contractor to promptly correct defective finishing work and to carry out finishing operations as specified.

One of the classes of finish as specified shall be applied to the various surfaces as set forth under applicability of finishes.

SECTION 505

No finishing or patching shall be permitted until the surface has been inspected by the Engineer.

505.9.1 Finishing Fresh Concrete in Bridge Decks: Upon placing the deck to a uniform and true surface, screed supports shall promptly be removed from the surface and any necessary hand finishing shall be promptly accomplished in the areas where the screed supports have been removed.

After final floating of the plastic concrete, bridge decks subject to vehicular traffic shall be textured transversely. Apparatus producing textured grooved shall be mechanically operated from an independent self-propelled bridge. Grooves shall be 1/16 to 1/8 inch in width and 3/32 to 6/32 in depth. Center to center spacing of the grooves shall be as follows: 7/8 inch, 3/4 inch, 1 inch, 3/4 inch, 1-1/8 inch and then repeated or other measurements as approved by the Engineer. Texturing shall be completed before surface of concrete is torn or unduly roughened by texturing operation. Grooves that close following texturing will not be permitted and will have to be retextured. Hand tine brooms shall be available on the job site, at all times during texturing operation, to repair faulty texturing grooves.

The finished surface will be tested with a 10 foot straightedge furnished by the Contractor. The testing will be accomplished by holding the straightedge in contact with the deck surface and parallel to the centerline. The surface shall not vary more than 1/8 inch from the lower edge of the straightedge. Areas showing high spots of more than 1/8 inch shall be corrected by cutting or planning. The cutting or planning machine shall be a rotary type, equipped with an adjustable cutter and having a minimum wheel base of 10 feet. Areas showing low spots of more than 1/8 inch shall be filled with an approved mixture of sand, cement and epoxy. The mixture shall firmly adhere to the surface and shall match the surrounding concrete. All areas corrected shall not show deviations in excess of 1/8 inch when tested with a 10 foot straightedge.

505.9.2 Finishing Fresh Concrete in Sidewalks and Bridge Sidewalks: After the concrete has been placed and spread between the forms, it shall be thoroughly worked until all the coarse aggregate is below the surface and the mortar comes to the top. Concrete may be consolidated by means of mechanical vibrators approved by the Engineer.

The surface shall then be struck off and worked to grade and cross-section with a wood float.

A mechanical finishing machine that will consolidate the concrete and strike off and finish the surface may be used if permitted by the Engineer, provided that the machine produces a sidewalk equal to or better in all respects than that produced by the methods specified herein.

The surface shall be sweat finished by means of a steel trowel followed by a light broom finish.

The sidewalks shall be marked and edged with the proper tools to form the joints, marking and edges shown on the plans.

505.9.3 Finishing Green Concrete: Class I Finish — All bolts, wires and rods shall be clipped and recessed. All holes, honeycomb, rock pockets and other surface imperfections shall be cleaned out, thoroughly moistened and carefully patched with mortar. Mortar shall be composed of 1 part of cement and 2 parts of fine sand. A portion of the required cement for mortar shall be white as required to match the color of the surrounding concrete.

Class II Finish — The surface shall be patched and pointed as specified above for Class I Finish and then promptly covered with polyethylene film, wet burlap or wet cotton mats. If polyethylene film is used, the film shall be held securely to the surface by means of weights, adhesive or other suitable means. Only white polyethylene film for covering will be acceptable.

When the mortar used in patching and pointing has set sufficiently, the surface shall be uncovered and thoroughly rubbed with either a float or a carborundum stone until the surface is covered with a lather. Cork, wood or rubber floats shall be used only on surfaces sufficiently green to work up such lather, otherwise a carborundum stone shall be used. During the rubbing process, a thin grout composed of 1 part cement and 1 part of fine sand may be used to facilitate producing a satisfactory lather; however, this grout shall not be used in quantities sufficient to cause a plaster coating to be left on the finished surface. A portion of the required cement for grout shall be white as required to match the color of the surrounding concrete. Rubbing shall continue until irregularities are removed and there is no excess material. At the time a light dust appears, the surface shall be brushed or sacked. Brushing or sacking shall be carried in one direction so as to produce a uniform texture.

Class III Finish — The surface shall be treated as specified above under Class II Finish except that after brushing, the surface shall again be securely covered with polyethylene film, wet burlap or wet cotton mats. In not less than 1 day nor more than 4 days, the surface shall be uncovered and rubbed with a carborundum stone. This rubbing shall continue until the entire surface

SECTION 505

is of a smooth texture and uniform color. During the process, the use of a thin mixture of equal parts of sand and cement with water will be permitted. At the time a light dust appears, the surface shall be brushed or sacked, care being taken to carry this brushing in one direction so as to produce a uniform texture.

505.9.4 Finish Hardened Concrete: If for reasons either beyond the control of the Contractor or with the approval of the Engineer, more than 6 days have elapsed between the time of placing concrete and the time of the removal of forms, the concrete shall be considered as hardened. Prior to finishing hardened concrete, the surface shall be covered with burlap or cotton mats and kept thoroughly wet for a period of at least 1 hour. Finishing shall be identical to the respective requirements for Class I, Class II and Class III Finish for green concrete, except that the use of a mechanically operated carborundum stone will be required for Class II and Class III Finishes.

505.9.5 Applicability of Finishes: Surfaces requiring Class I Finish — All formed structures that are to be covered by backfill and those surfaces that are normally not in view of either vehicular or pedestrian traffic such as the surfaces on the inside of barrels of culverts, the under surfaces of decks, surfaces of concrete girders, piers and abutment walls.

Surfaces requiring Class II Finish — All exposed surfaces of headwalls, wingwalls, deck edges on culverts, end of piers on bridges and culverts, retaining walls and those vertical surfaces under highway grade separation structures that are exposed to view of the traveling public, including piers and pier caps, the outside face of outside girders, and other similar surfaces.

When surfaces of uniform texture and pleasing appearance are obtained through the use of first class metal forms, paper tubing or the use of special form coatings and the use of special care, such surfaces may, upon approval of the Engineer, be excluded from the surfaces requiring Class II Finish.

Surfaces requiring Class III Finish for bridge structures — All formed or finished surfaces above the surface of the deck on the roadway side of the handrail and the outside vertical surfaces from the top of handrail and dado to the lower edge of the chamfer at the bottom of the deck.

505.10 DIMENSIONAL TOLERANCES:

The maximum allowable tolerances or deviations from dimensions shown on the project plans or the approved shop drawings shall be as follows:

505.10.1 Cast-in-Place Concrete:

- (A) Variation from plumb in the lines and surfaces of columns, piers, abutment and girder walls:
 - In any 10 foot or less length: 0.4 inches
 - Maximum for the entire length: 1 inch
- (B) Variation in cross-sectional dimensions of columns, piers, girders, and in the thickness of slabs and walls:
 - + 1/4 inch
 - 1/8 inch
- (C) Girders alignment (deviation from straight line parallel to center line of girder measured between diaphragms):
 - 1/8 inch per every 10 feet in length
- (D) Variation in footing cross-sectional dimensions in project plans:
 - + 2 inches
 - 1/2 inch
- (E) Variation in footing thickness:
 - Greater than specified - No Limit
 - Less than specified - 5 percent of specified thickness up to a maximum of 1 inch
- (F) Subgrade Tolerances:
 - Slab poured on subgrade excepting footing thickness:
 - + 1/4 inch
 - 3/4 inch

SECTION 505

(G) Girder Bearing Seats:

Deviation from plane surface (flatness): $\pm 1/8$ inch in 10 feet.

Deviation from required elevation:

+ $1/4$ inch

- $1/8$ inch

(H) Cast-in-Place concrete box girder superstructures:

Deviation in overall depth:

+ $1/4$ inch

- $1/8$ inch

Deviation in slab and wall thickness:

+ $1/4$ inch

- $1/8$ inch

Deviation of post-tensioning ducts:

$\pm 1/4$ inch

505.10.2 Minor Precast Concrete Structures: Precast units that do not comply with the dimensional tolerances specified herein will be rejected. Precast units that show evidence of cracks, pop outs, voids or other evidence of structural inadequacy, or imperfections that will reduce the aesthetics of the unit after final placement will be rejected. The maximum allowable tolerances or deviations from the dimensions shown on the drawings shall be as follows:

(A) Over-all dimensions of member: $\pm 1/4$ inch per 10 feet, maximum of $\pm 3/4$ inch.

(B) Cross-sectional dimensions: sections 6 inches or less $\pm 1/8$ inch

Sections 18 inches or less and over 6 inches $\pm 1/4$ inch

Sections 39 inches or less and over 18 inches $\pm 1/4$ inch

(C) Deviations from straight line:

Not more than $1/4$ inch per 10 feet

All exposed, sharp corners of the concrete shall be filleted $3/4$ inches with a maximum allowable deviation of $\pm 1/8$ inch.

505.11 MEASUREMENT:

505.11.1 Reinforcing Steel: When reinforcing steel is scheduled for payment as a specific item, it will be measured in pounds, based on the total computed weight for the size and length of bars, or for the area of welded wire fabric, as shown on the Project Plans or as approved by the Engineer.

Unit bar weights for deformed and plain billet-steel bars will be the nominal unit weights specified in AASHTO M-31 (ASTM [A615](#)).

Area unit weights for steel welded wire fabric will be calculated based on specified wire spacing's and unit weights for specified wire types and sizes. Unit weights for plain wire shall be based on the nominal areas specified for Wire Size Numbers in AASHTO M-32 (ASTM A82). Unit weights for deformed wire shall be the nominal unit weights specified for Deformed Wire Size Numbers in AASHTO M-225 (ASTM A496).

If the area unit weights for steel welded wire fabric are specified on the Project Plans or in the Special Provisions, both the Contractor and the Engineer shall independently calculate the area unit weight, using specified wire spacing's, types and sizes, and the criteria in the preceding paragraph. Any apparent discrepancy between the specified and calculated area unit weights shall be resolved by the Engineer prior to the Contractor placing the order for the steel welded wire fabric.

Lap splices made for the convenience of the Contractor will not be included in the measurement for payment.

Reinforcing steel for Minor Structures, as defined in Section [505.1.1](#), will not be measured, but will be included in the items unit price or specified method of payment, unless otherwise called out on the Project Plans or in the Special Provisions.

Dowel Placement will be measured by the unit each.

SECTION 505

505.11.2 Concrete: When concrete is scheduled for payment on the basis of cubic yards, the calculation of the quantity of concrete for payment will be made only to the neat lines of the structures as shown on the plans. The quantity will be based on the concrete having the specified plan lengths, widths/depths, and thicknesses. However, all concrete shall be placed to line and grade within the tolerances specified in Section [505.10](#), or as approved by the Engineer as being reasonable and acceptable for the type of work involved. No volumetric deductions will be made for rounded or beveled edges, space occupied by reinforcing steel, metal inserts, or openings 0.5 square yard or less in area.

The quantity of concrete will be calculated considering any mortar used to cover construction joints as being concrete. The cost of cement used in any mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be absorbed in the cost of the item of work of which said mortar is a part.

505.11.3 Deck Joint Assemblies: Deck joint assemblies will be measured to the nearest tenth of a foot. Measurement will be made along the centerline of the joint, at the surface of the roadway, from face-to-face of curb or barrier. No measurement will be made for that portion of the deck joint assembly required by plan details to extend through the barrier face or curb; that portion of the joint assembly will be considered incidental to the sealing of the joint.

505.11.4 Bridge Railing, Curbs, Barriers, and Approach Slabs:

Bridge Pedestrian Fence and Curb, Bridge Pedestrian Fence and Parapet, and Bridge Fence and Parapet will be measured to the nearest tenth of a foot, from end post to end post.

Bridge Traffic and Pedestrian Rail will be measured to the nearest foot, determined from the outside dimensions of the rail.

Bridge Concrete Barrier will be measured to the nearest tenth of a foot.

Barrier Concrete Barrier Transition will be measured as a unit for each constructed.

Reinforced Concrete Approach Slab will be measured to the nearest square yard.

505.12 PAYMENT:

Payment for Portland cement concrete structures will be made in conformity with the terms of the contract and will be based on unit prices and/or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, preparation of subgrade for placing of concrete and doing all work required to construct the structures in conformity with the plans and specifications.

505.12.1 Reinforcing Steel: The accepted quantities of reinforcing steel, of the type indicated on the Project Plans or specified in the Special Provisions, and measured in conformance with Section [505.11.1](#) will be paid for at the contract unit price per pound, complete in place.

The accepted quantity of dowels placed will be paid for at the contract unit price for Dowel Placement, which shall be full compensation for the work, complete in place. Steel reinforcement furnished for the dowels will be measured and paid for under the pay item Reinforcing Steel.

No measurement or direct payment will be made for dowels which are required to replace existing reinforcing steel that is damaged as a result of the Contractor's operations; the Contractor shall furnish and place such dowels at his own expense.

505.12.2 Concrete: Payment for Portland cement concrete structures will be made in conformity with the terms of the contract and will be based on unit prices and/or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, preparation of subgrade for placing of concrete, and doing all work required to construct the structures in conformity with the plans and specifications.

Where concrete is scheduled for payment on the basis of cubic yards, the calculation of the quantity of concrete for payment will be made only to the neat lines of the structures as shown on the plans and on the basis of the concrete having the specified lengths, breadths, and thicknesses. The quantity of such concrete will be calculated considering the mortar used to cover construction joints as being concrete and no deductions will be made for rounded or beveled edges, space occupied by

SECTION 505

reinforcing steel, metal inserts, or openings 5 square feet or less in area. The cost of cement used in mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be absorbed in the item of work of which said mortar is a part.

An adjustment in the contract unit price, to the nearest cent, will be made for the quantity of concrete represented by the results of cylinder strength tests that are less than the specified 28-day compressive strength. Strength tests will be conducted in accordance with Section [725.8](#). The adjustment in contract unit price, if the concrete is accepted, will be based on Table [725-2](#) in Section [725.9](#).

The contract unit price for structural concrete shall include full compensation for all items incidental to providing a concrete structure complete in place, including waterstops, roadway drains, scuppers, metal inserts, and bearing pads.

505.12.3 Minor Concrete Structures and Accessories:

The accepted quantities of:

Minor Structures	Each
Deck Joint Assemblies	0.1 Foot
Bridge Pedestrian Fence and Curb	0.1 Foot
Bridge Pedestrian Fence and Parapet	0.1 Foot
Bridge Fence and Parapet	0.1 Foot
Bridge Traffic and Pedestrian Rail	Foot
Bridge Concrete Barrier	0.1 Foot
Bridge Concrete Barrier Transition	Each
Reinforced Concrete Approach Slab	Square Yard

will be paid for at the unit price and/or lump sums as set forth in the proposal. The contract unit price shall include full compensation for all labor, materials, tools and equipment necessary to provide the concrete structure or accessory complete in place, including all concrete, reinforcing steel, and items embedded in the concrete, such as anchor bolts, grates and frames, metal inserts, etc.

- *End of Section* -

SECTION 506

PRECAST PRESTRESSED CONCRETE MEMBERS

506.1 DESCRIPTION:

This work shall consist of furnishing and placing precast prestressed concrete members in accordance with the details shown on the plans, and as provided in these specifications and special provisions.

This work shall include the manufacture, transportation and storage of girders, slabs, and other structural members of precast prestressed concrete and shall also include the placing of all precast prestressed concrete members.

The members shall be furnished complete including all concrete, prestressing steel, bar reinforcing steel, and incidental materials in connection therewith.

Prestressing may be performed by either pretensioning or posttensioning methods. The method of prestressing to be used shall be optional with the Contractor, subject to the requirements provided in these specifications.

Prior to casting any members to be prestressed, the Contractor shall submit to the Engineer for review complete details of the method, materials and equipment he proposes to use in the prestressing operations, including any additions or rearrangement of reinforcing steel from that shown on the plans. Such details shall outline the method and sequence of stressing and shall include complete specifications and details of the prestressing steel and anchoring devices, anchoring stresses, type of enclosures, and all other data of the prestressing steel in the members, pressure grouting materials and equipment. For any rearrangement of prestressing tendons the stress calculations shall be submitted for approval by the Engineer.

506.2 CONCRETE:

Concrete construction shall conform to the provisions in Section [505](#).

The Contractor shall be responsible for furnishing concrete for prestressed members which contains not less than 611 nor more than 752 lbs., of cement per cubic yard of concrete, which is workable and which conforms to the strength requirements specified. Batch proportions shall be determined by the Contractor.

The compressive strength of the concrete will be determined from concrete test cylinders cured under conditions similar to those affecting the member.

The use of admixtures for the purpose of producing high strength at an early date shall be subject to the approval of the Engineer. In no case shall calcium chloride or any additive containing calcium chloride be used in concrete for prestressed construction.

Concrete shall not be deposited in the forms until the Engineer has inspected the placing of the reinforcement, enclosures, anchorages, and prestressing steel.

The concrete shall be vibrated internally or externally, or both, as required to consolidate the concrete. The vibrating shall be done with care and in such a manner that displacement of reinforcement, enclosures, and prestressing steel will be avoided.

Holes for anchor bars, and for diaphragm dowels which pass through the member, openings for connection rods, recesses for grout and holes for railing bolts shall be provided in the members in accordance with the details shown on the plans. Where diaphragm dowels do not pass through the member, the dowels may be anchored in the member by embedment in the concrete or by means of an approved threaded insert.

Forms for interior cells or voids in the members shall be constructed of a material that will resist breakage or deformation during the placing of concrete and will not materially increase the weight of the member.

Forms may be removed when permitted by the Engineer provided that the concrete is not damaged in so doing and that adequate curing is provided. The members shall be properly supported to prevent dead load bending at all times prior to initial tensioning. After prestressing, the members shall be handled or supported at or near the final bearing points for storage.

SECTION 506

The members shall be supported in transporting in a manner that will allow reasonable conformity to the proper bearing points with consideration for limitations of adequate hauling equipment. At all times members shall be handled or supported securely in an upright position, avoiding tipping or racking.

Lifting devices shall not project above the surface of the member after erection unless they will be imbedded in a subsequent concrete pour, have a minimum concrete cover of 2 inches and do not interfere with the placement of reinforcing steel or concrete.

The steam curing method or other approved methods may be used for curing precast prestressed concrete members in lieu of water curing. Steam curing, if elected by the Contractor, shall conform to the following provisions:

(A) After placement of the concrete, members shall be held for a minimum 2-hour presteaming period. The initial application of the steam shall be from 2 to 4 hours after the final placement of concrete to allow the initial set of the concrete to take place.

(B) All exposed surfaces of the members shall be kept wet continuously during the holding and curing period.

(C) The steam shall be saturated below pressure and shall be distributed uniformly over all exposed surfaces of the member and shall not impinge on the exposed concrete surfaces.

(D) The steam hood shall be equipped with temperature recording devices that will furnish an accurate continuous permanent record of the temperatures under the hood during the curing period. The position of the temperature devices shall be approved by the Engineer.

(E) During application of the steam the ambient air temperature shall increase at a rate not to exceed 40°F. per hour until a maximum temperature of from 140°F. to 160°F. is reached. The maximum temperature shall be held until the concrete has reached the desired strength.

506.3 PRESTRESSING STEEL:

Prestressing steel shall be high-tensile wire conforming to ASTM [A421](#), high-tensile wire strand conforming to ASTM [A416](#), or high-tensile strength alloy bars conforming to the following requirements:

High-tensile strength alloy bars shall be thermal stress relieved to produce suitable metallurgical structure and shall be individually proof-tested during the process of manufacturing to a minimum of 90 percent of the manufacturer's minimum guaranteed ultimate strength. The mechanical properties of the completed bars shall be as follows:

	Regular Grade	Special Grade
Ultimate tensile strength psi. min.	145,000	160,000
Yield strength, measured by the 0.7 percent extension under load method, psi. min.	130,000	140,000
Elongation in 20 bar diameters after rupture, percent, minimum.....	4.0	4.0
Reduction of area, percent, min.	25.0	20.0
Modulus of elasticity at 70 percent of the manufacturer's minimum guaranteed ultimate strength psi.min.....	25×10 ⁶	25×10 ⁶

Diameter tolerances shall conform to ASTM [A29](#)

Bars of different ultimate strength shall not be used interchangeably in the same member, unless otherwise permitted by the Engineer.

In handling and shipping bars, every care shall be taken to avoid bending, injury from deflection, scraping or overstressing of the bars. All damaged bars will be rejected.

All wire and strand to be post-tensioned shall be:

SECTION 506

(A) Protected from corrosion during shipping by a factory treatment or processing.

(B) Protected against abrasion during shipment and handling.

Wires shall be arranged to produce equal stress in all wire of wire groups or parallel lay cables that are to be stressed simultaneously or when necessary to insure proper positioning in the enclosures.

Where wires are to be button-headed, the buttons shall be cold formed symmetrically about the axes of the wires, and shall develop the full strength of the wire. No cold forming process shall be used that causes indentations in the wire.

When the button-headed wire assembly is tested as a unit in tension at least 90 percent of the failures at or above the minimum guaranteed ultimate strength of the wire shall occur in the wire and not in the buttons.

All prestressing steel shall be protected against rust and other corrosion and damage and shall be free of all dirt, scale and pits due to rust, oil, grease and other deleterious substances when finally encased in concrete or grouted in the member.

506.4 ANCHORAGES AND DISTRIBUTION:

All post tensioned prestressing steel shall be secured at the ends by means of approved anchoring devices. The anchors shall be of such nature that they will not kink, neckdown or otherwise damage the prestressing steel.

The load from the anchoring device shall be distributed to the concrete by means of approved devices that will effectively distribute the load to the concrete.

Anchoring devices for all post-tensioned prestressing steel shall be of the permanent type.

Where the end of a post-tensioned assembly will not be covered by concrete, the anchoring devices shall be recessed so that the ends of the prestressing steel and all parts except tendons of the anchoring devices will be at least 2 inches inside of the end surface of the members, unless a greater embedment is shown on the plans. Following post-tensioning, the recesses shall be filled with grout, and finished flush.

When headed wires are used, the outside edge of any hold for prestressing wire through a stressing washer or through an unthreaded bearing ring or plate shall not be less than 1/4 inch from the root of the thread of the washer or from the edge of the ring or plate.

Distribution plates or assemblies shall conform to the following requirements:

(A) The final unit compressive stress on the concrete directly underneath the plate or assembly shall not exceed 3,000 psi, and a suitable grillage of reinforcing steel shall be used in the stressed area.

(B) Bending stresses in the plates or assemblies induced by the pull of the prestressing steel shall not exceed design working stress, as determined by the Engineer, in the anchorage plate when 100 percent of the ultimate load is applied.

(C) Materials and workmanship shall conform to the requirements in Section [515](#).

Should the Contractor elect to furnish anchoring devices of a type which are sufficiently large and which are used in conjunction with a steel grillage imbedded in the concrete that effectively distributes the compressive stresses to the concrete and steel distribution plates or assemblies may be omitted.

506.5 ENCLOSURES:

Enclosures for prestressing steel shall be metallic and mortar-tight and shall be accurately placed at the locations shown on the plans or approved by the Engineer.

In lieu of metallic enclosures, openings for prestressing steel may be formed by means of cores or ducts composed of rubber or other suitable materials that can be removed prior to installing prestressing steel.

SECTION 506

All enclosures or openings or anchorage assemblies shall be provided with pipes or other suitable connections for the injection of grout after prestressing.

506.6 PRESTRESSING:

All prestressing tendons shall be tensioned by the use of equipment allowing actual elongation to be measured directly and using a hydraulic ram equipped with an accurate method of determining the tensioning force applied using one of the following methods; a gauge measuring the internal hydraulic pressure of the ram, or force exerted by the ram; a spring-type dynamometer used with the tensioning force applied directly; an electronic load cell used with the tensioning force applied directly. Readings taken from any one of these gauges shall be converted to actual tensioning forces through the use of calibrated values taken from a certified chart from a recent calibration. All gauges shall be of sufficient size and adequately made to allow accurate readings to be made of load increments of one percent of the total capacity of the ram used, not to exceed two percent of the tensioning force used.

The force in each tendon as obtained from the calibrated value shall be compared with the tensioning force obtained from calculation using the modulus of elasticity, cross-sectional area and length of tendon for the actual net elongation measured directly. When there is a difference between the values in excess of 5 percent final anchorage of the tendon shall be delayed until the reason for the discrepancy is found and appropriate correction is made to reduce the difference to five percent or less. Within the allowable difference, final anchorage shall be made when the required tensioning force is obtained according to the elongation used in pretensioning and according to the corrected gauge reading in post-tensioning.

The tensioning of prestressing steel in any post-tensioned member and the cutting or releasing of prestressing steel in any pretensioned member shall not be performed until tests on concrete cylinders indicate that the concrete in the member has attained a compressive strength of not less than the value shown on the plans for transfer strength.

Subject to prior approval by the Engineer, a portion of the total prestressing force may be applied to a member when the strength of the concrete in the member is less than the value shown on the plans and the member may then be moved. Approval by the Engineer of such partial prestressing and moving shall in no way relieve the Contractor of full responsibility for successfully constructing the members.

The cutting and releasing of prestressed steel in pretensioned members shall be performed in such an order that lateral eccentricity of prestress will be a minimum. The prestressing steel shall be cut off flush with the end of the member and the exposed ends of the prestressing steel shall be heavily coated with roofing asphalt or coal tar.

Post-tensioning will not be permitted until it is demonstrated to the satisfaction of the Engineer that the prestressing steel is free and unbonded in the enclosure.

The tensioning process as applied to post-tensioned members shall be so conducted that tension being applied and the elongation of the prestressing steel may be measured at all times. A record shall be kept of gauge pressures and elongations at all times and shall be submitted to the Engineer for approval.

Draped prestressing steel in post-tensioned members shall be tensioned by simultaneous jacking at each end of the assembly, except where low frictional forces permit tensioning from one and as determined by the Engineer.

Determination of the jacking stresses shall be supported by calculations, or both calculations and field tests when specified, prepared by the Contractor. The Contractor shall submit his calculations to the Engineer for approval, and prior to making field tests shall submit details of his proposed gauges and load devices for determining the jacking load at each end of the test prestressing unit to the Engineer for approval. The stress at the center will be calculated from the average of the end test loads, when tests are required. Jacking stresses within 2 percent of the specified values will be considered satisfactory.

The following friction coefficients shall be used in calculating friction losses. K represents the wobble of the ducts, and U represents the curvature in draped cables:

SECTION 506

Type of Steel	Type of Duct	K	U
Bright metal wire or strand	Bright metal	0.002	0.30
	Galvanized	0.0015	0.25
Bright metal bars	Bright metal	0.0003	0.20
	Galvanized	0.0002	0.15

The maximum temporary tensile stress (jacking stress) in prestressing steel shall not exceed 75 percent of the ultimate tensile strength of the prestressing steel. The prestressing steel shall be anchored at stresses (initial stress) that will result in the ultimate retention of working forces of not less than those shown on the plans but in no case shall the initial stress exceed 70 percent of the ultimate tensile strength of the prestressing steel.

506.7 BONDING AND GROUTING:

Post-tensioned prestressing steel shall be bonded to the concrete by pressure grouting the enclosures or openings.

All prestressing steel to be bonded to the concrete shall be free of scale and pits due to rust, dirt, oil, grease and other deleterious substances.

Grouting equipment shall be capable of grouting to a pressure of at least 100 psi. The grouting shall consist of neat cement and water conforming to the provisions in Section [725](#). The grout shall completely fill the enclosure or opening.

All enclosures or openings shall be clean and free of all foreign materials that would impair bonding of the grout. Each enclosure or opening shall be thoroughly flushed out with water and blown out with air or cleaned by other approved methods immediately prior to grouting.

After post-tensioned prestressing steel has been pressure grouted, the member shall not be moved or otherwise disturbed until at least 24 hours have elapsed.

506.8 SAMPLES FOR TESTING:

Sampling and testing shall conform to the specifications or ASTM [A416](#) and [A421](#) as provided in this specification.

Samples from each size and each lot of prestressing steel wires and bars, from each manufactured reel of prestressing steel strand, and from each lot of anchorage assemblies and bar couplers to be used shall be furnished for testing.

All wire or bars of each size from each mill lot and all strands from each manufactured reel to be shipped to the site shall be assigned an individual lot number and shall be tagged in such a manner that each such lot can be accurately identified at the job site. Each lot of anchorage assemblies and bar couplers to be installed at the site shall be likewise identified. All unidentified prestressing steel, anchorage assemblies or bar couplers received at the site will be rejected.

The following samples of material and tendons, selected by the Engineer from the prestressing steel at the plant or job site, shall be furnished by the Contractor to the Engineer well in advance of anticipated use:

(A) For wire or strand one 7 foot long sample shall be furnished for each heat or reel and for bars one 6 foot long sample shall be furnished for each heat.

(B) If the prestressing tendon is to be prefabricated, one completely fabricated prestressing tendon 5 feet in length for each size of tendon shall be furnished, including anchorage assemblies. If the prestressing tendon is to be assembled at the job site, sufficient wire or strand and end fittings to make up one complete prestressing tendon 5 feet in length for each size of tendon shall be furnished, including anchorage assemblies.

SECTION 506

(C) If the prestressing tendon is a bar, one 6 foot length complete with one end anchorage shall be furnished and in addition if couplers are to be used with the bars two 3 foot lengths of bar equipped with one coupler and fabricated to fit the coupler shall be furnished. Prestressing systems previously tested and approved need not be furnished as complete tendon samples, provided there is no change whatsoever in the material, design or details previously approved. Shop drawings shall contain an identification of the project on which approval was obtained, otherwise sampling will be necessary.

For prefabricated tendons, the Contractor shall give the Engineer at least 10 days' notice before commencing the installation of end fittings or the heading of wires. The Engineer will inspect all end fitting installations and wire headings while such fabrication is in progress at the plant and will arrange for all required testing of the material to be shipped to the site.

No prefabrication tendon shall be shipped to the site without first having been released by the Engineer, and each tendon shall be tagged before shipment for identification purposes at the site. All unidentified tendons received at the site will be rejected.

Job site or site as referred to herein shall be considered to mean the location where the members are to be manufactured whether at the project site or a removed casting yard.

The release of any material by the engineer shall not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective.

506.9 HANDLING:

Extreme care shall be exercised in handling, storing, moving and erecting precast prestressed concrete members to avoid twisting, racking or other distortion that would result in cracking or damage to the members. Precast prestressed members shall be handled, transported and erected in an upright position and the points of support and directions of the reactions with respect to the members shall be approximately the same during transportation and storage as when the member is in its final position.

Precast prestressed concrete members shall be placed in the structure in the conformity with the plans and special provisions for the structure to be constructed.

506.10 PAYMENT:

Precast prestressed concrete members, will be paid for at the contract price or prices for furnishing and erecting precast prestressed concrete members of the various types and lengths set forth in the proposal.

The contract price paid for furnishing the member shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in constructing and furnishing the member at the site of the work complete in place as shown on the plans, and as specified.

Partial payment will be allowed for members which are in the stockpile at the manufacturer's plant.

- End of Section -

SECTION 510

CONCRETE BLOCK MASONRY

510.1 DESCRIPTION:

All materials for concrete block masonry shall conform to the requirements of Sections [775](#) and [776](#).

510.2 CONSTRUCTION:

Proper masonry units shall be used to provide for all windows, doors, bond beams, lintels, pilasters, etc. with a minimum of unit cutting. Where masonry unit cutting is necessary, all cuts shall be neat and regular and edges exposed in the finished work shall be cut with a power driven abrasive saw.

Where no bond pattern is shown, the wall shall be laid up in straight uniform course with regular running bond with alternate header joints in vertical alignment.

Intersecting masonry walls and partitions shall be bonded by staggering the joints to form a masonry bond and the use of 1/4 inch minimum diameter ties at 24 inches o.c. maximum.

Where stack bond is indicated on the plans, approved metal ties shall be provided horizontally at 24 inches o.c. maximum.

Where masonry facing is a part of wall construction metal, ties shall be furnished and installed as directed by the Engineer.

Mortar joints shall be straight, clean and uniform in thickness. Unless otherwise specified or detailed on the plans, horizontal and vertical joints shall be approximately 3/8 inch thick with full mortar coverage on the face shells; shall have vertical joints buttered well for a thickness equal to the face shell of the block and these joints shall be shoved tightly, so that the mortar bonds to both blocks. No slushing or grouting of a joint will be permitted, nor shall a joint be made by working in mortar after the units have been laid.

Exposed walls shall have joints tooled with a round bar or V-shaped bar to produce a dense, slightly concave surface well bonded to the block at the edges. Tooling shall be done when the mortar is partially set but still sufficiently plastic to bond. All tooling shall be done with a tool which compacts the mortar, pressing the excess mortar out of the joint rather than dragging it out.

If it is necessary to move a block so as to open a joint the block shall be removed from the wall, cleaned and set in fresh mortar.

510.3 PLACING REINFORCING STEEL:

Reinforcing steel shall be placed as indicated on the plans. Splices shall be lapped a minimum of 40 diameters, except that dowels other than column dowels need to be lapped only 30 diameters. Column dowels shall lap 50 diameters.

Outside horizontal steel shall lap around corners 40 diameters, and be carried through columns unless otherwise shown on the plans. Inside horizontal steel shall extend as far as possible and bend into corner core. A dowel shall be provided in the foundation for each vertical bar. Bending of dowels to fit openings will not be permitted and, where required, new dowels shall be installed by drilling and grouting. All lap joints shall be wired.

Vertical cores containing steel shall be filled solid with grout, and thoroughly rodded.

Where knockout blocks are used, steel shall be erected and wired in place before 3 courses have been laid. Vertical cores at steel locations shall be filled as construction progresses.

Where knockout blocks are not used, vertical cores at steel locations shall be filled in lifts of not more than 4 feet. The maximum height of pour shall be 8 feet. Cores shall be cleaned of debris and mortar and shall have reinforcing steel held straight in place. If ordered by the Engineer, inspection and cleanout holes shall be provided at the bottom of each core to be filled.

Reinforcing steel shall be inspected prior to placing grout.

SECTION 510

510.4 CURING:

Newly constructed masonry shall be kept damp for at least 5 days with a nozzle regulated fog spray sufficient only to moisten faces of the masonry but not of such quantity as to cause water to flow down over the masonry.

510.5 MORTAR AND GROUT:

Mortar and grout used for concrete block masonry shall conform to Section [776](#).

510.6 PAYMENT:

Payment for concrete block masonry will be included in the lump sum price for the structure of which the masonry is a part, unless another basis for payment is included in the proposal.

- End of Section -

SECTION 511

BRICK MASONRY

511.1 MATERIALS:

Unless otherwise specified, brick masonry shall be constructed of brick conforming to Section [775](#) and cement mortar as described in Section [776](#).

511.2 BRICKLAYING:

The amount of wetting will depend on the rate of absorption of the brick at the time of laying. When being laid, the brick shall have suction sufficient to hold the mortar and to delete the excess water from grout, and shall be sufficiently damp so that the mortar will remain plastic enough to permit the brick to be leveled and plumbed after being laid without breaking the mortar bond.

Brick work shall be plumb, level, straight and true to dimensions shown on the plans. Such work shall start, where feasible, at a least important corner of wall and the masonry contractor shall request an early inspection of the work by the Engineer. All pattern work, bonds or special details indicated on the plans shall be accurately and uniformly executed. Face bonding shall be as shown on the plans, but if not shown, shall be running bond for standard size brick and approximately $\frac{1}{3}$ bond for oversize brick and approximately $\frac{1}{4}$ bond for modular brick unless otherwise designated by the Engineer. All bed and head joints shall be solidly filled with mortar at the time of laying.

Unless otherwise shown or detailed on the plans the thickness of mortar joints shall be uniformly $\frac{1}{2}$ inch.

Face bricks shown to be laid in stack bond shall have the center lines of vertical joints plumb and the brick laid equidistant from the center line with not more than $\frac{1}{8}$ inch variation in the width of these joints. The brick in each separate stack shall not vary more than $\frac{1}{8}$ inch in length, but the separate stacks may vary in width of stacks.

When mortar has slightly stiffened, solidly fill with mortar all interstices between bricks and between bricks and other materials and also fill all line pin holes. Jointing and tooling shall be done before mortar has stiffened.

Masonry to be plastered shall have all mortar joints trowel cut flush.

Masonry to be painted and not shown to be tooled or raked, shall have all joints carefully and evenly struck with a trowel.

Masonry to be left exposed without paint or plaster, shall have all mortar joints carefully and evenly tooled with a metal jointing tool of a type as approved by the Engineer. Masonry shown or indicated to have raked joints shall have the joints raked out $\frac{3}{8}$ inch deep, then tooled with a flat jointing tool, then brushed with a stiff non-metallic brush. Sack-rubbing or wiping finished masonry with rags will not be permitted.

511.3 PROTECTION:

Protect all sills, ledges, offsets, other materials, etc., from droppings of mortar during construction. Protect the tops of all unfinished masonry from rain by using water-repellant covering such as roofing felt or tar paper.

Protect the surfaces of wall, piers, etc., from mortar droppings, or splashes at scaffold heights.

511.4 CURING:

Finished masonry shall not be wetted, except when exposed to extreme hot weather or hot wind, and then only by using a nozzle regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.

511.5 REINFORCED GROUTED BRICK MASONRY:

Mortar in all bed joints shall be held back $\frac{1}{4}$ inch from edges of brick adjacent to grout space, or shall be beveled back and upward from grout space. The thickness of head and bed joints shall be as hereinbefore specified or shown. Head joints specified or shown to be less than $\frac{5}{8}$ inch thick shall be solidly filled with mortar as brick are laid. Head joints $\frac{5}{8}$ inch or more

SECTION 511

in thickness may have mortar sufficient only to form dams to retain the grout. Bed joints shall not be deeply furrowed with the trowel. All brick shall be shoved at least $\frac{1}{2}$ inch into place. One outer tier shall be not more than 12 inches before grouting, but the other tier shall be not more than 4 inches high before placing the grout. Grout shall be thoroughly agitated and mixed to eliminate segregation before being placed. All interior grout spaces shall be filled with grout and immediately puddled or swished with a stick or rod (not a trowel) sufficiently to cause the grout to flow into all interstices between the bricks and to fully encase the reinforcing steel. Wherever possible, grouting shall be done from the inside face of exterior masonry. If any grout contacts the finished masonry, it shall be immediately removed, and the surface cleaned.

In masonry which is more than 2 tiers in thickness, including pilasters and columns, the interior shall be of whole or half bricks placed into grout with not less than $\frac{3}{4}$ inch of grout surrounding each brick or half brick. Except at the finish course, all grout shall be stopped 1 $\frac{1}{2}$ inches below the top of both outer tiers. Where necessary to stop off a longitudinal run of masonry, it shall be done only by racking back $\frac{1}{2}$ brick length in each course and stopping grout 2 inches back of the rack. Tothing will not be permitted unless special approval is given by the Engineer.

Reinforcing steel shall be accurately placed in strict accordance with the plans and notes thereon. Vertical steel shall be held firmly in proper position. Where necessary this shall be done by means of frames or other suitable devices. Horizontal steel may be placed as the work progresses.

511.6 PAYMENT:

Payment for brick masonry will be included in the lump sum price for the structure of which the masonry is a part unless another basis for payment is included in the proposal.

- End of Section -

SECTION 515

STEEL STRUCTURES

515.1 DESCRIPTION:

515.1.1 Shop Drawings: The Contractor shall prepare and submit to the Engineer for approval, complete shop drawings which shall show details, dimensions, sizes of materials, and all information and data necessary for the metal work, including full details of the match markings. Any materials fabricated by the Contractor prior to the approval of the drawings will be at his risk. The Contractor shall be responsible for the correctness of the drawings and for shop fits and field corrections, even though the drawings may have been approved by the Engineer.

515.1.2 False work: The Contractor shall be fully responsible for designing and providing false work capable of supporting all loads which are applied.

515.1.3 As Built Plans: When required by the special provisions, the Contractor shall furnish to the Engineer before formal acceptance of the work detailed plans of the structure as built. Inasmuch as the plans will be retained by the Contracting Agency as permanent records, they must be in the form of printable transparencies of quality satisfactory to the Engineer.

515.1.4 Methods and Equipment: When requested by the Engineer, before starting erection of any structural members, the Contractor shall inform the Engineer fully as to the methods he proposes to follow and the amount and character of equipment he proposes to use. The use of such methods and equipment shall be subject to the approval of the Engineer. Approval by the Engineer shall not be considered as relieving the Contractor of the responsibility for the safety of his methods or equipment or for carrying out the work in full accordance with the plans and specifications.

An inspector or other authorized representative of the Engineer may examine the metals and metal items to be fabricated before they are worked in the shop and may exercise constant surveillance over the work during its progress, with full power to reject materials or workmanship not conforming to the plans and specifications.

The Contractor shall give the Engineer sufficient advance notice to permit ample time for the inspection of materials before commencement of the fabricating operations.

The Engineer shall be furnished complete copies in triplicate of all mill reports. The Contractor shall furnish ample means and assistance for sampling all materials. Arrangements shall be made for the Engineer to have free access at all times to any portion of the shops where work is being done.

No fabricating, machining, cutting, welding, assembling, or painting shall be done except with the knowledge of the Engineer. Any work done otherwise will be subject to rejection.

The acceptance of any material or finished member by the Engineer shall not be a bar to subsequent rejection if it is later found to be defective. Rejected material and workmanship shall be promptly replaced.

Samples of materials, except castings, shall be cut from stock designated by the Engineer or will be selected from items furnished. Gray iron, steel, and bronze castings shall be cast with test coupons.

515.2 STEEL BUILDING AND MISCELLANEOUS STEEL STRUCTURES:

Details of design, fabrication and erection of such buildings and structures shall conform to the specifications for the design, fabrication and erection of structural steel for buildings of the AISC except as modified by the special provisions for any conflicts with the applicable building code which may exist.

The design, fabrication and erection of structural steel and all similar work incidental or appurtenant to steel construction for highway bridges shall be performed in accordance with the latest standard specifications for highway bridges adopted by AASHTO. The plans or special provisions will designate the members to be galvanized.

515.2.1 Miscellaneous Metal Fabrication: The provisions of this subsection shall apply to items not intended primarily for structural purposes and which are fabricated from metals.

SECTION 515

If straightening of any materials is necessary, the straightening shall be done by methods which will restore the material to its original shape or surface without residual blemish. Sharp kinks or bends will be considered a cause for rejection of the materials.

The finish of miscellaneous metal items shall not be less in quality and workmanship than that standard considered to be the commercial standard for the kind of member being furnished. Punched and drilled holes shall be burred and, unless otherwise specified, sheared and machined edges shall be finished by grinding to an appropriate radius. Riser, sprue, or vent marks on castings shall be ground flush with the adjacent surface. Blow holes in castings shall not be repaired by any method except as authorized in advance by the Engineer. Exposed edges of sheet metal shall be dressed with a stone or file to remove the sharp edges or corners. Drilled or punched holes which are improperly located or misaligned shall be cause for rejection and may not be corrected without the prior approval of the Engineer. All parts of assemblies shall be fabricated so that they may be assembled without forcing or drifting.

Welders proposed to be used on miscellaneous metal fabrication will be subject to qualifications.

515.3 WORKMANSHIP:

Workmanship and finish shall be equal to the best general practice in modern bridge shops.

Rolled material before being laid off or worked shall be straight. If straightening is necessary, it shall be done by methods approved by the Engineer. Kinks and bends may be cause for rejection of the material.

If straightening is necessary in the field only methods approved by the Engineer shall be used.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture.

Portions of the work exposed to view shall be finished neatly. Shearing, flame cutting and chipping shall be done carefully and accurately. Undercut gusset plates will not be accepted. All sharp corners and edges, and edges that are marred, cut or roughened in handling or erection, shall be slightly rounded by grinding or other suitable means.

515.4 COMPUTED WEIGHT:

The computed weight shall be obtained by the use of the following rules and assumptions:

(A) The weight of structural and cast steel shall be assumed at 0.2833 pound per cubic inch. The weight of cast iron shall be assumed at 0.2604 pound per cubic inch. The weight of wrought iron shall be assumed at 0.2776 pound per cubic inch.

(B) The weights of rolled shapes and of structural plates, shall be computed on the basis of their nominal weights and dimensions, as shown on the shop drawings, deducting for copes, cuts, and open holes, exclusive of rivet or bolt holes.

(C) Rivets, bolts, and welds shall be considered as incidentals and their price shall be included in the price of steel shapes and plates.

(D) The weight of castings and fillets shall be computed from the dimensions shown on the shop drawings, deducting for all openings or cuts in the finished casting.

(E) The weight of pins and rollers shall be computed from the dimensions shown on the shop drawings, deducting for all holes, openings, pockets, and metal removed by machine finishing.

Pilot nuts and driving nuts for each size of pin shall be furnished for erection work and the weights of such nuts will not be included in the weight of structural steel to be paid for.

(F) If computed weights are used to determine the pay quantities of galvanized metal, the weight to be added to the calculated weight of base metal for the galvanizing shall be determined from the table of weights of zinc coatings specified by the ASTM [A153](#).

SECTION 515

515.5 PAINTING:

With the exception of items which are to be galvanized, structural steel members and miscellaneous metal items shall have a shop prime coat of approved rust-inhibitive paint. Application shall be as specified in Section [530](#). The thickness of the prime coat shall be not less than one mill.

After erection of structural steel uncoated surfaces at connections, surfaces where the shop coat has been abraded or otherwise damaged shall be touched up. Match marks and identification marks shall be properly cleaned off and painted over. The paint shall be identical to that used for the shop prime coat.

515.6 MEASUREMENT:

Steel structures will be paid for at a lump sum price or at a price per pound for structural steel, and at prices per pound for cast steel and cast iron. The pay quantities will be determined by computed weights or, by scale weights obtained as provided in this specification. Only material actually used in the completed structure will be paid for.

The pay quantities will be determined by computed weights for rolled sections and scaled weights for castings except as otherwise specified.

Computed weights will be used to determine pay quantities of alloy and carbon steel when members contain both alloy and carbon steel.

The weight of erection bolts, paint, boxes, crates, and other containers used for packing and the materials used for supporting members during transportation will not be included in the weights of material to be paid for.

The weight of structural steel to be paid for will not exceed the computed weight by more than 1 ½ percent. The weight of cast steel or cast iron to be paid for will not exceed the computed weights by more than 7 ½ percent. If the scale weight of any member is less than 99 ½ percent of the computed weight of that member, the member will be rejected and will not be paid for.

If computed weights are used, the weight to be paid for will be the calculated weight as established by the Engineer and no allowance will be made for weight in excess thereof.

515.7 PAYMENT:

Unless otherwise provided in the proposal, the basis of payment for steel structures shall be as follows:

The price paid per pound for structural steel including full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing, fabricating, delivering, erecting and prime coating the steel work, complete in place, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

The prices paid per pound for cast steel, cast bronze and cast iron shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and placing the materials, complete in place, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

Full compensation for furnishing and placing sheet piling, performed fabric pads, elastomeric or elastic bearing pads, and red lead paste, and for grouting masonry or bearing plates as shown on the plans shall be considered as included in the price paid for structural steel and no separate payment will be made therefore. Where the specifications or plans require metal to be galvanized, the price paid per pound for the metal, including the weight of zinc coating, shall be considered as full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing the galvanized metal complete in place, as shown on the plans, and as specified in the specifications and the special provisions, and as directed by the Engineer.

- End of Section -

SECTION 520

STEEL AND ALUMINUM HANDRAILS

520.1 DESCRIPTION:

Metal handrail shall consist of furnishing all materials and constructing handrail of steel or aluminum, including railing, posts, fittings and anchorages. Metal handrail shall be fabricated, installed and painted, when required, in accordance with the details shown on the plans and these specifications.

520.2 FABRICATION:

Prior to beginning any work on the fabrication of the railing, the Contractor shall submit shop drawings for approval, showing complete railing details.

Materials furnished for metal handrail shall conform to the requirements specified on the plans.

The Engineer shall be furnished complete, copies in triplicate of all mill reports on steel and aluminum materials furnished.

Railings shall be fabricated from welded or seamless members of the size and thickness shown on the plans. Steel members shall conform to the requirements of ASTM [A53](#), Grade B structural steel conforming to ASTM [A36](#), or tubular sections of hot rolled mild steel, as shown. Aluminum handrails shall conform to the requirements of either ASTM [B429](#) for round extruded tube or ASTM [B221](#) for semi-hollow extruded tube with rounded corners.

Welding shall be performed by the electric arc process and shall be done in conformance with AASHTO/AWS D1.5, Bridge Welding Code. All butt welds on exposed surfaces shall be ground flush with adjacent surfaces.

Railing panels shall be straight and true to dimensions.

For structures on curves, either horizontal or vertical, the railing shall conform closely to the curvature of the structure.

The completed steel railing units shall be galvanized in accordance with the requirements of Section [771](#) unless otherwise specified.

Provide Series 300 stainless steel fasteners for aluminum alloy handrails.

520.3 ERECTION:

The railing shall be carefully erected, true to line and grade. Posts and balusters shall be vertical and parallel with the deviation from the vertical for the full height of the panel not exceeding 5/8 inch. After erecting the railing, any abrasions or exposed steel shall be repaired in accordance with Section [771](#) or Section [530](#).

520.4 MEASUREMENT:

The various types of railing will be measured by the linear foot from end to end along the face of the railing including terminal sections.

520.5 PAYMENT:

The price paid per linear foot for handrailing shall include full compensation for furnishing all labor, materials, tools, and equipment and doing all work involved in constructing the railing complete in place as shown on the plans and specified herein.

- *End of Section* -

SECTION 525

PNEUMATICALLY PLACED MORTAR

525.1 DESCRIPTION:

The work under this section shall consist of furnishing all material and pneumatically placing, by means of suitable equipment and competent operators, either premixed Portland cement and fine aggregate (dry mix process) or premixed concrete (wet mix process).

525.2 DRY MIX PROCESS:

The dry mix process shall consist of thoroughly mixing a proportional combination of fine aggregate and Portland cement and conveying this mixture through a delivery hose to a special nozzle where water is added and combined with the dry ingredients prior to discharge. The nozzle water ring shall be cleaned daily.

The fine aggregate shall be material sand, conforming to ASTM [C33](#), with Gradation No. 1 as shown in Table [525-1](#) and with not less than 3 percent or more than 7 percent moisture by weight.

Portland cement and mixing water shall conform to the requirements of Section [725](#).

The dry mix shall consist of 1 part Portland cement and 4.5 parts of fine aggregate by weight. Machine mixing will be required. This operation of proportioning and mixing shall be subject to the approval of the Engineer.

525.3 WET PROCESS:

The wet process shall consist of premixing by mechanical methods a proportional combination of Portland cement, aggregate and water required to produce mortar or concrete and conveying this mortar or concrete through the delivery hose to the special nozzle where additional compressed air is added prior to discharge. The air ports in the nozzle shall be cleaned daily.

The Portland cement concrete used for the Wet Mix Process shall conform to Section [725](#) and shall be Class A (3000 psi) unless otherwise specified. In no event shall a slump greater than 4 inches be used. As the work approaches the vertical, the maximum slump shall not exceed 1 inch.

The fine and coarse aggregate shall conform to ASTM [C33](#) using one of the three graduations shown in Table [525-1](#). Unless otherwise specified, Gradation No. 1 will be used.

TABLE 525-1			
PNEUMATICALLY PLACED MORTAR GRADATION (A.C.I. TABLE 2.2.1)			
Sieve size	Percent by weight passing individual sieves		
	Gradation No. 1	Gradation No. 2	Gradation No. 3*
3/4 in.	—	—	100
1/2 in.	—	100	80-95
3/8 in.	100	90-100	70-90
No. 4	95-100	70-85	50-70
No. 8	80-100	50-70	35-55
No. 16	50-85	35-55	20-40
No. 30	25-60	20-35	10-30
No. 50	10-30	8-20	5-17
No. 100	2-10	2-10	2-10

*Batch fine and coarse aggregates separately to avoid segregation.

525.4 REINFORCING STEEL:

Reinforcing steel bars or welded-wire fabric shall conform to Section [727](#) and shall be 6 x 6 - W 1.4 x 1.4 welded wire fabric unless otherwise specified. Reinforcement shall be placed as closely as possible to the center of the mortar.

SECTION 525

525.5 EQUIPMENT:

Prior to the start of construction, the Contractor shall demonstrate that his equipment, materials and operators are capable of providing a finished structure in accordance with the specifications. For this demonstration, the Contractor shall provide test panels, 30 inches by 30 inches, with a depth the same as the structure, but not less than 4 inches. A separate panel shall be provided for each shooting position to be used (overhead, slope and/or slab) and one half of each panel shall contain reinforcement as used in the structure. Cores will be taken for visual inspection and compressive strength tests. The Engineer has the authority to accept or reject equipment, materials and/or operators based on his evaluation and his decision will be final.

If the Contractor can present valid, factual documentation to the satisfaction of the Engineer that his equipment, materials and operators have produced satisfactory results on similar work within the past six months, the Engineer may eliminate the test panel procedure.

525.6 SURFACE PREPARATION:

The surface on which the mortar is to be placed shall be compacted and true to line and grade as required by the plans and specifications. The surface shall be uniformly moistened so that water will not be drawn from the freshly-placed mortar. Placement of the mix shall not start until the temperature is 35° F and rising and shall stop when the temperature is 40°F and falling.

525.7 FORMS AND GROUND WIRES:

Forms shall be plywood or some other suitable material, true to line and grade, sufficiently rigid to resist deflection during mortar placement.

Ground or gauging wires shall be installed where necessary to establish the thickness and finish lines of the structure.

525.8 JOINTS:

Construction joints shall be tapered to a shallow edge from not more than one inch thick over a width of approximately one foot except where the joint will be subjected to compressive stress. In this case, square joints shall be constructed. Joints shall be thoroughly cleaned and wetted prior to any additional application.

Install control joints in accordance with the plans. Reinforcement will not extend across control joints.

525.9 FINISHING:

Unless otherwise specified, the natural gun finish will be provided.

525.10 CURING:

Curing shall be accomplished using Type 2 compound as specified in Section [726](#). Application rate shall be not less than one tenth of a gallon per square yard. Subsection [505.6.2](#) Adverse Weather Concreting is applicable.

525.11 TESTING:

Tests to determine the quality of the mortar will be performed by the Engineer periodically during the course of work. Test panels shall be prepared by the Contractor.

Test panels shall be at least 12 inches square and as deep as the structure, but not less than 4 inches. Cores shall be taken from the panel for visual and compressive strength tests. The minimum compressive strength at the end of 28 days shall be 3000 psi.

The Engineer may allow the use of 6 inches by 12 inches hardware cloth cylinders for testing in lieu of the test panels. These cylinders will be furnished by the Contractor.

All rebound pockets and any mortar, defective in the compressive strength test, shall be cut out and replaced.

SECTION 525

525.12 PAYMENT:

Payment for pneumatically-placed mortar will be made at the unit price per square yard or the lump sum as set forth in the proposal. Such payment shall be full compensation for furnishing all labor, tools, equipment and accomplishing all work in conformity with the plans and specifications.

- End of Section -

SECTION 530

PAINTING

530.1 DESCRIPTION:

This work shall consist of furnishing paint and other necessary materials and painting metal, wood or other surfaces in accordance with the details shown on the plans and these specifications.

530.2 MATERIALS:

Materials used in paint for painting shall conform to the requirements of Section [790](#).

530.3 WEATHER CONDITIONS:

Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather. Except as provided below, painting will not be permitted when weather conditions during application are such that the atmospheric temperature will drop below 35°F. during the drying period. If fresh paint is damaged by the elements, it shall be replaced by the Contractor at no additional cost to the Contracting Agency.

Subject to the approval of the Engineer, the Contractor may provide suitable enclosures to permit painting during inclement weather. Provisions must be made to control atmospheric conditions artificially inside the enclosures within limits suitable for painting throughout the painting operation. The cost of providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work and no additional payment will be made therefore.

530.4 APPLICATION:

Painting shall be done in a neat and workmanlike manner. Unless otherwise specified paint shall be applied either by brush, roller, or spray methods.

If brushes are used, they shall have sufficient body and length of bristle to spread the paint in a uniform coat. In general, the primary movement of the brush shall be such as to fill thoroughly all irregularities in the surface, after which the coating shall be smoothed by a series of parallel strokes. Paint shall be evenly spread and thoroughly brushed out. If a considerable amount of brush marks appear, it will be considered that the paint has been improperly applied. If rollers are used, they shall be of a type that does not leave a stippled texture in the paint file.

On all surfaces which are inaccessible for brushing, the paint shall be applied by spray or by sheepskin daubers especially constructed for the purpose, or by other means approved by the Engineer.

If spray methods are used, the operator shall be thoroughly experienced. Runs, sags, thin areas in the paint coat, or skips and holidays shall be considered as evidence the work is unsatisfactory and the Contractor may be required to apply the remainder of the paint by brush.

A water trap acceptable to the Engineer shall be furnished and installed on all equipment used in spray painting.

Mechanical mixers shall be used to mix the paint. The paint shall be mixed a sufficient length of time, prior to use, to thoroughly mix the pigment and vehicle together. Paint shall be kept thoroughly mixed while being applied.

530.5 THINNING PAINT:

Paints specified are formulated ready for application and no thinning will be allowed. If the paint becomes thick in cool weather, it shall be heated in the container immersed in hot water.

530.6 PROTECTION OF WORK:

The Contractor shall protect all parts of the structure against disfigurement by spatters, splashes, and smirches of paint or of paint materials. The Contractor shall be responsible for any damage caused by his operations to vehicles, persons, or property, and shall provide protective means to guard against such damage at his expense.

SECTION 530

Paint stains which might result in an unsightly appearance shall be removed or obliterated by the Contractor.

When ordered by the Engineer, if traffic causes an objectionable amount of dust, the Contractor shall sprinkle the adjacent roadbed and shoulders with water for a distance on each side of the location where painting is being done sufficient to abate the dust nuisance. The Contractor shall furnish and post at his own expense DRIVE SLOWLY signs and take other necessary precautions to prevent dust and dirt from accumulating on freshly painting surfaces.

530.7 SAFETY PRECAUTIONS:

The following safety precautions shall be observed in addition to those prescribed by law in Section [107](#).

The applicable sections of NACE, A Manual for Painter Safety.

530.8 SURFACE PREPARATION FOR PAINTING:

530.8.1 Steel: Surface preparation for painting of the steel shall conform to the surface preparation specifications of the Steel Structures Painting Council.

Unless otherwise specified, the commercial blast method shall be used.

After erection and riveting or welding, all surfaces of structural steel which will be exposed to air in the completed structure and the repainting of existing steel structures where partial painting is required, the method of cleaning will be as directed by the Engineer or as specified in the special provisions.

530.8.2 Galvanized Surfaces:

(A) Hand Cleaning: Concrete spatter, heavy grease, and other foreign matter shall be removed from galvanized surfaces by hand scraping or wire brushing.

(B) Solvent Cleaning: After hand cleaning, all galvanized surfaces shall be cleaned by the solvent cleaning procedures prescribed in Section [530.8.1](#) above to remove oil, grease and other detrimental foreign matter.

(C) Pretreatment: After hand and solvent cleaning, the cleaned areas shall then be painted by brushing on at least 1 full coat of paint No. 1. Unless otherwise directed by the Engineer, the second coat shall be applied within 24 hours after the primer is applied.

530.8.3 Wood Surface: Wood surfaces shall be prepared for painting by removing all cracked or peeled paint, loose chalky paint, dirt, and other foreign matter by wire brushing, scraping, sanding, or other approved means immediately prior to painting. All surfaces shall be wiped or dry brushed to remove any dust or chalky residue that may result from cleaning operations. All wood designated to be painted shall be thoroughly dry before paint is applied.

530.9 PAINTING:

530.9.1 Structural Steel:

(A) Paint: Unless otherwise required on the plans or in the special provisions, the paints to be applied to structural steel surfaces shall consist of a shop prime coat, as specified in Section [515](#), a second coat, and a finish coat. The total dry film thickness of the prime and second coat shall be not less than 3 mills. The dry thickness of the paint will be measured in place with a calibrated magnetic film thickness gauge.

Excessively thick coats of paint will not be permitted. The thickness of each coat shall be limited to that which will result in uniform drying throughout the paint film.

Unless specified otherwise on the plans or in the special provisions, the paint coats shall be as specified for general use on structural steel in Section [790](#). Succeeding coats of paint, not otherwise materially different in color, shall have carbon black mixed into the paint in accordance with Section [790](#) to produce a perceptible color difference between the paint coat being applied and the preceding coat.

SECTION 530

Any damage to sound paint on areas not designated for treatment, resulting from the Contractor's operations, shall be repaired as directed by the Engineer.

Application of Paint: Painting of structural steel, except for shop applied prime coats and sections which will be inaccessible after erection as described below, shall be done after erection unless otherwise specified in the special provisions. Requests to do any additional painting prior to erection shall be submitted by the Contractor and approved by the Engineer in writing before such work is started. Painting prior to erection will be limited to a prime coat of paint, except that surfaces exposed to the atmosphere which would be inaccessible for painting after erection shall be painted the full number of coats prior to erection. Any deficiencies in the prime coat of paint, or any second coat shall be corrected to the satisfaction of the Engineer prior to the application of the finish coat of paint.

The surface of the paint coat being covered shall be free from moisture, dust, grease, or any other deleterious material which would prevent the bond of the succeeding coat. In spot painting, any old paint which lifts after application of the touch-up coat, shall be removed by scraping and the area repainted before application of the next coat.

The finish coat shall not be applied until the required total film thickness of the undercoats of paint, as described above is obtained.

Open seams at contact surfaces of built-up members which would retain moisture shall be caulked with red lead paste before applying the second coat of paint.

Except for anchor bolt assemblies, steel embedded in concrete need not be painted. Anchor bolt assemblies shall be painted or dipped with 1 coat of paint prior to installation.

With the exception of abutting chord and column splices and column and truss shoe bases, machine finished surfaces shall be coated with a rust inhibitor which can be easily removed. Surfaces of iron and steel castings which have been machine finished shall be painted with a coat of shop paint.

530.9.2 Machinery: Prior to installation, all surfaces of machinery exposed to the atmosphere which are subject to corrosion and are normally painted, shall be painted with 2 coats of paint. Unless otherwise specified, after installation of the machinery, such surfaces shall be painted with a finish coat. All coats shall be as specified for structural steel.

530.9.3 Galvanized Surfaces: Unless otherwise provided on the plans or in the special provisions, galvanized surfaces shall be left unpainted. Areas of galvanized coating damaged due to welding after fabrication or handling shall be prepared as specified above and then painted with 1 full coat of paint No. 15.

530.9.4 Metal Guard Rails: Metal guard rails when required to be painted shall be painted with 2 coats of paint No. 11.

530.9.5 Wood Surfaces:

(A) **Paint:** The surface shall be prepared as specified above and painted with paint No. 6 or 7. The number of coats of paint will be specified in the special provisions.

(B) **Application of Paint:** When permitted in writing by the Engineer, the prime coat of paint may be applied prior to erection. After the prime coat has dried and the timber is in place, all cracks, checks, nail holes, etc., shall be puttied flush with the surface and allowed to dry before the second coat is applied.

Skips, holidays, and thin areas or other deficiencies in any 1 coat of paint shall be corrected to the satisfaction of the Engineer before the succeeding coat is applied.

The surface of the paint coat being covered shall be free of any deleterious material before any additional paint is applied.

530.10 TESTING::

Paint and paint materials shall be sampled and tested prior to use. Tests shall be conducted in accordance with methods specified by ASTM or by methods set forth in Federal Standard 141. In the absence of any such methods, other suitable methods may be designed and utilized by the Engineer. Lots or batches of paint of proprietary brand, as defined in Section 790, which have been previously sampled and tested by the Contracting Agency, and approved, may be used without further testing, if permitted by the Engineer.

SECTION 530

530.11 PAYMENT:

Payment for the preparation of surfaces, shop prime coat and field touch-up coats on structural steel and miscellaneous metal items shall be considered as included in the prices for the structural steel and miscellaneous metal items. Payment for second and finish coats on structural steel or miscellaneous metal items shall be considered as included in payments for the structures, except that payment for cleaning all painting on miscellaneous metal items shall be considered as included in the price for the item when a separate price therefore is included in the proposal.

Full compensation for preparing surfaces and for painting machinery, galvanized metal, guard rails and wood shall be considered as included in the various prices paid for the contract items or work and no separate payment for such work will be made.

- End of Section -

PART 600

WATER, SEWER, STORM DRAIN AND IRRIGATION

Section	Last Revised	Title	Page
601	2016	Trench Excavation, Backfilling and Compaction	601-1
602	2016	Trenchless Installation of Steel Casing	602-1
604	2012	Placement of Controlled Low Strength Material	604-1
605	2014	Subdrainage	605-1
607	2015	Trenchless Installation of Smooth Wall Jacking Pipe	607-1
608	2016	Horizontal Directional Drilling	608-1
610	2015	Water Line Construction	610-1
611	2015	Water, Sewer and Storm Drain Testing	611-1
615	2015	Sanitary Sewer Line Construction	615-1
616	2015	Reclaimed Water Line Construction	616-1
618	2015	Storm Drain Construction	618-1
620	2012	Cast-In-Place Concrete Pipe	620-1
621	1998	Corrugated Metal Pipe and Arches	621-1
625	2016	Manhole Construction and Drop Sewer Connections	625-1
630	2012	Tapping Sleeves, Valves and Valve Boxes on Water Lines	630-1
631	2012	Water Taps and Meter Service Connections	631-1

This Page Reserved For Future Use

SECTION 601

TRENCH EXCAVATION, BACKFILLING AND COMPACTION

601.1 DESCRIPTION:

The work covered by this specification consists of furnishing all labor, equipment, appliances, materials, and performing all operations in connection with the excavation, backfilling and compaction of trenches for pipe installations.

Excavation for appurtenance structures, such as manholes, inlets, transition structures, junction structures, vaults, valve boxes, catch basins, etc., shall be deemed to be in the category of trench excavation.

The Trench Cross-Section Detail shown on Detail 200-2 illustrates the terminology used in this specification.

See Section 620 for cast-in-place concrete pipe.

Pipe materials that are considered to be rigid include reinforced concrete pipe, non-reinforced concrete pipe, reinforced concrete cylinder pipe, vitrified clay pipe, steel casings, cast iron, and ductile iron pipe.

Pipe materials that are considered to be flexible include thermoplastic pipes (HDPE, SRPE, PP, PVC) and corrugated metal pipe.

601.2 EXCAVATION:

601.2.1 General: The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the plans, and including excavation ordered by the Engineer of compacted backfill for the purpose of making density tests on any portion of the backfill.

601.2.2 Trench Widths: Trenches for a single pipe shall conform to the dimensions in Table [601-1](#). Multiple pipe installations in a single trench shall be installed in accordance with details on the plans or in the special provisions.

Table 601-1 TRENCH WIDTHS		
Size of Pipe (Nom. Dia.)	Maximum Width at Top of Pipe Greater Than O.D. of Bell	Minimum Width at Springline Each Side of Pipe Barrel
Rigid Pipes:		
Less than 18 inches	16 inches	6 inches
18 inches to 24 inches inclusive	19 inches	7.5 inches
27 inches to 39 inches inclusive	22 inches	9 inches
42 inches to 60 inches inclusive	30 inches	12 inches
66 inches to 78 inches inclusive	42 inches	15 inches
84 inches to 96 inches inclusive	50 inches	19 inches
102 inches to 120 inches inclusive	60 inches	24 inches
Flexible Pipes:		
Less than 18 inches	20 inches	8 inches
18 inches to 24 inches inclusive	23 inches	9.5 inches
27 inches to 39 inches inclusive	28 inches	12 inches
42 inches to 60 inches inclusive	34 inches	14 inches
66 inches to 78 inches inclusive	44 inches	16 inches
84 inches to 96 inches inclusive	48 inches	18 inches
102 inches to 120 inches inclusive	54 inches	21 inches

SECTION 601

The width of the trench shall not be greater than the maximum indicated in Table [601-1](#), at and below the level of the top of the pipe. The width of the trench above that level may be made as wide as necessary for shoring, bracing, and for proper installation of the work.

If the maximum trench width as specified in Table [601-1](#) is exceeded at the top of the pipe, additional load bearing capacity to compensate for the increased pipe loading may be required by the Engineer. The Contractor shall provide, at no additional cost to the Contracting Agency, the additional load bearing capacity. This may require changing the material requirements of initial backfill, a higher strength pipe, a concrete cradle, cap or encasement, or other means approved in writing by the Engineer. Where safety or undermining situations occur, a controlled low strength material (CLSM) backfill as specified in Sections 604 and 728 may be used as needed.

601.2.3 Trench Grade: Alignment and elevation stakes shall be furnished by the Contractor at set intervals and agreed upon offsets. On water main projects, elevation stakes will be furnished only when deemed necessary by the Engineer. In all cases where elevation stakes are furnished, the Contractor will also furnish the Engineer with cut sheets.

For all pipe 12 inches or greater in diameter, the Contractor shall excavate for and provide a bedding at least 4 inches thick or 1/12 the O.D. of the pipe barrel whichever is greater. This bedding material shall be placed at a uniform density with minimum compaction and fine graded as specified herein.

601.2.4 Fine Grading: The bedding or the bottom of the trench when bedding is not required shall be accurately graded to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for portions of the pipe where it is necessary to excavate for bells or other joint types and for proper sealing of the pipe joints.

601.2.5 Over-excavation: Except at locations where excavation of rock from the bottom of the trench is required, care shall be taken not to excavate below the depth needed to accommodate the required bedding depth.

Unauthorized excavation below the specified trench grade line shall be refilled at the Contractor's expense with ABC material compacted to a uniform density of not less than 95 percent of the maximum density as determined by AASHTO T-99 and T-191 or ASTM [D6938](#). When AASHTO T-99, method A or B, and T-191 are used for density determination, ARIZ 227c will be used for rock correction.

Whenever rock is encountered in the trench bottom, it shall be over-excavated to a minimum depth of six inches below the bottom of the pipe barrel. This over-excavation shall be filled with bedding material placed with the minimum possible compaction.

Whenever unsuitable soil incapable of supporting the pipe is encountered, the Contractor will notify the Engineer and a field determination will be made as to the depth of over-excavation and the granular fill required.

601.2.6 Excavation for Manholes, Valves, Inlets, Catch Basins and Other Accessories: The Contractor may place concrete directly against excavated surfaces for cast-in-place items, provided that the faces of the excavation are firm, unyielding, and are at all points outside the structure lines shown on the plans. If the native material is such that it will not stand without sloughing or if precast structures are used, the Contractor shall excavate as needed to place bracing, shoring, and forms or to place the precast structure.

Any unnecessary excavation below the elevation indicated for the foundation of any structure shall be replaced with the same class of concrete specified for the structure or with 1 1/2 sack controlled low strength material as specified in Section [728](#). When the replacement material is structural concrete, the material shall be placed at the same time as the structure. However, when using 1 1/2 sack controlled low strength material, placement of the material shall be per Section [604](#) which requires a time lag between placement of the controlled low strength material and the structural concrete. The placement of the additional material shall be at no cost to the Agency.

601.2.7 Pavement and Concrete Cutting and Removal: Where trenchless methods are not used and trenches or other excavations lie within the portland cement concrete section of streets, alleys, driveways, or sidewalks, etc., such concrete shall be completely removed between the closest adjacent joints. Removal methods shall produce neat, straight lines in such a manner that the remaining adjoining concrete will not be damaged.

Sidewalk, curb, gutter, and other concrete flatwork shall have complete joint to joint replacement of all damaged sections. The construction replacing damaged concrete sections and joints shall be compliant with Section [340](#).

SECTION 601

The existing joint system in portland cement concrete pavement (PCCP) shall be maintained. Reconstruction of PCCP panels and joints shall be in accordance with Section [324](#).

Initial asphalt pavement removal shall be clean-cut to be the minimum width required for conduit installation and proper trench compaction. No ripping or rooting will be permitted outside the pavement cut limits. Surfacing materials removed shall be hauled from the job site immediately, and will not be permitted in the backfill.

Final pavement removal for pavement matching and surface replacement shall occur after the final backfill and the aggregate base material are in place and compacted. Pavement matching and final surface replacement shall be in accordance with the requirements of Section [336](#).

601.2.8 Grading and Stockpiling: All grading in the vicinity of trench excavation shall be controlled to prevent surface water from flowing into the trenches. Any water accumulated in the trenches shall be removed by pumping or by other approved methods.

During excavation, material suitable for backfilling shall be placed in an orderly manner, a sufficient distance back from the edges of trenches, to avoid overloading and to prevent slides or cave-ins. Material unsuitable for backfilling, or excess material, shall be hauled from the job site and disposed of by the Contractor.

The Contractor shall, prior to commencement of the work, submit a letter to the Contracting Agency stating the location of each disposal site for all excess or unsuitable material and certify that he has obtained the property owner's permission for the disposal of all such materials.

Where the plans and/or special provisions provide for segregation of topsoil from underlying material for purposes of backfill, the material shall not be mixed.

601.2.9 Shoring and Sheathing: The Contractor shall do such trench bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. The bracing, sheathing, or shoring shall not be removed in one operation but shall be done in successive stages to prevent overloading of the pipe during backfill operations. The cost of the bracing, sheathing, or shoring, and the removal of same, shall be included in the unit price for the pipe or other item which necessitated the work.

All shoring and sheathing deemed necessary to protect the excavation and to safeguard employees, shall be installed. See Section [107](#).

601.2.10 Open Trench: Except where otherwise noted in the special provisions, or approved in writing by the Engineer, the maximum length of open trench, where the construction is in any stage of completion (excavation, pipe laying or backfilling), shall not exceed 1320 feet in the aggregate at any one location.

Any excavated area shall be considered open trench until all ABC for pavement replacement has been placed and compacted. With the approval of the Engineer, pipe laying may be carried on at more than one location, the restrictions on open trench applying to each location. Trenches across streets shall be completely backfilled as soon as possible after pipe laying.

Substantial steel plates with adequate trench bracing shall be used to bridge across trenches at street crossings where trench backfill and temporary patches have not been completed during regular work hours. Steel plates shall be installed in accordance with Detail 211. Safe and convenient passage for pedestrians shall be provided. The Engineer may designate a passage to be provided at any point he deems necessary. Access to hospitals, fire stations and fire hydrants shall be maintained at all times. Steel plates with adequate trench bracing shall be used to bridge across trenches as needed to provide driveway access to adjacent properties where trench backfill and temporary patches have not been completed during regular work hours.

SECTION 601

601.3 PROTECTION OF EXISTING UTILITIES:

601.3.1 Utilities: Unless otherwise shown on the plans or stated in the specifications, all utilities, either underground or overhead, shall be maintained in continuous service throughout the entire contract period. The Contractor shall be responsible and liable for any damages to or interruption of service caused by the construction.

If the Contractor desires to simplify his operation by temporarily or permanently relocating or shutting down any utility or appurtenance, he shall make the necessary arrangements and agreements with the owner and shall be completely responsible for all costs concerned with the relocation or shutdown and reconstruction. All property shall be reconstructed in its original or new location as soon as possible and to a condition at least as good as its previous condition. This cycle of relocation or shutdown and reconstruction shall be subject to inspection and approval by both the Engineer and the owner of the utility.

The Contractor shall be entirely responsible for safeguarding and maintaining all conflicting utilities that are shown on the plans (Sections [107](#) and [105](#) apply). This includes overhead wires and cables and their supporting poles whether they are inside or outside of the open trench. If, in the course of work, a conflicting utility line that was not shown on the plans is discovered, the Contracting Agency will either negotiate with the owner for relocation, relocate the utility, change the alignment and grade of the trench or as a last resort, declare the conflict as “extra work” to be accomplished by the Contractor in accordance with Section [104](#).

Backfill, around utilities that are exposed during trench excavation, shall be placed in accordance with the utility’s haunching and initial backfill requirements.

601.3.2 Irrigation Ditches, Pipes and Structures: The Contractor shall contact the owners of all irrigation facilities, and make arrangements for necessary construction clearances and/or dry-up periods.

All irrigation ditches, dikes, headgates, pipe, valves, checks, etc., damaged or removed by the Contractor, shall be restored to their original condition or better, by the Contractor at no additional cost to the Contracting Agency.

601.3.3 Building Foundations and Structures: Where trenches are located adjacent to building foundations and structures, the Contractor shall take all necessary precaution against damage to them. The Contractor shall be liable for any damage caused by the construction.

Except where authorized in the special provisions or in writing by the Engineer, water settling of backfill material in trenches adjacent to structures will not be permitted.

601.3.4 Permanent Pipe Supports: Permanent pipe supports for the various types and sizes of sewer, water and utility lines shall conform to the Standard Details or the details shown on the plans. Such pipe supports shall be erected at the locations shown on the plans and/or at any other location as necessary as determined by the Engineer.

601.4 FOUNDATION, BEDDING, HAUNCHING, BACKFILLING AND COMPACTION:

601.4.1 Foundation: The bottom of an excavation upon which a structure is to be placed or the bottom of a trench where the elevation is set below the pipe elevation shown on the plans or as directed by the Engineer. The elevation of the trench foundation is determined from the desired pipe elevation by taking into account the bedding and pipe wall thicknesses. The foundation surface will consist of native material or replacement material required due to over-excavation.

601.4.2 Bedding: Bedding is the material upon which a pipe is to be placed.

The bedding material type shall be ABC per Section 702 unless otherwise specified.

601.4.3 Haunching: Haunching is the material placed between the bedding and springline. If placed in lifts, the lift thickness shall not exceed 2 feet (1 foot for flexible pipe) and shall be deposited and compacted to the specified density uniformly on each side of the pipe to prevent lateral displacement of the pipe.

The haunching material shall be ABC per Section 702. With Agency approval an alternative granular material or CLSM may be used.

SECTION 601

601.4.4 Initial Backfill: The material placed between the springline to 12 inches above top of pipe. Initial backfill shall be placed in lifts that shall not exceed 2 feet (1 foot for flexible pipe) and which can be effectively compacted depending on the type of material, type of equipment, and methods used.

Initial backfill material shall be ABC per Section 702. With Agency approval an alternative granular material or CLSM may be used, and with agency approval native backfill with no piece larger than 1½ inches may be used for concrete pipe.

601.4.5 Final Backfill: Material placed above the initial backfill to the top of the trench or to the bottom of the road base material. Final backfill shall be placed in horizontal layers not more than twelve inches in depth before compaction. With Agency approval an increase in the loose non-compacted lift depth may be obtained for a project based on specific equipment, methods, and soil conditions. For approval of an increase of the non-compacted lift depth the Contractor shall demonstrate to the satisfaction of the Agency that the required density will be obtained using the Contractor identified equipment and methods. The non-compacted lift height shall not be more than can be compacted to the required density with the equipment and methods being used.

Final backfill shall be CLSM per Section [604](#), ABC per Section [702](#), and/or granular material or native backfill material per Section [601.4.8](#).

Backfill under street pavement shall be constructed per Detail 200-1 with the type of trench and surface replacement as noted on the plans or in the special provisions. Unless otherwise noted, backfill under single curb, curb and gutter, attached sidewalk, driveways, valley gutters, etc. shall be the same as the adjacent street pavement.

601.4.6 Compaction Densities: Trench backfill shall be thoroughly compacted to not less than the densities shown in Table [601-2](#) when tested and determined by AASHTO T-99 and T-191 or ASTM [D6938](#). When AASHTO T-99, method A or B, and T-191 are used for density determination, ARIZ-227c shall be used for rock correction.

Backfill material shall be within 2 percentage points of its optimum moisture content while being compacted.

When backfill material is CLSM and it is placed in accordance with [Section 604](#), no compaction testing is required, the compaction density shall be deemed acceptable.

TABLE 601-2				
MINIMUM TRENCH COMPACTION DENSITIES				
Backfill Type	Location	From Surface To 2 feet Below Surface	From 2 feet Below Surface To 1 foot Above Top of Pipe	From 1 foot Above Top of Pipe to Bottom of Pipe
I	Under any existing or proposed pavement, curb, gutter, attached sidewalk, roadway shoulders, and other areas within right-of-way subject to vehicular traffic, or when any part of the trench excavation is within 2-feet of the existing pavement, curb, or gutter.	100% for granular 95% for non-granular	95%	95%
II	On any utility easement or right-of-way outside limits of Type I backfill.	85%	85%	90%
III	Around any structures (manholes, etc.) or exposed utilities outside limits of Type I backfill.	95% in all cases		

601.4.7 Water Consolidation: Jetting is the only acceptable water consolidation method and its use is restricted. Jetting may only be used in Type I Backfill for the haunching and initial backfill zones and in Type II Backfill locations as defined in [Table 601-2](#).

Water consolidation by jetting shall use a 1 1/2 inch pipe of sufficient length to reach the bottom of the lift being settled and shall have a water pressure of not less than 30 psi. All jetting shall be accomplished transversely across the trench at intervals of not more than 6 feet with the jetting locations on one side of the trench offset to the jetting locations on the other side of the trench. The entire lift shall be leveled and completely saturated working from the top to the bottom.

SECTION 601

When jetting is used within the haunching and initial backfill zones, the Contractor shall be responsible for establishing each lift depth so as to avoid floating the pipe being placed and shall make any needed repair or replacement at no cost to the Contracting Agency. For pipes larger than 24 inches I.D. the first lift shall not exceed the springline of the pipe and subsequent lifts shall not exceed 3 feet.

Where jetting is used and the surrounding material does not permit proper drainage, the Contractor shall provide, at his expense a sump and a pump at the downstream end to remove the accumulated water.

The use of water consolidation does not relieve the Contractor from the responsibility to make his own determination that such methods will not result in damage to existing improvements. The Contractor shall be responsible for any damage incurred.

If jetting does not obtain the required compaction density, mechanical compaction methods shall be used to meet the compaction requirements. Water consolidated backfill material may need to be removed and replaced.

Jetting within Type I backfill locations shall not be used unless the material in which the trench is located and the backfill are both granular material. No exception shall be made for construction within new developments.

601.4.8 Granular Material and Native Backfill Material: For purposes of this specification, granular material is material for which the sum of the plasticity index and the percent of the material passing a No. 200 sieve does not exceed 23. The plasticity index shall be tested in accordance with AASHTO T-146 Method A (Wet Preparation), T-89 and T-90. The percent of the material passing a No. 200 sieve shall be tested in accordance with ASTM [C136](#) and ASTM [C117](#).

Native material used for backfill shall be sound earthen material free from broken concrete, broken pavement, wood or other deleterious material with no piece larger than 4 inches.

601.4.9 Rights-Of-Way Belonging to Others: Backfill and compaction for irrigation lines of the Salt River Valley Water Users' Association and Roosevelt Irrigation Districts and for trenches in State of Arizona or another entity's right-of-way outside the limits of the Contracting Agency shall be accomplished in accordance with their permit and/or specifications.

601.4.10 Test Holes: Boring logs shown on the plans do not constitute a part of the contract and are included for the Contractor's convenience only. It is not intended to imply that the character of the material is the same as that shown on the logs at any point other than that where the boring was made. The Contractor shall satisfy himself regarding the character and amount of rock, gravel, sand, silt, clay and water to be encountered in the work to be performed.

601.4.11 Bedding and Backfilling for Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines: The bedding and backfill for these underground facilities shall be native material or sand which conforms to the grading requirement of ASTM [C33](#) for fine aggregate. When backfill material consists of aggregate base course, crushed stone, or other material containing stones, only sand will be used within the bedding, haunching, and initial backfill zones. The bedding depth shall be six inches. Compaction shall be in accordance with Table 601-2.

601.5 CONTRACTOR CERTIFICATION OF INSTALLATION PROCEDURES:

When requested in the Special Provisions or by the Engineer prior to installation, the Contractor shall furnish to the Contracting Agency an affidavit (certification) from the pipe manufacturer (or his designee) stating that the Contractor is familiar with the manufacturer's suggested installation methods and procedures and the manufacturer's suggested installation methods and procedures are consistent with MAG requirements.

When required by the Special Provisions, the pipe manufacturer or his designee will review the Contractor's methods and procedures for pipe installation in the field. The Contractor will make any adjustments in the installation as recommended by the manufacturer or his representative. If necessary, the Contractor may be required to reinstall or provide corrections to pipe installed prior to the field review at no cost to the Agency. Once the manufacturer or his representative has reviewed the Contractor's installation methods and the Contractor has adjusted his installation methods as recommended by the same, the manufacturer or his representative shall furnish to the Contracting Agency an affidavit (certification) that the Contractor's installation methods and procedures, at the time of the review, complied with the manufacturer's installation practices. The

SECTION 601

affidavit must provide the name of the manufacturer's representative witnessing the pipe installation.

601.6 PAVEMENT REPLACEMENT AND SURFACE RESTORATION:

601.6.1 Grading: The Contractor shall do such grading in the area adjacent to backfilled trenches and structures as may be necessary to leave the area in a neat and satisfactory condition approved by the Engineer.

601.6.2 Restoring Surface: All streets, alleys, driveways, sidewalks, curbs, or other surfaces, in which the surface is broken into or damaged by the installation of the new work, shall be resurfaced in kind or as specified to the satisfaction of the Engineer in accordance with Section [336](#).

601.6.3 Cleanup: The job site shall be left in a neat and acceptable condition. Excess soil, concrete, etc., shall be removed from the premises.

601.6.4 Temporary Pavement: The Contractor shall install temporary asphalt pavement or the first course of permanent pavement replacement in accordance with Section [336](#) immediately following backfilling and compaction of trenches that have been cut through existing pavement. Except as otherwise provided in Section [336](#), this preliminary pavement shall be maintained in a safe and reasonably smooth condition until required backfill compaction is obtained and final pavement replacement is ordered by the Engineer. Temporary paving removed shall be hauled from the job site and disposed of by the Contractor at no additional cost to the Contracting Agency.

601.7 PAYMENT:

No pay item will be included in the proposal or direct payment made for trench excavation, backfilling, compaction, or placement of temporary pavement. The cost of these features of the work shall be included in the unit price per linear foot for furnishing and laying pipe.

- End of Section -

SECTION 602

TRENCHLESS INSTALLATION OF STEEL CASING

602.1 DESCRIPTION:

The Contractor shall furnish all labor, material and equipment as required for the trenchless operation to install steel casing using horizontal earth auger boring, hand tunneling or pipe ramming.

602.2 MATERIALS:

602.2.1 Steel Casing Fabrication: Steel casing shall conform to ASTM [A36](#), ASTM [A53](#), ASTM [A139](#), (American Petroleum Institute “API” Specification) API 5L Gr B, API 5L X42 or API 5L X52. Welding shall use matching filler metal requirements as listed in AWS D1.1 Table 3.1. Shop and field joints shall be welded in accordance with AWS D1.1/D1.1M. Welding shall be performed by AWS D1.1 qualified personnel.

602.2.2 Steel Casing Wall Thickness: The minimum wall thickness for steel casings shall be in accordance with Table [602-1](#).

Table 602-1	
Minimum Wall Thickness	
6”-36”	3/8”
37”-48”	1/2”
49”-60”	5/8”
61”-78”	3/4”
79” and up	1”

602.2.2.3 Steel Casing Diameter: The steel casing for pressurized carrier pipes shall be a minimum of 12-inches larger than the largest outside dimension of the carrier line, (including pipe bells and flanges) or the size indicated on the plans, whichever is greater.

The steel casing for gravity carrier pipes shall be a minimum of 18-inches larger than the largest outside dimension of the carrier line, (including pipe bells and flanges) or the size indicated on the plans, whichever is greater.

602.3 TRENCHLESS OPERATION:

Before starting operations, the Contractor shall submit in accordance with Section [105.2](#), detailed shop drawing of the bore pit and receiving pit shoring, bulkheads, carrier pipe installation method, and welder certifications. The contractor shall submit a letter of certification for the casing listing conformity to [602.2.1](#) and the ASTM or API stenciled on the outside matching the certification letter. The contractor shall submit a procedure detailing the trenchless installation method selected from [602.1](#) to be used for the project, if a geotechnical report is not available in the contract documents, the contractor shall define the soil limitation for the method selected.

The bore and reception pits for the trenchless operation shall be shored to safeguard existing sub-structures and surface improvements and to protect against ground movement. Survey of the bore alignment shall be taken prior to the installation of steel casing and taken after the installation of steel casing and shall be presented to the engineer.

On steel casing 37-inches (I.D.) or larger, grout connections shall be provided at a maximum spacing of every 20-feet located at 12 o’clock in the steel casing. Upon completion of the boring operation, the contractor shall inspect each grout hole to determine if grouting is required. Any gap greater than 2-inches outside the casing will require the boring contractor to grout fill the gap. After grouting the grout holes shall be closed with a threaded plug. The grout shall be a flowable fill.

Steel casing smaller than 36-inches (O.D.) installed by horizontal earth auger boring, hand tunneling or pipe ramming will not require outside grouting unless caving or earth movement occurs.

Unexpected loose soil conditions that do not accommodate the method submitted by the contractor, (horizontal earth auger boring, hand tunneling or pipe ramming), shall be brought to the agency attention to determine further course of action. Contractor shall stop boring until an alternative method is mutually agreed on.

SECTION 602

602.4 DEWATERING:

All water encountered during the trenchless operation shall be disposed of by the Contractor in a manner that will not damage public or private property or create a nuisance or health problem. The cost of furnishing pumps, pipes and equipment for dewatering shall be considered incidental to the work and no additional payment shall be made.

602.5 CARRIER PIPE PLACEMENT:

The tolerances allowed for the alignment and grade of carrier pipe shall comply with requirements of Section [610](#), [615](#) or [618](#) as applicable. The Contractor shall be responsible to obtain the required line and grade for the carrier pipe, the carrier pipe shall not contact or rest on the casing.

Pressurized carrier pipes, (i.e. water, gas, force main) shall be placed using casing spacers, wood skids or steel pipes for rails. Casing spacers shall be installed 3 per joint minimum with 8-foot maximum spacing. The annular space between the casing and carrier line shall be left empty unless otherwise directed. When the annular space is to be filled, 3/8-inch pea gravel shall be used.

Gravity carrier pipes, (i.e. sewer, storm drain, irrigation) shall be placed using wood skids or steel pipes for rails. The annular space between the casing and carrier line shall be left empty unless otherwise directed. When the annular space is to be filled, 3/8-inch pea gravel shall be used.

Bulkheads consisting of brick and mortar or concrete shall be constructed on the ends of the casing; bulkheads shall be a minimum of 8-inches thick. Alternative casing end closures may be substituted for brick and mortar or concrete bulkheads if approved by the engineer.

PVC conduits for dry utilities, (i.e. communications, fiber, electric) shall be placed using non-metallic PVC casing spacers. The annular space between the casing and carrier line shall be filled as indicated in the contract documents.

After completing the carrier pipe installation, the Contractor shall remove all loose and disturbed material in the bore pits and backfill the pits in accordance with Sections [601](#) and [336](#).

602.6 MEASUREMENT AND PAYMENT:

Measurement for steel casing shall be the number of horizontal linear feet from the end of casing in the bore pit to the end of casing in the reception pit. Payment for steel casing shall be full compensation for furnishing all labor, material, tools, and equipment required for the trenchless installation of steel casing, complete in place including but not limited to placement of carrier pipe, annular space fill material (when required), bulkheads, and the excavation and backfilling of pits. Payment for steel casing does not include payment for the carrier pipe. A separate payment will be made for the carrier pipe and any required testing of the carrier pipe.

- End of Section -

SECTION 604

PLACEMENT OF CONTROLLED LOW STRENGTH MATERIAL

604.1 DESCRIPTION:

The work covered by this specification consists of furnishing all materials, labor and equipment for the placement of controlled low strength material (CLSM).

The type of backfill to be used shall be as specified in the special provisions, plans or by the Engineer.

The following is a brief description of the types of CLSM and their intended uses:

1/2 SACK: General trench backfill in areas where future excavation into the backfill with conventional hand tools is anticipated or in areas of low loading such as streets, parking areas, behind retaining walls, etc.

1 SACK: General trench backfill and backfill behind retaining walls where additional strength is required above that of 1/2 sack CLSM.

1-1/2 SACK: Structural backfill under foundations and as thermal fill and/or mechanical protection of duct banks and conduits.

604.2 MATERIALS:

CLSM shall conform to the requirements of Section [728](#). Ready-mixed concrete shall not be used in lieu of CLSM without prior approval from the Engineer and shall be subject to rejection.

604.3 PLACEMENT:

The controlled low strength material shall be placed directly into the excavation. The CLSM shall be placed in a uniform manner that will prevent voids in or segregation of the material. Foreign material which falls into the trench prior to and during placing of the CLSM shall be immediately removed. The CLSM shall have consistency, workability, plasticity, flow characteristics and pumpability (when required) such that the material when placed is self-compacting. Mechanical compaction or vibration may be used to consolidate around structures, pipes, multiple conduits, etc., otherwise no mechanical compaction or vibration shall be required. The total elapsed time between the initial addition of water to the CLSM and the completed placement shall not exceed 90 minutes.

When CLSM is used for backfill around pipes or conduits, the CLSM shall be placed equally on both sides of pipe or conduit to prevent lateral displacement. Also, the CLSM shall be placed in lifts. The height of each lift shall not exceed the depth that will cause floating of the pipe or conduit. When placing the CLSM in greater lift depths, sufficient anchorage shall be provided so the pipe or conduit will not float.

Where CLSM is used for backfill around pipes or conduits with a depth less than 20 feet, the width of the excavation shown on the plans or in Section [601](#) may be reduced so that the minimum clear distance between the outside of the pipe or conduit and the side of the excavation (each side) shall be 12 inches for pipes or conduits 42 inches and larger, 6 inches for pipes or conduits between 4 inches and 42 inches and 3 inches for pipes or conduits 4 inches and smaller.

When CLSM is used behind retaining walls, the depth of each lift shall be limited so it will not induce hydraulic loads greater than the design loads.

For long trenches or installations which require a large amount of CLSM, bulkheads of wood, dirt, sand bags, etc. can be used to control the material's flowability. The bulkhead shall be removed prior to the continuation of the backfilling.

CLSM shall NOT be permitted to come in contact with any aluminum, copper or brass materials, e.g., aluminum pipes or culverts, copper water pipe, saddles, fittings, etc. Protection shall be any combination of the following: place a layer of noncorrosive material around the pipe e.g., native material, import material, etc. or provide a protective covering or wrapping such as polyethylene wrap per Section [610.6](#). Pipes smaller than 4 inches can be completely wrapped with tape as per Section [610.6](#) or approved equal.

SECTION 604

Generally, CLSM does not resist freezing and thawing and in some cases may propagate the condition. CLSM mixes must be modified where long term freeze-thaw durability is indicated as a concern. The mix design shall have an air content of no less than six percent by volume, when tested in accordance with ASTM C6023.

604.4 PERFORMANCE TESTING:

CLSM placed within the traveled way or otherwise to be covered by paving or embankment materials, shall not be covered until one of the following performance criteria have been met:

- (A) When a person of average weight and shoe size can walk on the surface of the CLSM without creating greater than 1/8-inch indents in the material, or
- (B) When the in-place CLSM has reached a strength of 30 psi, when tested in accordance with ASTM [D4832](#), or
- (C) When a ball drop indentation of 3-inches or less is obtained, when tested in accordance with ASTM [D6024](#), or
- (D) When a penetration resistance reading of 650 is achieved, when tested in accordance with ASTM [C403](#).

Additionally, CLSM shall not be covered if proof rolling by pneumatic-tired or steel wheel vibratory roller results in the bringing of free water to the surface or results in surface undulation (pumping).

When CLSM is placed in foundation excavations, the material shall be protected from foundation loading and placement of foundation concrete prior to having reached initial set per ASTM [C403](#), or allowed to set in place for 24 hours, whichever occurs first.

604.5 ACCEPTANCE:

CLSM shall be considered deficient and may be rejected at the discretion of the Engineer if:

- (A) The CLSM is outside of the limits specified in Table [728-1](#) and/or
- (B) The aggregate gradation is outside the limits specified in Section [728.2](#).

Rejected material not placed shall be immediately removed from the job site. Rejected material placed shall be removed and replaced with acceptable material. Removing and disposing of the rejected material shall be at no additional cost to the Contracting Agency.

604.6 PAYMENT:

No pay item will be included in the proposal nor direct payment made for CLSM unless specifically included in the Project Specifications and Fee Proposal. The cost for placing the material shall be included in the unit price for the specific work function (laying pipe, placing structure foundation, construction retaining wall, etc.).

- End of Section -

SECTION 605

SUBDRAINAGE

605.1 DESCRIPTION:

The subdrainage system shall be constructed in accordance with the notes and details shown on the plans and the applicable provisions of these specifications except as modified in the special provisions.

605.2 CONCRETE:

All concrete placed in drainage structures, subdrain outlets, pipe collars, and similar features of the subdrainage system shall conform to the applicable provisions of Section [725](#).

605.3 SUBDRAINAGE PIPE:

Subdrainage pipe, both perforated and non-perforated, shall be either bell and spigot concrete, bell and spigot vitrified clay, or corrugated metal pipe, as shown on the plans or specified in the special provisions. However, if the particular kind of pipe is not shown on the plans nor specified in the special provisions, subdrainage pipe shall be concrete pipe of at least standard strength quality and shall conform to the requirements of Section [736](#). Vitrified clay pipe shall conform to the requirements of Section [743](#). Corrugated metal pipe shall conform to the requirements of Section [760](#).

605.3.1 Pipe Joints: Unless the pipe joints are of a self-aligning type, have the bottom half of the bell joint filled with mortar to securely hold the pipe in alignment and to bring the inner surface of abutting pipes flush and even. Where a tight joint for non-perforated pipe is required, the bell joint shall be completely filled with mortar.

605.4 SUBDRAINAGE MANHOLES:

Subdrainage manholes, including inlets, outlets, flap gates, gate boxes, and drop steps, shall comply with the requirements of the plans and the special provisions.

605.5 FILTER MATERIALS:

The filter materials shall be placed within the limits shown on the plans. The compositions of the filter materials shall each conform to one of the grading requirements in Table [605-1](#); the particular requirement to be used will be specified in the special provision.

The materials used shall conform to requirements for concrete aggregates in Section [725.3](#); however, the requirements for grading, and reactivity, as stated therein, shall not apply. The minimum bulk specific gravity shall be 2.50, by ASTM [C127](#).

TABLE 605-1			
FILTER MATERIAL GRADING - % PASSING			
Screen or Sieve Size	TYPE		
	F1	F2	F3
3/4"		100	100
3/8"	100	80 - 100	70 - 100
No. 4	90 - 100	60 - 85	45 - 75
No. 8	75 - 90	45 - 70	30 - 60
No. 16	55 - 80	30 - 55	20 - 45
No. 30	30 - 60	15 - 40	10 - 30
No. 50	10 - 40	5 - 20	0 - 15
No. 100	0 - 15	0 - 10	0 - 5
No. 200	0 - 5	0 - 5	

SECTION 605

605.6 PLACEMENT:

605.6.1 General: The excavated subgrade shall be kept free of surface water. Mudholes, ruts, or soft spots due to the Contractor's operations shall be repaired at no additional cost to the Contracting Agency, as ordered by the Engineer.

Filter and drain material shall be placed around drainage pipe so as to provide even support throughout the entire length of the pipe and to permit the installed pipe to lie upon true alignment and grade. The minimum thickness of filter material surrounding the pipe shall be 6 inches.

Filter material shall be spread to such depth as to obtain the required thickness after compaction and shall be uniform and true to the line and grades indicated on the plans.

The surface under sloped bank lining or invert shall not show any variation or departure greater than ½ inch from the testing edge of a 10 foot straightedge. Ridges and humps shall be regarded depressions filled and compacted, and tested for straightness until grading is accomplished within the tolerance specified. No relative density will be required.

Pipe damage during placement or compaction shall be replaced by the Contractor at no additional cost to the Contracting Agency. The Contractor shall exercise due care to prevent water from surface drainage or other sources, mud, muck, or debris, from running into the filter material both during and after its placement, until the lining, backfill, or structure placed thereon is completed or set. The Contractor shall provide and operate drainage sumps and pumps, or equivalent means satisfactory to the Engineer, to prevent any such saturations of the filter materials.

605.6.2 Under Sloped Bank Lining: Those portions of filter materials which become subgrade for sloped bank lining shall be compacted by 4 passes of a small roller weighing not less than 600 pounds, and 20 pounds per inch of roller width, or by other means approved by the Engineer.

605.6.3 Under Invert: Those portions of filter materials which become subgrade for channel invert linings shall be compacted by 2 passes of a smooth-wheeled roller lapping 1 foot each pass, or by use of manually-operated hand tampers, or by other means as approved by the Engineer. The weight of the roller or the size of the tamper shall be approved by the Engineer.

605.6.4 In Trenches and Along Heels or Walls of Sides of Structures: The filter materials shall be placed in 1 foot lifts and compacted by hand-held tamping or vibrating equipment to the satisfaction of the Engineer.

605.7 TESTS OF THE SUBDRAINAGE SYSTEM:

Two separate tests shall be made on each subdrain line by the Contractor to assure the proper functioning of the subdrainage system.

Each test shall be conducted in the presence of the Engineer and shall consist of the flushing of the subdrain line with sufficient water to develop a flow of 5 cubic feet per minute out of the end of the line being tested, as measured by approved measuring equipment furnished by the Contractor.

When a channel invert slab is required, the first test of each completed section of the subdrain system shall be performed immediately prior to the placement of reinforcing steel for the channel invert slab and the second test shall be performed after completion of the channel invert work. Manholes shall be cleared of all debris prior to beginning the second test.

Final acceptance of the subdrainage system will be made only if the discharge is of uniform flow and of adequate quantity. Any necessary clearing of drain lines to meet the above requirements shall be performed by the Contractor at no additional cost to the Contracting Agency.

All costs involved in the performance of the tests, including the furnishing of all labor, equipment, and material required therefore, shall be included in the prices bid for the items under which the subdrainage system is to be constructed.

SECTION 605

605.8 PAYMENT:

Payment for the work included in this specification will be made on the basis of the lump sum or unit prices stipulated in the proposal, unless the payment for subdrainage work is included in the cost for other improvements. Such payment shall include full compensation for furnishing all labor, tools, and equipment and incidentals for doing the work involved.

- End of Section -

SECTION 607

TRENCHLESS INSTALLATION OF SMOOTH WALL JACKING PIPE

607.1 DESCRIPTION:

The Contractor shall furnish all labor, material and equipment as required for the trenchless operation for the installation of thirty-inch inside diameter (30" ID) and larger, tongue and groove smooth wall jacking pipe installed by horizontal earth pipe jacking or hand tunneling.

607.2 MATERIALS:

The jacking pipe shall be tongue and groove smooth wall reinforced concrete pipe per ASTM [C76](#) class V, unless vitrified clay pipe per ASTM [C1208](#), or centrifugally cast fiberglass reinforced polymer mortar pipe per ASTM [D3262](#), is approved by engineer.

607.3 TRENCHLESS OPERATION:

Before starting operations, the Contractor shall submit in accordance with Section [105.2](#), detailed shop drawing of the bore pit and receiving pit shoring, the jacking pipe, bulkheads, installation method, and the annular grouting mix design and grouting method. The proposed installation method and equipment shall be at the Contractor's option, no field construction shall commence until the proposed installation method is approved in writing by the Engineer. The Engineer's approval shall in no way relieve the Contractor of the responsibility for damages of any nature which might occur as a result of the methods used.

The bore and reception pits for the trenchless operation shall be shored to safeguard existing sub-structures and surface improvements against ground movement.

The leading section of jacking pipe shall be equipped with a tunnel shield. Excavation shall be carried out entirely within the tunnel shield and no excavation in advance thereof will be permitted. Every effort shall be made to avoid any loss of earth outside of the tunnel shield. Excavated material shall be removed from the jacking pipe as excavation progresses.

Upon completion of the jacking operation and if the grade of the jacking pipe is acceptable, all voids around the outside of the pipe shall be filled with grout.

607.4 DEWATERING:

All water encountered during the trenchless operation shall be disposed of by the Contractor in a manner that will not damage public or private property or create a nuisance or health problem. The cost of furnishing pumps, pipes and equipment for dewatering shall be considered incidental to the work and no additional payment shall be made.

607.5 MEASUREMENT AND PAYMENT:

Measurement for jacking pipe shall be the number of horizontal linear feet from the end of jacking pipe in the bore pit to the end of jacking pipe in the reception pit.

Payment for jacking pipe shall be full compensation for furnishing all labor, material, tools, and equipment required for the trenchless installation of the jacking pipe, complete in place including but not limited to shop drawings, dewatering, jacking pipe, bulkhead placement, grouting, and the excavation and backfilling of pits.

When a Contractor has the option of jacking and/or boring or open cut construction, and elects to construct a pipeline by the jacking and/or boring method, he will be paid for the replacement of such items of work as pavements, curb and gutter, sidewalk, driveway and alley entrances, as allowed for by open cut construction.

- End of Section -

SECTION 608

HORIZONTAL DIRECTIONAL DRILLING

608.1 DESCRIPTION:

This specification covers requirements for installation of underground infrastructure using the trenchless technology method known as Horizontal Directional Drilling (HDD). All installations shall be in accordance with the approved HDD Consortium's "Horizontal Directional Drilling Good Practices Guideline, Third Edition" and updates thereof.

The HDD method involves first drilling a pilot bore in the location(s) as indicated on the plans, and then next enlarging the drilled pilot bore to facilitate the installation of the required pipe line or bundle, herein referred to as the "product pipe." The pilot bore is enlarged approximately 1.5 times the size of the product pipe and then the product pipe is pulled into the enlarged borehole.

Installations are classified as small, medium or large which serves as a general indication of the level of equipment required for the installation. The size of bore is measured in inch-feet and is calculated by multiplying the nominal product pipe diameter in inches by the minimum allowable length of crossing in feet as indicated on the plans or as can reasonably be inferred from the locations of such bends, fittings, service connections, valves and any other equipment requiring excavation and/or connection to the pipe line at a specified location. The bore size refers to each individual bore, not the total footage of the permitted design.

Bore size calculation: 200 foot installation of a 4 inch diameter pipe has a bore size of 800 in-ft.
(200 ft. \times 4 in. = 800 in-ft)

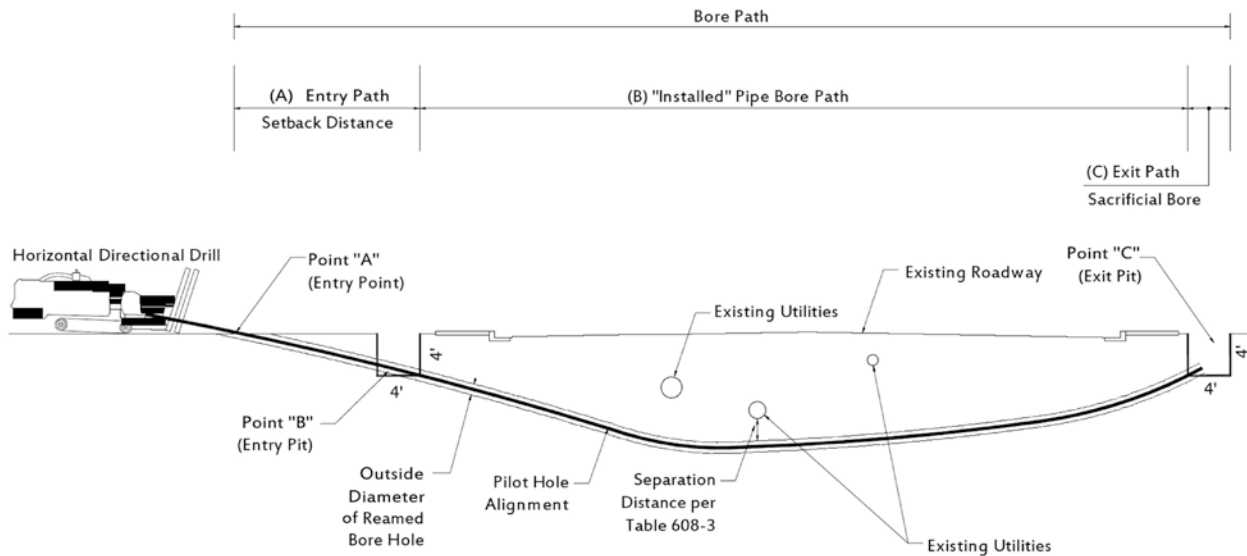
TABLE 608-1	
CLASSIFICATION OF BORE SIZES	
Classification	Bore Size
Small	Up to 6,000 in-ft
Medium	6,001 in-ft to 15,000 in-ft
Large	Above 15,000 in-ft

608.2 HDD TERMS AND DEFINITIONS:

- (A) Pilot Hole: The initial controlled drilled horizontal shaft used to guide the enlargement to design size and eventual installation of the product pipe.
- (B) Reaming: The back reaming hole opener is attached to the drill pipe and rotated and pulled back through the pilot hole to enlarge the bore in one or more passes to the size needed for product pipe installation.
- (C) Pullback: The pipe installation pulled back by a swivel/pulling head connected behind the reamer, which pulls the prepared product pipe into place.
- (D) Drilling Fluids: Fluids consisting of water, bentonite, and any approved additives such as environmentally safe polymers, lubricants, and viscosifiers.
- (E) Bore-tracking Equipment: Methods and systems generally defined as a walkover or non-walkover. To be specified by the Contractor and used to measure the actual accuracy of the bore to the specific line and grade. The bore path is monitored during the pilot bore by taking periodic readings of the inclination and azimuth of the probe located within the sonde housing.
- (F) Bore-tracking Pit: An excavated area for entry, exit, slurry sump or any other excavation used to manage, control, and track the progress of the bore.
- (G) Critical Structure: Any pipeline, utility, building, structure, bridge, pier, or similar construction partially or entirely located within a zone of active excavation.

SECTION 608

Figure 608-1



The setback distance is dependent upon elevation difference from A (surface) to B (desired grade), entry angle of rig, and bending radius of drill rods.

608.3 MATERIALS:

All product pipe material shall be of the size, type, and class as shown on the plans.

Sectional pipe is pipe that requires assembly of the joints, such as a bell and spigot pipe. Sectional pipe shall be specifically designed for installation by HDD.

Non-sectional pipe is pipe that requires joining together by a fusion or welding process. It is assembled prior to pulling the product pipe into the bore hole.

Non-sectional pipe that requires fusion of the joints, such as HDPE or Fusible-PVC, shall be fused by a skilled operator. The Contractor is responsible for using qualified personnel to ensure the fusion process follows the pipe manufacturer's recommended procedures. The Contractor shall submit certification from the pipe manufacturer or an accredited training agency documenting personnel qualifications. Untrained personnel shall not be permitted to perform fusion of any pipe on the project. The Contractor shall use a data-logger or manually record the following information for each fused joint in the product pipe line, unless the product pipe is used as a sleeve, pulled through a sleeve, or used for dry utilities.

- Date and time of joint
- Temperature
- Fusion pressure applied to joint
- Joining/fusion time
- Cooling time

Solid tracer wire AWG #14 or larger shall be pulled with the product pipe to ensure compliance with ARS 40-360.22, paragraph M.

608.4 RECORD DOCUMENTS AND SUBMITTAL REQUIREMENTS:

Submittal requirements are based on the bore size classification as shown in Table [608-2](#). The required items contained in items 1 through 10 shall be submitted prior to the authorization to commence field construction. Copies of all documents shall be maintained at the construction site and be available for inspection.

SECTION 608

TABLE 608-2			
SUBMITTAL REQUIREMENTS			
Required Record Document	Bore Size Classification		
	Small	Medium	Large
1. Agency Approved Plans	•	•	•
2. Personnel Qualifications	•	•	•
3. Surface Survey			
4. Bore Plan/Profile		•	•
5. Drilling Fluid Management Plan		•	•
6. Equipment & Site Setup			•
7. Drilling Fluid Pressure Calculations			•
8. Pipe Stress and Pullback Calculations			•
9. Bore Data	•	•	•
10. As-Built	•	•	•

608.4.1 Agency Approved Plans: The facility owner shall submit plans for approval to the Agency in whose right-of-way the facility owner is proposing to install the new utility. Any changes from the approved plans will require a re-submittal of plans and re-approval. Plans are to identify the location of all property lines, right-of-way, and easements within the project construction limits. No work is to take place outside of the construction limits as shown on the agency approved plans.

608.4.2 Personnel Qualifications: The Contractor shall provide a competent and experienced individual familiar with the equipment and the type of HDD operations to be performed. The individual shall be present onsite while HDD operations are being performed and be in direct charge and control of the HDD operations. Documentation of experience and appropriate training evidenced by a certificate of attendance from a training program shall be provided upon request.

608.4.3 Surface Survey: A surface survey is not required for small bores unless specified by contract or permit documents. A surface survey requires the contractor prior to starting the drilling operation to submit to the Engineer a surface survey of elevations along the planned bore alignment, the maximum interval between elevations shall be ten feet (10'). Upon completion of the installation of the product pipe, the Contractor shall have a second survey performed and shall have the elevations compared with the pre-bore survey elevations. The second survey and the comparative results shall be submitted to the Engineer. Any change in elevation of a paved surface greater than ½" shall be considered excessive and shall be repaired at the Contractor's expense. Any elevation deviation of a paved flow line that is greater than ¼" shall be considered excessive and shall be repaired at the Contractor's expense.

608.4.4 Bore Plan/Profile: A scaled plan and profile drawing of the proposed pilot bore shall be submitted by the Contractor. The bore plan/profile shall show existing surface features and grade, the proposed pilot bore size and path, and all existing utilities with dimensioned vertical and horizontal clearances.

608.4.5 Drilling Fluid Management Plan: Indicate the type and amount of the drilling fluid planned to be used on the project. Include safety data sheets for the identified drilling fluid components and additives. The drilling fluid plan is developed based upon the anticipated soil conditions, and a sufficient supply of fluid is to be available to enable successful completion of the bore. Indicate the intended method of disposal of spent drilling fluids and include approvals from off-site disposal sources. The Drilling Fluid Management Plan shall identify contingency measures to be employed in case of inadvertent returns. The contingency plan may include containment with sediment control devices, removal with vacuum equipment or other such contingency measures as appropriate. In all cases, the plan shall indicate that if primary control measures fail and inadvertent returns cannot be controlled, work will be suspended until such a time as the plan can be revised and effective control measures can be implemented.

608.4.6 Equipment & Site Setup: Specifications on directional drilling equipment shall be used to ensure that the equipment will be adequate to complete the project. Equipment list is to include, but not be limited to: drilling rig, mud system, mud motors (if applicable), down-hole tools, guidance system, and rig safety systems. Include calibration records for guidance equipment. Identify the site setup dimensions and where the equipment shall be located. Equipment shown on the site layout

SECTION 608

is to include but not be limited to: drilling rig, mud system, drill rod stock pile and mud return pit. Identify the pipe staging and assembly areas.

608.4.7 Drilling Fluid Pressure Calculations: Provide documentation sealed by an Arizona registered professional engineer for the calculations of minimum required and maximum allowable drilling fluid pressures anticipated throughout the bore to maintain drilling fluid circulation and minimize the occurrence of inadvertent returns. Indicate how such pressures shall be monitored and recorded throughout the progression of the bore. Provide manufacturer's specifications for the down hole fluid pressure monitoring system(s) and properly calibrate such system(s) prior to commencing the installation.

608.4.8 Pipe Stress and Pullback Calculations: Submit documentation indicating the product pipe manufacturer's specified maximum allowable bending radius and maximum allowable pulling force for the pipe being installed. Provide calculations sealed by an Arizona registered professional engineer that show the anticipated bending radii for each segment of the pipe and the total anticipated pulling force required to complete the installation and that the maximum radius and the maximum allowable pulling forces for the pipe are within tolerable limits. The drill rig to be employed shall be capable of exerting a pullback force of at least two times that of the total anticipated pulling force required to complete the installation of the pipe specified. Furnish documentation indicating how the pulling forces introduced to the pipe will be monitored and indicate the methods that will be employed to record such data and ensure that the force exerted on the pipe does not exceed the pipe's maximum allowable pulling force.

608.4.9 Bore Data: Identify the installed location of the bore by writing down each rod and indicating the depth and pitch. Submit a copy of this information when requested.

- Rod/joint number
- Depth and pitch of locate reading

608.4.10 As-Built: Identify the installed location of the bore on a scaled drawing referencing any benchmark information provided on the original construction drawings. Also indicate the location of all existing utilities as provided on the original construction drawings and verified in the field, as well as any undisclosed utilities as discovered in the field throughout the prosecution of this work. Also submit copies of any drilling fluid logs, pipe fusion logs, and any other such information as it pertains to the work undertaken pursuant to this specification.

608.5 CONSTRUCTION:

608.5.1 Horizontal Directional Drilling Equipment: The HDD equipment is to have an electronic "walkover" tracking system or a Magnetic Guidance System (MGS) to accurately guide boring operations; a system to monitor maximum pullback pressure during pull-back operations; a system to detect electrical current from the drill string shall be in place with an audible alarm that automatically sounds when an electrical current is detected; a vacuum unit of sufficient capacity to handle the drilling fluid volume; and trained and competent personnel to operate the systems. All equipment shall be in good, safe condition with sufficient supplies, materials, and spare parts on hand to maintain the system in good working order for the duration of the project.

608.5.2 Guidance System: An electronic "walkover" tracking system, or a MGS probe or proven (non-experimental) gyroscopic probe, and interface for continuous and accurate determination of the location of the drill head shall be used during the drilling operation. The locating system shall be capable of determining the in ground position of the drill head and shall be accurate to $\pm 2\%$ of the distance from the transmitter to the receiver. It shall enable the driller to guide the drill head by providing information on the pitch; roll and clock face orientation of the drill head. The locating system shall be capable of determining the depth of the drill head from the transmitter to the surface at any location along the path of the bore. The locating system shall be calibrated per the manufacturer's specifications prior to commencing the bore.

608.5.3 Drilling Fluid (Mud) System: A self-contained, closed, drilling fluid mixing system of sufficient size to mix and deliver drilling fluid composed of bentonite clay, uncontaminated water, and appropriate additives shall be used. The mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank shall be of sufficient capacity to supply an amount of drilling fluid that is equal to the maximum rated output of the drilling fluid pump over at least a fifteen minute duration. Ensure the drilling fluid is mixed per drilling fluid manufacturer's recommendations and continually agitate the drilling fluid during drilling operations.

SECTION 608

The Contractor shall be responsible to monitor drilling fluid properties and return fluid properties and shall modify the drilling fluid mix as appropriate for the soil conditions encountered. Contractor shall continually monitor and record any necessary drilling fluid properties such as viscosity as determined by a marsh funnel standard test method (ASTM [D6910](#)). The drill fluid pumping system shall be capable of delivering drilling fluid at a sufficient output rate and at minimum pressures as necessary to enable successful completion of the bore. Furnish pumping equipment and/or vacuum truck(s) of sufficient size to convey drilling fluid from containment areas, to storage and recycling facilities or disposal.

608.5.4 Directional Drilling Operation: Prior to drilling the pilot hole, “walk” the bore path with the locating system, as per the manufacturer’s specifications, attempting to identify any areas of potential interference and record the results of such inspections. Verify that all known utilities have been located and there is no conflict with the proposed work. Ensure all utilities that run parallel within 2’ of the proposed work are exposed at intervals sufficient to determine there will be no conflict with the proposed work. Comply with surface survey requirements.

Determine the depth of the drill head every 10’ or every rod length, whichever distance is greater. Record location information for the entirety of the bore, either manually in a driller’s log or automatically via the locating system. Make all recorded readings, and plan and profile information available at all times. Do not allow the deflection radius of the drill pipe exceed the deflection limits of the product pipe at any time throughout the crossing. Use white paint and mark the depth of the pilot bore on the ground at an interval not exceeding 10’.

Stabilize the open bore hole by means of bentonite drilling slurry pumped through the drill rod and through openings in the drill head or reamer. The drilling slurry shall be in a homogenous/flowable state serving as an agent to carry the loose cuttings to the surface through the annulus of the borehole. Calculate the volume of drilling fluid required for each reamer pass based upon hole size and soil conditions. The driller shall not be permitted to “outrun his mud” which is the condition occurring when the drilling penetration or retrieval rate is generating cuttings at a rate faster than the drill fluid pumping system can suspend and convey the cuttings out of the bore hole.

Contain all drilling fluids in pits or holding tanks for recycling or disposal. Monitor drill fluid circulation throughout the duration of the bore activity and immediately take corrective actions to restore fluid circulation should circulation be lost.

Upon completion of the pilot bore, ream the bore hole up to a large enough diameter to accommodate the pullback of the product pipe. The final reamed hole opening shall be 1.5 times the outside diameter of the product pipe for pipe lines 24” or less, or no larger than 12” plus the outside diameter of the product pipe for pipe lines greater than 24”.

Maintain a one foot (1’) minimum separation between the outside of the pilot bore hole and the outside of the utility when no reaming is required to install the product pipe.

When the pilot bore hole is to be reamed, maintain a minimum separation between the outside of the pilot bore hole and the outside of existing utility equal to one foot greater than the largest required reamer diameter.

Minimum separation between the bore and any existing underground utility shall conform to Table [608-3](#).

TABLE 608-3	
MINIMUM SEPARATION FROM EXISTING UNDERGROUND UTILITIES	
Minimum Separation	Type of Underground Utility
2’ vertical	Outside of bore to outside of wet utility (wastewater, storm, flood irrigation, water, etc.)
1’ vertical	Outside of bore to outside of dry utility
6’ horizontal	Running line to outside of wet utility

608.5.5 Handling Product Pipe: Care shall be taken during transportation of the product pipe to prevent it from being cut, kinked, or damaged. Use ropes, fabrics, or rubber protected slings and straps when handling pipes. Do not use chains, cables, or hooks inserted into the pipe ends. Use slings spread apart for lifting each length of pipe. Do not drop pipe or fittings onto rocky or unprepared ground.

Store pipe on level ground that is free of sharp objects that could damage the pipe. Limit the stacking of pipes to a height that will not cause excessive deformation of the bottom layers of pipe under anticipated temperature conditions. Where necessary

SECTION 608

due to ground conditions store the pipe on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

Handle assembled pipe in a manner that avoids damage to the pipe. The pipe is not to be dragged over sharp objects. Position slings to prevent stress on pipe joints. Product pipe that has cuts, gouges, or excessive deformation shall be removed and replaced.

608.6 MEASUREMENT:

Measurement of product pipe installed by HDD shall be by the lineal foot of pipe installed. Measurement shall be along the centerline of the product pipe, through all valves, fittings and manholes, from centerline to centerline of valves, fittings or structures or to the end of pipe.

608.7 PAYMENT:

Payment will be made at the contract unit price for each type and size of product pipe installed and accepted. Payment shall be compensation in full for the product pipe and furnishing all labor, material, tools, and equipment required for the horizontal directional drilled installation of product pipe, complete in place, including all related excavation, shoring and bracing, backfill, and compaction. When specified payment shall also include, testing, disinfecting, restoration, and connections to existing lines or works.

- End of Section -

SECTION 610

WATER LINE CONSTRUCTION

610.1 DESCRIPTION:

The construction of all water lines shall conform to applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

610.2 GENERAL:

All pipes shall be delivered, handled and installed in accordance with the manufacturer's recommendations and/or applicable provisions of AWWA standards for installation of the various types of water mains specified, insofar as such recommendations and provisions are not in variance with the standard specifications and details.

Where water lines are to be constructed in new subdivisions or in conjunction with street repaving projects, the streets shall be pre-graded to within 6 inches of the new street subgrade prior to trenching or cut stakes shall be set for trenching.

610.3 MATERIALS:

All pipes for water lines shall be of the classes shown on the plans or as specified below.

(A) The 4-inch through 16-inch diameter pipe sizes may be PVC C900 or ductile iron, except where a particular material is specified by the agency or the contract documents. All pipes shall be minimum 150 psi design unless otherwise specified.

(B) Pipe 16 inches and larger may be either ductile iron, or concrete pressure pipe-steel cylinder type.

Ductile iron and cast iron water pipe and fittings per: Section [750](#). Concrete pressure pipe-steel cylinder type per: Section [758](#). C900 PVC per: AWWA C900-07.

Service material containing brass or bronze must comply with the current NSF 61-8 standards at the time the project begins.

All brass or bronze service material must meet the current AWWA C-800 standards.

Any product used in water line construction containing brass or bronze that comes in contact with potable water shall meet the current NSF standards and federal law.

Only such packing materials as are included in the list of acceptable materials in AWWA C-600 for installation of cast iron water main shall be used. The packing materials shall be handled in such a manner as to avoid contamination, and shall be dry when placed in the joints. All such materials shall be free of oil, tar, or greasy substances, except that treated paper packing material, jute, cement, or sulfur compound caulking will not be permitted.

610.4 CONSTRUCTION METHODS:

610.4.1 Trenching/Cover: All water mains in major streets shall have a minimum cover of 48 inches over the top of the pipe. Water mains in other locations shall have a minimum cover over the top of the pipe as follows:

(A) 36 inches for mains smaller than 12 inches.

(B) 48 inches for mains 12 inches and larger.

Cover for water mains will be measured from existing or proposed finished grade of pavement or from natural ground, whichever is deeper.

Except as otherwise required in this specification, the special provisions, or by the Engineer, trench excavation, backfilling and compaction shall be in accordance with the requirements of Section [601](#). Backfilling may be accomplished as soon as the pipe line has been installed to the satisfaction of the Engineer, subject to the requirements for testing per Section [611](#).

SECTION 610

610.4.2 Laying Pipe: No water main shall be deflected, either vertically or horizontally, in excess of that recommended by the manufacturer of the pipe or coupling.

If adjustment of the position of a length of pipe is required after it has been laid, it shall be removed and rejoined as for a new pipe.

Curb stops with flushing pipes or fire hydrants shall be installed at the ends of dead-end mains according to standard details.

Thrust blocks shall be installed in accordance with this specification.

Valve boxes and covers shall be according to standard details.

Ductile iron pipe shall be installed in accordance with this specification and pipe and fittings shall be in accordance with Section [750](#).

PVC C-900 pipe shall be installed in accordance with AWWA C900 and Section [601](#).

610.4.3 Blocking and Restraints: All pipe lines, valves and fittings 16 inches and smaller in diameter shall be blocked with concrete thrust blocks in accordance with standard details. Thrust block areas for pipe, valves and fittings larger than 16 inches in diameter shall be installed per details shown on the plans. The areas stipulated in the standard details are minimums and shall not be decreased.

If irregular soil or pressure conditions are encountered, a thrust block design revision or an alternate joint restraint system may be required by the Engineer.

When restrained/welded joints are specified to resist thrust forces, blocking is not required.

With the Engineers approval, restrained/welded joints may be used in lieu of thrust blocks.

Where restrained joints are specified on mains sixteen (16) inches in diameter and smaller, ductile iron pipe shall be used with an approved joint restraint method.

On mains sixteen (16) inches in diameter and larger where plans specify welding joints and where ductile iron pipe is furnished, joints shall be restrained by an approved joint restraint method for the distance specified.

610.4.4 Maintain Pipe Cleanliness / Pipe Cleaning: The interior of all pipe and fittings shall be kept as free as possible of all dirt and foreign material at all times, until the pipe is placed in the new line.

Every precaution shall be taken to prevent foreign material from entering the pipe. When on the project site, the ends of the pipe section shall be plugged, wrapped or tarped at all times when pipe laying is not in progress, which includes storage and staging at the site. The pipe shall be stored on a pallet, blocking or other means to prevent foreign materials from entering the pipe. The pipe line shall be protected by a water-tight plug or other means approved by the Engineer when the pipe is in the trench if pipe laying is not in progress.

If in the opinion of the Engineer, the pipe contains dirt that will not be removed during the flushing operation; the interior of the pipe shall be cleaned and swabbed, as necessary, with a .005 to .010 percent chlorine solution.

If the Contractor or pipe-laying crew cannot install the pipe in the trench without getting earth into it, the Engineer may require that, before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size be placed over each end of the pipe and left there until the connection is to be made to the adjacent pipe.

At the close of each day's work, and at times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer. Joints of all pipe in the trench shall be completed before the work is stopped. If water is in the trench, the seal shall remain in place until the trench is pumped dry.

SECTION 610

610.4.5 Testing: Hydrostatic testing shall be in accordance with [Section 611](#). After pressure testing and before placing in service, all water lines shall be disinfected. Disinfection shall be accomplished in accordance with [Section 611](#). All corporation stops used for testing and chlorination shall be left in the pipe line with the stop closed and all connecting pipe removed.

610.5 SEPARATION:

610.5.1 General: Water lines and sewer lines shall be separated to protect water lines from contamination by sewer lines.

The angle of a water line and sewer line crossing shall be limited to between (45) forty-five degrees and (90) ninety degrees. Intersection angles of less than (45) forty-five degrees shall not be allowed.

Separation distances are measured from the outside diameter of the water or sewer line, or the centerline of a manhole.

When water and sewer lines cannot meet separation requirements, extra protection is required as described in Subsection [610.5.5](#) and shown in Standard Details 404-1, 404-2 and 404-3.

Extra protection requirements for line crossings are measured from the closest outside surfaces of the sewer and water line.

Water line service connections to individual building supply and distribution plumbing shall not be placed below sewer lines, and shall otherwise comply with the separation requirements of the applicable plumbing code as applied by the Agency (Administrative Authority). Methods described for extra protection do not apply to these service lines.

Water and sewer lines shall not be constructed parallel within a common trench.

610.5.2 Water Line Separation from Gravity Sewer Lines: Water lines shall not be placed within two (2) feet horizontal and one (1) foot vertical above and two (2) feet vertical below gravity sewer lines.

Extra protection is required where a water line is placed within six (6) feet horizontal and two (2) feet vertical above a gravity sewer line.

Extra protection is required where a water line is placed within six (6) feet horizontal and any distance below a gravity sewer line.

610.5.3 Water Line Separation from Pressurized Sewer Lines: Water lines shall not be placed within six (6) feet horizontal and within two (2) feet vertical below or within two (2) feet vertical above a pressurized sewer line.

Extra protection is required where a water line is placed within six (6) feet horizontal and within six (6) feet vertical above a pressurized sewer line.

Extra protection is required where a water line is placed within (6) feet horizontal and any distance below a pressurized sewer line.

610.5.4 Water Line Separation from Manholes: Water lines shall not pass through or come into contact with any part of a sewer manhole and shall be separated six (6) feet horizontal from the center of a sewer manhole.

610.5.5 Extra Protection: New water lines that require extra protection from new sewer lines, shall have extra protection provided by using ductile iron pipe for both lines. Lines of standard pipe length shall be centered at the point of crossing so that no joints exist within six (feet) horizontal and only restrained or mechanical joints exist within ten (10) feet horizontal.

New water lines that require extra protection from sewer lines, shall have identification wrap and/or tape installed on the water and sewer lines for the length that requires extra protection for each line.

New water lines that require extra protection from existing sewer lines shall be constructed using the extra protection specified for new water lines, and the existing sewer line:

SECTION 610

- (1) shall be reconstructed using a standard length of ductile iron pipe centered at the point of crossing so that no joints exist within six (6) feet horizontal and only restrained or mechanical joints exist within ten (10) feet horizontal, or
- (2) shall be encased in 6 inches of concrete for the horizontal distance of the line that requires extra protection but for a distance no less than ten (10) feet horizontal.

Existing water lines that require extra protection from new sewer lines shall provide for extra protection by:

- (1) constructing the new sewer line and reconstructing the existing water line using ductile iron pipe for both lines with standard pipe lengths centered at the point of crossing so that no joints exist within six (feet) horizontal and restrained or mechanical joints exist within ten (10) feet horizontal, or
- (2) encasement of both the existing water line and the new sewer line in six (6) inches of concrete for the horizontal distance of the lines that require extra protection but for a distance no less than ten (10) feet horizontal.
- (3) Extra protection for existing ductile iron water lines can be met by the installation of restrained or mechanical joints on the existing water line within ten (10) feet horizontal of the crossing and either
 - (a) construction of new sewer line using a standard pipe length of ductile iron pipe centered at the point of crossing so that no joints exist within six (6) feet horizontal and restrained or mechanical joints exist within ten (10) feet horizontal, or
 - (b) encasement of the new sewer line in 6 inches of concrete for the horizontal distance of the line that requires extra protection but for a distance no less than ten (10) feet horizontal.

610.6 POLYETHYLENE CORROSION PROTECTION:

610.6.1 General: Where called for in the plans and specifications or directed by the Engineer, pipe, valves and fittings shall be protected from corrosion by encasement in a polyethylene protective wrapping referred to hereafter as polywrap. Although not intended to be a completely air and water tight enclosure the polywrap shall provide a continuous barrier between the pipe and surrounding bedding and backfill.

610.6.2 Materials: The polywrap shall be of virgin polyethylene, not less than 8 *mils* in thickness, formed into tubes or sheets as may be required. Naturally pigmented material may be used where exposure to ultraviolet light will be less than 48 hours.

Otherwise the material shall be pigmented with 2 to 2 1/2 percent of well dispersed carbon black with stabilizers.

The polywrap shall be secured as specified below with 2-inch wide pressure sensitive tape not less than 10 mils thick. This flexible tape shall consist of a polyethylene or polyvinyl chloride backing with a synthetic elastomeric adhesive film comprised of butyl rubber. Tape shall remain flexible over a wide range of temperatures, with tensile strength and elongation properties in conformance with ASTM [D1000](#).

The minimum tube size for each pipe diameter shall be per Table [610-1](#).

SECTION 610

TABLE 610-1 (from AWWA C105-05)
POLYWRAP FLAT TUBE WIDTHS

Nominal Pipe Diameter (Inches)	Cast Iron Or Ductile Iron With Push-On Joints (inches)	Cast Iron or Ductile Iron With Mechanical Joints (inches)
4	14	16
6	16	20
8	20	24
10	24	27
12	27	30
14	30	34
16	34	37
18	37	41
20	41	45
24	54	53
30	67	.
36	81	.
42	81	.
48	95	.
54	108	.
60	108	.
64	121	.

610.6.3 Installation: The polyethylene tubing shall be cut into lengths approximately 2 feet longer than the pipe sections. With the pipe suspended from the center the tube shall be slipped over the spigot end and bunched up between the point of support and the spigot end. After the pipe is installed into the bell of the adjacent pipe the pipe shall be lowered to the trench bottom and the supporting sling removed from the center of the pipe. The pipe shall then be raised at the bell end enough to allow the tube to be slipped along the full length of the barrel with enough left at each end to overlap the adjoining pipe about 1 foot. A shallow bell hole must be made at each joint to facilitate installation of the polywrap.

Pull the bunched-up polywrap from the preceding length of pipe, slip it over the end of the new length of pipe, and secure in place with one circumferential turn of tape plus enough overlap to assure firm adhesion. Then slip the end of the polywrap from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Tape it in place.

The loose wrapping on the barrel of the pipe shall be pulled snugly around the barrel of the pipe, and excess material folded over the top of the pipe and the folds held in place by means of short strips of adhesive tape, at about 3 foot intervals along the pipe.

Repair any rips, punctures or other damage to the tube with the adhesive tape or pieces of tube material secured with tape.

Bends and reducers in the line shall be covered with polyethylene in the same manner as pipe.

Valves, tees, crosses and outlets shall be wrapped with flat sheets of the same material. The sheets shall be passed under valves and brought up around the body to the stem. Edges shall be brought together, folded twice and secured with the adhesive tape.

610.6.4 Payment for Polywrap: Payment for this item shall be per the provisions of Subsections [109.4](#) and [109.5](#) of the specifications unless this item is specifically called for on the plans or in the supplemental specifications or special provisions as a specific component and pay item for a given project.

610.7 VALVES:

Valves shall be installed in accordance with AWWA C-600 or AWWA C-603 modified as follows:

All tapping sleeves, gate valves, butterfly valves, air release and vacuum valves and corporation stops shall be in accordance with Section [630](#).

Just before installation in the trench, valves shall be fully opened and closed to check the action, and a record made of the

SECTION 610

number of turns required to fully open or close the valve. For valves 16 inches and larger, a member of the water utility shall be present to check the action and record the number of turns. The inside of all valves shall then be thoroughly cleaned and the valve installed.

Valves 12 inches and smaller in size shall be supported by concrete blocks, in accordance with the standard details.

Valves 16 inches and larger in size along with their bypass valves, shall be supported on concrete slabs, and/or concrete piers, as indicated on the plans.

Concrete supports shall be provided under valves in vaults and manholes, and shall be constructed an inch low, then grouted with non-shrink grout. Adjustable pipe supports shall be as indicated on the plans. Buried valves shall be supported on concrete blocks as detailed on the plans.

Valve boxes shall be installed over all buried valves in accordance with standard details.

Standard couplings or matching joints shall be used when more than one length of pipe is required, or when two or more pieces are joined, to form the valve box riser. Install extension stems on all valves where the operating nut is 5 feet or more below grade.

610.8 MANHOLES AND VAULTS:

Construction shall consist of furnishing all materials and constructing manholes or vaults complete in place, as detailed, including foundation walls, cast iron steps, frames, covers, and any incidentals thereto, at location shown on the plans.

Manholes shall be constructed to conform with the requirements of Section [625](#) and standard details, except the inside diameter shall be 60 inches.

Vaults shall be constructed of reinforced concrete conforming to Section [725](#) and of concrete pipe conforming to ASTM [C76](#) Wall A or B. Vaults shall be kept moist for 7 days before backfilling.

610.9 FIRE HYDRANTS:

The Contractor shall furnish all labor, materials, and equipment necessary to install fire hydrants complete in place at locations shown on the plans in accordance with the standard details and special provisions. Fire hydrants furnished by the Contractor shall conform to the requirements of Section [756](#).

If paint is chipped, scuffed, or otherwise damaged during handling and installation, the Contractor shall touch up such spots as may be designated by the Engineer.

All hydrants must be flushed and left in good working condition with the control valve open.

610.10 COUPLINGS, JOINTS, GASKETS AND FLANGES:

(A) **Couplings:** The couplings used to join the pipe to flanged valve adapters shall have a minimum working pressure of 150 psi, and shall have a fusion-bonded epoxy finish. The coupling sleeves shall be carbon steel with a minimum yield of 30,000 psi. The flanges shall have a minimum yield of 30,000 psi and be ductile iron or carbon steel for sizes up to 12", or high-strength, low-alloy steel for sizes 14" and larger.

(B) **Joints:** The joints and fitting shall conform to Sections [750](#) and [752](#).

Bolts and Nuts:

- (1) Bolts, studs, and nuts used in underground field flanged connections or for connecting fittings shall be carbon steel compliant with ASTM [A307](#), Grade A unless Grade B is specified. Bolts, studs, and nuts shall be in accordance with AWWA C111. Bolts and studs shall have Class 2A thread tolerance with the corresponding nuts having Class 2B

SECTION 610

tolerance. Bolts, studs and nuts shall have a hot-dipped zinc coating in accordance with ASTM [F2329](#). All bolt diameters shall normally be 1/8 inch smaller than the bolt hole diameter. If specified, allowable exceptions to zinc coating shall be bolts, studs, and nuts made from 316 stainless steel per ASTM [F593](#) or cadmium plated per ASTM [B766](#). All bolts shall be hexagonal heads.

- (2) The minimum requirement for underground mechanical joint connections using T-head bolts shall meet the requirements of AWWA C111 using a high strength low alloy steel manufactured for atmospheric corrosion resistance per ASTM [A242](#).

These bolted joints shall be protected as follows: Following installation and before backfilling, all couplings, steel flanges, bolts, nuts, anchor bolts and rods, bolting of all flanged valves, and all exposed steel shall be protected from corrosion by either of the two methods outlined below at the Contractor's option.

(A) Below ground installations shall be coated with NO-OX-ID "A" with a film of not less than 1/32 inch thick and then coated with cement mortar not less than 1 inch thickness before backfilling. Cement mortar shall be composed of 1 part cement, ASTM [C150](#), Type II, low alkali, to 3 parts sand. Before application of the cement mortar coating the area to be protected shall be covered with a layer of 2 x 2 inch No. 14 gage welded wire fabric, firmly wired in place.

(B) Below ground installations shall be protected by the application of hot coal-tar enamel. The coal-tar enamel shall be in accordance with AWWA C-203 and shall be applied to the top part of the pipe or fittings by daubers for at least 2 coats for a total minimum thickness of 1/16 inch. The coal-tar for under side of the pipe flanges or fittings shall be applied by the pan or cocoon method as described below and in AWWA Manual M-11, Steel Pipe.

Pan Method: The coating pan is securely anchored in place on the underside of the pipe and straddling the connection to be coated. The pan shall be wide enough so that the entire connection will be coated.

Hot coal-tar enamel is poured into the pan, from one side only, until the pan is completely filled. The drain plug or valve, is then opened and the excess coal-tar drained out. The pan can then be removed. Details of the coating pan and corresponding dimensions are given in AWWA Manual M-11.

The upper portion of the connection, and all remaining exposed steel pipe, will then be coated by the use of a dauber. The coal-tar coating shall be applied in at least 2 coats for a minimum thickness of 1/16 inch. The daubers and method of application shall conform to AWWA C-203. No thinning will be allowed.

(C) **Cocoon Method:** The cocoon is formed by placing glass fiber cloth or roofing paper, of the proper width, around the underside of the connection and adjacent exposed steel pipe. The edges of the cocoon shall be securely fastened to the pipe. Backfill is lightly placed to the spring line, and the top of the cocoon is opened and layed back on the filled area and hot coal-tar enamel poured, from one side only, until the cocoon is completely filled. The loose backfill prevents rupture of the cocoon. The upper portion of the connection and remaining exposed steel pipe shall be coated as above.

(D) **Gaskets:** Except as otherwise provided, all gaskets for pipe lines shall be one piece full faced gaskets from one-ply cloth inserted SBR rubber material. Gaskets for flanges 20 inches and smaller shall be from 1/16 inch thick material. Gaskets for flanges 24 inches and larger shall be from 1/8 inch thick material. Gasket material shall be J-M 109 as manufactured by Johns-Manville Corporation or an approved equal. Physical characteristics of the rubber compound shall meet ASTM [D2000](#), Class 4AA805A13.

(E) **Flanges:** Cast iron flanges shall conform to AWWA C-110 as to material, diameter, thickness, drilling, etc. Steel flanges shall be ring or hub type, and shall conform to AWWA C-207, Class D. All flanges shall be drilled and have flange diameters and bolt circles conforming to AWWA C-110, except bolt holes will be 1/8 inch larger than the bolts given for the various sizes. All bolts shall be as specified above and all flanges shall have a flat facing.

610.11 CONNECTION TO EXISTING MAINS:

Existing pipe to which connections are to be made shall be exposed by the Contractor as directed by the Engineer, to permit field changes in line, grade or fittings, if necessary.

SECTION 610

All connections to existing mains shall be constructed according to the plans.

Valves connecting new work to the existing system shall be kept closed at all times.

Only Agency personnel shall operate existing valves. The Contractor shall not operate valves in the existing system.

After disinfected samples have been taken and the new work passes the bacteriological tests, the new line shall then be turned over to the Contracting Agency with all branch lines and tie-in valves closed.

When shutdown of an existing water main is necessary in order to connect to the new lines, the Contractor shall make application and pay the required charges to the Contracting Agency. A conference between the Contractor's representative, Engineering Inspection, and Water Distribution personnel shall establish the time and procedures to insure that the shutdown will be for the shortest possible time. If necessary to minimize inconvenience to customers, shutdowns may be scheduled during other than normal working hours. The water supply to some customers, such as hospitals, cannot be shut off at any time. Provisions to furnish a continuous supply of water to such establishments will be required. After the procedures and time for a shutdown are agreed upon, it shall be the Contractor's responsibility to notify all customers in advance that the water will be turned off. When possible, customers shall be notified 24 hours in advance and in no case, except in emergency, shall notification be less than 30 minutes. Notification shall be in writing, giving the reason for the shutdown and the time and duration the water service will be shut off.

The Contracting Agency will close existing valves, but will not guarantee a 100% complete shutdown.

610.12 FIRE LINE SERVICE CONNECTIONS:

Fire line service connections shall be installed in accordance with standard details.

The fire line from the control valves at the main to the detector check valve shall be constructed of ductile iron pipe per Section [750](#).

610.13 METER SERVICE CONNECTIONS:

All new meters must be installed by the Contracting Agency after the proper application as required by Code with fees paid at prevailing rates.

When plans call for connections from a new water main to an existing water meter, the work shall include new copper pipe and fittings except as follows:

(A) Wrapped galvanized pipe shall be used to connect or extend existing galvanized service pipe. Type K soft copper pipe or tubing shall be used to connect or extend existing copper service pipe except when otherwise called for in the plans.

(B) When the existing main is not abandoned, and the existing meter is to be connected to the new line, the corporation stop at the old main shall be closed and the abandoned service line cut 6 inches from the old main.

(C) Taps and service connections to the new main shall be made prior to testing and disinfection of the new line.

(D) Meter service piping may be installed by drilling in place of open cut construction when approved by the Engineer.

When called for on the plans, the meter and box shall be relocated by the Contractor as directed by the Engineer. Existing meters which are shown on the plans to be relocated shall be located and installed in accordance with standard details.

Water meter boxes which are broken during construction shall be replaced by the Contractor at no additional cost to the Contracting Agency. Existing meter boxes which are already broken prior to start of construction shall be replaced by the Contractor with boxes furnished by the Contracting Agency. Boxes may be picked up by the Contractor after written authorization is received from the Engineer. The written authorization shall include the street address of each broken meter box and the size of meter box required. All water meter boxes shall conform to the standard details.

SECTION 610

610.14 CLEANUP:

When testing, chlorination, compaction, and cleanup do not follow pipe laying in an orderly manner, the Engineer reserves the right to close down trenching and pipe laying until these operations are adequately advanced.

610.15 PAVEMENT AND SURFACING REPLACEMENT:

Pavement and surfacing replacement shall be in accordance with the requirements of Section [336](#).

610.16 MEASUREMENT AND PAYMENT:

(A) Pipe:

- (1) Measurement of all pipe shall be of the linear feet of pipe installed, measured along the centerline of the pipe, through all valves and fittings, from the centerline of the fittings or centerline of valves on ends of pipe to the centerline of fittings, centerline of valves on ends of pipe or to the end of pipe, as the case may be, for all through runs of pipe. Measurement of lateral line pipes shall start at the centerline of valve at connection to the main. Measurement of service lines shall be from the centerline of the new main to the connection at the meter. Measurement shall be to the nearest foot.
- (2) Payment will be made at the contract unit price per linear foot of each type and size of pipe. Such payment shall be compensation in full for furnishing and installing the pipe and fittings, specials, adapters, etc., complete in place, as called for on the plans and/or on the standard details, and shall include all costs of excavation, removal of obstructions, shoring and bracing, bedding, backfilling, compaction, maintenance of traffic, testing, disinfecting, connections to existing lines or works, and all work not specifically covered in other pay items.

(B) **Service Line Connections:** Measurement shall be of the number of unit connections made for water services, if called for in the bid. Each bid item unit shall consist of the connection to the water main and to the meter, as may be required in the plan details. Payment will be made at the contract unit price for each water service connection and shall be compensation in full for labor materials (other than pipe) equipment, tapping, and all necessary incidentals. Payment for new service pipe required to make the connection will be made separately, as stipulated above. If no contract bid item exists for connections, then the cost for connections to meters and main lines shall be included in the corresponding pipe bid item unit price.

(C) **Relocation of Existing Meters and Boxes:** Measurement shall be of the number of meters and boxes moved and reinstalled. Payment will be made at the contract unit price for each meter and box relocated and installed.

(D) **Permanent Pipe Supports and Encasement of Existing Pipes:** Measurement shall be of each unit included in the bid, and payment shall be compensation in full for supporting or encasing existing pipe, as required on the plans, including excavation, form work, reinforcing, concrete, handling and controlling flows in the existing pipe, removing and replacing existing pipe where necessary, supporting, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section [336](#).

(E) **Concrete Thrust Blocks:** Concrete thrust blocks and anchors for all pipe 16 inches and larger shall be measured by the cubic yard(s) of concrete placed, as required on the plans and/or as directed by the Engineer. Payment will be made at the contract unit price per cubic yard, and shall be compensation in full for excavation, formwork, placing and finishing concrete, reinforcing, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section [336](#). All thrust blocks and anchors for 12 inches and smaller pipe shall be included in the linear foot cost of the pipe.

(F) **Valves:** Measurement of and payment for valves, tapping sleeves and valves, and valve boxes shall be for each item furnished and installed, as designated in Section [630](#).

(G) **Fire Hydrants:** Measurement shall be the number of fire hydrants installed. Payment will be at the contract unit price for the installation of each fire hydrant complete in place and in operating condition. The 6 inch ductile iron pipe and fittings, required for making the connection from the main to the hydrant, shall be a separate pay item in the proposal as described above.

SECTION 610

(H) **Pavement and/or Surfacing Replacement:** Payment for pavement and/or surfacing replacement will be made as stipulated in Section [336](#), except as otherwise established in this specification. The cost of pavement and/or surface replacement required for service line installations shall be included in the contract unit price for service line pipe.

- *End of Section* -

SECTION 611

WATER, SEWER AND STORM DRAIN TESTING

611.1 HYDROSTATIC TESTING:

Water lines, including all fittings and connections to the water mains shall be tested for water-tightness by subjecting each section to hydrostatic testing in accordance with applicable provisions of AWWA C-600, except as modified below, and shall consist of pressure testing and allowance testing.

The test section shall be slowly filled with potable water and all air shall be vented from the line. The rate of filling shall be as determined by the Superintendent of Water Distribution, with at least 24 hour notice required before tests are scheduled.

The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pumps, and measuring devices and all other equipment necessary for making the tests, including pressure gages, and shall pay the Contracting Agency for water used in the tests.

Hydrostatic Testing: Pressure testing may be made before or after backfilling, but backfilling must be completed before allowance testing. If the pipe is center-loaded, a visual inspection for leaks may be made along the pipe line while the test section is under test pressure, and all visible leaks repaired. However, if mechanical compaction is to be used in the backfilling operations as spelled out in AWWA C-600, the tests shall not be made until the backfilling is completed and compacted. Backfill and compaction for the full distance encompassed by restrained/welded joints shall be completed prior to testing. All connections, blowoffs, hydrants and valves shall be tested with the main as far as is practicable. Hydrostatic testing shall not begin until the pipe has been filled with water for at least 24 hours to allow for air venting.

- (A) **Pressure Testing:** Unless otherwise noted in the contract documents, the minimum prescribed test pressure shall be at least 200 psi for lines smaller than 16 inches and 150 psi for lines 16 inches or larger, not to exceed 5 psi over the minimum prescribed test pressure, as measured at the lowest end of the section under test. The duration of each pressure test shall be at least 2 hours, during which time the test section shall not drop below the minimum prescribed test pressure. If the pressure in the pipe test section has not stabilized by the end of the testing period, a hydrostatic retest will be required.

Each section of a new line between sectionalizing valves or between the last sectionalizing valve and the end of the project shall be tested separately as required in AWWA C-600, and/or as modified in these specifications, except that any such section less than 500 feet in length may be tested with the adjacent section, if both sections of line have the same pipe class rating. No section greater than 1/2 mile in total pipe length shall be tested without special written permission of the Engineer.

- (B) **Testing Allowance/Makeup Water:** Makeup water volume shall be determined after the pressure test has been satisfactorily completed and all backfilling and compaction has been completed to top of trench. Testing allowance shall be defined as the maximum quantity of makeup water necessary to be supplied into the pipe line section under test to restore the ending test pressure to the beginning test pressure, after the pipe line has been filled with water and all air expelled. The Contractor shall furnish the necessary apparatus and assistance to conduct the test.

The duration of each makeup water test shall be at least 2 hours. To pass the allowance testing, the quantity of makeup water from the pipe line shall not exceed the makeup water quantity allowed by the following formula, from AWWA C-600:

$$M = \frac{SD \sqrt{P}}{148,000}$$

in which

M = testing Allowance (makeup water), in gallons per hour.

S = length of pipe tested, in feet

D = nominal diameter of pipe, in inches.

P = test pressure of the pipe being tested, per 610.15 (A)

SECTION 611

Should the test on any section of the pipe line require more makeup water than allowed by the above formula, the Contractor shall locate and repair the defective pipe, fittings, or joint until the makeup water volume is within the specified allowance. All repairs and retests, if required, shall be made at the Contractor's expense.

Connections to the existing pipelines or existing valves shall not be made until after that section of new construction has satisfactorily passed the hydrostatic tests.

Ductile iron pipe used in conjunction with ACP will be tested to the ACP standards, unless otherwise directed by the Engineer. High pressure systems of all ductile iron pipe will be tested in accordance with AWWA C-600, Section 4.1.

611.2 DISINFECTING WATER MAINS

611.2.1 Flushing Completed Pipe Lines:

- (A) **Preliminary Flushing:** All mains 12 inches and smaller shall be flushed, prior to chlorination, as thoroughly as possible with the water pressure and outlets available. Flushing shall be done after the pressure test has been made. It must be understood that flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying. It is difficult to flush mains over 12 inches in diameter, so in such instances the requirements above, must be rigidly adhered to.

Heavy duty, factory bushed, tapped couplings, with corporation stops shall be located at all high points in the lines to allow the air to be removed prior to testing the water lines and at disinfection points as may be required. Field taps will not be permitted.

The couplings, at high points and disinfection points, shall be left exposed during backfilling until the testing is complete. Couplings and corporation stops shall be left on the mains upon completion of water mains.

- (B) **Valve Damage by Foreign Material:** Unless proper care and thorough inspection are practiced during the laying of water mains, small stones, pieces of concrete, particles of metal, or other foreign material may gain access to mains newly laid or repaired. If it is believed that such foreign material(s) may be in the main, all hydrants on the line shall be thoroughly flushed and carefully inspected after flushing to see that the entire valve operating mechanism of each hydrant is in good condition.

611.2.2 Chlorine Residual: Before being placed in service, all new mains and repaired portions of, or extensions to existing mains shall be chlorinated so that a chlorine residual of not less than 10 ppm remains in the water after 24 hours standing in the pipe.

611.2.3 Methods of Applying Chlorine: Any of the following methods of application of chlorine (arranged in order of preference) may be used, subject to the approval of the Engineer.

- Liquid chlorine gas-water mixture.
- Direct chlorine feed.
- Calcium or sodium hypochlorite and water mixture.

611.2.4 Application of Liquid Chlorine: A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device or, if approved by the Engineer, the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas or of the gas itself must provide means for preventing the backflow of water into the cylinder.

611.2.5 Chlorine-Bearing Compounds in Water: On approval of the Engineer, a mixture of water and a chlorine-bearing compound of known chlorine content may be substituted for liquid chlorine.

SECTION 611

(A) Compounds to be used: The chlorine-bearing compounds that may be used are: calcium hypochlorite*, and sodium hypochlorite**.

(B) Preparation of mixture: High-test calcium hypochlorite must be prepared as a water mixture for introduction into the water mains. The powder should first be made into a paste and then thinned to approximately a 1 percent chlorine solution (10,000 ppm). The preparation of a 1 percent chlorine solution requires the following proportions of powder to water:

Product	Amount of Compound	Quantity of Water (Gallons)
High-test calcium hypochlorite (65—70% Cl)	1 lb.	7.50
Liquid laundry bleach (5.25% Cl)	1—2 pts.	12.6

- **611.2.6 Point of Application:** The preferred point of application of the chlorinating agent is at the beginning of the pipe line extension or any valved section of it and through a corporation stop inserted in the top of the newly laid pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipe line extension.

- **611.2.7 Rate of Application:** Water from the existing distribution system or other source of supply shall be controlled so the rate of flow shall not exceed 500 gpm, unless approved by the Superintendent of Water Distribution, through a suitable measuring device into the newly laid pipe line during the application of chlorine. The rate of chlorine solution flow shall be in such proportion to the rate of water entering the pipe that the chlorine dose applied to the water entering the newly laid pipe shall produce at least 10 ppm of residual chlorine after 24 hours standing in the pipe. This may be expected with an application of 50 ppm, although some conditions may require more

On lines 12 inches in diameter or less, determination of the rate of flow of water into the line to be treated may be made by starting with the line full of water and measuring the rate of discharge at a hydrant located at the end of the pipe farthest away from the point of chlorine application.

For lines larger than 12 inches in diameter, the disinfection operation is generally started with the line empty.

Measurement of the flow of water into and out of all lines shall be made by means of a pitot gage, current type meter, or other approved device.

- **611.2.8 Preventing Reverse Flow:** Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Check valves shall be used to accomplish this.
- **611.2.9 Retention Period:** Treated water shall be retained in the pipe long enough to destroy all nonspore-forming bacteria. This period should be at least 24 hours and should produce no less than 10 ppm residual chlorine at the extreme end of the line at the end of the retention period.

NOTE: If the circumstances are such that less than a 24 hour retention period must be used, the chlorine concentration shall be increased to 100 ppm. Under these conditions, special care should be taken to avoid attack on pipes, valves, hydrants and other appurtenances.

- **611.2.10 Chlorinating Valves and Hydrants:** In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent. All valves in lines being disinfected shall be opened and closed several times during the 24 hour period of disinfection.
- **611.2.11 Final Flushing, Sampling and Testing:** Following chlorination, all treated water in the newly laid pipeline shall be thoroughly flushed until the replacement water throughout the new pipeline can be proved, by laboratory testing, comparable in quality to the water served to the public from the existing water system. Prior to sampling for laboratory testing, the residual chlorine throughout the length of the pipeline shall be reduced to 1.0 ppm or less. Once the required residual chlorine level in the pipeline is achieved, samples shall be taken as outlined below.

*Comparable to commercial products known as HTH, Perchloron, and Pittchlor.

** Known commercially as liquid laundry bleach.

SECTION 611

The Contracting Agency or its authorized representative will collect all samples for testing of the new water mains. To initiate the sampling and testing, the Contractor will present to the Contracting Agency a written request for such work no later than 24 hours prior to the time when samples are to be taken.

Samples shall be taken from a tap and riser located and installed in such a way as to prevent outside contamination. Samples shall never be taken from an unsterilized hose or fire hydrant, because such samples will seldom meet bacteriological standards. The number of sampling locations shall be as follows: Waterlines up to but less than 150 feet in length require one sampling riser installed as near the end as possible; lines 150 feet to 300 feet in length, two sampling risers, one near each end of the line; lines 300 to 3,000 feet in length, a minimum of three sampling risers. In addition, dead ends on main lines should be represented with a sampling riser.

The number of samples taken at each sampling location shall be determined by the Contracting Agency based on one of the following methods.

- (A) One sample from each sampling location which is examined and analyzed in the laboratory over a three day (72 hour) period.
- (B) Two samples taken on separate days from each sampling location. Satisfactory water quality of the new main shall continue for a period of at least two days (48 hours) as demonstrated by laboratory examination of these samples.

Upon completion of laboratory testing, results of all tests shall be sent by the laboratory to the Contracting Agency. Results of laboratory analysis will be interpreted by the Contracting Agency, and reported to the Contractor. Under no circumstance shall the Contractor contact the laboratory. If there is need for test results before written reports are submitted, such information shall be obtained only from the Contracting Agency or its authorized representative.

611.2.12 Repetition of Chlorination Procedure: Should the initial treatment fail to result in the conditions specified above, the original chlorination procedure shall be repeated until satisfactory results are obtained.

611.3 SEWER LINE TESTING:

Pressure testing of force mains shall be done in accordance with Section [611.1](#)

Sewers and pipe lines shall be subject to acceptance testing after backfilling has been completed but prior to the placement of the finished surface material.

The Contracting Agency reserves the right to require testing of the entire installation. Cost of repairs or corrections necessary to conform to the following testing requirements will be borne by the Contractor at no additional cost to the Contracting Agency.

(A) Low Pressure Air Test:

Testing will be accomplished by the means of "Low Pressure Air Testing." Tests may be conducted by the Contractor or an independent testing firm. However, acceptance tests shall be made only in the presence of the Engineer.

Test Procedure:

- (1) Before testing, the pipe shall be thoroughly cleaned.
- (2) The Contractor shall seal off the section of pipe to be tested at each manhole connection. Test plugs must be securely braced within the manholes.
- (3) A minimum of two connecting hoses to link the air inlet test plug with an above ground test monitoring panel must be provided.
 - (a) One hose is to induce air through the test plug and into the test chamber.
 - (b) The second hose is for the purpose of monitoring the test pressure from within the enclosed pipe.
- (4) UNDER NO CIRCUMSTANCES ARE WORKERS TO BE ALLOWED IN THE CONNECTING MANHOLES WHILE A PRESSURE TEST IS BEING CONDUCTED.

SECTION 611

- (5) Add air slowly into the test section. After an internal pressure of 4.0 psi is obtained, allow internal air temperature to stabilize.
- (6) After stabilization period, adjust the internal air pressure to 3.5 psi, disconnect the air supply and begin timing the test.
- (7) Refer to Table [611-1](#) to determine the length of time (minutes) the section under test must sustain while not losing in excess of 1 psi as monitored by the test gauge. If the section of line to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.
- (8) Sections so determined to have lost 1 psi or less during the test period will have passed the leakage test. Those sections losing in excess of 1 psi during the test period will have failed the leakage test.
- (9) Appropriate repairs must then be completed and the line retested for acceptance.

TABLE 611-1			
SANITARY SEWER AIR TEST			
Minimum Test Time for Various Pipe Sizes*			
Nominal Pipe Size, in.	T (time), min/100 ft	Nominal Pipe Size, in.	T (time), min/100 ft.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

* The time has been established using the formulas contained in ASTM [C828](#), Appendix.

(B) Hydrostatic Test:

Exfiltration Testing (water):

Sanitary sewer testing by means of exfiltration should only be considered when low pressure air testing cannot be used and only with the approval of the Engineer.

Testing Procedure:

- (1) The Contractor shall furnish all equipment for testing.
- (2) Seal off the downstream end of the line and fill with water to a minimum head of 4 feet in a stand pipe at the high end.
- (3) A period of at least one hour will be allowed for absorption time before making the test.
- (4) A suitable meter or method of measuring the quantity of water used is necessary.
- (5) The allowable water loss for sanitary sewers shall not exceed 0.158 gallons per hour per 100 feet of pipe per inch of diameter of pipe under a minimum test head of 4 feet above the top of the pipe at the upper end.

(C) Deflection Test for HDPE and PVC Pipe:

In addition to the tests prescribed above, the Contractor shall perform a deflection test on the system as directed by the Engineer. Any part of the installation which shows deflection in excess of 5% of the nominal inside diameter per Section [738](#) for HDPE pipe or in excess of 5% of the average inside diameter per ASTM [D3034](#) for PVC pipe, shall be evaluated and appropriate remedy, if any, shall be performed.

After acceptance but prior to the termination of the warranty period, the Contracting Agency may test the long term deflection of the sewer. If the Contracting Agency determines that the deflection has exceeded 7 ½% of the average inside diameter, that portion of the installation shall be corrected by the Contractor at no cost to the Contracting Agency.

SECTION 611

(D) Closed Circuit T.V. Inspection:

The Contracting Agency reserves the right to visually inspect the interior of the sewer line using a television camera. Any defects in the pipe or construction methods revealed shall be corrected by the Contractor at no additional cost to the Contracting Agency.

611.4 POST INSTALLATION INSPECTION OF NEW MAINLINE STORM DRAINS:

(A) Video Inspection:

The Contractor shall provide the Engineer with an annotated video inspection record (either VHS or DVD format) of the new mainline storm drain pipeline. The video shall clearly show all joints, seals, connecting pipes, and manholes. This video shall be provided to the Engineer, and reviewed and approved by the Engineer prior to the Contractor being allowed to place the final pavement over the storm drain line.

(B) Deflection Test for HDPE and PVC Pipe:

In addition to the tests prescribed above, the Contractor shall perform a deflection test on the system as directed by the Engineer. Any part of the installation which shows deflection in excess of 5% of the nominal inside diameter per Section [738](#) for HDPE pipe or in excess of 5% of the average inside diameter per ASTM [D3034](#) for PVC pipe, shall be evaluated and appropriate remedy, if any, shall be performed.

After acceptance but prior to the termination of the warranty period, the Contracting Agency may test the long term deflection of the storm drain. If the Contracting Agency determines that the deflection has exceeded 7 ½% of the average inside diameter, that portion of the installation shall be corrected by the Contractor at no cost to the Contracting Agency.

611.5 PAYMENT:

No separate pay item shall be contained in the proposal for disinfecting water mains. This operation shall be included in the price bid for the water mains, installed complete in place, as specified in the proposal

The Contracting Agency will pay for the initial Sewer C.C.T.V. inspection. Any additional inspection(s) required, due to the failure of the initial inspection, shall be paid for by the Contractor.

No separate payment will be made for this Storm Drain Video or Deflection Testing; the cost of the video and deflection testing shall be included in the cost of the pipe.

- End of Section -

SECTION 615

SANITARY SEWER LINE CONSTRUCTION

615.1 DESCRIPTION:

The construction or extension of sanitary sewer lines shall conform to the applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

615.2 MATERIALS:

Pipe used for sewer line construction, including specials, joints, and gaskets, shall be according to the following Sections, or as modified by the special provisions.

- Reinforced Concrete Pipe (RCP), see Section [735](#)
- High Density Polyethylene (HDPE) Pipe, see Section [738](#)
- Steel Reinforced Polyethylene (SRPE) Pipe, see Section [739](#)
- Polypropylene Pipe (PP), see Section [740](#)
- Vitrified Clay Pipe (VCP), see Section [743](#)
- Polyvinylchloride Pipe (PVC), see Section [745](#)
- Ductile Iron Pipe (DIP), see Section [750](#)

615.3 TRENCHING:

Trench excavation shall be accomplished in accordance with Section [601](#), except as specified below, or as modified by special provisions.

The Engineer shall furnish the Contractor alignment and elevation stakes at agreed-upon intervals and offset together with cut sheets showing the difference in elevation from the top of the stakes to the flow line of the pipe.

The trench shall be dry when the fine grading of the trench bedding is accomplished. Before placement of pipe the fine grade shall be carefully checked by use of a string line, laser beam, or other means so that when in final position the pipe will be true to line and grade, ± 0.05 feet for 12 inch and smaller diameter pipe and ± 0.10 feet for 15 inch and larger diameter pipe.

615.4 SEPARATION:

To protect water lines from contamination by sewer lines, separation and extra protection shall be in accordance with Section [610](#).

Sewer lines that are constructed of ductile iron pipe for extra protection shall be internally lined for sewer service.

615.5 PIPE INSTALLATION:

Pipe shall be of the type, class, and size called for on the plans. All pipe shall be protected during handling against impact shocks and free falls. No damaged or defective pipe shall be installed in the work. Pipe shall be kept clean at all times, and as the work progresses, the interior of the pipe shall be cleared of all dirt and superfluous materials of every description.

The laying of the pipe shall be in trenches free from water or debris, and shall commence at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a closed concentric joint with the adjoining pipe and to prevent sudden offsets of the flowline. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

The alignment and grade of each length of pipe shall be checked after setting by measurement from the string line, laser beam target or other means approved by the Engineer.

SECTION 615

At all times when work is not in progress, open ends of the pipe and fittings shall be securely closed to the satisfaction of the Engineer, so that no water, earth or other substance will enter the pipe or fittings.

615.6 FITTINGS:

All fittings shall conform to the requirements of the pipe specifications and shall be located as shown on the plans, or as directed by the Engineer, in accordance with the standard details.

615.7 JOINTING:

615.7.1 Gasket Joints: Prior to joining pipes, all surfaces of the portions of the pipes to be joined shall be cleaned, dried, and prepared in accordance with the manufacturer's recommendations. The joints shall then be carefully centered and completed.

Trenches shall be kept water-free during the installation of joints and couplings.

The joint and coupling materials shall be as specified in the appropriate pipe sections and shall be installed in accordance with the manufacturer's recommendations. Cement mortar joints will NOT be permitted in sanitary sewer construction.

615.7.2 Water Stops: Water stops will be required when connecting pipes other than VCP or RCP to concrete structures, manholes, etc. The water stop shall comply with Section [738](#) and shall be installed per manufacturer recommendations.

615.8 SANITARY SEWER SERVICE TAPS:

Sanitary sewer service taps shall be constructed in accordance with standard details.

To maintain structural integrity of the pipe, service tap connections into an existing flexible pipe shall be made in accordance with the pipe manufacturer's recommendations.

When any damage occurs to the pipe, the Contractor shall perform repairs, as recommended by the manufacturer at no cost to the Contracting Agency. Damage to the pipe will include but not be limited to gouging, marring, and scratching forming a clear depression in the pipe.

The locations of the service tap for each property shall be in the downstream $\frac{1}{3}$ of the lot, or as requested by the property owner. Sewer service taps shall not be covered until they have been plugged and marked in accordance with standard details and their location has been recorded by the Engineer. Electronic markers shall be placed at no greater depth than electronic locating devices can locate them (typically 2'-4').

615.9 SANITARY SEWER CLEANOUTS:

Cleanouts shall be constructed at locations shown on the plans, in accordance with the standard details.

615.10 MANHOLES:

Manholes shall be constructed to conform with the requirements of Section [625](#) and standard details.

615.11 BACKFILLING:

Backfilling and compaction shall be accomplished in accordance with Section [601](#) except as modified by special provisions.

615.12 TRENCHLESS INSTALLATIONS:

Trenchless installation of pipe shall be in accordance with [Section 602](#) or [Section 607](#).

SECTION 615

615.13 INSPECTION AND TESTING

Testing and inspection shall be in accordance with [Section 611](#).

615.14 PAVEMENT AND SURFACING REPLACEMENT:

Pavement and surfacing replacement shall be in accordance with Section [336](#).

615.15 CLEANUP:

The Engineer has the right to close down forward trenching and pipe laying where testing, backfill, compaction and cleanup does not follow in an orderly manner.

615.16 MEASUREMENT AND PAYMENT:

(A) Sanitary Sewer Pipe and Fittings:

Measurement will be made horizontally through manholes and fittings and from centerline to centerline of structures, for the various types and sizes of pipe called for on the plans and in the proposal.

Payment for the various sizes and types of pipe will be made at the contract unit price per linear foot, and shall be compensation in full for furnishing and installing the pipe and fittings complete in place, as specified, including excavation, removal of obstructions, backfilling, compaction, sheeting and bracing, testing, and all incidental work not specifically covered in other pay items.

(B) Sanitary Sewer Service Lines and Taps:

Measurement of the number of taps installed will only be made when pay items for sanitary sewer taps are contained in the contract.

When pay items for sanitary sewer taps are contained in the contract, payment for sanitary sewer service taps will be made at the contract unit price and shall be compensation in full for furnishing and installing pipe and fittings needed to connect to the main, complete in place, as specified and called for on the plans and standard details, including all cost for furnishing and installing electronic markers, and all cost of excavation, removal of obstructions, shoring and bracing, backfilling, compaction, pavement replacement, maintenance of traffic, and all work incidental thereto.

The length of pipe required for the service lines shall be measured and payment made as Sanitary Sewer Pipe and Fittings. If no pay item is provided for the sanitary sewer taps, the connection cost including all costs for furnishing and installing electronic markers shall be included in the unit cost of the sanitary sewer pipe.

(C) Sanitary Sewer Cleanouts:

Measurement will be the number and type of cleanout installed.

Payment will be made at the contract unit price and shall be compensation in full for furnishing and installing pipe, fittings, and frame and cover as called for on the plans and in accordance with the standard details.

- End of Section -

SECTION 616

RECLAIMED WATER LINE CONSTRUCTION

616.1 GENERAL:

This specification prescribes standards for utility water mains for the purpose of conveying, under pressure, reclaimed water for permitted reuse. Installation of reclaimed water mains shall be constructed in accordance with these specifications for materials, installation, and identification.

616.2 MATERIALS:

Pipe materials shall be in accordance with Section [610](#).

Valves shall be in accordance with Sections [610](#) and [630](#).

Valve boxes shall be in accordance with Section [345](#), this Section and Detail 391-1 and 391-2. Manholes shall be in accordance with Section [625](#), [787](#) and this Section, and applicable Details.

616.3 INSTALLATION:

Pipe shall be installed in accordance with Sections [601](#), [610](#), and this Section.

Valves and risers shall be installed in accordance with this section.

Valve box debris caps shall be installed in accordance with this Section and Detail 392.

When a reclaimed water main is adjacent to or crosses a potable water main, the reclaimed water main shall be considered a pressure or force sanitary sewer and comply with Details 404-1, 404-2 and 404-3 for separation and/or protection. When reclaimed water main is adjacent to or crosses a gravity, pressure or force sanitary sewer, the reclaimed water main shall be considered a potable water main and comply to Detail 404-1, 404-2 and 404-3 for separation and/or protection.

616.4 IDENTIFICATION:

The color purple shall be used for identifying all pipes, valves, and other equipment used for conveying reclaimed water.

Reclaimed water identification tape shall be an inert polyethylene plastic impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The tape shall be a minimum of 4.0 mils thick and no less than 3 inches wide. The tape shall be purple and shall have the words, "CAUTION: RECLAIMED WATER LINE" or similar wording printed in black lettering continuously along the entire length. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water identification sleeving (pipe socks) shall be an inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The sleeving shall be a minimum of 4.0 mils thick. The sleeving shall be purple and shall have the words, "CAUTION: RECLAIMED WATER LINE" or similar wording printed in black lettering continuously along the entire length. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water identification decals shall be made of inert material resistant to cracking, peeling, and fading due to sunlight and heat. Decals shall have an aggressive adhesive to ensure permanent bonding to the surface that is being identified. The decals shall have the words, "CAUTION: RECLAIMED WATER - DO NOT DRINK" or similar wording printed in black lettering on a purple background. Lettering shall be a minimum 1 inch high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water pipe identified by stenciling shall use paint or ink resistive to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. Stenciled pipe shall have the words, "CAUTION: RECLAIMED WATER - DO NOT DRINK" or similar wording printed in black or white lettering on a purple background continuously along the entire length.

SECTION 616

Lettering shall be a minimum of 1 ½ inches high lettering shall be placed on a painted purple band a minimum of 3 inches wide that runs the entire length of the pipe.

Reclaimed water locating tape shall be an inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The tape shall be a minimum of 4.0 mils thick, 3 inch wide and contain a minimum thickness of 1/3 mil metallic foil or two embedded copper wires. The tape shall be purple and printed with the words, "CAUTION: RECLAIMED WATER LINE BELOW" or similar wordings printed in black lettering continuously along the entire length. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Integral colored reclaimed water pipe shall be purple in color and shall have the words, "CAUTION: RECLAIMED WATER-DO NOT DRINK" or similar wording printed in black lettering at intervals no greater than 3 feet. Lettering shall be a minimum 1 ½ inches high. Spacing between the individual words of the message shall not exceed three inches.

Reclaimed water valve tags shall be inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. The tags shall be purple and shall have the words, "CAUTION: RECLAIMED WATER-DO NOT DRINK" or similar wording printed in black lettering. The lettering shall be a minimum of ½ inch high.

616.4.1 Below- Ground Pipe:

(A) All below-ground reclaimed water pipelines shall be marked by identification tape, or sleeving, or integral coloring, or stenciling in conformance with this section.

Identification tape shall be installed parallel to the centerline and on top of the pipe. The identification tape shall be installed continuously for the entire length of the pipe and shall be securely fastened with plastic adhesive tape banded around both the pipe and identification tape at no more than 4-foot intervals.

Identification sleeving shall be installed so the wording runs along the top of the pipe. Care shall be exercised to avoid displacement of sock and to ensure its integrity.

Stenciled pipe shall be installed so the wording is parallel to the centerline and on top of the pipe.

(B) The Agency will need to maintain adequate records, install locating devices, conduct surveys, etc. to be capable of locating all below-ground reclaimed water mains as required by Arizona Revised Statutes 40-360. The means for locating the mains shall be at the discretion of the Agency. When locating tape is used, the tape shall be installed with the printed side up, directly above the pipe, parallel to the centerline, and buried 24 inches below the finished surface grade. The backfill shall be sufficiently leveled so that the tape is installed on a flat surface. Care shall be exercised to avoid displacement of the tape and to ensure its integrity.

In lieu of locating tape, a locating wire can be fastened by plastic adhesive tape to the top center of the pipe. The adhesive tape shall be banded around both the pipe and wire at no more than 4 foot intervals. The wire shall be continuous for the entire length of the pipe, without gaps, breaks, etc. The wire shall terminate above ground in a valve riser housing.

616.4.2 Above-Ground Pipe: All above ground pipe shall be identified by stenciling or decals in conformance to this section.

Stenciled pipe shall be installed so that the wording runs along both sides of the pipe.

Identification decals shall be placed on both sides of the pipe at intervals no greater than 3 feet. Surfaces shall be prepared to ensure proper adhesion of the decals.

616.4.3 Valves and Risers: Valve handles shall be affixed with tags in accordance with this section. Tags shall be securely fastened in a manner that ensures their visibility.

SECTION 616

Riser pipes shall be painted purple both inside and out from the top of the pipe to at least one foot below the finished grade.

Debris caps shall be required in all valve housings per Detail 392 and shall be colored purple and affixed with tags in accordance with this section. Tags shall be securely fastened in a manner that ensures their visibility.

616.4.4 Valve and Manhole Covers: Valve and manhole covers shall be stamped with the words or shall have raised lettering with the words "RECLAIMED WATER". Reclaimed water valve covers shall be of a shape that is not interchangeable with potable water valve covers.

-End of Section -

SECTION 618

STORM DRAIN CONSTRUCTION

618.1 DESCRIPTION:

This section covers pipe line construction used for the conveyance of irrigation water and storm drainage in streets, easements, and alley right of ways, under low hydrostatic heads.

Installation of pipe in laterals of Salt River Valley Water Users' Association or other irrigation districts shall conform to the specifications and permit of the respective irrigation district.

Installation of pipe in State Highways shall conform to the specifications and permit of the Arizona Department of Transportation.

Installation of pipe under railways shall conform to the specifications and permit of the respective railway agency.

618.2 MATERIALS:

Pipe used for storm drain construction, including specials, joints, and gaskets, shall be according to the following Sections, or as modified by special provisions.

- Cast-in-Place Concrete Pipe (CIPP), see Section [620](#).
- Reinforced Concrete Pipe (RCP), see Section [735](#). For permitted construction reinforced concrete pipe strength shall be equal to or higher than Class III, A-III, HE-III, or VE-III.
- Non-Reinforced Concrete Pipe, see Section [736](#).
- High Density Polyethylene (HDPE), see Section [738](#).
- Steel Reinforced Polyethylene (SRPE) Pipe, see Section [739](#).
- Polypropylene Pipe, see Section [740](#).
- Corrugated Metal Pipe, see Section [760](#).

The size, type, and minimum strength of pipe shall be as shown on the plans, or as specified. Pipe stronger than that specified may be furnished at the Contractor's option and at no additional cost to the Contracting Agency.

When specified in the special provisions pipe line layout drawings shall be furnished to the Engineer prior to the manufacture of the concrete pipe. Catch basin connector pipe need not be included in the pipe line layout; however, special prefabricated pipe connections to the main line shall be included. In lieu of including catch basin connector pipe in the pipe layout, a list of catch basin connector pipes shall accompany the layout. The connector pipe list shall contain the following information.

(A) Size and Class of pipe.

(B) Station at which pipe joins main line.

(C) Number of section of pipe, length of section, type of sections (straight, horizontal bevel, vertical bevel, etc.).

The pipe layouts will be used by the Contracting Agency for reference only, but their use shall in no way relieve the Contractor of the responsibility for the correctness of the layout.

618.3 CONSTRUCTION METHODS:

Trench excavation, backfilling, and compaction shall be accomplished in accordance with Section [601](#), except as specified below, or as modified by special provisions.

The laying of the pipe shall be in finished trenches free from water or debris, and shall be commenced at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden off-sets of the flow line. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

SECTION 618

Trenchless installation of pipe shall be in accordance with Section 602 or Section 607.

Variation from prescribed alignment and grade shall not exceed 0.10 foot and the rate of departure from or return to established grade or alignment shall be no more than 1 inch in 10 feet of pipe line unless otherwise approved by the Engineer. For closures and deflection angles greater than 10 degrees, joints shall be made by use of a bend, specially manufactured fitting, or by a concrete collar, per standard details.

618.4 POST INSTALLATION INSPECTION AND TESTING:

Post installation inspection and testing shall be in accordance with Section 611.4.

618.5 MEASUREMENT:

(A) Main Line Pipe: Shall be the number of linear feet of pipe laid as measured along the pipe axis.

Unless hereinafter modified, measurement shall extend through manholes when no change in pipe size occurs. When a change in pipe size occurs within a manhole, unless hereinafter modified, measurement for each size will be taken to the centerline of the manhole.

(B) Connecting Pipe: Shall be the number of linear feet of pipe installed, as measured along the pipe axis from a main line pipe, or a manhole, or a catch basin to a catch basin, or a plugged end, and shall include the portions of the connecting pipe embedded in the above structures.

618.6 PAYMENT:

(A) Main Line Pipe: Will be paid at the contract unit price per linear foot, to the nearest foot, for each size and type of pipe and shall be compensation in full for furnishing and installing the type of pipe as specified and as shown on the plans including removal of obstructions, excavation, bedding, backfilling, compacting, testing, joint materials, joining, collars, and field closures.

(B) Connecting Pipe: Will be paid at the contract unit price per linear foot, to the nearest foot for each type and size of pipe and shall be compensation in full for furnishing and installing complete in place as shown on the plans and as specified, the connecting pipe and specials including spur connections, removal of obstructions, excavation, bedding, backfilling, compacting, joint materials, joining, collars, field closures, and testing.

End of Section

SECTION 620

CAST-IN-PLACE CONCRETE PIPE

620.1 GENERAL:

This specification covers cast-in-place non-reinforced concrete pipe intended for use as storm sewers or irrigation lines. The abbreviated title is CIPP. CIPP is conduit made of Portland cement concrete cast monolithically in a properly prepared trench, using equipment specifically designed for this purpose. The type of equipment to be used by the Contractor must be approved by the Engineer and the Contractor may be required to furnish evidence of the successful use of this equipment on prior work. CIPP will be placed only:

- (A) By experienced operators. The Engineer will be the sole judge as to experience level.
- (B) In the presence of the Engineer.
- (C) In ground capable of standing unsupported from the bottom of the trench to the top of the pipe without sloughing.
- (D) In fill when it can be demonstrated to the satisfaction of the Engineer that the fill will adequately support the pipe.

620.2 MATERIALS:

620.2.1 Cement shall be ASTM [C150](#), Type II, and low alkali as per Section [725](#).

620.2.2 Sand aggregate used for concrete and mortar shall conform to Section [725.3](#). Maximum size of the aggregate shall not be greater than $\frac{1}{3}$ of the minimum wall thickness up to and including a wall thickness of 4 $\frac{1}{2}$ inches. The maximum aggregate size is 1 $\frac{1}{2}$ inches.

620.2.3 Water used for concrete and for curing the pipe shall be as per Section [725](#).

620.2.4 Concrete shall be Class A in accordance with Section [725](#). Slump shall be the minimum required for satisfactory placement of the concrete by the equipment used by the Contractor. The slump shall not exceed 3 inches.

620.2.5 Bonding mortar shall consist of two (2) or more parts of cement to three (3) parts of sand by volume.

620.3 CONSTRUCTION METHODS:

620.3.1 Excavation: The trench will be neatly excavated with vertical sides and semi-circular bottom. The trench shall be shaped to form the bottom outside of the pipe on the alignment and to the grades specified in the plans. Departure from and return to established grade shall not exceed 1 inch per 10 linear feet with a maximum allowable departure of 1 $\frac{1}{2}$ inches. Departure from and return to specified alignment shall not exceed 2 inches per 10 linear feet with a maximum allowable alignment departure of 4 inches. The bottom of the trench, hereinafter known as the trench form, will be shaped to provide full, firm, and uniform support by undisturbed earth or compacted fill for at least the bottom 210 degrees of the pipe. Density of the fill shall be at least five percent (5%) greater than the natural in-place soil, but in no case less than 85 percent (85%) when tested in accordance with AASHTO T-99, Method A and T-191 or ASTM [D6938](#).

When it is necessary to install the pipe in rocky areas, the rock will be removed and replaced with suitable fill material compacted to proper density. The rock will be over-excavated to leave 6 inches minimum compacted soil cushion between the rock and the pipe. For construction accuracy, areas left void by rock removal will be completely filled with compacted material, then trenched for the pipe as though natural ground. If the rock below the pipe subgrade is fractured or fragmented or if it consists of large cobblestones or boulders, the replacement fill material will be carefully selected to insure that it is of such gradation that it will not be removed downward by fluctuation of the water table. In no case will expansive soils be used for fill. A similar procedure of over-excavation, backfill, compaction, and retrenching will be used where sloughing sand or where soft or spongy soil conditions are encountered. When expansive clays are encountered, they will be thoroughly moistened by ponding, to completely expand the soil, and the moisture maintained until the concrete is placed.

Where the pipe is to be constructed through fill materials, such fill shall have stability in the zone of the trench form equal to firm undisturbed earth, in the area adjacent to the fill.

Upon direction of the Engineer, the Contractor shall substitute RCP or an acceptable alternate at locations where the conditions are unsuitable for CIPP. All cost for this substitution shall be borne by the Contractor.

SECTION 620

620.3.2 Placement: At the time of concrete placement, all soil in the trench will be adequately moistened so that water is not drawn from the freshly placed concrete. However, the trench form will be completely free of water, mud, and debris. All forming devices, including the slipforms and hopper of the placement device, shall be thoroughly moistened.

Concrete shall not be placed when temperature of the concrete exceeds 90 degrees Fahrenheit or is less than 50 degrees Fahrenheit. The soil adjacent to the trench shall be at a temperature above freezing.

The pipe shall be constructed in one placement, the entire cross-section being placed monolithically. Inside forms shall be sufficiently rigid to withstand consolidation of the fresh concrete. Placement shall be such as to produce a thoroughly consolidated homogeneous concrete mixture conforming to the test requirements of this specification. Effective consolidation means shall be applied to the fresh concrete over the entire circumference and from within the pipe shell. Consolidation means shall be capable of effectively placing and consolidating fresh concrete at production speeds. Methods of consolidating shall be capable of building up sufficient pressure to effectively bond the concrete to the surrounding earth and to keep loose sand, mud, and water out of the pipe shell.

(A) Construction Joints:

When work is stopped at the end of a placement or for any period that would permit initial set to take place, a construction joint shall be formed. The ends of the pipe that are to be in butt contact shall be left in rough condition with a slope of approximately 45 degrees. Before resuming, if the pipe diameter is 60 inches or less, an excavation shall be made along the sides and bottom of the joint to permit casting of a concrete collar around the outside of the joint. This collar shall have a minimum thickness of 1 1/4 times the wall thickness of the pipe and shall lap the entire joint by at least two (2) times the wall thickness. Immediately before resuming concrete placement the surfaces to be bonded shall be cleaned of all laitance, coatings, foreign materials, and loose or defective concrete, thoroughly wetted and coated with a layer of bonding mortar (Subsection [620.2.5](#)) approximately 1/4 inch thick. In lieu of the bonding mortar, neat cement paste may be thoroughly scrubbed onto the wet surface of the previously placed concrete.

For a joint that may be used for connections to another pipe or structure, a joint shall be made by squaring off the end of the pipe. An excavation shall be made along the sides and bottom of the cast-in-place pipe, for any diameter, to permit casting of a concrete collar as described above.

The outside top of all joints shall be capped for the entire width of the pipe that is exposed, that is, between the earth walls of the excavated trench. This cap shall have a minimum thickness equal to the wall thickness of the pipe and shall lap the joint, both upstream and downstream from the joint by at least twice the wall thickness of the pipe. A cap as described is required regardless of pipe size.

(B) Pipe Dimensions and Tolerances:

- (1) The internal diameter of the pipe at any point shall not be less than 95 percent of the nominal diameter, and the average of any four (4) measurements of the internal diameter made at 45 degree intervals shall not be less than the nominal diameter.
- (2) For pipe less than 15 inches inside diameter, the minimum wall thickness shall be 2 inches. For pipe with an inside diameter of 15 inches to 24 inches the minimum wall thickness shall be 2 1/2 inches. For pipe exceeding 24 inches inside diameter, the minimum wall thickness shall be 1/12 of the inside diameter, plus 1/2 inch.
- (3) Offsets at form laps and horizontal edges shall not exceed 1/2 inch for pipe having inside diameter not greater than 42 inches; 3/4 inch for pipe having inside diameter greater than 42 inches, but not greater than 72 inches; and 1 inch for pipe having inside diameter greater than 72 inches.

620.3.3 Curing and Backfilling: The Contractor shall be responsible for proper curing of the concrete and backfilling the trench to an even grade. Final backfill and compaction shall not be started until concrete has developed a compressive strength of at least 2,000 psi. Curing shall be performed in such a manner as to prevent the premature drying of the concrete. The Contractor shall use one of the four methods described below.

(A) A 3 inch layer of moist loose soil or sand shall be carefully placed over the top of the pipe immediately after the pipe is cast. The backfill shall be material free of clods and rocks having a diameter greater than 2 inches and any other deleterious foreign materials. The backfill shall be carefully placed over the top of the pipe to prevent damage to the wet concrete. The thickness of

SECTION 620

the backfill shall be increased by 9 inches after initial set of the concrete has occurred. The backfill shall be kept moist at all times until the pipe has been covered to a depth of 12 inches or more

(B) The exposed top portion of the pipe may be covered with wet burlap or other material of high moisture retentive properties immediately after the pipe is cast. The covering material shall be kept continuously moist until the placement of final backfill as described above. Moisture retentive material may be removed or left in place at the option of the Contractor.

(C) A pigmented membrane-curing compound conforming to ASTM [C309](#) may be applied to the exposed surface immediately after the pipe is cast. The compound shall be applied at the rate of not less than one (1) gallon for each 150 square of exposed concrete. The pipe shall then be covered with a minimum of 3 inches of moist loose soil when the curing compound is sufficiently hard to resist damage from the fill. Final backfill shall be placed when the pipe attains suitable strength.

(D) Polyethylene film complying with ASTM [C171](#), nominal thickness 0.0015 inches may be placed on the exposed top surface of the pipe immediately after the pipe is cast. The film shall be anchored in place with loose soil to assure continuous, adequate curing. The trench shall be completely backfilled as soon as the pipe attains suitable strength.

A humid atmosphere within the pipe, as evidenced by condensation on the interior surface, shall be maintained for at least seven (7) days following placement, except for a maximum period of 48-hours allowed for removing forms and making repairs. To prevent air drafts which may dry the pipe and to maintain a humid atmosphere inside the pipe, all openings into the pipe line shall be kept closed or covered, except when and where work is actually in progress on the inside of the pipe. If necessary to promote high humidity, the pipe line will be partially filled with ponded water during the curing period.

620.3.4 Repair: Care shall be taken when removing the forms that the pipe is not damaged. Immediately after the removal of the forms, the inside of the pipe shall be inspected and all required repairs made before final backfilling begins. All spalls, cracks or indentations not satisfying Subsection [620.3.2](#)(A) shall be filled with mortar per Subsection [620.2.5](#). Cracks may be repaired with epoxy materials.

Longitudinal cracks exceeding 0.01 inches in width and 12 inches in length shall be cause for rejection of the pipe. The pipe section or reach in question shall either be removed or replaced or shall be repaired in a manner approved by the Engineer.

620.3.5 Finish: Except for the form offsets the interior surface of the pipe shall be equivalent to or better than a wood float finish. All extraneous concrete shall be removed from the interior surface.

620.4 METHODS OF TESTS:

Wall thickness shall be checked at the top, sides and bottom, every 100 feet. Where thickness is not determined by probes through the fresh concrete, small holes shall be drilled a day or so after placement. The holes shall be properly and permanently closed and sealed, flush with the inside surface of the pipe, after measurements are made.

Test cylinders shall be prepared and tested as per Section [725](#). If the cylinder tests indicate that the concrete does not meet the specified strength requirements, cores shall be taken from the same section of concrete represented by the faulty test cylinder under the supervision of the Engineer. The concrete should be at least 14 days old before the core specimens are taken. The diameter of the core specimens for the determination of compressive strength should be at least three (3) times the maximum nominal size of the coarse aggregate used and must be at least twice the maximum nominal size of coarse aggregate.

The length of the specimen, when capped, should be twice the core diameter. A core having a maximum height of less than 95 percent of its diameter before capping or a height less than its diameter after capping shall not be tested.

If cores are taken, the Contractor shall patch all core holes in such a manner that the patch will be permanent, will not leak, and will have a smooth interior finish flush with the interior surface of the pipe.

Procedures and payment for coring shall be in accordance with applicable portions of Section [725](#).

The Engineer will evaluate the test results and his decision as to required corrective action will be final.

SECTION 620

620.5 MEASUREMENT:

Measurement of cast-in-place concrete pipe will be the number of linear feet of pipe measured horizontally along the pipe axis from end to end of the pipe. At changes in diameter, the measurement shall be to center of manhole or transition.

620.6 PAYMENT:

Payment will be made at the contract unit price bid per linear foot to the nearest foot for each size of pipe and shall be compensation in full for furnishing and installing the cast-in-place concrete pipe as specified, including removal of obstructions, excavation, backfilling, compacting, testing, and all incidental costs not specifically covered in other items in the proposal.

- End of Section -

SECTION 621

CORRUGATED METAL PIPE AND ARCHES

621.1 DESCRIPTION:

These specifications cover plain galvanized, bituminous coated, and bituminous coated and paved galvanized corrugated metal pipe for use in storm sewers. The pipe shall be of the types, constructed as specified, and shall be manufactured in accordance with the requirements of the stated specifications. Except as otherwise required, corrugated metal pipe shall conform to AASHTO M-36 for Type I, Type IA, II and Type IIA. The external coating and internal lining shall be in accordance with AASHTO M-190 and Section [760](#).

621.2 MATERIALS:

The types of pipe and fabrication shall be in accordance with Section [760](#).

All helically-wound corrugated metal pipe shall have a marking system which shall provide a quick external visual check of diameter variations during and after the manufacturing process.

621.3 INSTALLATION:

Excavation, bedding and backfill shall be in accordance with Section [601](#), except as modified by standard details.

No pipe shall be laid except in the presence of an inspector. Each pipe shall be carefully inspected immediately before it is laid and defective pipe will be rejected. Pipe lines shall be laid to the grades and alignment indicated on the drawings. Variation from prescribed grade and alignment shall not exceed 0.10 foot, and the rate of departure from, or return to established grade or alignment shall be no more than 1 inch in 10 feet, unless otherwise approved by the Engineer. Proper facilities shall be provided for lowering sections of pipe into trenches. All pipes, elliptical or round, as well as pipe arches requiring external coating or internal lining shall be equipped with lifting lugs as required and shall have connecting bands designed to provide positive connection without damaging the coating on the pipe or pipe arch.

All field repairs to the bituminous coating or paving shall be made with approved fiber reinforced bituminous mastic.

Corrugated metal pipe and/or pipe arches shall be laid with separate section joined together in such a manner that the joint space shall not exceed ½ inch, with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the side. Elliptical pipe shall be installed so that the major or minor axis, whichever the case may be, and which should be indicated by suitable markings on the top of each end of the pipe sections, coincides with the survey alignment of the trench excavation. Any metal in the joints which is not thoroughly protected shall be coated with bituminous mastic. During the installation, the pipe shall be handled with care so as not to damage the external coating or internal lining. Coupling band bolts and damaged areas of the coupling bands and pipe shall be given a coating of bituminous mastic as specified above prior to placing the backfill. As determined by the Engineer, pipe that is damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced at no additional cost to the Contracting Agency.

621.3.1 Joints: Before the connecting band is placed around the pipe, the ends of the pipe that will be beneath the band, shall be coated with bituminous mastic or, if of suitable design, fitted with circular rubber gaskets to provide a watertight joint. The band shall be tightened evenly, keeping equal tension on the bolts. If mastic is used, tension shall be maintained over an interval of time until the flow of mastic terminates. The joint shall remain uncovered over a period designated by the Engineer, and before covering the joint the nuts shall be tested for tightness. If the nut has a tendency to loosen its grip on the bolt, it shall be tightened again and remain uncovered until a tight, permanent joint can be obtained. Prior to backfilling around the joint, the bolts, lugs, and nuts shall be given a coating of bituminous mastic. The annular space between abutting pipe sections shall be filled with bituminous mastic after jointing.

621.3.2 Pipe Elongation: Except as otherwise specified, the standard details shall control as to conditions under which pipe must be elongated. Pipe shall be elongated $5 \pm \frac{1}{2}$ percent of the nominal diameter to take advantage of the buildup of side support as it settles back toward a full round shape under the backfill load. The method or technique for obtaining and releasing the elongation shall be optional to the Contractor. Under no circumstances shall the vertical diameter of the pipe at any point along the pipe section, after backfill and compaction is completed, be less than the nominal diameter of the pipe, or more than 5 percent greater than the nominal diameter of the pipe as shown on the plans or specified elsewhere in this specification. Any

SECTION 621

damage done as a result of strutting shall be repaired as directed by the Engineer at no additional cost to the Contracting Agency. Strutting of pipe shall be approved by the Engineer.

621.3.3 Cutting: The Contractor will be prohibited from using conventional welding torches in cutting full lined CMP due to fire hazard. Pipe will either be sawcut or cut with special cutting tools which will not expose the pipe to the fire hazard of a normal acetylene torch. Whenever possible, connections shall be shop fabricated to prevent any exposure to fire hazard.

621.3.4 Repair of Damage to Coatings: Corrugated metal pipe shall be carefully handled at all times to prevent damage to the external coating, spelter coating, or internal lining. Each length of pipe shall be carefully inspected immediately prior to placing in the trench to ascertain that no damage has been done to the exterior coating that will be concealed when the pipe is placed. Any damage to the spelter coating shall be repaired to the satisfaction of the Engineer in accordance with Section [771](#). Any damage to the external coating or internal lining shall be repaired to the satisfaction of the Engineer with bituminous mastic as specified above.

621.4 TEST SPECIMENS:

All tests on the bituminous coating shall be made on samples secured from pipe delivered to or about to be delivered to the Contractor, or from the coating and lining facility of the pipe fabricator at the time the pipe is being coated.

Compliance with these specifications as set forth, shall be the responsibility of the Contractor. Three certified copies of test results indicating compliance shall be furnished for each lot or shipment prior to delivery of the material to the Contractor.

621.5 MEASUREMENT:

Measurement of corrugated metal pipe will be the number of linear feet of pipe, measured horizontally, from end to end of the pipe through manholes and specials. At changes in diameter the measurement will be to center of manhole or special.

621.6 PAYMENT:

Payment will be made at the contract unit price bid per linear foot, to the nearest foot, for each size and type of pipe and shall be compensation in full for furnishing and installing the corrugated metal pipe as specified, including removal of obstructions, excavation, backfilling, compacting, testing, and all incidental costs not specifically covered in other items in the proposal.

- End of Section -

SECTION 625

MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS

625.1 DESCRIPTION:

625.1.1 Manholes: Construction shall consist of furnishing all materials and constructing manholes complete in place, as detailed, including foundation walls, manhole frames, covers, and any incidentals thereto, at locations shown on the plans.

625.1.2 Sanitary Drop Sewer Connections: Construction shall consist of furnishing all materials and constructing drop sewer connections complete in place as detailed, including foundation materials, pipe, and any incidentals thereto, at locations shown on the plans.

625.2 MATERIALS:

Unless otherwise shown on the plans or specified in the special provisions, materials to be used shall conform with the following:

If allowed by the contracting agency, brick may be used for maintenance and adjustment of the existing sanitary sewer manhole or ring and cover. For the use of bricks in manholes see Section [775](#).

Cement mortar for manholes Class D, per Section [776](#).

Concrete for cast in place sanitary sewer manhole bases shall be Class A, for drop sewer connection shall be Class C, per Section [725](#).

Pipe used in sanitary sewer manholes or drop sewer connections shall comply with pipe requirements of Section [615](#).

Manhole frame and cover per Section [787](#) and cast in accordance with standard details.

Manhole steps shall not be used.

625.3 CONSTRUCTION METHODS:

625.3.1 Manholes: Manholes shall be constructed of precast concrete sections, or cast in place concrete. The invert channels shall be smooth and semi-circular in shape, conforming to the inside of the adjacent sewer sections. Changes in direction of flow shall be made with a smooth curve, having a consistent radius as large as the manhole will permit with no angle points. Changes in size and grade of the channels shall be made gradually, evenly, and uniformly throughout the manhole base.

Invert channels may be formed of concrete, half tile laid in concrete, or be constructed by laying full section of sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. The bench of the manhole outside the channels shall be smoothed and shall slope towards the channels.

The excavation shall be in such a manor, access is maintained around the manhole base before, during, and after placement of the manhole.

For cast-in-place manhole bases, a foundation of Class A concrete shall be constructed in accordance with the standard details and Section [505](#).

No brickwork shall be laid in water, nor, except as prescribed for curing, shall water be allowed to stand or run on any brickwork until the mortar has thoroughly set. Where new work is joined to existing unfinished work, the contact surfaces of the latter shall be thoroughly cleaned and moistened.

SECTION 625

Bricks shall be thoroughly moistened prior to placing, and shall be laid in full cement mortar beds. Every course may be a header course, but at least every fourth course shall be a header course. The horizontal cross-section of the manhole shall be circular unless otherwise called for on the plans or standard details. An oval or egg-shaped section will not be permitted. The brick manholes shall be mortared outside with ½ inch of cement mortar as shown. Inside of the brick wall shall be neatly pointed. The mortar coat shall be cured with a liquid membrane-forming compound conforming with Section [726](#) immediately after mortar has been placed and finished.

All machined surfaces on the frame and cover shall be such that the cover will lie flat in any position in the frame and have a uniform bearing through its entire circumference. Any frame and cover which creates any noise when passed over by automobiles shall be replaced. Frames shall be set firmly in a bed of mortar true to line and grade, all as shown on the plans and as called for in these specifications.

Backfilling shall be done in accordance with the requirements for trench backfilling as stated in Section [206](#).

625.3.2 Sanitary Sewer Drop Connections: Drop sewer connections shall be constructed in conformance with standard details.

Backfilling shall be done in accordance with the requirements for trench backfilling as stated in Section 206.

625.4 MEASUREMENT:

Each type of manhole installed, shall be measured as a complete unit, no distinction shall be made based on manhole depth.

625.5 PAYMENT:

Payment will be made at the contract unit price for each accepted manhole, and shall be compensation in full for furnishing and installing the manhole, complete in place, with formed or pre-cast inverts, concrete foundation, sanitary sewer drop connections sheeting and bracing, removal of obstructions cast iron frame and cover, excavation and backfill, paving cut replacement in excess of the applicable pay widths authorized in Section [336](#), and any incidentals thereto, in conformance with the plans and specifications.

- End of Section -

SECTION 630

TAPPING SLEEVES, VALVES AND VALVE BOXES ON WATER LINES

630.1 DESCRIPTION:

The installation of all tapping sleeves, valves and valve boxes shall conform to this specification and standard details, except as otherwise required on the plans or as modified in the special provisions.

630.2 GENERAL:

For valves 12 inches and smaller, the Contractor shall furnish the manufacturer's standard data and catalogues for gate valves, tapping valves, tapping sleeves, curb stop valves, butterfly valves and any castings.

For valves larger than 12 inches, the Contractor shall furnish shop drawings and technical data required for evaluating and approval of each type of valve, tapping sleeve and valve and butterfly valve. This information shall include complete details, dimensions, weights, diameter of stems, alloy for all valve parts, and any information that may be required to assemble, install, operate and maintain the valve.

The name of the manufacturer, the year of manufacture, the size of the valve, model number and rated working pressure, shall be cast on the body of each valve.

The Contracting Agency may test 10 percent of each type and size of valve furnished. Failure of any of the valves tested to meet these specifications shall be deemed sufficient cause to reject the entire lot delivered.

The internal working parts of valves of the same make, type, and size, shall be interchangeable.

630.3 GATE VALVES:

630.3.1 General: All valves shall conform to the latest revisions of AWWA standards supplemented as follows:

Valves shall be of the non-rising stem type and shall be counter-clockwise opening (left-hand).

The valve may be furnished with valve stems made from 300 or 400 series stainless steel.

Unless otherwise noted, valves shall have a 2 inch square operating nut.

All valves shall be class 150 or higher as necessary to withstand the requirements of the pressure and leakage test.

Bronze for all interior parts of valves shall contain no more than 6 percent zinc if made from cast bronze, or must conform to Copper Development Association #67600 if made from bar stock material.

All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with two coats of asphaltic varnish conforming to Federal Specifications TT-V-51c, or shall be epoxy coated as required above for interior surfaces.

By-pass valves, valves attached to side outlets and valves in blow-off lines shall be flanged.

Valves in air release and vacuum relief lines shall be flanged or screwed as shown on the plans.

Valves in fire hydrant lines shall have a flanged joint end on the side towards the main and a restraint or mechanical joint end on the side towards the hydrant.

SECTION 630

Valves larger than 20 inches shall have flanged ends, unless otherwise noted.

Valves 20 inches and smaller may be furnished with flanged ends, mechanical joint ends, or push-on joint ends compatible with the type of pipe used, unless otherwise noted.

630.3.2 Supplements Specifically Relating to Valve Sizes:

(A) Valves smaller than 3 inches:

Valves shall be threaded, all bronze, standard double disc, non-rising stem with wheel handles or brass ball style.

Service Material containing Brass or Bronze must comply with the current NSF 61-8 Standards at the time the Project begins.

All Brass or Bronze service material must meet the current AWWA C-800 Standards.

(B) Valves 3 inches through 12 inches:

Valves shall be iron body resilient-seated gate valves in accordance with the latest revision of AWWA C-509 or AWWA C-515.

The valve shall be designed to work equally well with pressure on either side of the gate.

The valve shall be equipped with o-ring packing.

(C) Valves. 14 inches through 20 inches:

Valves shall be iron body resilient-seated gate valves in accordance with the latest revision of AWWA C-509 or AWWA C-515, or shall be double-disc gate in accordance with AWWA C-500.

Valves designed in accordance with AWWA C-509 shall be designed to work equally well with pressure on either side of the gate

Valves designed in accordance with AWWA C-500 shall be equipped with bronze tracks, rollers and scrapers. The bolts, nuts, studs, etc., used with the gear case shall conform the requirements for Bonnet Bolting in AWWA C-500.

Valves shall be for operation in a horizontal position. The valve shall have bevel gears. The gears and stuffing box shall be enclosed in a watertight iron case, for operation in a buried location. The case shall be filled with grease at the factory.

By-pass valves shall be furnished and installed on each valve unless otherwise indicated on the approved plans. See Table [630-1](#) for by-pass valve sizes.

(D) Valves 24 inches and larger:

Valves shall be double-disc gate in accordance with AWWA C-500.

Valves shall be for operation in the horizontal position and equipped with bronze tracks, rollers and scrapers. Valves shall have bevel gears. The gears and stuffing box shall be enclosed in a watertight iron case, for operation in a buried location. Bolts, nuts, studs, etc., used with the gear case shall conform to the requirements for Bonnet Bolting in AWWA C-500. The case shall be filled with grease to the factory.

By-pass valves shall be furnished and installed on each valve unless otherwise indicated on the approved plans. See Table [630-1](#) for by-pass valve sizes.

630.4 TAPPING SLEEVES AND VALVES:

630.4.1 Tapping Valves: Tapping valves shall be identical in construction with the above specifications for gate valves. Tapping sleeves are considered an integral part of a tapping sleeve and valve assembly, with openings the same as the valve. Tapping valves shall have ends and seat rings of sufficient size to permit the use of full size cutters of either the Mueller or

SECTION 630

Smith type tapping machines. Tapping sleeve valves shall be flanged on one end to fit the tapping sleeve and a flange hub-end or mechanical joint on the other.

The tapping valve shall have the discs and seat ring so constructed that the inside diameter of the rings shall be at least 3/16 inch larger than the nominal size of the valve. The seat rings shall be bronze and shall have a minimum seating surface area equal to that of a standard gate valve, and the discs shall be proportionately larger to match.

Once the tap has been completed, the Contractor shall not operate the valve unless under direct supervision of the inspector.

TABLE 630-1	
BY-PASS VALVE SIZES	
Gate Valve Diameter in Inches	By-Pass Valve Diameter in Inches
16 to 20	3
24 to 30	4
36 to 42	6
48	8

630.4.2 Tapping Sleeves: Tapping sleeves shall be of extra heavy construction to provide resistance to line pressures. They shall be built in two halves for assembly around the main to be tapped.

The branch outlet shall have a flanged face for bolting to the tapping valve.

The inside diameter of the outlet branch shall be sufficiently larger than the nominal size to provide clearance for the full size cutters of the tapping machine.

Tapping sleeves shall be of the following types:

(A) Tapping sleeves for pipelines constructed of cast iron, ductile iron or asbestos cement:

Unless otherwise noted, the tapping sleeve assembly shall be pressure tested to 200 psi for a minimum of 30 minutes. The pressure test shall occur prior to tapping the main.

(1) Tapping sleeves in which the water is allowed to circulate between the sleeve and the outside surface shall comply to the following:

Gaskets of approved material shall be provided to form watertight joints along the entire length of the sleeve. The circumferential joints at the ends of the run of these sleeves shall be sealed by mechanical joints. Mechanical joints shall conform to the requirements set forth in AWWA C-111 as to dimensions, clearance, materials, etc. except the gaskets and glands for mechanical joints shall be in two pieces.

The longitudinal gaskets shall be totally confined or compressed between ridges and/or grooves extending continuously for the full length of both halves of the sleeve casting. Bolts shall be located close to the outside of the gaskets and closely spaced so as to exert sufficient pressure to form a watertight joint and to amply take care of any design stresses.

(2) Tapping sleeves in which the water is confined to the immediate area of the tap opening may be either of the following:

(a) Cast Iron - The outlet half of each sleeve shall be fitted with a continuous gasket of approximately circular cross-section permanently cemented into a groove surrounding the outlet opening. The back half of each sleeve shall be fitted with elastomeric pads, a metal shoe, or other device for developing adequate pressure on the gasket to prevent leakage at any pressure within the design capacity of the pipe. The sleeve shall be similar in construction to the Kennedy Square Seal or Rich-Corey improved sleeve.

(b) Stainless Steel, Type 304 - All integral metal parts of the sleeve shall be stainless steel, type 304. All welds shall be chemically treated and the residue removed so as to return the welded stainless steel to its original corrosion resistant state. The sleeve shall be capable of withstanding 125 ft.-lbs. of bolting torque without deformation of any

SECTION 630

sleeve components. Actual bolting torque during installation shall be as specified by the manufacturer.

All gaskets shall be of virgin styrene butadiene rubber (SBR), or equal, compound for water services. The complete circle gasket shall be 0.25 inch ± 0.03 thick and permanently attached to the sleeve. A dielectric insulating flange insulation kit shall be installed between the stainless steel flange and the cast iron valve. The kit shall contain full faced gaskets, full length sleeves, and single insulating washers. Insulation gasket material shall be neoprene-faced phenolic, insulation sleeves shall be mylar or minlon and full length, insulation washers shall be phenolic, or approved equal. All insulation material shall be of a type designated by the manufacturer as suitable for service at the operation temperatures and pressure specified.

(B) Tapping sleeves for concrete pressure pipes shall be fabricated tapping sleeves and comply to the following:

The sleeves shall be installed in accordance with AWWA Manual M-9. They shall also meet AWWA C-301, and AWWA C-303 standards pertaining to design, manufacturing, testing and welder qualifications. When tapping AWWA C-301 pipe, additional considerations pertaining to installation, testing and tapping shall be noted in the special provision and/or the plans.

The tapping sleeve assembly shall be designed to meet or exceed the pressure rating of the pipe using the same safety factors.

The tapping sleeve assembly shall be pressure tested to at least 5 percent over the actual working pressure in the pipeline. The main shall be pressurized to full working pressure during the test of the sleeve. The test shall occur prior to tapping of the main.

The sleeve shall be a three part design, back half, front half with draw flange and a gland as shown in Detail 342. The sleeve shall be designed to permit the cutting of the rods or prestressing wires of the pipe after installation of the two sleeve halves. The gland shall have a sealing gasket set in a retaining groove on the pressure plate. The sealing portion of the gasket shall be square or rectangular in shape and have minimum dimensions of 1/2 inch x 1/2 inch. The pressure plate on the gland shall be stabilized to eliminate flexing. The gland shall be equipped with load bearing set screws to protect the pipe cylinder from any excess loading caused by the valve, tapping machine, etc. The annular space between the sleeve and the gland shall be grouted through an opening in the sleeve.

Both halves of the sleeve shall be the same thickness and width. With approval from the Engineer, stainless steel strapped back sleeves will be permitted when the outside pipe diameter is irregular and cannot accommodate a full back sleeve.

The sleeves shall be furnished with grout horns/openings through which the annular space between the outside pipe surface and the sleeve shall be grouted.

All interior and exterior ferrous surfaces shall be epoxy coated to a minimum dry film thickness of 12 mils. Epoxy coating shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550 for use in a potable water system.

All bolts shall be 304 stainless steel.

No weld-on sleeves or nozzles will be permitted.

Tapping sleeves shall be JCM #415 Type 2 ESS or approved equal.

All external surfaces of the tapping sleeve shall be covered with a minimum of two inches of mortar. The mortar shall be Type "M" per Section [776](#) using Type II low alkali cement. The mortar shall be held in place by use of wire mesh.

The Contractor shall obtain the necessary dimensions for ordering the sleeve from direct field measurements. Excavation may be required to obtain the measurements. If an excavation is required, the Engineer may require the Contractor to return the land to its original use until the materials are delivered.

The contractor shall provide, for approval of the Engineer, the manufacture, shop drawings, calculations, and any other technical data as required by the Engineer for the tapping sleeve. Also, the contractor shall submit the manufacture history of

SECTION 630

6 successful production of the sleeves over the last year. The submittal shall include but not limited to the number, size, location, agency and contact person, etc.

The Contractor shall also provide, for approval by the Engineer, the name of the company/contractor/subcontractor to install the sleeve and perform the tap. The submittal shall include a history of 5 successful sleeve installations and taps per year over the last 3 years. The submittal shall include but not limited to the sizes and locations of the taps, the agencies and contact persons, the addresses and telephone numbers, etc.

630.4.3 Tapping and Associated Fees: Except for meter service connections, taps shall be made by the Agency at prevailing rates or by approved Contractors when allowed or requested by the Contracting Agency. After installation of the tapping sleeve and valve, the Contractor shall provide an excavation sufficient in size to accommodate the tapping operation.

The Contractor shall pay the established shutdown charge to the Contracting Agency every time it is necessary to shut off valves and take a section of a water main out of services.

The above charges, as well as charges for tap connections to steel cylinder and reinforced concrete pipe, are subject to change, as established by the Contracting Agency.

630.5 BUTTERFLY VALVES:

(A) 16 inches and larger:

Valves shall be in accordance with AWWA C-504 latest revision as modified herein:

- (1) Valve body shall be of cast iron or ductile iron with connecting ends one of or a combination of Flanged (Short Body), mechanical joint or ACP Hub End.
- (2) Valves shall be Class 150-B unless otherwise specified.
- (3) When requested the manufacturer shall furnish records of tests specified in AWWA C-504.
- (4) Shaft seal may be O-ring seal, V-type packing or pull down packing.
- (5) The valve disc may be either cast iron or ductile iron.
- (6) Valves and operators shall be for direct burial installation.
- (7) Valves to be furnished with manual operators and 2 inch square operating nut. Operator torque rating shall be calculated in accordance with AWWA C-504.
- (8) Valves shall open when turning the operating nut counter-clockwise.
- (9) Valves shall be installed with valve shaft in a horizontal position and the operating shaft vertical.
- (10) All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.
- (11) All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with two coats of asphaltic varnish conforming to Federal Specification TT-V-51c, or shall be epoxy coated as required above for interior surfaces.
- (12) A manufacturer's affidavit of compliance shall be furnished.
- (13) Shop drawings shall be furnished.

SECTION 630

(B) 3 inches through 12 inches:

This specification generally describes valves and operator assemblies designed for underground service, as manufactured by Dresser Industries, B-I-F Industries Incorporated, Henry Pratt Company, Allis Chalmers Manufacturing Company, or approved equal.

Where material or equipment is designated on the plans or in this specification by a trade or manufacturer's name, it is so designated primarily to establish standards of quality, finish, appearance and performance.

All specific requirements of this specification must be adhered to, and all necessary modifications shall be made in the article specified by the trade name, type or model or manufacturer's equipment to make it conform to all specific requirements of this specification.

The valves shall be in accordance with AWWA C-504, Class 150-B, except as modified herein:

- (1) Valve ends may be the thin type or wafer type to be installed between flanges drilled in conformance with ASA B 16.1-125 or may be flanged both ends or the valves may have bell ends with rubber gaskets, forecast iron pipe or asbestos cement pipe conforming to the kind of pipe being used.
- (2) Valves shall be designed for buried service with the valve shaft in a horizontal position and the operating shaft vertical.
- (3) Valves shall be left-hand opening, counter-clockwise unless shown otherwise on the plans.
- (4) Discs shall be Ni-Resist, ASTM [A436](#), Type 1, or cast iron, ASTM [A48](#), Class 40, in accordance with the following variations:
 - (a) Cast iron disc may be used providing the rubber seat ring is contained on the disc with the rubber ring closing against a Type 304 stainless steel ring or a bronze ring contained in the body of the valve.
 - (b) Ni-Resist disc may be used where rubber seat is contained in the valve body.
 - (c) Valves with rubber seats in the valve body may have cast iron discs with a Type 304 stainless steel or bronze edge seating surface retained on the edge of the disc.

Shafts and disc shaft fasteners shall be constructed of Type 304, stainless steel, unless the shaft is completely sealed from the line fluid. Valve shafts completely sealed from the line fluid may be of high strength steel with all other metal parts in contact with the line fluid to be Type 304 stainless steel.

Valves with rubber seat mounted in the body shall have the rubber either bonded or mechanically retained in its final position. Rubber seats which are on the disc edge shall be retained by a clamping ring and screws. Clamping ring and screws shall be made of 18-8 stainless steel, Type 304, or bronze conforming to ASTM [B61](#) or ASTM [B584](#).

Manual operators shall have AWWA 2 inch square operating nuts and shall require at least 2 turns per inch diameter to rotate the disc 90 degrees. Operators must accept a minimum of 300 ft. lbs. input torque on stops at ends of travel without damage to valve or operator. The operator torque rating shall equal, or exceed, the valves shown in Table I of AWWA C-504 for valve class specified above.

All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils.

Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions.

The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements AWWA C550-81, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with 2 coats of asphaltic varnish conforming to Federal Specification TT-V-51c, or shall be epoxy coated as required above for interior surfaces.

SECTION 630

630.6 AIR RELEASE AND VACUUM VALVES

Valve assemblies shall be furnished and installed where shown and as detailed on the drawings.

(A) Air release on water mains shall be controlled by the use of an air release valve assembly, of size and type as shown on the plans. Air release valves shall be of the flanged or screwed type as designated on the Agency's approved products list or in the special provisions.

(B) Vacuum and Air Relief when called for on the plans shall be controlled by a vacuum relief valve on the air release valve noted above. The valves shall be of the same manufacture or may be a combination air and vacuum valve assembly designated on the Agency's approved products list or in the special provisions.

630.7 CONSTRUCTION METHODS:

All valves, their supports, manholes, vaults, and valve boxes shall be installed in accordance with Section [610](#).

Valves 16 inches and larger, before being shipped from the factory, shall have the flanged ends completely covered with plywood. Plywood shall be left on the valve until just before installation in the line.

630.8 MEASUREMENT:

Measurement will be by the unit each of the various kinds and sizes of valves, manholes, vaults, or tapping sleeves and valves, including valve boxes and covers.

630.9 PAYMENT:

Payment will be made at the contract unit price and shall be compensation in full for the complete installation in place including all labor, materials, equipment, and all incidentals necessary to complete the installation. The compensation will also include the cost of necessary pavement replacement in excess of the pay widths allowed in Section [336](#) for pavement replacement over pipe trenches.

- End of Section -

SECTION 631

WATER TAPS AND METER SERVICE CONNECTIONS

631.1 DESCRIPTION:

This specification covers work by Contractors installing water services in new subdivisions by Permit and in projects under Contract. All the materials used shall comply with applicable standard specifications and the work performed in accordance with these specifications and standard details. The service connections shall be complete and all material shall be furnished by the Contractor except for the water meter.

All water service connections shall be constructed of Type K copper tubing or ultra high molecular weight polyethylene pipe of nominal iron pipe outside diameter.

All new subdivision water lines shall be staked for line and grade at 100 foot intervals by the Developer's Engineer prior to construction. All meter locations shall be staked by setting two stakes for line and marking one of the stakes for grade.

631.2 MATERIALS:

Copper pipe, tubing and fittings shall conform with Section [754](#). Polyethylene pipe shall conform with Section [755](#).

All fittings, pipe and tubing for polyethylene and copper pipe shall be as noted on standard details and as indicated in Section [610.3](#) Materials.

631.3 INSTALLATIONS:

631.3.1 General: Installation of copper tubing for meter service connections shall be in accordance with Section [754](#).

Meter service connection with copper tubing shall be in accordance with standard details.

The water service connection shall include the tap on the main, the corporation stop, the saddle if applicable, service pipe, appurtenant fittings, the curb stop, meter box and meter box cover, in accordance with standard details. Water meter boxes shall be installed in accordance with standard details to line and grade set by the Developer's Engineer. Upon acceptance, the Developer shall be responsible for damage to water meter boxes and covers until such time as the meters are installed by the Contracting Agency.

After the installation and acceptance of the water main and meter service pipe connections the water meter will be installed by the Contracting Agency upon proper application and payment of prevailing fees.

631.3.2 Standards: Except as otherwise specified all work shall be done in accordance with Sections [601](#) and [610](#).

631.3.3 Excavation and Backfill: The backfilling and compaction may be done as soon as the service line is installed, except backfilling and compaction shall not be completed around the corporation stop at the main water line until after inspection and recording of all tap locations. Trench bottom must be smooth and free of sharp objects. The minimum width of trench for water service pipe shall be 3 inches. The minimum depth of service pipe shall be 30 inches below the finished paving grade.

631.3.4 Polyethylene Pipe: Polyethylene pipe shall not be kinked, gouged or damaged during installation and backfilling operations. The pipe shall be placed in the trench allowing at least 12 inches per 100 feet for thermal contraction and expansion. Polyethylene pipe has a high thermal expansion and should never be confined under tension. The pipe should not be stored in the sun or left in the trench under abnormal high temperature. The pipe shall be carefully snaked in the trench bottom and covered up with uniform slack throughout its length. In trenches less than 8 inches in width, the expansion shall be obtained by making the tap on the opposite side of the main from the water meter and providing a loop of slack service pipe back over the top of the water main. Before installing, inspect pipe to detect any damage that may be caused by shipping, storage or handling. Damage spots can be cut out and pipe recoupled with Ford C-66-33, C-66-44, or approved equal brass compression fitting to form a continuous length. Damaged pipe shall not be used. Polyethylene pipe shall be cut only with a tubing cutter with rollers properly designated for the size of pipe being cut. When polyethylene pipe is used, the meter box setting must be placed parallel to the back of the sidewalk in accordance with standard details. Polyethylene pipe shall be installed with large sweeping bends

SECTION 631

with radius of not less than 18 inches. Polyethylene pipe has a cold flow characteristic and must not be installed under a stressed condition. Compression fittings only may be used with the plastic being held securely between metal to metal. Stainless steel or brass inserts shall be placed in the proper position in each compression fitting with care taken to assure that the insert remains in place when the fitting is tightened. All meter service lines shall extend at right angles from the main to the curb lines.

631.3.5 Service Taps: One inch and 3/4 inch service taps to new meter mains may be made with a saddle, tapped coupling or direct tap in accordance with the following provisions:

The Developer may use heavy tapped couplings for meter service connections on all sizes of pipe including the 3 inch pipe in cul-de-sac streets. Bronze corporation stops must be installed in the tapped couplings prior to pressure testing or disinfection of the water main. Normally in subdivisions no saddles are required for 6 inch pipe and larger. At the Contractor's option, saddles may be used on all 6 inch pipe and larger. All service connections on major and collector streets shall be made with saddles or heavy duty tapped couplings regardless of the water main size or service pipe size. All taps on pipe smaller than 6 inches must be made by either a saddle or heavy tapped coupling with bronze insert. Direct taps must be made by the use of a corporation stop with tapered AWWA machine thread. All wet taps must be made by the Mueller Type B-100 tapping machine or approved equal. A sharp tapping bit must be used in order to obtain clean sharp threads. In general, each tapping tool should be resharpened or discarded after making 6 taps. The minimum distance between taps, saddles, and tapped couplings shall be 3 feet.

631.4 TESTING:

All services, service taps and fittings shall be tested along with the water main in accordance with Subsection [610.14](#).

631.5 CLEANUP AND COMPLETION:

Upon completion and acceptance of all phases of the water main and meter service lines the Developer shall release the new subdivision water system to the Contracting Agency for final operation and maintenance with all interior valves and corporation stops in open position and with all meter curb stops and valves at the connections to existing mains closed.

631.6 INSPECTION:

The Developer's Engineer shall make an as-built plan and make a record of the locations of all water service connections prior to the connections being covered up. This as-built plan shall give the stationing of each service tap. The stationing to be continuous for each street, and shall begin at the street intersection or property line at the end of the block.

631.7 SERVICE OVER 2 INCHES:

All service taps larger than 2 inches shall be made by the Agency after an application and payment of prevailing fees, unless otherwise required by the Agency.

631.8 SERVICE ON EXISTING MAINS:

Where all or part of a new subdivision is served by existing water mains, only authorized personnel of the Contracting Agency shall install the service connections upon proper application and payment of prevailing fees.

- *End of Section* -

PART 700
MATERIALS

Section	Last Revised	Title	Page
701	2013	<u>Aggregate</u>	701-1
702	2013	<u>Base Materials</u>	702-1
703	2012	<u>Riprap</u>	703-1
705	2012	<u>Portland Cement Treated Base</u>	705-1
708	2011	<u>Asphalt Pavement Core Bonding Materials</u>	708-1
710	2016	<u>Asphalt Concrete</u>	710-1
711	2014	<u>Paving Asphalt</u>	711-1
712	1999	<u>Liquid Asphalt</u>	712-1
713	2012	<u>Emulsified Asphalts Materials</u>	713-1
714	2012	<u>Microsurfacing Materials</u>	714-1
715	2012	<u>Slurry Seal Materials</u>	715-1
716	2012	<u>Cover Material</u>	716-1
717	2016	<u>Asphalt-Rubber Asphalt Concrete</u>	717-1
718	2016	<u>Preservative Seal for Asphalt Concrete</u>	718-1
725	2014	<u>Portland Cement Concrete</u>	725-1
726	2015	<u>Concrete Curing Materials</u>	726-1
727	2008	<u>Steel Reinforcement</u>	727-1
728	2013	<u>Controlled Low Strength Material</u>	728-1
729	2014	<u>Expansion Joint Filler</u>	729-1
735	2016	<u>Reinforced Concrete Pipe</u>	735-1
736	2012	<u>Non-reinforced Concrete Pipe</u>	736-1
738	2012	<u>High Density Polyethylene Pipe and Fittings for Storm Drain and Sanitary Sewer</u>	738-1
739	2015	<u>Steel Reinforced Polyethylene Pipe & Fittings for Storm Drain, Irrigation & Sanitary Sewer</u>	739-1
740	2014	<u>Polypropylene Pipe & Fittings for Storm Drain, Irrigation & Sanitary Sewer</u>	740-1
741	2011	<u>Lining for Reinforced Concrete Sanitary Sewer Pipe</u>	741-1
742	2015	<u>Precast Manhole</u>	742-1
743	1998	<u>Vitrified Clay Pipe</u>	743-1
745	1998	<u>PVC Sewer Pipe and Fittings</u>	745-1
750	2015	<u>Iron Water Pipe and Fittings</u>	750-1
752	1998	<u>Asbestos-Cement Water Pipe and Fittings</u>	752-1
753	2000	<u>Galvanized Pipe and Fittings</u>	753-1
754	2012	<u>Copper Pipe, Tubing and Fittings</u>	754-1

Section	Last Revised	Title	Page
755	2012	Polyethylene Pipe for Water Distribution	755-1
756	2008	Dry Barrel/Fire Hydrants	756-1
757	1998	Sprinkler Irrigation System	757-1
758	2005	Concrete Pressure Pipe - Steel Cylinder Type	758-1
759	2002	Steel Pipe	759-1
760	1998	Coating Corrugated Metal Pipe and Arches	760-1
761	1998	Structural Plate Pipe, Arches, and Pipe Arches	761-1
770	2013	Structural and Rivet Steel, Rivets, Bolts, Pins, and Anchor Bolts	770-1
771	2016	Galvanizing	771-1
772	2016	Chain Link Fence	772-1
775	2015	Brick and Concrete Masonry Units (Blocks)	775-1
776	2012	Masonry Mortar and Grout	776-1
778	1998	Lumber	778-1
779	1998	Wood Preservatives	779-1
787	1999	Gray Iron Castings	787-1
790	1999	Paint	790-1
792	2010	Dust Palliative	792-1
795	2014	Landscape Material	795-1
796	2010	Geosynthetics	796-1

SECTION 701

AGGREGATE

701.1 GENERAL:

Coarse and fine aggregates are defined in accordance with ASTM [D2487](#). Material property requirements for specific uses are provided in applicable MAG sections.

Apparent specific gravity shall be at least 2.50, when tested in accordance with ASTM [C127](#).

701.2 COARSE AGGREGATE:

Rock and gravel shall be clean, hard, sound, durable, uniform in quality, and free of any detrimental quantity of soft, friable, thin elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance. Aggregate sources shall include, but not be limited to alluvial deposits, terrace aggregates, quarry stone, or other suitable sources including recycled products that meet all material test requirements as approved by the Engineer. Aggregate classification shall be made by size as noted herein.

701.2.1 Boulders: Particles of rock that will not pass a 12-inch square opening.

701.2.2 Cobbles: Particles of rock that will pass a 12-inch square opening, but are retained on a 3-inch square opening.

701.2.3 Coarse Gravel: Particles of rock that will pass a 3-inch U.S. standard sieve, but are retained on a 3/4-inch U.S. standard sieve.

701.2.4 Fine Gravel: Particles of rock that will pass a 3/4-inch U.S. standard sieve, but are retained on a No. 4 U.S. standard sieve

701.3 FINE AGGREGATE (SAND):

Fine aggregate (sand) shall be fine granular material produced by the crushing of rock or gravel or naturally produced by disintegration of rock and shall be sufficiently free of organic material, mica, loam, clay, and other deleterious substances to be thoroughly suitable for the purpose for which it is intended. Fine aggregates particles shall pass a No. 4 U.S. standard sieve, but are retained on a No. 200 U.S. standard sieve.

701.4 RECLAIMED CONCRETE MATERIAL (RCM)

Reclaimed concrete material (RCM) is defined as an aggregate material that is derived from the crushing, processing and classification of Portland cement concrete construction materials recovered, salvaged, or recycled from roadways, sidewalks, buildings, bridges, and other sources.

In accordance with Section 7 of AASHTO M319, RCM shall not contain more than five percent by mass of brick or concrete block and shall be substantially free of wood, metal, plaster, and gypsum board. RCM shall be free of all materials that fall under the category of solid waste or hazardous materials as defined by the state or local jurisdiction. With the approval of the Engineer, these respective quantities may be adjusted if the performance of the RCM is not adversely impacted. RCM may be used alone or uniformly blended with other approved aggregate materials to obtain the applicable performance criteria. RCM shall not be used in Portland Cement Concrete without the prior approval of the Engineer.

701.5 RECLAIMED ASPHALT PAVEMENT (RAP):

Reclaimed asphalt pavement (RAP) is defined as all recovered, salvaged or recycled asphalt road waste, large particles or milled material that has been size-reduced, crushed and or screened appropriately, making it reusable. This material shall be of a consistent and relatively clean manner as to not adversely affect the final material usage. RAP may be used alone or uniformly blended with other approved aggregate materials to obtain the applicable performance criteria. RAP shall not be used in Portland Cement Concrete without the prior approval of the Engineer.

SECTION 701

701.6 SAMPLING:

Sampling of aggregates shall be performed in accordance with ASTM [D75](#).

- End of Section -

SECTION 702

BASE MATERIALS

702.1 GENERAL:

Base materials shall be as defined in Section [701](#), consisting of appropriately sized coarse and fine aggregates, Reclaimed Concrete Material (RCM) or Reclaimed Asphalt Pavement (RAP), other inert materials, and/or aggregates that have been treated for plasticity index mitigation, as approved by the Engineer. These materials, whether virgin or reclaimed or a uniform blend of both, shall conform to the end result quality requirements of this section.

When base material without further qualification is specified, the Contractor shall supply materials that meet the gradation and other quality requirements for Aggregate Base Course as defined in Table [702-1](#). When a particular classification of base material is specified, the Contractor may substitute materials meeting the gradation and other quality requirements for Aggregate Base Course for Select material, when approved by the Engineer.

The Contractor shall provide the Engineer laboratory testing documentation on the source of the base material showing compliance to Table [702-1](#) at least 10 business days prior to placement except where the base materials are being obtained from a currently approved source from a list maintained by the appropriate Agency or as determined by the Engineer. Included in the documentation shall be the percentage of RCM or RAP, if applicable.

RCM meeting the requirements of Section [701.4](#) can be utilized in base material at a maximum quantity of 50% and may be used in roadway applications or where otherwise specified by project plans or special provisions.

RAP meeting the requirements of Section [701.5](#) can be utilized in base material up to 100% and may be used in roadway applications or where otherwise specified by Project plans or special provisions.

702.1.1 Aggregate Base Course is primarily used in roadway applications or where otherwise specified by project plans or special provisions.

702.1.2 Select Material is primarily used, as a sub base in roadways, fill and embankment applications or where otherwise specified by project special provisions.

702.2 PHYSICAL PROPERTIES:

702.2.1 Base material shall meet the physical properties listed in Table [702-1](#).

SECTION 702

Table 702-1			
Sieve Analysis			
Test Methods AASHTO T-27, T-11			
Sieve Size	Accumulative Percentage Passing Sieve, by Weight		
	Select Material		Aggregate Base Course
	Type A	Type B	
3 in.	100	--	--
1-1/2 in.	--	100	100
1 in.	--	--	90 – 100
No. 4	30 - 75	30 - 70	38 - 65
No. 8	20 - 60	20 - 60	25 – 60
No. 30	10 - 40	10 - 40	10 – 40
No. 200	0 - 12	0 - 12	3 – 12
Plasticity Index			
Test Methods AASHTO T-89 Method A, T-90, T146 Method A			
Maximum allowable value	5	5	5
Fractured Face, One Face			
Test Method ARIZ 212, Percent by Weight of the Material Retained on a #4 Sieve			
Minimum required value	50	50	50
Resistance to Degradation and Abrasion by the Los Angeles Abrasion Machine			
Test Method AASHTO T-96, Percent Loss by Weight			
Maximum allowable value at 100 revolutions	10	10	10
Maximum allowable value at 500 revolutions	40	40	40

702.2.2: When tested for acceptance, Base material that does not meet Table [702-1](#) properties for gradation or PI may be approved at the Engineer's discretion if the R-Value is at least 70, when determined by test method AASHTO T-190 (see Table [310-1](#)).

- End of Section -

SECTION 703

RIPRAP

703.1 GENERAL:

Aggregate for grouted and ungrouted riprap shall meet the requirements of Sections [701.2](#) and [703.2](#) unless otherwise stated in the project specifications.

Aggregate shall be color-matched with adjacent landscape aggregate if specified on the plans or in the special provisions.

The Contractor shall provide the Engineer, in writing, material information and the source location at least 10 days prior to use of the material unless the material is currently acceptable for use as determined by the Engineer.

703.2 PHYSICAL PROPERTIES:

Riprap shall have the following physical properties:

(A) The maximum aggregate size shall be 150% of the indicated D_{50} size and the minimum aggregate size shall be 50% of the indicated D_{50} size.

(B) Aggregate shall be angular and shall not exceed 3:1 ratio for flat and/or elongated pieces when determined by ASTM [D4791](#). Rounded aggregate shall only be allowed when specified or approved by the Engineer.

(C) The loss by abrasion in the Los Angeles Abrasion Machine, determined as prescribed in ASTM [C535](#), shall not exceed 40 percent (by weight) after 1000 revolutions.

- End of Section -

SECTION 705

PORTLAND CEMENT TREATED BASE:

705.1 GENERAL:

The cement treated base shall consist of aggregate, cement, and water. Use of other types of materials must be approved by the Engineer. The compressive strength requirement shall be determined by the project specifications. The amount of cement used in the mix design shall be determined by the project specifications.

705.2 AGGREGATE FOR CEMENT TREATED BASE:

The aggregate for cement treated base shall conform to the requirements of Section [702.2](#) Aggregate Base Course.

705.3 PORTLAND CEMENT AND WATER:

Portland cement and water shall conform to the requirements of Section [725](#).

705.4 CEMENT TREATED BASE MIX DESIGN:

A cement-treated base mix design incorporating the proposed materials shall be completed prior to the start of work. The mix design shall be performed in accordance with Arizona Department of Transportation test methods ARIZ-220, ARIZ-221, and ARIZ-222. Compressive strength specimens shall be tested in accordance with ARIZ-241.

The final report shall include the following elements:

- (1) The source and supplier of the aggregate including gradation and plasticity index testing.
- (2) The source, supplier, and type of cement.
- (3) The cement content required to meet the project specifications. Cement content shall be calculated by the dry weight of the combined aggregate-cement mixture.
- (4) The optimum moisture and maximum dry density of the proposed blend at the target cement content as determined by ARIZ-221.
- (5) The rock corrected optimum moisture and maximum dry density of the proposed blend at the target cement content as determined by ARIZ-222.
- (6) A summary of design compressive strength testing including a graph plotting cement content as the x-axis and compressive strength as the y-axis.

- End of Section -

SECTION 708

ASPHALT PAVEMENT CORE BONDING MATERIALS

708.1 GENERAL:

This specification covers the materials required to bond asphalt pavement cores to the asphalt concrete pavement from which it was originally removed.

708.2 MATERIALS:

Bonding material shall be a single component cementitious, rapid hardening, high strength, waterproof bonding agent conforming to the physical properties shown in Table [708-1](#).

TABLE 708-1		
Bond Material Properties		
Property	ASTM Test Method	Requirements
Bond Strength, psi	C882	20 min.
Compressive Strength, psi, (70 degrees F., 30 minute cure)	C109	200 min.

Bonding material shall be impervious to water penetration at the joint after curing.

Bonding material shall, within 30 minutes at minimum ambient temperature of 70 degrees F., allow an 18" diameter core to support a traffic load equivalent to at least three (3) times the AASHTO H-25 standard wheel load.

The bonding material is required to securely bond the asphalt concrete core to asphalt concrete pavement and to fill all voids between the core and pavement and within the core.

708.3 TEST REPORT:

Specifications and test results for the bonding material shall be submitted to the Agency for review and approval before use.

- End of Section -

SECTION 710

ASPHALT CONCRETE

710.1 GENERAL:

Asphalt concrete shall be a mixture of asphalt cement and mineral aggregates. Mineral admixture shall be included in the mixture when required by the mix design or by the Engineer. Asphalt concrete shall be produced in accordance with Section [321](#).

The designation for asphalt concrete mixes shall be based on the nominal maximum aggregate size of the mix. The applicable mix designations are 3/8 inch, 1/2 inch, 3/4 inch and Base (1") mix.

Each mix shall be designed using Marshall or Gyratory compaction methods. Either Gyratory or Marshall Mixes may be used for low or high traffic conditions, as determined by the agency. Low traffic conditions are conditions where the asphalt mix will be subject to low volume and low weight vehicle usage. Examples of this condition are residential streets, most parking lots and residential minor collector streets. High traffic conditions are conditions where the asphalt mix will be subject to high volume and/or heavy weight vehicle usage as found on major collector, arterial and commercial streets. Street classifications (i.e. minor collector and major collector) shall be determined by the specifying agency.

The following table (Table [710-1](#)) displays the recommended lift thickness for various asphalt concrete mix designations found within Section [710](#). Please note that these recommended lift thicknesses are minimums based on each mix designation's "Nominal Aggregate Size" and the relative coarseness of its gradation. The compacted thickness of layers placed shall not exceed 150% of the Minimum Lift Thickness of Table [710-1](#) except as otherwise provided in the plans and specifications, or if approved in writing by the Engineer.

TABLE 710-1		
RECOMMENDED MINIMUM LIFT THICKNESS FOR ASPHALT CONCRETE MIXES		
Asphalt Concrete Mix Designation (inches)	Minimum Lift Thickness Marshall Mixes	Minimum Lift Thickness Gyratory Mixes
3/8"	1.0 inches	1.5 inches
1/2"	1.5 inches	2.0 inches
3/4"	2.5 inches	3.0 inches
Base	3.0 inches	n/a

710.2 MATERIAL:

710.2.1 Asphalt Binder: The asphalt binder specified in this section has been developed for use in desert climate conditions. When used in other climates, consideration should be given to adjustments in the asphalt binder selection. The asphalt binder shall be Performance Grade Asphalt conforming to the requirements of Section [711](#) for PG 70-10, unless otherwise approved by the Engineer or specified differently in the plans or special provisions.

710.2.2 Aggregate: Coarse and Fine aggregates shall conform to the applicable requirements of this section. Coarse mineral aggregate shall consist of crushed gravel, crushed rock, or other approved inert material with similar characteristics, or a combination thereof, conforming to the requirements of these specifications.

Coarse aggregate for hot mix asphalt is material retained on or above the No. 4 sieve and Fine aggregate is material passing the No. 4 sieve. Aggregates shall be relatively free of deleterious materials, clay balls, and adhering films or other material that prevent coating with the asphalt binder. Coarse and Fine aggregates shall conform to the following requirements when tested in accordance with the applicable test methods.

SECTION 710

TABLE 710-2			
COARSE/FINE AGGREGATE REQUIREMENTS			
Characteristics	Test Method	Low Traffic	High Traffic
Fractured Faces, % (Coarse Aggregate Only)	Arizona 212	75, 1 or more	85, 1 or more 80, 2 or more
Uncompacted Voids, % Min.	AASHTO T-304, Method A	42	45
Flat & Elongated Pieces, % 5:1 Ratio	ASTM D4791	10.0 Max.	10.0 Max.
Sand Equivalent, %	AASHTO T-176	50 Min.	50 Min.
Plasticity Index	AASHTO T-90	Non-plastic	Non-plastic
L.A. Abrasion, % Loss	AASHTO T-96	9 max. @ 100 Rev. 40 max. @ 500 Rev.	9 max. @ 100 Rev. 40 max. @ 500 Rev.
Combined Bulk Specific Gravity	AI MS-2/SP-2	2.35 – 2.85	2.35 – 2.85
Combined Water Absorption	AI MS-2/SP-2	0 – 2.5%	0 – 2.5%

Tests on aggregates used in asphalt concrete outlined above, shall be performed on materials furnished for mix design purposes and composited to the mix design gradation.

Blend sand (naturally occurring or crushed fines) shall be clean, hard and sound material which will readily accept asphalt binder coating. The blend sand grading shall be such that, when it is mixed with the other mineral aggregates, the combined product shall meet the requirements of Table [710-2](#).

The natural sand shall not exceed 20 percent for the Marshall mixes and 15 percent for the Gyratory mixes by weight of the total aggregate for a mix.

710.2.3 Reclaimed Asphalt Pavement (RAP): When allowed by the Engineer, Reclaimed Asphalt Pavement (RAP), as defined in Section [701.5](#), may be used in asphalt concrete provided all requirements of Section [710](#) are met. References to use of RAP in Section [710](#) apply only if RAP is used as part of the mixture.

When RAP is used in asphalt concrete, it shall be of a consistent gradation, asphalt content, and properties. When RAP is fed into the plant, the maximum RAP particle size shall not exceed 1 1/2 in. The percentage of asphalt in the RAP shall be established in the mix design. The percentage of RAP binder shall be established in the mix design.

When RAP is used in base and intermediate courses, the amount of RAP aggregate and RAP binder should not exceed 30% contribution; Surface courses should be limited to 20% RAP aggregate and RAP binder contribution.

In addition to the requirements of Section [710.3.1](#), the job mix formula shall indicate the percent of asphalt RAP and the percent and performance grade of virgin (added) asphalt binder.

When less than or equal to 15% RAP binder is used by weight of total binder in the mix, the added virgin binder shall meet the requirements for PG 70-10 as shown in Section [711](#). When greater than 15% RAP is used by weight of the total binder in the mix, the added virgin binder will be dropped one grade for low and high temperature properties to a PG 64-16, unless testing indicates that the blend of the recovered RAP binder and virgin binder meets the requirements for PG 70-10 as shown in Section [711](#). The virgin asphalt binder shall not be more than one standard asphalt material grades different than the specified mix design binder grade.

710.2.4 Mineral Admixture: Mineral admixture when used as an anti-stripping agent in asphalt concrete shall conform to the requirements of AASHTO M-17. Mineral admixture used in asphalt concrete shall be dry hydrated lime, conforming to the requirements of ASTM [C1097](#) or Portland cement conforming to ASTM [C150](#) Type II or ASTM [C595](#) Type IP. The amount of hydrated lime or Portland cement used shall be determined by the mix design. The minimum mineral admixture content within a mix will be 1.00 percent, by weight of total aggregate.

SECTION 710

710.3 MIX DESIGN REQUIREMENTS:

710.3.1 General: The mix design for asphalt concrete shall be prepared by a laboratory that is accredited through the AASHTO Accreditation Program (AAP) in Hot Mix Asphalt Aggregates and Hot Mix Asphalt. The laboratory shall be under the direct supervision of a Civil Engineer, registered by the State of Arizona, and who is listed by ADOT as a “Qualified Asphaltic Concrete Mix Design Engineer” within ADOT’s latest list of approved laboratories. The latest list of approved laboratories is available on ADOT’s web page www.azdot.gov. The date of the design shall not be older than one year from the date of submittal, unless supportive documentation is provided and approved by the Engineer.

The mix design report shall include the following elements as a minimum.

- (1) The name and address of the testing organization and the person responsible for the mix design report.
- (2) The mix plant identification and/or location, as well as the supplier or producer name.
- (3) A description of all products that are incorporated in the asphalt concrete along with the sources of all products, including admixtures and asphalt binder, and their method of introduction.
- (4) The supplier and grade of asphalt binder, the source and type of mineral aggregate, and the percentage of asphalt binder and mineral admixture used.
- (5) The percentage of RAP and RAP Binder being contributed to the total mix shall be included in the mix design report.
- (6) The mix design report whether Gyratory or Marshall shall state the traffic condition (low or high traffic) and size designation.
- (7) The results of all testing, determinations, etc., such as: specific gravity and gradation of each component, water absorption, sand equivalent, loss on abrasion, fractured coarse aggregate particles, Tensile Strength Ratio (ASTM [D4867](#)), Marshall stability and flow, asphalt absorption, percent air voids, voids in mineral aggregate, and bulk density. Historical abrasion values may be supplied on existing sources. The submittal should include a plot of the gradation on the Federal Highway Administration’s 0.45 Power Gradation Chart, plots of the compaction curves and the results of moisture sensitivity testing.
- (8) The laboratory mixing and compaction temperature ranges for the supplier and grade of asphalt binder used within the mix design.
- (9) A specific recommendation for design asphalt binder content and any limiting conditions that may be associated with the use of the design, such as minimum percentages of crushed or washed fine aggregate.
- (10) The supplier’s product code, the laboratory Engineer’s seal (signed and dated), and the date the design was performed.
- (11) If a Warm Mix Technology or additive is used; the following shall be included:
 - Technology type and supporting manufacturer information; including instructions pertaining to laboratory mixture temperatures and curing.
 - Amount (%) of additive (technology) used in the mixture.
 - Attached copy of the ADOT approved product list, showing additive/technology
 - Minimum plant production temperature shall not fall below manufacturer’s recommendation.
 - Minimum field compaction temperature shall be identified.
 - Identify any special mixing or compaction temperatures or special methods to be used when conducting Quality Assurance or Quality Control testing of field collected samples. Example: if the field collected samples of warm mix asphalt can be treated as conventional hot asphalt mix, provide the equivalent conventional hot asphalt mix compaction temperature.

SECTION 710

The mix design shall be submitted to the Agency or Engineer by the Contractor/Supplier for which it was developed as part of his project submittals. Once the mix design has been approved by the agency or Engineer, the Contractor and/or his supplier shall not change plants nor use additional mixing plants without prior approval of the Engineer. Any changes in the plant operation, the producer's pit, the asphalt binder, including modifiers in the asphalt binder, or any other item that will cause an adjustment in the mix, shall be justification for a new mix design to be submitted.

710.3.2 Mix Design Criteria: The mix design shall be performed by one of two methods, Marshall Mix Design or Gyratory Mix Design. The method shall be specified on the plans, special provisions, or by the Engineer. A minimum of 4 points will be used to establish the mix design results. The oven aging period for both Marshall and Gyratory mix design samples shall be 2 hours.

710.3.2.1 Marshall Mix Design: The Marshall Mix Design shall be performed in accordance with the requirements of the latest edition of the Asphalt Institute's Manual, MS-2 "Mix Design Methods for Asphalt Concrete." The mix shall use the compactive effort of 75 blows per side of specimen. The mix shall comply with the criteria in Table [710-3](#).

TABLE 710-3					
MARSHALL MIX DESIGN CRITERIA					
Criteria	Requirements				Designated Test Method
	3/8" Mix	1/2" Mix	3/4" Mix	Base Mix	
1. Voids in Mineral Aggregate: %, min	15.0	14.0	13.0	12.0	AI MS-2
2. Effective Voids: %, Range	4.0±0.2	4.0 ±0.2	4.0 ±0.2	4.0 ±0.2	AI MS-2
3. Absorbed asphalt: %, Range*	0-1.0	0-1.0	0-1.0	0-1.0	AI MS-2
4. Dust to Eff. Asphalt Ratio, Range **	0.6-1.4	0.6-1.4	0.6-1.4	0.6-1.4	AI MS-2
5. Tensile Strength Ratio: % Min.	65	65	65	65	ASTM D4867
6. Dry Tensile Strength: psi, Min.	100	100	100	100	ASTM D4867
7. Stability: pounds, Minimum	2,000	2,500	2,500	3,000	AASHTO T-245
8. Flow: 0.01-inch, Range	8-16	8-16	8-16	8-16	AASHTO T-245
9. Mineral Aggregate Grading Limits					AASHTO T-27
	Percent Passing with Admix				
Sieve Size	3/8 inch Mix	1/2 inch Mix	3/4 inch Mix	Base Mix	
1-1/4 inch				100	
1 inch			100	90-100	
3/4 inch		100	90 – 100	85-95	
1/2 inch	100	85 – 100	---	---	
3/8 inch	90-100	62 – 85	62 – 77	57-72	
No. 8	45-60	40 – 50	35 – 47	33-43	
No. 40	10-22	10 – 20	10 – 20	9-18	
No. 200	2.0 – 10.0	2.0 – 10.0	2.0 – 8.0	1.0 – 7.0	

* Unless otherwise approved by the Engineer.

** The ratio of the mix design composite gradation target for the No. 200 sieve, including admixture, to the effective asphalt content shall be within the indicated range.

SECTION 710

710.3.2.2 Gyratory Mix Design: Gyratory Mix Designs shall be performed in accordance with the requirements of latest edition of the Asphalt Institute's SP-2 manual. Mix design laboratory compacted specimens shall be prepared using a gyratory compactor in accordance with AASHTO T-312.

The mix design shall be formulated in a manner described for volumetric mix designs in the current edition of the Asphalt Institute Manual SP-2, except the number of trial blend gradations necessary will be determined by the mix design laboratory. Duplicate gyratory samples shall be prepared at a minimum of four (4) binder contents to select the recommended binder content. The gyratory specimens shall be compacted to 160 gyrations. Volumetric data for the design number of gyrations, N_{des} , and the initial number of gyrations, N_{ini} , are then back calculated based on the bulk specific gravity, G_{mb} , of the N_{max} specimens and the height data generated during the compaction process of those same specimens.

TABLE 710-4		
Number of Gyrations		
	Low Traffic	High Traffic
N_{ini}	7	8
N_{des}	75	100
N_{max}	115	160

For Low traffic designs, volumetric data for 115 gyrations, N_{max} for Low Traffic designs, is also back calculated from the specimens compacted to 160 gyrations.

The corrected density of the specimens shall be less than 89.0 percent of maximum theoretical density at N_{ini} . The corrected density of the specimens shall be less than 98.0 percent of maximum theoretical density at N_{max} . The Gyratory mix shall comply with the criteria in Table [710-5](#).

TABLE 710-5				
GYRATORY MIX DESIGN CRITERIA				
Criteria	Requirements			Designated Test
	3/8" Mix	1/2" Mix	3/4" Mix	Method
1. Voids in Mineral Aggregate: %, Min.	15.0	14.0	13.0	AI SP-2
2. Effective Voids: %, Range	4.0 <input type="checkbox"/> 0	4.0 <input type="checkbox"/> 0	4.0 <input type="checkbox"/> 0	AI SP-2
3. Absorbed Asphalt: %, Range *	0 - 1.0	0 - 1.0	0 - 1.0	AI SP-2
4. Dust to Eff. Asphalt Ratio, Range **	0.6 - 1.4	0.6 - 1.4	0.6 - 1.4	AI SP-2
5. Tensile Strength Ratio: %, Min.	75	75	75	ASTM D4867
6. Dry Tensile Strength: psi, Min.	75	75	75	ASTM D4867
7. Mineral Aggregate Grading Limits				AASHTO T-27
	Percent Passing with Admix			
Sieve Size	3/8 inch Mix	1/2 inch Mix	3/4 inch Mix	
1 inch			100	
3/4 inch		100	90-100	
1/2 inch	100	90-100	43-89	
3/8 inch	90-100	53-89	-	
No. 8	32-47	29-40	24-36	
No. 40	2-24	3-20	3-18	
No. 200	2.0-8.0	2.0-7.5	2.0-6.5	

* Unless otherwise approved by the Engineer.

** The ratio of the mix design composite gradation target for the No. 200 sieve, including admixture, to the effective asphalt content shall be within the indicated range.

SECTION 710

710.3.2.3 Moisture Sensitivity Testing: Moisture sensitivity testing will be performed in accordance with ASTM [D4867](#) for both Marshall and Gyratory mix designs, without the freeze/thaw cycles. The minimum required Tensile Strength Ratio is indicated in the tables above.

- End of Section -

SECTION 711

PAVING ASPHALT

711.1 GENERAL:

The asphalt shall be produced from crude asphalt petroleum or a mixture of refined liquid asphalt and refined solid asphalt. It shall be free from admixture with any residues obtained by the artificial distillation of coal, coal tar, or paraffin oil and shall be homogeneous and free from water.

Polymer modified asphalt cement shall be produced from crude asphalt petroleum and a polymer or blend of polymers mixed to produce a homogeneous material free from water.

Asphalt shall not be heated during the process of its manufacture, storage, or during construction so as to cause injury as evidence by the formation of carbonized particles.

711.2 TESTING REQUIREMENTS:

Paving asphalt shall be classified by the Performance Grading System and shall conform to the requirements set forth in Table 711-1 and AASHTO M-320 with the PAV temperature changes noted in the table. On all Grades Flash Point Temperature AASHTO T48: Minimum 230 °C and Mass Loss, Maximum 1.00 percent.

TABLE 711-1				
PERFORMANCE GRADING SYSTEM				
	PG 58-22	PG 64-16	PG 70-10	PG 76-16
Original Asphalt				
Viscosity, AASHTO T-316 (Note 1) Max. 3 Pa-s, Test Temp, °C	135	135	135	135
Dynamic Shear AASHTO T-315 (Note 2) G*/Sin δ, Min., 1.0 kPa Test Temp. @ 10 rad/s, °C	58	64	70	76
Tests Using Rolling Thin Film Oven Residue (AASHTO T-240)				
Mass Loss, Maximum %	1.0	1.0	1.0	1.0
Dynamic Shear AASHTO T-315 G*/Sin δ, Min., 2.20 kPa Test Temp. @ 10 rad/s, °C	58	64	70	76
Tests Using Pressure Aging Vessel Residue (AASHTO R-28)				
PAV Aging Temperature, °C (AASHTO R-28)	100	100	110	110
Dynamic Shear AASHTO T-315 G*/Sin δ, Max., 5000 kPa Test Temp. @ 10 rad/s, °C	22	28	34	34
Creep Stiffness, AASHTO T-313 (Note 3) S, Maximum, 300.0 Mpa m-value, Minimum, 0.300 Test Temp. @ 60s, °C	-12	-6	0	-6
Direct Tension, AASHTO T-314 (Note 3) Failure Strain, Minimum 1.0% Test Temp. @ 1.0 mm/min. °C	-12	-6	0	-6

NOTES:

(1) This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.

(2) For quality control of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be substituted for dynamic shear measurements of G*/sin (δ) at test temperatures when the asphalt is a

SECTION 711

Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometer (AASHTO T-210 or AASHTO T-202).

(3) If the Creep Stiffness is below 300 MPa, the direct tension test is not required. If the Creep Stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used in lieu of the Creep Stiffness requirement. Direct tension test is recommended for polymer modified asphalt binders. The m-value requirement must be satisfied in all cases.

Polymer modified paving asphalt shall be classified by the Performance Grading System and shall conform to the requirements set forth in Table 711-2 and AASHTO M320 with the PAV temperature changes noted in the table. On all Grades Flash Point Temperature AASHTO T48: Minimum 230 °C and Mass Loss, Maximum 1.00 percent. P is for Polymer and TR is for Tire Rubber.

TABLE 711-2				
PERFORMANCE GRADING SYSTEM				
	PG 64-28P	PG-76-22P	PG76-22TR Type 1 (Note 4)	PG76-22TR Type 2 (Note 4)
Viscosity, AASHTO T-316 (Note 1) Max. 3 Pa-s, Test Temp, °C	135	135	135	135
Dynamic Shear, AASHTO T-315 (Note 2) G*/Sin δ, Min., 1.0 kPa Test Temp. @ 10 rad/s, °C	64	76	76	76
Elastic recovery, ASTM D6084 Procedure "B" @ 10°C	65	65	65	55
Phase Angle, Max	75	75	75	75
Separation test, Texas 540 % Max	4	4	4	4
Solubility in Trichloroethylene, ASTM D2042 or n-propyl bromide, ASTM D7553 % Minimum	–	–	97.5	–
Tests Using Rolling Thin Film Oven Residue (AASHTO T-240)				
Mass Loss, Maximum %	1.0	1.0	1.0	1.0
Dynamic Shear, AASHTO T-315 G*/sin δ, Min., 2.20 kPa Test Temp. @ 10 rad/s, °C	64	76	76	76
Tests Using Pressure Aging Vessel Residue (AASHTO R-28)				
PAV Aging Temperature, °C (AASHTO R-28)	100	110	110	110
Dynamic Shear, AASHTO T-315 G*/sin δ, Max., 5000 kPa Test Temp. @ 10 rad/s, °C	22	31	31	31
Mass Loss, AASHTO T-240 Weight % Max	1.0	1.0	1.0	1.0
Creep Stiffness, AASHTO T-313 S, Maximum, 300 Mpa m-value, Minimum, 0.300 Test Temp. @ 60s, °C	-18	-12	-12	-12
Direct Tension, AASHTO T-314 (Note 3) Failure Strain, Minimum 1.0% Test Temp. @ 1.0 mm/min. °C	-18	-12	-12	-12

SECTION 711

NOTES:

- (1) This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.
- (2) For quality control of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be substituted for dynamic shear measurements of $G^*/\sin \delta$, at test temperatures when the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometer (AASHTO T-210 or AASHTO T-202).
- (3) If the Creep Stiffness is below 300 MPa, the direct tension test is not required. If the Creep Stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used in lieu of the Creep Stiffness requirement. Direct tension test is recommended for polymer modified asphalt binders. The m-value requirement must be satisfied in all cases.
- (4) "TR" binders shall have 9% to 11% reclaimed tire rubber and enough virgin polymer to meet all performance grade criteria specified. The blend percentages shall be listed on the Certificate of Compliance by the manufacturer. Type 1 shall meet solubility limits.

711.3 TEST REPORT AND CERTIFICATION:

At the time of delivery of each shipment of asphalt, the supplier supplying the material shall deliver to the purchaser 3 certified copies of the test report which shall indicate the name of the refinery and supplier, type and grade of asphalt delivered, date and point of delivery, quantity delivered, delivery ticket number, purchase order number, and results of the above specified tests. The test report shall be signed by an authorized representative of the supplier certifying that the product delivered conforms to the specifications for the type and grade indicated.

Until the certified test reports and samples of the material have been checked by the Engineer, that material will be only tentatively accepted by the Contracting Agency. Final acceptance will be dependent upon the determination of the Engineer that the material involved fulfills the requirements prescribed. The certified test reports and the testing required in connection with the reports shall be at no additional cost to the Contracting Agency.

711.4 TEMPERATURES:

Paving asphalt shall be heated in such a manner that steam or hot oils will not be introduced directly into the paving asphalt during heating.

711.5 CONVERSION OF QUANTITIES:

When pay quantities of paving asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM [D1250](#). In converting volume to weight, the computations shall be based on Table [711-3](#).

TABLE 711-3		
ASPHALT CEMENT QUANTITY CONVERSION		
Grade of Material	Gals. Per Ton of 60 °F.	Lbs. Per Gal at 60 °F.
PG 58-22	236	8.47
PG 64-16	235	8.51
PG 70-10	235	8.51
PG 64-28P	236	8.47
PG 76-22P,TR	236	8.47
PG 76-16	233	8.58

- End of Section -

SECTION 712

LIQUID ASPHALT

712.1 GENERAL:

Liquid asphalt shall consist essentially of either natural crude or refined asphalt petroleum, or a residual product thereof.

The liquid asphalt shall be medium curing product designed by the letters MC, and shall consist of a paving asphalt conforming to the provisions in Section [711](#), fluxed or blended with a kerosene type solvent.

The asphalt shall not be heated during the process of its manufacture or during construction so as to cause injury as evidence by the formation of carbonized particles.

712.2 TEST REQUIREMENTS:

The liquid asphalt shall consist of materials specified above and shall conform to the requirements set forth in Table [712-1](#).

712.3 TEST REPORTS AND CERTIFICATIONS:

Test reports and certifications will be furnished in accordance with Section [711](#).

712.4 CONVERSION OF QUANTITIES:

When pay quantities of liquid asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM [D1250](#). In converting volume to weight, the computations shall be based on the data contained in Table [712-2](#).

TABLE 712-1										
AASHTO M-82 TABLE 1										
	MC-30		MC-70		MC-250		MC-800		MC-3000	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Kinematic Viscosity at 60°C (140°F) centistokes	30	60	70	140	250	500	800	1600	3000	6000
Flash point (Tab. open-cup), degrees C° (F)	38 (100)	...	38 (100)	...	66 (150)	...	66 (150)	...	66 (150)	...
Water percent	...	0.2	...	0.2	...	0.2	...	0.2	...	0.2
Distillation test: Distillate percentage by volume of total distillate to 360°C (680°F)										
to 225°C (437°F)	...	25	0	20	0	10
to 260°C (500°F)	40	70	20	60	15	55	0	35	0	15
to 315°C (600°F)	75	93	65	90	60	87	45	80	15	75
Residue from distillation to 360°C (680°F) Volume percentage of sample by difference	50	...	55	...	67	...	75	...	80	...
Tests on residue from distillation:										
Absolute viscosity at 60°C (140°F) poises	300	1200	300	1200	300	1200	300	1200	300	1200
Ductility, 5 cm/min, cm.	100	...	100	...	100	...	100	...	100	...
Solubility in Trichloroethylene, percent	99	...	99	...	99	...	99	...	99	

SECTION 712

TABLE 712-2		
LIQUID ASPHALT QUANTITY CONVERSION		
Grade of Materials	Gals. Per Ton at 60 Degrees F.	Lbs. Per Gals. at 60 Degrees F.
70	253	7.90
250	249	8.03
800	245	8.16
2000	241	8.30

- End of Section -

SECTION 713

EMULSIFIED ASPHALTS MATERIALS

713.1 GENERAL:

Emulsified asphalts shall be composed of a paving asphalt base uniformly emulsified with water and an emulsifying or stabilizing agent. It shall be homogeneous throughout and if stored, shall show no separation of ingredients within 30 days after delivery. Emulsified asphalt shall be classified as quick setting, rapid setting, medium setting or slow setting type in either anionic or cationic emulsions.

Emulsified asphalt shall be specified as follows:

(A) Penetration type and high viscosity type emulsion shall be designated by the letters RS-Rapid Setting.

(B) Mixing type emulsion shall be designated by the letters SS-Slow Setting, MS-Medium Setting and QS-Quick Setting.

713.2 TESTING REQUIREMENTS:

The emulsified asphalt shall conform to the requirements set forth in Table [713-1](#).

713.3 TESTS REPORT AND CERTIFICATION:

Test reports and certifications shall be made in accordance with Section [711](#).

TABLE 713-1														
REQUIREMENTS FOR ANIONIC EMULSIFIED ASPHALT (Specification Designation)														
Type	Rapid-Setting				Medium-Setting						Slow-Setting			
Grade	RS-1		RS-2h		MS-1		MS-2		MS-2h		SS-1		SS-1h	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Tests on emulsions														
Viscosity, Saybolt Furol at 77°F (25°C.), sec	20	100			20	100	100		100		20	100	20	100
Viscosity, Saybolt Furol at 122°F (50°C.), sec			75	400										
Demulsibility, 35 ml. 0.02 N. CaCl ₂ , percent	60		60											
Coating ability and water resistance														
Coating, dry and aggregate					good		good		good					
Coating, after spraying					fair		fair		fair					
Coating, wet aggregate					fair		fair		fair					
Coating, after spraying					fair		fair		fair					
Cement mixing test, percent											2		2	
Sieve test, percent		0.1		0.1		0.1		0.1		0.1		0.1		0.1
Residue by distillation, percent	55		63		55		65		65		57		57	
Tests on Residue from Distillation Test:														
Penetration 77°F (25°C), 100g, 5 s	100	200	40	90	100	200	100	200	40	90	100	200	40	90
Ductility, 77°F (25°C), 5 cm/min. cm.	40		40		40		40		40		40		40	
Solubility in trichloroethylene, %	97.5		97.5		97.5		97.5		97.5		97.5		97.5	

SECTION 713

TABLE 713-1 (continued)									
REQUIREMENTS FOR ANIONIC/CATIONIC EMULSIFIED ASPHALT (Specification Designation)									
Type	Quick Setting		Rapid Setting		Medium Setting		Slow Setting		Quick Setting
Grade	QSH	CQSH	CRS-1	CRS-2h	CMS-2	CMS-2h	CSS-1	CSS-1h	PMCQS-1h
	Min Max	Min Max	Min Max	Min Max	Min Max	Min Max	Min Max	Min Max	Min Max
Tests on emulsions:									
Visc., Saybolt Furol at 77°F., sec.	20 100	20 100					20 100	20 100	20 100
Visc., Saybolt Furol at 122°F., sec			20 100	100 400	50 450	50 450			
Storage Stability Test, 1 day, %	1	1	1	1	1	1	1	1	1
Demulsibility, 35 ml 0.8% sodium dioctyl sulfosuccinate, %			40	40					
Coating ability and water resistance:									
Dry aggregate					Good	Good			
after spraying					Fair	Fair			
wet aggregate					Fair	Fair			
after spraying					Fair	Fair			
Particle charge test		Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Sieve Test, %	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Cement Mixing test, %							2.0	2.0	
Distillation:									
Oil distillate, by volume of emulsion, %			3	3	12	12			
Residue, %	57	57	60	65	65	65	57	57	60
Test on residue from distillation test:									
Penetration, 25°C (77°F), 100 g. 5 sec.	40 110	40 110	100 250	40 90	100 250	40 90	100 250	40 90	55 75
Ductility, 25°C (77°F.) 5 cm per min, cm.	40	40	40	40	40	40	40	40	40
Ring and Ball Softening Point, AASHTO T-53									130
Elastic Recovery, % AASTHO T30									55
Solubility in trichloroethylene, %	98	98	98	98	98	98	97.5	97.5	97.5

* If the Particle Charge Test result is inconclusive for CSS-1 or CSS-1h, material having a maximum ph value of 6.7 will be accepted.

* If using PMCQS-1h the Residue from distillation shall be obtained from ARIZ-504.

SECTION 713

713.4 TEMPERATURES:

Unless otherwise specified, the various grades of emulsified asphalt shall be applied at temperatures within the limits specified in Table [713-2](#) the exact temperature to be determined by the Engineer. Emulsified asphalt shall be reheated if necessary. But at no time, after loading into a tank car or truck for transportation to the work site, shall the temperature of the emulsion be raised above the maximum temperature shown in Table [713-2](#). During all reheating operations, the emulsified asphalt shall be agitated to prevent localized overheating. Emulsified asphalt shall not be permitted to cool to a temperature of less than 40 degrees F.

TABLE 713-2		
APPLICATION TEMPERATURE OF EMULSIFIED ASPHALT		
Grade of Emulsified Asphalt	Minimum °F.	Maximum °F.
RS-1, MS-1, SS-1, SS-1h, CSS-1, CSS-1h	70°F.	140°F.
RS-2, MS-2, MS-2h, CRS-1, PMCQS-1h CRS-1h, CRS-2h, CMS-2, CMS-2h, QSH, CQSH	125°F.	185°F.

Emulsified asphalt shall be heated in such a manner that steam or hot oils will not be introduced directly into the emulsified asphalt during heating.

713.5 CONVERSION OF QUANTITIES:

When pay quantities of emulsified asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM [D1250](#). In converting volume to weight, the computations shall be based on Table [713-3](#).

TABLE 713-3		
EMULSIFIED ASPHALTS QUANTITY CONVERSION		
Grade of Material	Gals Per Ton at 60°F.	Lbs Per Gal. at 60°F.
All grades	240	8.33

- End of Section -

SECTION 714

MICROSURFACING MATERIALS

714.1 GENERAL:

Microsurfacing materials shall consist of a properly proportioned mixture of cationic polymer modified asphalt emulsion, mineral aggregates, mineral filler, water, and other additives.

714.2 AGGREGATE:

714.2.1 Mineral Filler: Mineral filler, as required by the mix design, shall be any recognized brand of non-air-entrained Type I/II normal Portland cement that is free of lumps and clods, with a minimum of 85% passing the #200 sieve, added by weight of aggregate as specified by the mix design.

714.2.2 Mineral Aggregate: Coarse and fine aggregates or approved mineral filler shall be per Section [701](#). Aggregates shall be 100% crushed with no rounded particles. No natural sand will be allowed. The mineral aggregate shall conform to Table [715-1](#) for gradation only. Application rates shall be 18-24 pounds of aggregate/square yard for Type II, and 24-35 pounds/square yard for Type III.

The mineral aggregate and mineral filler shall have a sand equivalency value not less than 50 (ASTM [D2419](#)) and be non-plastic.

If more than one kind of aggregate is used, the correct amount of each kind of aggregate needed to produce the required gradation shall be proportioned separately in a manner that will result in a uniform and homogeneous blend. The final blended aggregate shall meet the above requirements for grading, sand equivalency, and plasticity.

714.3 BITUMINOUS MATERIAL:

The Polymerized Emulsion is a slow-setting, cationic type emulsion for mixing applications and seal coats. A minimum of 4% saturated polymer shall be high sheared into the asphalt prior to the emulsification process. The Agency may choose to sample the polymerized asphalt for testing. The amount of polymer will be based on weight of polymer and asphalt (total weight) and be certified by the supplier. The polymerized emulsion will meet the following specifications listed in Table [714-1](#).

SECTION 714

Table 714-1		
Polymerized Emulsion		
Test	AASHTO Method	Specification Limits
Tests on Emulsion		
Viscosity, SSF, @ 77°F. sec.	T59	15-100
Sieve Test, %	T59	0.30 Maximum
Particle Charge	T59	Positive
Storage Stability, 24 hr. %	T59	1.0 Maximum
Evaporation Residue, %	Arizona 512	60 Minimum
Tests on Evaporation Residue Arizona 504		
Kinematic Viscosity 275°F.cst	T201	650 Minimum
Penetration, 77°F 100g @ 5 sec	T49	40-90
Softening Point, degrees F.	T53	140 Minimum
Ductility, 77%, 5 cm/min.	T51	60 Minimum
Tests on Evaporation Residue after RTFO		
Kinematic Viscosity, 275°F. aging ratio, cst	T201	2.5 Maximum
Softening Point, degrees F.	T53	140 Minimum
The emulsion, upon standing undisturbed for a period of twenty-four (24) hours, shall show no white or milky colored substance on its surface, and shall be a homogeneous brown color throughout.		

714.4 MODIFIER TYPE AND CONTENT:

The modifier shall be saturated. The use of latex type modifier will be allowed only if both the test results and field performance are accepted by the Engineer. The asphalt cement shall contain a minimum of 4% solid polymer by weight of asphalt residue, sheared into the asphalt prior to emulsification. Plant verification by the Agency, and certification of the polymer content and type by the supplier, will be required throughout the duration of the contract. Each tank of emulsion produced shall be certified as to its compliance with these specifications; this certification shall be provided to the Agency.

714.5 WATER:

Water shall be potable water, free of any injurious impurities. The Contractor shall identify the water source to the Agency.

714.6 ADDITIVES:

Additives may be used to accelerate or retard the breaking point and set times of the mix, or to improve the resulting finished surface.

The use of additives in the mix shall be supplied in quantities predetermined by the laboratory mix design.

714.7 TEST CERTIFICATES AND REPORTS:

Test certificates and reports for the bituminous material shall be furnished in accordance with Section [711.3](#).

- End of Section -

SECTION 715

SLURRY SEAL MATERIALS

715.1 GENERAL:

Slurry seal shall consist of a properly proportioned mixture of emulsified asphalt, mineral aggregate, mineral fillers, additives (if necessary), and water.

All material sources must be approved prior to their use. The Contractor will submit a job mix formula and if requested prequalifications for materials at least seven days prior to start of construction. When requested, additional samples will be furnished during the construction period at no cost to the Contracting Agency. This is a non-pay item.

715.2 AGGREGATE:

715.2.1 Mineral Filler: Mineral filler shall consist of finely divided matter, such as hydrated lime, Portland cement, limestone dust or fly ash, conforming to the requirements of ASTM [D4318](#). Mineral filler shall be used only when needed to reduce the setting time, to improve the workability or to reduce the stripping characteristics of the aggregate emulsion mixture. The minimum amount of the required filler will be used and it will be considered as part of the blended aggregate. The expected range shall be between .25% and 2.0% by weight of aggregate.

715.2.2 Mineral Aggregate: Coarse and fine aggregates or approved mineral filler shall be per Section [701](#). The mineral filler will be considered as part of the blended aggregate. The material shall be non-plastic (ASTM [D4318](#)) with a sand equivalent (ASTM [D2419](#)) of at least 50. The abrasion loss (ASTM [C131](#)) shall not exceed 35 percent. Historical test data from source aggregate may be used that was run within the past two years. Mineral aggregates used shall be 100% crushed. No natural sand shall be allowed. The gradation of mineral aggregate without mineral filler shall conform to Table [715-1](#).

TABLE 715-1			
SLURRY SEAL AGGREGATE			
SIEVE SIZE	Type I % PASSING	Type II % PASSING	Type III % PASSING
3/8	100	100	100
No. 4	100	85/100	70/90
No. 8	90/100	65/90	45/70
No. 16	65/90	45/70	28/50
No. 30	40/60	30/50	19/34
No. 50	25/42	18/30	12/25
No. 100	15/30	10/21	7/18
No. 200	10/20	5/15	5/15
Emulsified Asphalt content as a % of Dry Wt. Of Aggregate (approx.) ASTM D3910 (W.T.A.T. TEST)	18	16	14
Residual Asphalt Range requirements % of Dry Wt. of Aggregate ASTM D3910 (W.T.A.T. TEST)	10-16	7.5-13	6.5-12
Pounds of Aggregate per Square Yard (approx.)	8-10	12-18	18-25

715.3 BITUMINOUS MATERIAL:

The emulsified asphalt used for seal coating shall be quick setting or slow setting as per Section [713](#).

SECTION 715

Polymer modified cationic quick setting emulsion (PMCQS-1h) may be used when approved by the Engineer.

The quick setting emulsified asphalt shall be of the anionic or cationic quick set type such as QSH, CQSH, or PMCQS-1h that will react to chemically active mineral fillers such as Portland cement in such a way that the applied slurry mixture can support controlled traffic in 45-60 minutes after application. The amount of chemically active filler shall be determined by job mix formula and field performance.

Polymer modified cationic quick setting emulsion (PMCQS1-h) shall be homogeneous and the polymer used shall consist of either a solid polymer milled / blended into the asphalt or latex blended into the emulsifier solution prior to the emulsification process. The PMCQS-1h shall contain a minimum of three percent polymer and shall conform to Section [713](#).

Slow setting emulsion may be used when traffic control is not a critical item.

Quick Set Emulsion Mix Properties	
Slurry Seal Mixing, 70-85 degree F., Sec.	120 Sec. Min.
Slurry Seal Setting text, 70-85 degree F., 1 hour cure	No Brown Stain
Slurry Seal Water Resistance Test, 70-85 degree F., 30 minute cure	No More Than Slight Discoloration

Placement of slurry seal is temperature dependent and should be tested under field conditions.

715.4 WATER:

Water shall be potable and be compatible with the slurry ingredients used.

715.5 DETERMINATION OF JOB MIX FORMULA:

The job mixture shall be designed to provide a suitable surface for traffic conditions, climate and curing. All materials shall be pre-tested in a qualified laboratory to determine their suitability for use in the slurry seal. The Wet Track Abrasion Test (W.T.A.T.) will be used for design purposes to establish the mix design to be used in the specified slurry seal.

The test will show a maximum wear loss of 75 grams per square foot. Samples of materials to be used on the job shall be used to run the W.T.A.T. The test will be performed in accordance with ASTM [D3910](#) Design Testing and Construction of Slurry Seal.

715.5.1 Composition of Slurry Seal Mixtures: The job mixture shall conform to the requirements of the contract documents. The mixture shall attain an initial set in not less than 5 minutes not more than one hour. In cases where the surface is not critical to be open to traffic, a longer set time may be allowed, however not to exceed 12 hours. The setting time may be adjusted by the addition or removal of approved mineral fillers or chemical agents. The mixture shall be one of three types whose combined aggregates conform to the graduation requirements of Table [715-1](#). The mixture shall be sufficiently free flowing to fill cracks in the pavement. The mixture shall not segregate during or after laydown. The mixture shall produce a skid-resistant surface.

715.5.2 Trial Applications: The Contractor shall place a test strip of 60 square yards in the area designated by the Engineer. The test section shall be placed using the same equipment and methods as will be used on the job. The slurry mixture placed in a test strip shall conform to the design mix as determined by the W.T.A.T. with minor variations to obtain crack filling, set time, pavement bond and a skid resistant texture. If the materials do not meet the requirements for fluidity, non-segregation, or surface texture, a new job mix shall be formulated and tested. Work shall not proceed before approval of design mix and acceptance following the placing of a test strip.

715.6 TEST CERTIFICATES & REPORTS:

Test certificates and reports for the bituminous material shall be furnished in accordance with Section [711](#).

SECTION 715

715.7 CONVERSION OF QUANTITIES:

Volumetric conversions shall be accomplished in accordance with Section [713](#).

- *End of Section* -

SECTION 716

COVER MATERIAL

716.1 GENERAL:

Cover material “chips” shall consist of precoated or uncoated aggregate spread in conjunction with a bituminous or asphalt-rubber seal coat.

716.2 COVER MATERIAL AGGREGATE:

716.2.1 Properties:

- (1) When tested in accordance with AASHTO T-96, the loss shall not exceed 40 percent at 500 revolutions.
- (2) When tested in accordance with AASHTO T-104 (Sodium Sulfate Soundness), the loss shall not exceed 12 percent.
- (3) When tested in accordance with ARIZ-212, a minimum of 75 percent, by weight, of the material retained on the No. 8 sieve, shall have at least one fractured face.

716.2.3 Gradation: When tested in accordance with AASHTO T-27 and T-11, the gradation shall comply with Table [716-1](#) and/or Table [716-2](#).

TABLE 716-1	
COVER MATERIAL (CHIPS) GRADATION For Low Volume Traffic Only	
Sieve Size	Percent Passing
½ inch	100
3/8 inch	97/100
1/4 inch	70/100
#8	0-5
#200	0-2

TABLE 716-2	
COVER MATERIAL (CHIPS) GRADATION For High Volume Traffic	
Sieve Size	Percent Passing
3/4 inch	100
½ inch	97/100
3/8 inch	70/100
1/4 inch	0-10
#8	0-5
#200	0-2

SECTION 716

716.3 PRECOATED CHIPS:

When specified, the aggregate shall be heated and precoated with asphalt cement as specified in Section [711](#). The quantity of bituminous material used shall not be less than 0.30 percent or greater than 0.70 percent of the combined weight of the bituminous material and the aggregate to achieve a “salt and pepper” appearance.

The final percentage of asphalt used for coating shall be as directed by the Engineer. The precoating shall be done in a drum mix hot plant. With approval of the Engineer a pug mill mixing facility may be used.

716.4 UNCOATED CHIPS:

When liquid or paving grade asphalt is used as the bituminous binder, the uncoated chips shall not contain moisture in excess of a saturated surface dry condition.

When emulsified asphalt is used as the bituminous binder, the uncoated chips shall be surface wet but free from running water.

- *End of Section* -

SECTION 717

ASPHALT-RUBBER ASPHALT CONCRETE

717.1 DESCRIPTION:

The work under this section shall consist of furnishing, proportioning and mixing all the ingredients necessary to produce an asphalt-rubber Asphalt Concrete (ARAC) material. ARAC mixes may be used for low or high traffic conditions, as determined by the agency. Low traffic conditions are conditions where the asphalt mix will be subject to low volume and low weight vehicle usage. Examples of this condition are residential streets, most parking lots and residential minor collector streets. High traffic conditions are conditions where the asphalt mix will be subject to high volume and/or heavy weight vehicle usage as found on major collector, arterial and commercial streets. Street classifications (i.e. minor collector and major collector) shall be determined by the specifying agency.

717.2 MATERIALS:

717.2.1 Asphalt-Rubber Binder (ARB): The blended ARB shall meet the criteria list below. The ARB may be blended in a dedicated blending and storage unit connected to the hot plant or at the asphalt binder supplier's facility.

717.2.1.1 Asphalt Cement: Asphalt cement shall conform to the requirements of Section [711](#).

717.2.1.2 Crumb Rubber: Crumb Rubber shall meet the gradation requirements as shown in Table [717-1](#) below when tested in accordance with Arizona Test Method 714.

TABLE 717-1	
GRADATION REQUIREMENTS OF CRUMB RUBBER	
Sieve Size	Percent Passing
2.00 mm (#10)	100
1.18 mm (#16)	65 - 100
600 µm (#30)	20 - 100
300 µm (#50)	0 - 45
75 µm (#200)	0 - 5

The crumb rubber shall have a specific gravity of 1.15 ± 0.05 and shall be free of wire or other contaminating materials, and shall contain not more than 0.5 percent fabric. Calcium carbonate, up to four percent by weight of the crumb rubber, may be added to prevent the particles from sticking together.

Certificates of Compliance conforming to Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted. In addition, the Certificates shall confirm that the rubber is a crumb rubber, derived from processing at ambient temperature, whole scrap tires or shredded tire materials; and the tires from which the crumb rubber is produced is taken from automobiles, trucks, or other equipment owned and operated in the United States. The Certificates shall also verify that the processing does not produce, as a waste product, casings or other round tire material that can hold water when stored or disposed of above the ground. The crumb rubber to be used in ARB shall be the type produced through a process of mechanical grinding at ambient temperature. Use of crumb rubber granules produced from a cryogenic process is prohibited.

717.2.1.3 ARB Proportions and Properties: Ground crumb rubber in ARB shall be a minimum of 18 percent by weight of total binder.

ARB shall be Type 1 unless otherwise specified and conform to the requirements of Table [717-2](#).

SECTION 717

**TABLE 717-2
PHYSICAL PROPERTIES OF ARB**

Property	Requirement		
	Type 1	Type 2	Type 3
Grade of base asphalt cement	PG 64-16	PG 58-22	PG 52-28
Rotational Viscosity*; 350° F, Pascal seconds	1.5-4.0	1.5-4.0	1.5-4.0
Penetration; 39° F (4° C), 200g, 60 sec. (ASTM D5); dmm, min	10	15	25
Softening Point; (ASTM D36); °F, min.	135	130	125
Resilience; 77°F (ASTM D5329); %, min	25	20	15
* The Viscometer used must be a hand held rotational viscometer, such as a Rion (formerly Haake) Model VT – 04, or an equivalent, using Rotor No. 1. The rotor, while in the off position, shall be completely immersed in the binder at a temperature from 350° to 355° F for a minimum heat equilibrium period of 60 seconds, and an average viscosity determined from three separate constant readings (± 0.5 pascal-seconds) taken within a 30 second time frame with the viscotester level during testing and turned off between readings. Continuous rotation of the rotor may cause thinning of the material immediately in contact with the rotor, resulting in erroneous results.			

717.2.1.4 ARB Design: At least two weeks prior to paving, the Contractor shall submit an ARB design prepared by an ADOT approved laboratory. Such design shall meet the requirements specified herein. The design shall show the values obtained from the required tests, along with the following information: percent, grade and source of the asphalt cement used; and percent, gradation and source(s) of the crumb rubber used, as well as the ARB blending location: on-site or at the asphalt binder supplier's facility.

717.2.2 Aggregate: Coarse and fine aggregates shall conform to the applicable requirements of Tables [717-3](#) and [717-4](#) below. Coarse mineral aggregate shall consist of crushed gravel, crushed rock, or other approved inert material with similar characteristics, or a combination thereof, conforming to the requirements of these specifications.

Coarse aggregate is material retained above the Number 8 sieve and fine aggregate is material passing the Number 8 sieve. Aggregates shall be free of deleterious materials, clay balls, and adhering films or other material that prevent thorough coating with the asphalt cement. Mineral aggregate shall conform to the following requirements when tested in accordance with the applicable test methods.

**TABLE 717-3
MIX DESIGN GRADATION REQUIREMENTS WITH MINERAL ADMIXTURE**

Overlay Thickness	1" & 1- 1/2"	2"
Sieve Size	Percent Passing	Percent Passing
1" (25 mm)	100	100
3/4" (19 mm)	100	95-100
1/2" (12.5 mm)	95-100	78-92
3/8" (9.5 mm)	78-92	61-75
No. 4 (4.75 mm)	28-45	30-40
No. 8 (2.36 mm)	15-25	15-25
No. 30 (600 µm)	5-15	5-15
No. 200 (75 µm)	3.0-7.0	2.0-6.0

The combined aggregate properties shall conform to the requirements of Table [717-4](#).

SECTION 717

TABLE 717-4		
COARSE/FINE AGGREGATE REQUIREMENTS		
Characteristics	Test Method	Requirements
Fractured Faces, % (Plus No. 8)	ARIZ-212	85, 1 fracture 80, 2 or more
Uncompacted Voids, %	ARIZ-247	45.0 (High Traffic Volume) 42.0 (Low Traffic Volume)
Sand Equivalent (Minus No. 4)	AASHTO T-176	65 minimum
Plasticity Index	AASHTO T-89 & T-90	Non Plastic
L.A. Abrasion, % Loss	AASHTO T-96	9 max. @ 100 Rev. 40 max. @ 500 Rev.
Combined Bulk Specific Gravity	AI MS-2	2.35-2.85
Combined Water Absorption, %	AI MS-2	0-2.5

717.2.3 Mineral Admixture: Mineral admixture used in ARAC shall be dry hydrated lime conforming to the requirements of ASTM [C1097](#) or Portland cement conforming to ASTM [C150](#) for Type II, or ASTM [C595](#) for Type IP. The minimum mineral admixture content will be 1.0percent, by weight of total aggregate.

717.3 MIX DESIGN REQUIREMENT:

717.3.1 General: The mix design for ARAC shall be prepared by a laboratory that is accredited through the AASHTO Accreditation Program (AAP) in Hot Mix Asphalt Aggregates and Hot Mix Asphalt. The laboratory shall be under the direct supervision of a Civil Engineer, registered by the State of Arizona, and who is listed by ADOT as a “Qualified Asphalt Concrete Mix Design Engineer” within ADOT’s list of approved laboratories.

The date of the design shall not be older than two years from the date of submittal, unless supportive documentation is provided and approved by the Engineer.

The mix design method used shall be in accordance with the Marshall Mix procedure, 75 blows, as described in Arizona Test Method 832 “Marshall Mix Design Method for Asphaltic Concrete (Asphalt Rubber) [AR-AC]” with the exceptions that:

- (1) Mineral admixture shall be considered part of the total weight of aggregate and all combined specific gravity and combined absorption calculations for aggregates and mineral admixture will be done in accordance with Asphalt Institute’s Manual MS-2.
- (2) Course aggregate shall be separated from the fine aggregate on the #8 sieve.

Mix designs are subject to approval by the Engineer.

717.3.2 Mix Design Criteria: The mix shall comply with the criteria in Table [717-5](#).

TABLE 717-5		
MARSHALL MIX DESIGN CRITERIA		
Criteria	Low Volume Traffic	High Volume Traffic
ARB Content		
1” and 1-1/2” Overlay Thickness	8.4% minimum	8.0% minimum
2” Overlay Thickness	N/A	7.0% minimum
Mixture Air Voids, %	3.5-4.5	4.5-5.5
Voids in Mineral Aggregate, %	19.0 min	19.0 min
Tensile Strength Ratio, AASHTO T-283	65% minimum	65% minimum
Marshall Stability, pounds minimum	800	800
Marshall Flow, 0.01 inch minimum	16	16

The mix design report shall include the following elements as a minimum.

- (1) The name and address of the testing organization and the person responsible for the mix design report.
- (2) The mix plant identification and/or location, as well as the supplier or producer name.

SECTION 717

- (3) The traffic condition (low or high traffic) and lift thickness.
- (4) A description of all products that are incorporated in the ARAC along with the sources of all products, including the base asphalt cement, crumb rubber, mineral aggregate, and admixtures.
- (5) The results of all testing, determinations, etc., such as: specific gravity and gradation, water absorption, sand equivalent, loss on abrasion, fractured coarse aggregate particles, Tensile Strength Ratio (AASHTO T-283), Marshall bulk density, stability and flow, asphalt absorption, percent air voids, voids in mineral aggregate, and mineral admixture content. Historical abrasion values may be supplied on existing sources. The submittal should include a plot of the gradation on the Federal Highway Administration's 0.45 Power Gradation Chart and plots of the compaction curves.
- (6) The laboratory mixing and compaction temperature ranges for the ARB used within the mix design.
- (7) A specific recommendation for design ARB content and any limiting conditions that may be associated with the use of the design, such as minimum percentages of crushed or washed fine aggregate.
- (8) The supplier's product code, the laboratory Engineer's seal (signed and dated), and the date the design was completed.
- (9) The ARB design.

The mix design shall be submitted to the Agency or Engineer by the Contractor/Supplier for which it was developed as part of his project submittals. Once the mix design has been approved by the agency or Engineer, the Contractor and/or his supplier shall not change plants nor utilize additional mixing plants without prior approval of the Engineer. Any changes in the plant operation, the producer's pit, the ARB, or any other item that will cause an adjustment in the mix, shall be justification for a new mix design to be submitted.

- *End of Section* -

SECTION 718

PRESERVATIVE SEAL FOR ASPHALT CONCRETE

718.1 GENERAL

Asphalt Concrete preservative seal shall be one of the following types or equal, with typical application rates.

TYPE A - Asphalt rejuvenating agent shall be an emulsion composed of a petroleum resin oil base uniformly emulsified with water. Each supplier must submit a certified statement from the asphalt rejuvenator manufacturer showing that the asphalt rejuvenating emulsion conforms to the required physical and chemical requirements. They also must provide documentation of tests that determine the acceptable range of application of the product. Typical application rates are 0.07 to 0.18 gallons per square yard.

TYPE B - Petroleum Hydrocarbon emulsion. Applied at 0.05 to 0.20 gallons per square yard, diluted.

TYPE C - Tire modified surface sealer (TRMSS) or equal not diluted, and applied at a rate of 0.10 to 0.20 gallons per square yard.

TYPE D - Acrylic polymer modified emulsion Diluted to the manufacture's recommendation and applied at a rate of 0.08 to 0.20 gallons per square yard.

TYPE E - Polymer modified rejuvenating emulsion. (PMRE) Diluted to the manufacture's recommendation and applied at a rate of 0.08 to 0.20 gallons per square yard.

718.2 TEST METHODS AND REQUIREMENTS PRESERVATIVE SEAL

Preservative seal for asphalt concrete material, shall meet type A, B, C, D or E on Table [718-1](#) by certification from the manufacturer.

Tests shall be performed by AMRL accredited laboratory, accredited in the specified test being performed.

TABLE 718-1						
PRESERVATIVE SEAL SPECIFICATIONS						
Properties	Method	Type-A	Type-B	Type-C	Type-D	Type-E
Saybolt Viscosity @ 77°F (sfs)	ASTM D244	15-40	25-150	200-2000 Cp (Note 1)	15-40	50-150
Sieve test %	ASTM D244	0.1 max	0.1 max	0.1 max	0.1 max	0.1 max
Storage Stability, 24 hours, %	ASTM D244					1.0 max
Settlement test, 5 days, %	ASTM D244		2.0 max		5.0 max	
Test on residue by:		ASTM D244 Evaporation To 138°C	ASTM D244 Evaporation To 138°C	ASTM D244 Evaporation To 138°C	ASTM D244 Evaporation To 138°C	ASTM D244 Distillation To 177°C
Residue Content, %	ASTM D244	60 min	62 min	30 min	53 min	65 min
Oil Distillate, % by volume	ASTM D244					0.5 max
Flash point ^(Note 2) °F	ASTM D92	400°F	450°F	450°F	450°F	
Softening point, °F	ASTM D5			140 min.	130 min	
Viscosity ^(Note 3) , 60C, Poise	ASTM D2171					5000 max
Elastic Recovery ^(Note 4) , 10C, %	AASHTO T301					50 min
Test on residue by:		ASTM D244 Evaporation To 138°C	ASTM D244 Evaporation To 138°C	ASTM D244 Evaporation To 138°C	ASTM D244 Evaporation To 138°C	ASTM D244 Distillation To 177°C
Ductility, 25C, 5 cm/min, cm	ASTM D113			.	20 min	

SECTION 718

TABLE 718-1						
PRESERVATIVE SEAL SPECIFICATIONS						
Properties	Method	Type-A	Type-B	Type-C	Type-D	Type-E
Penetration, 25C, 100g/5 sec, dmm	ASTM D5				20-80	
Penetration, 4C, 200g/60 sec, dmm	ASTM D5					20-70
Kinematic Viscosity, 140°F, cSt	ASTM D2170	100-200	1,000-9,500			
Accelerated Weathering test ^(Note 5)	ASTM D4799				Plant certification within 12 months	
Test on		Evaporative Residue	Evaporative Residue			Rejuvenating Agent Base
Asphaltenes, % w	ASTM D2006	1.0 max	10.0 Max.			1.0 max
Maltene Dist. Ratio (PC+A ₁)/(A ₂ +S)	ASTM D2006	0.3-0.6	0.2-1.4			
PC/S Ratio	ASTM D2006	0.5 min	0.5 min.			
Saturated Hydrocarbons, S	ASTM D2006	28 max	28 max.			30 max
Kinematic Viscosity, 140°F, cSt	ASTM D2170					50-175
Flash point °F	ASTM D92					375 min
Test on residue from RTFO:	ASTM D2872					Rejuvenating Agent Base
Mass Change, %,	ASTM D2872					6.5 max
Kinematic Viscosity, 140°F, cSt	ASTM D2170					Report
Kinematic Viscosity, Ratio ^(Note 6)						3.0 max

Notes:

1. Brookfield viscosity using spindle #27 (ASTM [D4402](#)) test temperature at 140°F temperature equilibrate the sample for a minimum of 20 minutes. Sample test time is at 5 minutes inside the Brookfield viscosity tube.
2. Flash point on residue may be waived by the engineer during production sampling and testing provided manufacturer submits results performed in the previous 12 months in compliance.
3. Viscosity in poise may be determined using AASHTO T315 by converting the Complex Dynamic Shear Viscosity to Viscosity in poise.
4. Elastic Recovery molds shall have straight sides as shown in Fig. 1 of AASHTO T301.
5. Other Accelerated Weathering test procedures may be presented for acceptance by the engineer prior to project start. These results shall be provided at no additional cost to the agency.
6. Kinematic Viscosity Ratio will be determined by dividing the viscosity of the material after RTFO aging by the original viscosity.

- End of Section -

SECTION 725

PORTLAND CEMENT CONCRETE

725.1 GENERAL:

Portland cement concrete shall be composed of cementitious materials, fine and coarse aggregates, water, and, if specified or allowed, certain chemical admixtures and additives.

TABLE 725-1		
CONCRETE CLASSES - MINIMUM REQUIREMENTS		
Class of Concrete	Minimum Cementitious Materials Content (lbs. per cubic yard)	Minimum Compressive Strength (1) at 28 Days (psi)
AA	600	4000
A	520	3000
B	470	2500
C	420	2000

(1) In accordance with section [725.8](#).

725.2 CEMENTITIOUS MATERIALS:

Cementitious materials to be used or furnished under this specification shall be:

Portland cement, meeting the requirements of ASTM [C150](#)

Type II, low alkali, when no other specific type is specified

Type III, low alkali, for high early strength, when applicable or specified

Type V, low alkali, when specified in the special provisions for applications requiring high sulfate resistance

Portland Pozzolan Cement ASTM [C595](#)

Type IP (MS), when no other specific type is specified

Supplementary Cementitious Materials (SCM) shall not be used as an additional cementitious materials replacement in concrete in combination with Portland Pozzolan Cement.

Cementitious materials shall be sampled and tested as prescribed in the applicable ASTM specifications. The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the material manufacturer, identifying the cementitious material and stating that the cementitious material delivered to the batching site complies with the appropriate specifications. When requested by the Engineer, the Contractor shall furnish three copies of the cementitious materials certification. The cost of furnishing tested cementitious materials shall be considered as included in the contract bid price and no additional allowance will be made therefore.

When suitable facilities, as recommended by the Concrete Plant Manufacturer's Bureau, and approved by the Engineer, are available for handling and weighing bulk cementitious materials, such facilities shall be used. Otherwise the cementitious material shall be delivered in original unopened sacks that bear the name or brand of the manufacturer. The type of cementitious material, and the weight contained in each sack shall be plainly marked thereon.

Cementitious materials shall be stored in such manner as to permit ready access for the purpose of inspection and identification, and so as to be suitably protected against damage by contamination or moisture. Should any lot of bulk cementitious material be delivered to the site show evidence of contamination, the Engineer may require that such lot be removed from the site.

725.2.1 Supplementary Cementitious Materials (Pozzolans): Supplementary Cementitious Materials to be used in concrete or furnished under this specification shall conform to the appropriate ASTM requirements as follows:

Fly ash or natural pozzolan

ASTM [C618](#) and [C311](#)

Silica Fume

ASTM [C1240](#)

SECTION 725

Up to 25 percent by weight of the Table [725-1](#) minimum cementitious materials requirements may be an approved fly ash or natural pozzolan. Additional pozzolanic material in excess of the minimum Table [725-1](#) requirements may be incorporated into a concrete mix design to achieve enhanced performance, upon approval of the Engineer.

The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the pozzolan supplier identifying the pozzolanic material and stating the pozzolan delivered to the batching site complies with the appropriate specifications. The cost of furnishing tested pozzolan shall be considered as included in the contract bid price and no additional allowance will be made therefore.

Pozzolanic materials shall be handled and stored in the same manner as other cementitious materials. When facilities for handling a bulk pozzolan are not available, the pozzolan shall be delivered in original unopened sacks bearing the name and brand of the supplier, the type and source of the pozzolan, and the weight contained in each sack plainly marked thereon.

725.3 AGGREGATES:

Coarse and fine aggregate shall conform to the applicable requirements of ASTM [C33](#). Coarse aggregate grading requirements shall conform to the appropriate rock size designation in the Grading Requirements for Coarse Aggregate, Table 2. Fine aggregate grading requirements shall conform to the Fine Aggregate Grading section.

The average value of 3 successive sand equivalent samples shall not be less than 70 when tested in accordance with ASTM [D2419](#). No individual sample shall have a sand equivalent less than 65.

The loss by abrasion in the Los Angeles Abrasion Machine, determined as prescribed in ASTM [C131](#), shall not exceed 10 percent, by weight, after 100 revolutions nor 40 percent after 500 revolutions.

Prior to the delivery of the aggregates and whenever required during concrete production, the Contractor shall make stockpiles available to the Engineer for testing. All required samples shall be furnished at the expense of the Contractor, and the cost of sampling and testing shall be at the expense of the Contracting Agency.

Reclaimed Concrete Materials (RCM) and Reclaimed Asphalt Pavement (RAP) as defined in [Section 701](#) shall not be used in Portland Cement Concrete without the prior approval of the Engineer.

725.4 WATER:

The water used for mixing concrete shall be potable or shall meet the requirements of ASTM [C1602](#), when tested by a qualified independent testing laboratory.

725.5 ADMIXTURES AND ADDITIVES:

Admixtures or additives of any type, except as otherwise specified, shall not be used unless identified in the approved mix design or authorized by the Engineer.

Water reducing admixtures incorporated into the approved concrete mix design shall meet the requirements of ASTM [C494](#) for the appropriate type.

Air entraining admixtures incorporated into the approved concrete mix design shall meet the requirements of ASTM [C260](#).

Pigments incorporated into the approved concrete mix design for integrally colored concrete shall meet the requirements of ASTM [C979](#).

Fibers incorporated into the approved concrete mix shall meet the requirements of ASTM [C1116](#).

Any admixtures used shall be included in the price for that item.

SECTION 725

725.6 MIX DESIGN PROPORTIONING:

A concrete mix design carrying the producer's designated mix number for each type of concrete being furnished under these specifications shall be submitted to the Engineer at least once each year for approval. Each design shall utilize the proper proportioning of ingredients to produce a concrete mix that is homogeneous and sufficiently workable to provide a consistent and durable concrete product that meets the specified compressive strength and other properties as required by the application.

In the event there is a modification to the mix design proportions:

(A) Modifications that do not require a new mix design submittal/approval:

- (1) Modifications which do not result in batch target weights for the fine aggregate or combined coarse aggregates changing by more than 5 percent from the original approved mix design.
- (2) Modifications to the percentage of coarse aggregate fractions that do not change the total coarse aggregate volume.
- (3) Modifications to dosages of chemical or air-entraining admixtures, within the manufacturer's recommendations.
- (4) The incorporation or elimination of chemical admixtures which are listed on the mix design to effect a change in the time-of-set (retarders or accelerators).

(B) Modifications that require a new mix design submittal/approval and may require performance verification:

- (1) Modification to the class of concrete per Table [725-1](#).
- (2) Modification to the type/class/source of cement, fly ash, natural pozzolan, or silica fume.
- (3) Modification to the percentage of fly ash, natural pozzolan, or silica fume.
- (4) Modification to a coarse aggregate size designation.
- (5) Modification of the type of chemical admixture, or the incorporation or elimination, of an air-entraining admixture.
- (6) Modification of coarse or fine aggregate source.

725.7 MIXING:

All proportioning/batching/mixing equipment shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or National Ready Mixed Concrete Association. The proportioning shall consist of combining the specified sizes of aggregates with cementitious materials, admixtures/additives, and water as herein provided. No method which may cause the segregation or degradation of materials shall be used.

Weighing and metering devices used for the purpose of proportioning materials shall fulfill requirements as to accuracy and tolerance prescribed by the Weights and Measures Division of the State of Arizona and shall be sealed and certified in accordance with the procedures established by this agency. This certification shall not be over 12 months old and shall be renewed whenever required by the Engineer. When portable plants are set up at a new or temporary location, the scales and scale assembly shall be inspected and certificate issued regardless of the date when the scales were last tested. The Engineer may require the Contractor to run a quick scale check at any time with certified weights furnished by the Contractor and order the scale recertified if necessary.

Any admixture/additive shall be measured accurately by mechanical means into each batch by equipment or in a method pre-approved by the Engineer.

The equipment for measuring and supplying the water in the mixer shall be so constructed and arranged that the amount of water to be added to the mixture can be measured, in gallons or by weight. The amount of water shall be varied in accordance with the percentage of free moisture in the material and the requirements of the workability of the aggregate.

SECTION 725

Machine mixing will be required in all cases unless pre-approved by the Engineer. Regardless of the method employed, mixing shall be commenced as soon as possible after the cementitious material is placed in contact with the aggregates or water. All concrete mixers shall be of such design and construction, and so operated, as to provide a thoroughly and properly mixed concrete in which the ingredients are uniformly distributed.

725.7.1 Paving and Stationary Mixers: Paving and stationary mixers shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or the National Ready Mixed Concrete Association.

Mixers shall be maintained in proper and serviceable working condition, and any part or portion thereof that is out of order, or becomes worn to such extent as to detrimentally affect the quality of mixing, shall be promptly repaired or replaced.

The proper proportions of aggregate, cementitious materials, admixtures/additives and water for each batch of concrete shall be placed in the mixer, and shall be mixed for a period of not less than 50 seconds after all such materials are in the drum.

The rotating speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

The total volume of materials mixed in any one batch shall neither exceed the water level capacity of the mixer nor the manufacturer's catalog rated capacity of the mixer.

725.7.2 Transit Mixers: Transit mixers shall meet the requirements of the Truck Mixer Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or the National Ready Mixed Concrete Association. Ready mix concrete and shall comply with ASTM [C94](#) except as herein specified.

Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates, installed by the manufacturer, on which is plainly marked the capacity of the drum in terms of the volume of mixed concrete and the speed of rotation for the agitating and mixing speeds of the mixing drum or blades.

Each mixer shall have an identification number painted on the truck in such a location that it can be easily read from the batching platform.

The total volume of materials introduced into the mixer for mixing purposes shall not exceed the manufacturer's guaranteed mixing capacity. If the concrete so mixed does not meet the uniformity requirements of this section, the amount of materials charged into the mixer shall be reduced.

The rotation speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

Each batch of concrete placed in the mixer shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades, at the speed designated by the manufacturer of the equipment as mixing speed. Additional mixing shall be at the agitating speed designated by the manufacturer of the equipment. The revolving of the drum shall be continuous until the concrete is completely emptied from the drum. Before any portion of the materials for any batch of concrete is placed therein, the drum of the mixer shall be completely emptied of the previously mixed batch.

At the time of delivery to the job site, the Engineer shall be provided with a legible delivery ticket which shall contain the following information:

Date and Truck Number.

Name of the Supplier.

Name of the Contractor.

Specific designation of job (name and location).

Number of cubic yards in the batch.

Time the transit mixer is loaded.

SECTION 725

Amount of water added at the job site at request of receiver, and his signature or initials.

Suppliers' mix design code number.

Type and amount of admixture or additive that is not already included in the approved mix design, if any.

Serial number of the ticket.

Additional water may be added on the jobsite in accordance with ASTM [C94](#) Tolerances in Slump section to adjust slump providing the slump after such water addition does not exceed the maximum allowed by these specifications in Section [725.9](#) (A) (1) and that water so added is mixed into the batch for a minimum of 30 additional revolutions at mixing speed. Loss of cement mortar during discharge which in the opinion of the Engineer would be of sufficient amount to affect the homogeneity of the concrete shall be cause for rejection of the load. The Contractor shall be responsible for all concrete to which water is added at the job site.

725.7.3 Job Mixed Concrete: All job mixed materials and procedures shall be pre-approved by the Engineer. A prepackaged commercial product shall be used for job mixed concrete placement in accordance with the manufacturer's recommended procedure.

In lieu of the use of a prepackaged commercial product, individual ingredients for concrete placement shall be prepared in a watertight container of suitable volume in batches not to exceed 1/3 cubic yard each. Proportioning of batches shall be in accordance with the applicable required mix design in Table [725-1](#) and Section [725.6](#). All mixing shall be done prior to placement in the forms and in accordance with the following procedure:

- (A) Mixing shall be done in a mechanical batch mixer of approved type.
- (B) The mixer shall be rotated at a speed recommended by the manufacturer.
- (C) Mixing shall continue for at least 1-1/2 minutes after all materials are in the mixer, unless a shorter time is shown to be satisfactory by the mixing uniformity tests of ASTM [C94](#).
- (D) Materials handling, batching, and mixing shall conform to the applicable provisions of ASTM [C94](#).
- (E) Suitable records shall be kept to identify the number of batches, proportions of materials used, and time and date of mixing and placement along with the approximate location in the structure.

725.7.4 Dry Batched Unmixed Concrete: All dry batched unmixed concrete materials and procedures shall be pre-approved by the Engineer. An accurate batch weight shall be provided to record the quantities of cementitious materials, aggregate, admixtures/additives, and water batched into the containers. The date of batching, the container number and the batching certificate number shall be recorded at the time of batching. Copies of the batch weight records shall be submitted to the Engineer upon request.

All dry batched unmixed concrete delivered to the job site shall be stored in containers so constructed that the cement cannot come in contact with the water and aggregate within the container. Any admixture/additive added in powder form shall be added to the cement; if added in liquid form, it shall be added to the water.

The contents of the container shall be discharged into a mixer at the job site. Following discharge of the first container into the mixer, the mixer shall be operated at mixing speeds during the discharge of the remaining containers. After the contents of the last container have been discharged into the mixer, the concrete shall be mixed as specified in this specification for transit mixers, and drum or turbine type mixers.

Any spillage of cementitious materials, aggregate, water or admixtures/additives during the filling, transporting, or the discharging of the container, shall be cause for rejection of the container or the contents of the mixer if any portion of the rejected container is discharged into the mixer.

725.7.5 Volumetric Batching and Continuous Mixing Concrete and Equipment: Volumetric-batching and continuous-mixing concrete and equipment may be utilized upon approval of the Engineer for job site concreting applications. Material handling, procedures, and operations shall be in accordance with ACI 304.6R, Guide for the use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment and all concrete produced and all test performed shall be in accordance with ASTM [C685](#), Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing. All equipment shall meet the requirements of the Volumetric Mixer Standards of the Volumetric Mixer Manufacturers Bureau

SECTION 725

and shall have a suitable copyrighted rating plate furnished by the Bureau and attached to the volumetric mixing equipment.

725.8 TESTS AND TEST METHODS:

725.8.1 Field Sampling and Tests: Concrete shall be sampled in accordance with ASTM [C172](#) for determination of temperature, slump, unit weight and yield (when required) and air content (when required) as well as for fabrication of test cylinders for compressive strength determination at 28 days. Samples shall be of sufficient size to perform all the required tests and fabricate the necessary test cylinders but in no case less than 1 cubic foot. Concrete shall be sampled during discharge of the middle portion of the batch. At the discretion of the Engineer, a sample may be obtained at the beginning of the discharge if the properties of the concrete do not appear to be within the specification limits for slump or temperature.

All sampling and testing shall be done by a certified technician meeting the requirements of the ACI Concrete Field Testing Technician, Grade I or equivalent.

Temperature of the concrete mixture shall be determined in accordance with ASTM [C1064](#).

Slump of the concrete mixture shall be determined in accordance with ASTM [C143](#).

Air content of the concrete mixture (when required) shall be determined in accordance with ASTM [C231](#) or [C173](#), whichever is applicable.

Unit weight and yield of the concrete mixture (when required) shall be determined in accordance with ASTM [C138](#).

All compressive strength test specimens shall be made, cured, handled, protected, and transported in accordance with the requirements of ASTM [C31](#). The contractor shall provide and maintain for the sole use of the testing laboratory/technician adequate facilities for safe storage and proper curing of concrete test cylinders on the project site including sufficient access on weekends and holidays to allow the timely pick-up of cylinders specimens. Any and all deviations from the standard procedure of any test method shall be promptly identified and corrected. Any deviations shall be clearly noted by the testing laboratory on all written reports. Testing results obtained from non-standard testing procedures shall be considered invalid and discarded by Engineer.

Sampling and testing performed for concrete acceptance will be at the expense of the Contracting Agency. Sampling and testing for the Contractor's purposes of quality control or other needs shall be at the Contractor's expense.

725.8.2 Concrete Cylinder Test: A cylinder strength test shall be the average of the strengths of at least two 6 inch by 12 inch cylinders or at least two 4 inch by 8 inch cylinders made from the same sample of concrete and tested at 28 days. An adequate number of cylinder specimens shall be made for each 50 cubic yards or not less than each half-day's placement of each class of concrete. All specimens will be tested in a laboratory approved by the Engineer in accordance with ASTM [C39](#) for concrete acceptance. Should an individual cylinder show evidence of improper sampling, molding, curing, or testing, the results shall be discarded and the compressive strength shall be the result of the average of the remaining cylinder(s). Additional cylinder specimens may be made and tested at other ages to obtain additional compressive strength information and shall not be considered as acceptance tests. Cylinder testing performed for concrete acceptance will be at the expense of the Contracting Agency. Cylinder testing for the Contractor's purposes of quality control or other needs shall be at the Contractor's expense.

725.8.3 Additional Concrete Testing: If the 28-day strength test does not meet the compressive strength requirements, additional concrete testing may be performed to further evaluate the concrete in question for purposes of acceptability or payment. This may involve testing of additional cylinders at later ages, (for example - hold cylinders at 56 days or more), or core testing to determine in-place concrete strengths. This additional testing and all coring repairs shall be pre-approved by the Engineer and at the expense of the Contractor. If core testing is performed, at least three representative cores shall be obtained, conditioned and tested in accordance with ASTM [C42](#) from each concrete member or area of concrete to be tested at locations designated by the Engineer. Cores damaged subsequent to or during removal shall be rejected and additional core samples taken. Cores shall be obtained and delivered to a laboratory acceptable to the Engineer in time to allow complete strength testing within 48 days of original concrete placement. The Contractor may elect to have a representative present during sampling and testing. A core strength test shall be the average of the results of the three cores. Should an individual core show evidence of improper sampling, curing, or testing, the results shall be discarded and the compressive strength shall be the result of the average of the remaining core(s). Results of the core strength testing shall replace the results of the cylinder strength test for that sample.

SECTION 725

725.9 ACCEPTANCE:

(A) Plastic Concrete Properties

(1) The slump of the concrete shall meet the requirements of ASTM [C94](#) Tolerances in Slump section. When the approved mix design or project specification requirements for slump are a “maximum” or “not to exceed”, the following tolerances apply:

Specified slump:	If 3” or less	If more than 3”
Plus tolerance	0 inch	0 inch
Minus tolerance	1 1/2 inch	2 1/2 inch

When the approved mix design or project specification requirements for slump are not written as a “maximum” or “not to exceed”, the following tolerances apply:

For design slump of:	Tolerance
2 inch and less	+/- 1/2 inch
More than 2 through 4 inch	+/- 1 inch
More than 4 inch	+/- 1 1/2 inch

(2) Limit the maximum allowable temperature of the concrete mixture immediately before placement to 90 degrees F unless otherwise specified or unless a higher allowable temperature is pre-approved by the Engineer. At the discretion of the Engineer, recommended practices in ACI 305, Specification for Hot Weather Concreting, can provide good reference information and may be used to modify maximum allowable concrete temperature and acceptance.

Per ACI 306, Specification for Cold Weather Concreting, when the atmospheric temperature at the time of placing concrete is above 30°F the temperature of the concrete, as placed, shall not be less than 60°F. When the atmospheric temperature at the time of placing concrete is between 0°F and 30°F the temperature of the concrete, as placed, shall not be less than 65°F.

(3) Air entrained concrete shall meet the requirements of ASTM [C94](#) Air-Entrained Concrete section. The air content of air-entrained concrete when sampled from the transportation unit at the point of discharge shall be within the approved mix design tolerance or +/- 1.5 % of the specified value. When a representative sample taken prior to discharge shows an air content below the specified level by more than the allowable tolerance, additional air entraining admixture shall be added to the concrete mix to achieve the desired air content level, followed by a minimum of 30 revolutions at mixing speed.

(4) Per ASTM [C94](#) Mixing and Delivery section, discharge of the concrete shall be completed within 1 1/2 hour after the introduction of the mixing water to the cementitious materials or the introduction of the cementitious materials to the aggregates. The Engineer may allow the continuation of concrete placement after the 1 1/2 hour time limit has been reached if the concrete is of such slump or workability that it can be placed without the addition of water to the batch.

Any concrete failing to meet the tolerances for plastic concrete properties in 725.9 (A) (1) through (4) shall be reviewed by the Engineer and is subject to rejection.

(B) Hardened Concrete Properties – Compressive Strength

Compressive strength of concrete shall be determined on the basis of cylinder strength tests obtained in accordance with section [725.8.2](#) and shall be acceptable if the tests meet or exceed the minimum specified strength. When the validity of cylinder strength tests are suspect, the strength of concrete in question shall be determined in accordance with Section [725.8.3](#).

When compressive strength test results are less than the specified minimum, an Engineering Analysis to determine the impact of the strength reduction may be required by the Engineer prior to the decision to accept or reject the concrete. The Engineering Analysis will be at the Contractor’s expense. Any concrete that is rejected by the Engineer shall be removed and replaced by the Contractor at the Contractor’s expense.

When concrete is accepted by the Engineer on the basis of test results of less than 100% of the required minimum compressive strength, an adjustment in the concrete unit price may be made for the quantity of concrete represented by such strength tests in accordance with Table [725-2](#).

SECTION 725

TABLE 725-2

Adjustment in Concrete Unit Price Based on Strength Deficiency

Class AA and Class A		Class B and Class C	
Percent of Specified Minimum 28-day Compressive Strength Attained (Nearest 1%)	Percent of Concrete Unit Price Allowed	Percent of Specified Minimum 28-day Compressive Strength Attained (Nearest 1%)	Percent of Concrete Unit Price Allowed
100 % or greater	100	100 % or greater	100
98-99	90	95-99	95
96-97	85	90-94	90
95	80	85-89	85

- *End of Section* -

SECTION 726

CONCRETE CURING MATERIALS

726.1 GENERAL:

Curing materials shall consist of waterproof paper, polyethylene film or liquid membrane-forming compounds which, when applied to fresh concrete, will inhibit moisture loss and reduce temperature rise during the curing period. All curing materials and methods shall be approved by the Engineer prior to use. Wet coverings such as burlap, cotton mats, or other moisture-retaining fabrics also may be used, or may be required by special provisions.

726.2 MATERIALS:

(A) Waterproof paper, or polyethylene film, shall conform ASTM [C171](#).

(B) Liquid membrane-forming compounds shall conform ASTM [C309](#). Type 1 compound with either a Class A or Class B vehicle shall be used for concrete structures, except bridge decks, approach slabs, and portland cement concrete pavement. Type 2 white pigmented compound, with either a Class A or Class B vehicle shall be used for portland cement concrete pavement, bridge decks and approach slabs.

(C) Burlap cloth made from jute or kenaf shall conform to AASHTO M-182.

- *End of Section* -

SECTION 727

STEEL REINFORCEMENT

727.1 GENERAL:

The following specifications set forth the requirements for bar reinforcement, wire reinforcement, and wire mesh reinforcement. The reinforcement shall conform accurately to the dimensions and details indicated on the plans or otherwise prescribed and before being placed in any concrete work, shall be thoroughly cleaned of all loose rust, mill scale, mortar, oil, dirt, or coating of any character, which would be likely to destroy, reduce, or impair its proper binding with the concrete.

No reinforcing steel will be accepted under this specification until it has been approved by the Engineer. When required by the Engineer, the Contractor or supplier shall furnish a spot sample taken on the project and notify the Engineer as to when and where they will be available. Such samples shall be furnished at the expense of the Contractor or supplier, but the cost of any testing that may be required will be borne by the Contracting Agency. Samples shall only be taken in the presence of the Engineer. The Contractor shall furnish 3 certified mill test reports or certificates of compliance for each heat or size of steel which can be clearly identified with the lot. When such information has been furnished, placing of the steel will not be held up until results of spot samples have been received. Unless otherwise specified, all reinforcing steel bars shall be deformed intermediate grade 40 billet steel conforming with ASTM [A615](#) and the shapes shall conform with ASTM [B670](#).

In testing bar reinforcement, only the theoretical cross-sectional area will be used in all computations.

Bending of steel shall conform to the requirements of Section [505.5.2](#).

The various grades of steel shall not be used interchangeably in structures.

727.2 WIRE REINFORCEMENT:

Wire reinforcement shall in all respects fulfill requirements prescribed in ASTM A82.

727.3 WIRE MESH REINFORCEMENT:

Mesh reinforcements shall conform to ASTM A185. The gage of the wire and the dimension of the mesh will be specified in the special provisions or shown on the plans. The wire mesh reinforcement shall be so constructed as to retain its original shape and form during necessary handling. The effective cross-sectional area of the metal shall be equal to that specified or indicated on the plans.

727.4 WIRE TIES:

Wire for ties shall be black, annealed, not lighter than 16 gage.

- End of Section -

SECTION 728

CONTROLLED LOW STRENGTH MATERIAL

728.1 GENERAL:

Controlled Low Strength Material (CLSM) is a mixture of cementitious materials, aggregates, admixtures\additives, and water that, as the cementitious materials hydrate, forms a soil replacement. CLSM is a self-compacting, flowable, cementitious material primarily used as a backfill, structural fill, or a replacement for compacted fill or unsuitable native material. Placement and usage of each type of CLSM is described in Section [604](#).

728.2 MATERIALS:

Cementitious materials shall conform to Section [725.2](#).

Coarse aggregate shall conform to ASTM [C33](#) grading size No. 57. The size and gradation of fine aggregates (sand) shall conform to ASTM [C33](#). Alternate materials meeting the applicable requirements of Section [701](#) or [702](#) such as combinations of other aggregates, Aggregate Base Course (ABC) or Reclaimed Concrete Material (RCM) may be used to replace the required coarse and fine aggregate as long as the approved mix design meets the requirements of Table [728-1](#) and is approved by the Engineer.

Water shall conform to Section [725.4](#).

728.3 PROPORTIONING OF MIXTURES AND PRODUCTION TOLERANCES:

Proportioning of the mixture shall comply with Section [725.6](#) and Table [728-1](#). The CLSM shall have consistency, workability, plasticity, and flow characteristics such that the material when placed is self-compacting. A minimum of 40% coarse aggregate shall be used. A mix design shall be submitted for the Engineer's approval prior to the excavation for which the material is intended for use. Sampling shall be in accordance with ASTM [D5971](#). The flow consistency shall be tested in accordance with ASTM D6103. Unit weight (when applicable) shall be obtained by ASTM [D6023](#). Compressive strength shall be tested in accordance with ASTM [D4832](#).

TABLE 728-1	
CONTROLLED LOW STRENGTH MATERIAL REQUIREMENTS	
Portland Cement Content, Sack/cu yd	Flow, inches
1/2 Sack	9±2
1 Sack	9±2
1 1/2 Sack	9±2

Note for Table [728-1](#):

- (1) CLSM mixes meeting the table requirements will not generally be placeable by means of a concrete pump or may not provide the needed workability for certain conditions. When pumpable mixes or increased workability are required, the addition of fly ash or a natural pozzolan in excess of the required Portland Cement Content may be used.
- (2) Ready-mixed structural concrete or grout shall not be used in lieu of CLSM without prior approval from the Engineer and shall be subject to rejection.

728.4 MIXING:

CLSM mixing shall comply with Section [725.7](#). Mixing shall continue until the cementitious material and water are thoroughly dispersed throughout the material. Mixes shall be homogenous, readily placeable and uniformly workable.

- End of Section -

SECTION 729

EXPANSION JOINT FILLER

729.1 PREMOLDED JOINT FILLER:

Expansion joint filler materials shall consist of preformed strips of a durable resilient compound and comply with ASTM [D5971](#), [D1752](#), or [D2628](#), as specified by the Contracting Agency or as approved by the Engineer.

729.2 POUR TYPE JOINT FILLERS FOR PORTLAND CEMENT CONCRETE PAVING (PCCP):

Pour type joint fillers shall comply with ASTM D3406 or as approved by the Engineer. Joint sealant shall not contain any coal tar materials. The following requirement shall be added to paragraphs 7.1 of ASTM D3406:

The minimum ambient temperature during application and ambient temperatures under various storage conditions shall be clearly marked on the container.

729.3 TEST REPORT AND SHIPMENT CERTIFICATE:

Each shipment shall be accompanied by a certificate from the supplier that the material will comply with the above specifications and such certificate shall be delivered to the Engineer.

- End of Section -

SECTION 735

REINFORCED CONCRETE PIPE

735.1 GENERAL:

These specifications cover reinforced concrete pipe and related structures intended to be used for conveyance of sewage, industrial waste, and storm and irrigation water.

Except as modified herein reinforced concrete pipe shall be manufactured and tested in conformance with the requirements of ASTM [C76](#) for circular pipe, ASTM [C506](#) for arch pipe, and ASTM [C507](#) for elliptical pipe.

Whatever struts or other protective methods proved necessary to furnish and install the pipe to meet the limitation of cracks as specified herein, shall be provided and maintained throughout pipe handling and transportation.

735.2 JOINTS:

Bell Reinforcement: All reinforced concrete pipes less than 36 inch inside diameter and the same approximate equivalent size shall include an area of reinforcing steel in the bell not less than the area required for the circumferential reinforcement in the wall of the pipe.

Rubber gaskets shall be in accordance with ASTM [C443](#).

Cement Mortar Joints for RCP will be in accordance with Subsection 736.3

735.3 FABRICATED SPECIALS – WYES, TEES, CURVES, BENDS AND CLOSURES :

Fabricated pipe specials shall be made equal in strength, diameter, and other physical characteristics to the standard straight pipe lengths by the use of extra concrete, extra reinforcing or steel items.

Horizontal and vertical long-radius curves shall be formed by bevel adapters or by beveling the straight pipe joint. The bevel of the pipe shall not exceed 5 degrees and the total angular deflection, for beveled pipe, shall not exceed 10 degrees. Small angular changes may be made with straight pipe provided that the joint opening does not exceed 3/4 inch. Short radius curves and closures shall be formed with fabricated specials; however, the angular deflection of any segment of the fabricated section shall not exceed 10 degrees.

735.4 MATERIALS:

Except when otherwise permitted by the Engineer, no materials other than water, Portland cement, Pozzolan materials, mineral aggregates and steel shall be used in the manufacturing of the pipe, with the following exceptions:

(A) Portland Cement: Portland cement shall comply with ASTM [C150](#), Type II, and low alkali. The pipe manufacturer shall supply a cement mill certificate in triplicate for each load of cement delivered, showing the specification, type, chemical analysis, and quantity. In lieu of the above, on stockpiled pipe the manufacturer shall certify that the type of cement used meets this specification. The pipe manufacturer shall also certify in writing that the cement content of the concrete complies with the specifications as to yield per cubic yard of concrete poured.

(B) Concrete Admixtures: The pipe manufacturer shall certify in writing that no calcium chloride or admixture containing calcium chloride has been used in the manufacture of the pipe. Other admixtures may be used if approved by the Engineer. The pipe manufacturer shall certify to the brand and chemical content of such admixtures used.

(C) Steel Reinforcement: The pipe manufacturer shall supply three copies of mill certificates showing heat numbers, chemical analysis, and physical tests on reinforcing steel. In lieu of the above, on stockpiled pipe the manufacturer shall certify that the type of steel used meets this specification.

735.5 MANUFACTURER'S QUALIFICATIONS AND EQUIPMENT REQUIREMENTS:

The manufacturer shall be competent to manufacture the type, size and quality of pipe; in addition, the manufacturer shall have satisfactory curing and storage facilities, and satisfactory financial resources.

SECTION 735

Calibration of Cement and Aggregate Scales: The pipe manufacturer shall make whatever alterations are necessary to his equipment to enable the Contracting Agency's Sealer or State Inspector of Weights and Measures to check, calibrate, and seal the aggregate and cement scales used in the pipe production.

735.6 CURING OF PIPE:

(A) Steam Curing: The manufacturer shall provide adequate steam plant, piping, enclosures, and other facilities for curing the pipe. The enclosures shall be such that the temperature is maintained continuously between 110 and 150°F.

(B) Curing of the pipe shall not commence until the concrete has attained its initial set, but in any event not sooner than 1 hour and no later than 8 hours after placing of the concrete. Rate of rise of temperature shall not exceed 30°F per hour.

(C) Water Curing: The pipe shall be kept moist during daylight hours. The pipe, including the ends, shall be covered with burlap for the first 3 days, except that, if the pipe is kept constantly and completely wet with fog sprays during the daylight hours, the burlap covering may be omitted. If the manufacturer fails to proceed immediately with the required water curing the surfaces of the concrete, except joint surfaces that are to be grouted shall be sealed with an approved white pigmented sealing compound in accordance with Section [726](#).

735.7 TESTS AND ACCEPTANCE:

(A) Basis of Acceptance: The basis of acceptance for the reinforced concrete pipe shall be in accordance with ASTM [C76](#), ASTM [C506](#), or ASTM [C507](#), as applicable, including the method stated in the special provision and as amended herein. However, the purchaser may, at his option, make concrete cylinder tests for the purpose of determining release dates for shipment of the pipe and for his information in regard to general quality of the concrete.

(B) Segregation of Material: The slump of the concrete mix shall not exceed 4 inches so as to preclude excessive segregation of the materials used and shall be proportioned so that the result shall be a homogeneous concrete mixture of such quality that the pipe will conform to the tests and design requirements of these specifications.

(C) A pipe has failed the D-load test when the opening crack exceeds .01 inch for a distance of 1 foot when measured at close intervals. These measurements are taken within the 1 foot measured span only when the crack line is more or less parallel to the axis of the pipe, as it is obvious that where the crack deviates substantially from parallel, and approaches a direction normal to the axis, that the edges of the crack tend to slip past each other, instead of opening up under load. The intent of the test is to measure the crack opening under stress.

(D) Porous or honeycomb concrete areas 6 inches or less in diameter may be removed and repaired. Pipe having defects or repairs greater than 6 inches in diameter will not be accepted.

(E) Any crack exceeding 1 foot in length that goes completely through the pipe, is not considered acceptable whether repaired or not, except that a single end crack that does not exceed the depth of the joint as measured from the end to the inside shoulder is acceptable.

(F) Any crack that is .01 inch in width for one-sixteenth inch in depth or deeper, for a length of 1 foot or more and continues as a hairline crack down to the reinforcing steel for over 1/2 the length of the pipe is not considered acceptable whether repaired or not.

(G) A single continuous hairline crack which does not extend to the reinforcing steel and not in excess of .01 inch in width for a distance of 1 foot is acceptable without repair. This type of crack, longer than 1 foot shall be repaired.

(H) Repairs shall be made by filling the defect with epoxy under pressure or by chipping out a V-Section to the full depth of the defect and repairing with an approved patching compound. The composition of the patching compound shall be furnished to the Engineer for approval.

(I) The words regarding acceptability and repair ability in the above paragraphs shall also apply when the crack occurs after loading of the pipe in the trench with backfill. Cracks wider than .01 inch shall be assumed to indicate overstress of the steel. In

SECTION 735

such case, the defective portion of the installation shall be replaced or repaired in a manner acceptable to the Engineer. After structural repairs are completed, the remaining cracks shall be filled as required above. All corrective measures shall be at the expense of the Contractor.

(J) Blisters: All pipe joints having blisters involving less than 1/4 the interior surface area shall be repaired by removing all loose material and exposing all hollow area and replacing with fresh concrete properly bonded, with an acceptable bonding agent, and curing the repair with membrane coating. Blisters with larger areas are not considered to be repairable or acceptable.

(K) Painting of pipe, or portion of pipe, with grout to cover defects, minor or major, will not be permitted until approved by the Engineer.

(L) Where the modified or special design method, under the ASTM Standard is elected, acceptance on the basis of material tests and inspection of manufactured pipe for defects and imperfections shall be as stated in the ASTM Standard, and as amended herein. However, one joint of each size and D-load shall be selected by the Engineer for test purposes, and shall be tested for strength by the 3 edge bearing method, ASTM [C497](#), with the results being used for confirmation of the submitted design for this D-load. If the pipe section tested fails in compression or shear before reaching the D-load specified, the test shall be considered a failure. Additional sections of the same diameter size and class shall be tested as specified above until the load requirements are met for the D-load strength. This test procedure shall be accomplished only once per manufacture regardless of the number of contractors he supplies. Placing of reinforcing steel in the test section of pipe to control shear cracks will not be permitted.

Requirements regarding defects shall be the same as stated above for standard pipe.

Concrete test requirements specified under compression tests of the ASTM Standard shall be amended in part to read as follows: "The average of any 5 consecutive strength tests of the laboratory-cured specimens shall be equal to or greater than the specified strength set forth in the design strength requirements table for the type and class of pipe being produced, and not more than 20 percent of the strength tests shall have values less than the specified strength. If more than 20 percent have values less than the specified strength, the lot represented shall be considered to be defective and not acceptable. In no case shall any cylinder tested fall below 80 percent of the specified design strength. If anyone cylinder falls below 80 percent of the specified design strength, then the entire production represented by that cylinder will not be accepted for purchase by the Contracting Agency unless the Contractor can demonstrate by coring to the satisfaction of the Engineer, that the cylinder in question is not representative of the entire production, or is representative of only a portion of the entire production."

During the fabrication of the pipe, concrete cylinders shall be made from a representative sample of the concrete. Concrete cylinders and slump tests shall be made by the Engineer or under his direct supervision. A set of cylinders shall consist of five. A minimum of one set shall be made for each day's production.

In vibrated and spun pipe, where the slump of the concrete approaches 0, the cylinders shall be made as follows:

Fill the cylinder can in 3 equal layers. Each layer shall be vibrated and assisted by rodding or other mechanical contrivance simultaneously until the moisture comes to the surface. Care shall be taken that the material is not over-vibrated which will cause segregation. When the moisture rises to the surface of the third layer, it is struck off and leveled. The cap is put on the cylinder and it is marked for identification. It shall then be steam cured in the same manner as the pipe, at the conclusion of which, the cylinders shall be brought into the laboratory for standard moist curing until the prescribed time for the compressive test.

The cylinders shall be made according to ASTM [C31](#) where the pipe is manufactured with concrete that has enough slump for the material to be hand rodded. For reinforced concrete pipe made by the centrifugal method, the manufacturer may substitute centrifugally cast test cylinders for standard test cylinders. Centrifugally cast cylinders shall be made in accordance with AWWA C302 and cured in the same manner as normal test cylinders, except that the net area of the hollow cylinder will be used to determine the compressive strength.

735.8 SANITARY SEWER PIPE:

In addition to the above, sewer pipe shall meet the requirements of ASTM [C76](#), reinforced concrete pipe having O-ring Rubber Gasket Joints with an interior lining of plastic liner plate in accordance with Section [741](#).

(A) Pipe Design: The wall thickness and the amount of circumferential reinforcement shall not be less than that required for the D-load indicated on the plans and required by the specifications. The calculations for wall thickness and amount of steel area

SECTION 735

per foot of pipe, having concrete lining, shall be for a pipe 2 inches larger in internal diameter than that specified on the plans. The additional concrete lining shall not be considered in the calculation for the area of steel required, nor in any of the load calculations.

D-load class of pipe and the date poured shall be plainly marked inside each pipe section. Specific approval must be obtained, prior to submitting a bid; to decrease the cover over the reinforcing steel at the joint should the steel interfere with the rubber gasket in the groove at the spigot end.

(B) Pipe Construction: Tamped or packer head pipe will not be allowed. Pipe having concrete lining shall have the internal diameters indicated on the plans, measured to the inside of the additional 1 inch of covering. The various sizes of pipe shall be centrifugally spun. Pipe having plastic liner plate shall be vibrocast to 1/2 inch tolerance to match the unlined pipe of the D-load indicated on the plans.

(C) Test and Acceptance: In addition to the statements above, any crack that goes completely through the pipe, regardless of length of crack is not considered acceptable whether repaired or not, except that a single end crack that does not exceed the depth of the joint as measured from the end to the inside shoulder is acceptable.

735.9 ACCEPTANCE MARK:

The Engineer may, at the place of manufacturer, indicate his acceptance of the pipe for delivery to the job by marking the pipe with the Contracting Agency's mark. Such acceptance, however, shall not be considered a final acceptance.

If the pipe is subsequently rejected, the mark placed thereon by the Engineer shall be defaced.

- End of Section -

SECTION 736

NON-REINFORCED CONCRETE PIPE

736.1 GENERAL:

The size and classes of the non-reinforced concrete pipe to be furnished shall be as shown on the plans, or as specified under the item of work for the project of which the concrete pipe is a part.

Strength classes of non-reinforced concrete shall be as identified in ASTM [C14](#), Class 1 non-reinforced concrete pipe. Class 2 non-reinforced concrete pipe or Class 3 non-reinforced concrete pipe.

Unless otherwise specified, Class 3 non-reinforced concrete pipe will be used.

736.2 MATERIALS:

Materials used in manufacturing the pipe shall be as specified in ASTM [C14](#), with the following exception:

Cement shall conform to ASTM [C150](#), Type II, and low alkali. Samples and testing shall conform to the methods designated therein. The pipe manufacturer shall supply a cement mill certificate, in triplicate, for each load of cement delivered, showing the specification, type, chemical analysis, and quantity. On stockpiled pipe in lieu of the above, the manufacturer shall certify that the type of cement used meets this specification. Satisfactory facilities shall be provided for identifying, inspecting, and sampling cement at the mill, the warehouse, and the site of the work. The Contracting Agency shall have the right to inspect the cement and obtain samples for testing at any of these points. The cement shall be stored in a weathertight, dry, well ventilated structure approved by the Engineer. Cement salvaged by cleaning cement sacks, mechanically or otherwise, shall not be used in the work. Cement containing lumps will be rejected and shall immediately be removed from the site of the work. If the temperature of the cement exceeds 150°F., it shall be stored until cooled to that temperature.

736.3 PIPE JOINTS:

The joints may be tongue and groove mortared joints, or rubber gaskets joints. With rubber gasket joints, inside mortaring and outside grouting is not required. Tongue and groove joints shall be mortared inside and grouted outside. Grouting of outside joints shall be by the diapering method.

736.3.1 Cement Mortar Joints:

(A) The mortar or grout shall consist of 1 part Portland cement and 2 parts sand, by volume. The quantity of water in the mixture shall be sufficient to produce a soft workable mortar, but shall in no case exceed a water-cement weight ratio of 0.53. Where outside joints are made by the diaper method, the grout shall be composed of 1 part cement to 3 parts sand, and shall be mixed to the consistency of thick cream. The sand shall conform to Section [776.3](#), and the cement shall conform to Section [725](#).

(B) The pipe ends shall be thoroughly cleaned and wetted with water before the mortar or grout is placed. No backfilling around the joints shall be done until the joints have been fully inspected and approved.

(C) Mortar joints shall be cured by keeping them wet for three days or by using a curing compound.

736.3.2 Rubber Gasket Joints: Rubber gaskets shall be in accordance with ASTM [C443](#) or AASHTO M-315.

736.4 CURVES, BENDS AND CLOSURES:

Horizontal and vertical long-radius curves shall be formed by slight deflection at the joints, provided that the maximum joint opening caused by such deflection shall not exceed 3/4 inch. Short radius curves shall be formed by straight pipe in which the joints are beveled. The bevel of the pipe shall not exceed 5 degrees, and the total angular deflection for beveled pipe shall not exceed 10 degrees at any joint.

SECTION 736

736.5 CARE OF PIPE AND MATERIALS:

All pipe and materials shall be manufactured, handled, loaded, shipped and unloaded in such manner as to be undamaged and in sound condition, in the completed work. Particular effort shall be exercised to protect the ends of pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer otherwise they shall not be used in the work and shall be replaced with an equal pipe or special in an acceptable condition. At all times rubber gaskets shall be stored in a cool, dark place until ready for use.

736.6 TESTS:

Before pipe is delivered to the job site for use in any work under the contract, test pipes shall meet the requirements of the hydrostatic pressure test and the loading test described in ASTM [C14](#). The test shall be made at the point of manufacturer and shall be made under the presence of the Engineer.

- End of Section -

SECTION 738

HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS FOR STORM DRAIN AND SANITARY SEWER

738.1 GENERAL:

This specification covers the requirements of profile-reinforced and corrugated (Type S or Type D) high density polyethylene (HDPE) pipe manufactured per ASTM [F894](#), AASHTO M-252 or AASHTO M-294 for gravity flow, low pressure storm drain and sanitary sewer systems. When noted on the plans or in the special provisions, gravity flow, low pressure storm drains and sanitary sewers may be constructed using HDPE pipe. The HDPE pipe will be of the sizes 8 inch diameter through 120 inch diameter. For the purpose of this specification, low pressure is defined as the test pressures of 3.5 psi of air or 4 feet of water as specified in Section [615.11](#).

All pipe joints shall conform to the controlled pressure test of 10.8 psi of air or 25 feet of water as stipulated in ASTM [D3212](#).

The size and class of the HDPE pipe to be furnished shall be designed by the Engineer and shown on the plans or in the project specifications. At no time will the class designed be less than RSC-63 for profile pipe, or minimum equivalent Pipe Stiffness (PS) for corrugated pipe per the requirements of AASHTO M-252 or AASHTO M-294.

738.2 MATERIALS:

738.2.1 Base Material Composition: Profile pipe base material and fittings shall, in accordance with ASTM [F894](#), be made from a PE plastic compound meeting the requirements of Type III, Class C, Category 5, Grade P34 as defined in ASTM [D1248](#) and with established hydrostatic design basis (HDB) of not less than 1250 psi for water at 73.4 degrees F° as determined in accordance with Method ASTM [D2837](#). Materials meeting the requirements of cell classification PE 334433 C or higher cell classification, in accordance with ASTM [D3350](#) are also suitable. Corrugated pipe base material shall comply with the requirements of AASHTO M-252 (Type S) or AASHTO M-294 (Type S or D) and have a minimum cell classification PE 335420C.

738.2.2 Other Pipe Materials: Materials other than those specified under Base Materials shall comply with ASTM [F894](#), AASHTO M-252 or AASHTO M-294.

738.2.3 Gaskets: Rubber gaskets shall be manufactured from a natural rubber, synthetic elastomer or a blend of both and shall comply in all respects with the physical requirements in ASTM [F477](#).

738.2.4 Water Stops: Water stops shall be manufactured from a natural or synthetic rubber and shall conform to the requirements of ASTM [C923](#). The water stop shall have expansion rings, a tension band, or a take-up device used for mechanically compressing the water stop against the pipe.

738.2.5 Thermal Welding Material: The material used for thermally welding the pipe material shall be compatible with the base material.

738.2.6 Lubricant: The lubricant used for assembly shall comply to manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

738.3 JOINING SYSTEMS:

738.3.1 Gasket Type: Joints for the piping system and fittings shall consist of an integrally formed bell and spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket located on the spigot is compressed radially on the pipe or fitting bell to form a water tight seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM [F477](#).

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configurations for the fittings shall be compatible to those used for the pipe.

SECTION 738

Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear, shall be smooth and free of any imperfections, which would adversely affect sealability. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

738.3.2 Thermal Weld Type: The pipe ends shall consist of an integrally formed bell and spigot, with or without the elastomeric centering gasket, which join together to form an interface between bell and spigot, such that it is suitable to seal by thermal weld using the extrusion welding process, in accordance with the manufacturer's recommended procedure.

Thermal welded joints may be effected by welding from inside the pipe or outside, or both.

The assembly of the welded joints shall be in accordance with the manufacturer's recommendations.

Thermal welded joints shall be used only when specified on plans or in specifications.

738.4 FITTINGS:

Fittings for HDPE profile wall or corrugated pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket type or thermal weld type joints in accordance with Subsection [738.3](#).

A clamp gasket or approved method shall be provided at manhole entry or connection to reduce infiltration and exfiltration. Where precast manholes are used, entrance holes must be large enough to allow for proper grouting around the manhole gasket. A non-shrink grout shall be used for grouting.

738.5 CERTIFICATION:

The manufacturer shall furnish an affidavit (certification) that all materials delivered shall comply with the requirements of ASTM [F894](#) or AASHTO M-252.

Pipe and resin producers that manufacture according to AASHTO M-294 shall be certified according to the Plastic Pipe Institute protocol for their Third Party Certification Program.

738.6 DIMENSIONS AND TOLERANCES:

Profile wall HDPE pipe dimensions shall comply with dimensions given in Table 1 of ASTM [F894](#). The "average or nominal inside diameter" of profile wall HDPE pipe shall not deviate from its normal pipe size by more than as specified in Table 1 of ASTM [F894](#). Corrugated HDPE pipe dimensions shall be "nominal inside diameter" dimensions and shall not deviate from its nominal pipe size by more than the minimum and maximum tolerances as described in AASHTO M-252 or AASHTO M-294, Section 7.2.3.

Profile pipe shall have a Ring Stiffness Constant (RSC) or Pipe Stiffness (PS) as shown on the plans. The minimum RSC for profile HDPE pipe shall be RSC-63. The minimum PS for corrugated pipe shall be as shown in AASHTO M-252 (Section 7.5) or AASHTO M-294 (Section 7.4), and tested per ASTM [D2412](#). In no case shall the minimum PS be less than the equivalent PS value for RSC-63.

738.7 CLASSIFICATIONS:

HDPE profile-reinforced pipe products shall be made in four standard Ring Stiffness Constant (RSC) classifications, 40, 63, 100 and 160. These are referred to as RSC-40, RSC-63, RSC-100 and RSC-160. The RSC test shall be conducted in accordance with ASTM [D2412](#) with the exceptions listed in accordance with ASTM [F894](#). HDPE corrugated pipe (Type S or Type D) shall meet the minimum Pipe Stiffness (PS) requirements of AASHTO M-252 or AASHTO M-294. The PS test shall be conducted in accordance with ASTM [D2412](#) with the exceptions listed in accordance with AASHTO M-252 or AASHTO M-294.

SECTION 738

738.8 MARKINGS:

Markings on pipe shall be per ASTM [F894](#), AASHTO M-252 or AASHTO M-294. These markings shall be clearly shown on the pipe at intervals of approximately 12 feet and include but not limited to the following: the manufacturer's name or trademark, nominal size, the specification designation, plant designation code, date of manufacture or an appropriate code. All fittings shall be marked with the designation number of the specification and with the manufacturer's identification symbol. In addition, manufacturers of corrugated HDPE, AASHTO M-294, shall print on or affix the appropriate Plastic Pipe Institute Program Mark on each length of pipe produced that meets the requirements of the program.

738.9 CARE OF PIPE AND MATERIALS:

Care of pipe materials shall comply with Subsection [736.5](#).

HDPE profile reinforced RSC type pipe in shipping or storage shall not be stacked higher than three rows for pipes 21 inches in diameter or less, nor higher than two rows for pipes 24 to 36 inches in diameter inclusive. Pipe shall not be stacked, shipped, or stored with weight on the bells of the pipe.

Corrugated HDPE pipe in shipping and storage shall be stacked per manufacturer's recommendation, but in no case higher than 5 rows for pipe 24 inches or less in diameter, or 3 rows for pipe greater than 24 inches in diameter.

Pipe that is gouged marred or scratched forming a clear depression shall not be installed and shall be removed if damaged in the installation.

- End of Section -

SECTION 739

STEEL REINFORCED POLYETHYLENE PIPE AND FITTINGS FOR STORM DRAIN, IRRIGATION AND SANITARY SEWER

739.1 GENERAL:

This specification covers the requirements of Steel Reinforced Polyethylene (SRPE) pipe manufactured per ASTM [F2562](#) for storm drains, irrigation and sanitary sewer systems. When noted on the plans or in the special provisions, storm drains, irrigation and sanitary sewers may be constructed using SRPE pipe. SRPE pipe shall be designed in accordance with AASHTO LRFD Bridge Design. Specifications, Section 12. Trench excavation, backfilling and compaction for this flexible pipe shall be in accordance with Section [601](#). Construction and installation shall be in accordance with Section [618](#) for storm drain and irrigation water or Section [615](#) for sanitary sewers.

The pipe stiffness class shall be Class 1, per Table 1 of ASTM [F2562](#), unless otherwise specified.

739.2 MATERIALS:

739.2.1 Base Steel Materials: Continuous high strength galvanized ribs shall be cold rolled steel meeting the requirements of either ASTM [A1008](#) or ASTM [A1011](#) with minimum yield strength of 80,000 psi. The steel shall have a galvanized coating meeting the requirements of ASTM [A653](#) with a G60 minimum coating weight. Steel ribs shall be completely encased within the HDPE profile.

739.2.2 HDPE Material Composition: SRPE pipe HDPE material and fittings shall, in accordance with ASTM [F2562](#), be made from HDPE plastic compound meeting the minimum requirements of cell classification 335464C or higher cell classification, in accordance with ASTM [D3350](#).

739.2.3 Gaskets: Elastomeric gaskets shall comply with the requirements in ASTM [F477](#) and be as recommended by the pipe manufacturer.

739.2.4 Water Stops: Elastomeric Water stop gaskets shall conform to the requirements of ASTM [C923](#).

739.2.5 Thermal Welding Material: The material used for thermal welding of the pipe shall be compatible with the pipe's base material.

739.2.6 Lubricant: The lubricant used for assembly shall comply with manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

739.3 JOINING SYSTEMS:

739.3.1 Gasket Type: Steel reinforced bell and spigot joints for the piping system and fittings shall consist of an integrally formed bell and spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket located on the spigot is compressed radially on the pipe or fitting bell to form a water tight seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM [F477](#). Gasketed watertight pipe joints shall meet a minimum laboratory test pressure of 10.8 psi when tested in accordance with ASTM [D3212](#).

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made. The bell and spigot configurations for fittings shall be compatible to those used for the pipe.

Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear, shall be smooth and free of any imperfections, which would adversely affect the seal. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

739.3.2 Thermal Weld Type: Thermal weld joints, when specified, shall utilize plain ended pipe welded together by internal pressure testable couplers. The internal couplers shall have a minimum wall thickness equal to or greater than the pipe wall thickness as defined in ASTM [F2562](#). The assembly of the welded joints shall be in accordance with the manufacturer's recommendations. Thermal welded pipe joints shall meet a minimum laboratory test pressure of 10.8 psi when tested in accordance with ASTM [D3212](#).

SECTION 739

739.3.3 Pipe to Concrete Structure Connections: An approved flexible connector, mechanical seal or water stop shall be provided at manhole entry or concrete structure connection to reduce infiltration and exfiltration. When grouting is necessary at a water stop connection, non-shrink grout shall be used.

739.4 FITTINGS:

Fittings for SRPE pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket type or thermal weld type joints in accordance with Subsection [739.3](#).

739.5 CERTIFICATION:

The manufacturer shall furnish a certification that all delivered materials comply with the requirements of ASTM [F2562](#). The certification shall also identify the steel as galvanized with a G60 minimum coating weight, 80,000 psi yield strength and the cell classification of the HDPE material as 335464C minimum.

739.6 MARKINGS:

Markings on pipe and fittings shall be per ASTM [F2562](#). The markings shall be clearly shown on the pipe, at least, at the end of each length of pipe and spaced at intervals of not more than 10 feet. Markings shall include the following information: ASTM [F2562](#), the nominal pipe size in inches, the pipe stiffness class, the manufacturer's name, trade name or trademark, the manufacturer's production code: identifying plant location, machine, and date of manufacture.

739.7 CARE OF PIPE AND MATERIALS:

All pipe, fittings, gaskets and water stop materials shall be manufactured, handled, loaded, shipped, unloaded, and installed in such a manner as to be undamaged and in sound condition, in the completed work. Particular effort shall be exercised to protect the ends of the pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer or removed from the project site. Rubber Elastomeric gaskets shall be covered in a factory applied protective wrap.

- End of Section -

SECTION 740

POLYPROPYLENE PIPE AND FITTINGS FOR STORM DRAIN, IRRIGATION AND SANITARY SEWER

740.1 GENERAL:

This specification covers the requirements of profile wall (both dual wall - Type S and triple wall - Type D) polypropylene (PP) pipe manufactured per ASTM [F2736](#) and AASHTO M330 for storm drain, or ASTM [F2736](#) or ASTM [F2764](#) for sanitary sewer systems. When noted on the plans or in the special provisions, storm drains, irrigation and sanitary sewers may be constructed using PP pipe. PP pipe approved sizes are 12 inch diameter through 60 inch diameter. Trench excavation, backfilling and compaction for flexible pipe shall be in accordance with Section [601](#) and manufacturer's installation recommendations. Construction and installation shall be in accordance with Section [618](#) for storm drain and irrigation water or Section [615](#) for sanitary sewers.

740.2 MATERIALS:

740.2.1 Base Material Composition: Profile pipe base material and fittings shall meet polypropylene materials requirements as stated in Section 4, Table 1 of ASTM [F2736](#), Section 5, Table 1 of ASTM [F2764](#) or Section 6, Table 1 of AASHTO M330.

740.2.2 Gaskets: Elastomeric gaskets shall comply with the requirements in ASTM [F477](#) and be as recommended by the pipe manufacturer.

740.2.3 Water Stops: Elastomeric water stop gaskets shall conform to the requirements of ASTM [C923](#).

740.2.4 Lubricant: The lubricant used for assembly shall comply with manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

740.3 JOINING SYSTEMS:

740.3.1 Gasket Type: Joints for the piping system and fittings shall consist of an integrally formed bell and spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket located on the spigot is compressed radially on the pipe or fitting bell to form a water tight seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM [F477](#). Gasketed watertight joints shall meet laboratory test pressure of 10.8 psi when tested in accordance with ASTM [D3212](#).

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configurations for fittings shall be compatible to those used for the pipe.

Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear, shall be smooth and free of any imperfections, which would adversely affect the seal. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

740.3.2 Pipe to Concrete Structure Connections: An approved flexible connection, mechanical seal, or water stop shall be provided at manhole entry or concrete structure connections to reduce infiltration and exfiltration. When grouting is necessary at a water stop connection, non-shrink grout shall be used.

740.4 FITTINGS:

Fittings for PP pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket type joints in accordance with Subsection [740.3](#).

The material used for thermally welding the fitting shall be compatible with the base pipe material.

740.5 CERTIFICATION:

The manufacturer shall furnish a certification that all delivered materials comply with the requirements of ASTM [F2736](#), ASTM [F2764](#), or AASHTO M330.

SECTION 740

740.6 MARKINGS:

Markings on pipe and fittings shall be per ASTM [F2736](#), ASTM [F2764](#) or AASHTO M330. The markings shall be clearly shown on the pipe, at least, at each end of each length of pipe and spaced at intervals of not more than 10 feet. Markings shall include the following information: the manufacturer's name or trademark, nominal size, the specification designation, plant designation code, date of manufacture or an appropriate code. All fittings shall be marked with the designation number of the specification and with the manufacturer's identification symbol.

740.7 CARE OF PIPE AND MATERIALS:

All pipe, fittings, gaskets, and water stop materials shall be manufactured, handled, loaded, shipped, unloaded, and installed in such manner as to be undamaged and in sound condition, in the completed work. Particular effort shall be exercised to protect the ends of pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer or removed from the project site. At all times elastomeric gaskets shall be covered in a factory applied protective wrap until ready for use.

- End of Section

SECTION 741

LINING FOR REINFORCED CONCRETE SANITARY SEWER PIPE

741.1 GENERAL:

The interior area of the reinforced concrete pipe as indicated on the plans, shall be sealed and protected with lining, as specified below.

The installation and application of the pipe lining shall be accomplished by the supplier of the reinforced concrete pipe.

All work for and in connection with the installation of lining in concrete pipe and the field sealing of joints shall be done in strict conformance with all applicable published specifications, instructions and recommendations of the approved lining manufacturer. The pipe supplier shall furnish all labor, material and equipment to successfully accomplish the lining.

741.2 MATERIALS:

741.2.1 Material Composition: The material shall be a liner plate which is a combination of inert, synthetic resins, pigments, and plasticizers, compounded to make permanently flexible sheets.

The liner plate shall be resistant to the following: Oxidizing agents, sulfuric, phosphoric, nitric, chromic, oleic, and stearic acids; sodium and calcium hydroxides; ammonia, sodium, calcium, magnesium, and ferric chlorides; ferric sulfate, petroleum oils and greases; vegetable and animal oils, fats, greases and soaps.

Liner plate shall be impermeable to sewage gasses and liquids and shall be non-conductive to bacterial or fungus growth. All liner plates shall be factory checked electrically to insure freedom from any porosity with a high voltage holiday detector set at a minimum of 20,000 volts.

Joint strips and welding strips shall have the same composition and corrosion resistance as liner plate, but shall not have locking extensions.

The lining shall have good impact resistance, shall be flexible and shall have an elongation sufficient to bridge up to 1/4 inch setting crack which may take place in the pipe or in the joint after installation, without damage to the lining.

Once cast into the pipe, the lining shall be permanently and physically attached to the concrete by a locking extension and shall not rely on an adhesive bond.

741.2.2 Material Details and Dimensions: The liner plate shall not be less than 0.065 inches in thickness. Locking extension shall be of the same material as the liner and shall be integrally extruded with the sheets. If steel bands are used to secure the liner plate to the forms transversely, strap channels shall be integrally molded into the sheet.

Liner plate shall be supplied as pipe size sheets fabricated by shop welding together the basic size sheets.

Joint straps shall be 4 inches \pm 0.25 inches in width and shall have each edge beveled prior to application.

Welding strips shall be 1 inch \pm 0.125 inch in width and shall have the edges beveled at time of manufacture.

The Contractor shall submit a shop drawing showing liner plate details for approval by the Engineer, prior to fabrication of the pipe.

741.3 INSTALLATION OF LINER PLATE:

The installation of liner plate, including the welding of all joints, shall be done in accordance with the manufacturer's recommendations. Nailing through the plate will not be tolerated. Liner plate shall be installed with locking extensions parallel with the longitudinal axis of the sewer, unless otherwise shown on the plans. All joints between individual sheets or sections of liner plates shall be continuously heat-welded by the use of welding strips of the same kind and equivalent thickness of material as the liner plates (with the exception of the integral extension ribs).

SECTION 741

Liner plate shall be held snugly in place against inner forms by means of light gage steel wire, light steel banding straps or other suitable means. If steel banding straps are used, they shall be applied in strap channels provided for this purpose.

Locking extensions (T-shaped) shall be integrally extruded to all lower, terminal or longitudinal edges of liner plate as applied to concrete pipe. If banding straps are used, a steel rod 1/4 inch in diameter may be inserted in each locking extension along the longitudinal edges of each sheet of liner plate for concrete pipe or some other approved method for holding the lower edge of the liner plate snugly against the form shall be provided.

Concrete poured against liner plate shall be compacted in a careful manner so as to protect the liner plate and to produce a dense, homogeneous concrete securely anchoring the lock extensions into the concrete.

In removing forms, care shall be taken to protect liner plate from damage. Sharp instruments shall not be used to pry forms from lined surfaces. All holes and cut, torn or seriously abraded areas in the liner plate shall be patched. Patches made entirely with welding strip shall be fused to the liner plate over the entire patch. Larger patches may consist of smooth liner plate applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the sound liner plate adjoining the damaged area.

The Contractor shall take all necessary measures to prevent damage to installed liner plate from equipment and materials used in or taken through the work.

The applied lining shall be free from bubbles due to poor workmanship, and the Contractor shall cut out said bubbles and weld a similar sheet in place of the bubble, unless otherwise directed by the Engineer.

Application on Concrete Pipe-Special Requirements: Liner plate shall be set flush with the inner edge of the bell or groove end of a pipe section and shall extend to the spigot or tongue end or to approximately 3 inches beyond the tongue end, depending upon the type of liner plate to be made with the adjoining concrete pipe.

Wherever concrete pipe, which are protected with liner plate, join structures not so lined, such as brick structures, concrete pipe, cast-in-place structures or clay pipe, the liner plate shall be extended over and around the end of the pipe and back into the structure for not less than 4 inches.

Where a pipe spur, not of plastic lined concrete, is installed through lined concrete pipe, the liner plate shall be returned 4 inches at the surface of contact. The seal between the liner plate and the spur shall be made using an approved adhesive material and strapped in place.

If the joint space is too wide or the joint space surface too rough to allow satisfactory sealing with this adhesive, the joint space shall be filled with 2 inches of densely caulked lead wool or other approved caulking material.

Lined concrete pipe may be cured by standard curing methods. Care shall be exercised, in handling, transporting and placing lined pipe to prevent damage to the liner plate. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or with a suitable fork lift.

No pipe with damaged lining will be accepted until and unless the damage has been repaired to the satisfaction of the Engineer.

741.4 FIELD JOINTS:

The Contractor shall obtain the services of qualified personnel to weld the liner plate field joints. Pipe joints must be dry before the liner plate joints are made. All mortar and other foreign material shall be removed from liner plate surfaces adjacent to the pipe joint, leaving them clean and dry.

No liner plate joints shall be made until the trench has been backfilled.

Field joints in the liner plate at pipe joints may be either of the following described types:

Type P-1- The joint shall be made with a separate 4 inch joint strip and 2 welding strips. The 4 inch strip shall be centered over the joint, secured to the liner plate with an approved adhesive, or other approved means, and welded along each edge to adjacent liner plate with a 1 inch weld strip. The width of the space between adjacent liner plate sheets shall not exceed 2 inches. The

SECTION 741

4 inch joint strip shall lap over each liner plate a maximum of 1 inch. Type P-2 - The joint shall be made with a plastic strip, without locking extensions integrally extruded with the liner plate and extending approximately 3 inches beyond the spigot end. A 1 inch welding strip is required. The joint strip shall overlay the liner plate a minimum of 1 inch on the downstream side of the pipe joint. An approved adhesive, or other approved means, shall be used to hold the lap in place during the welding. The joint strip on beveled pipe shall be trimmed to a width, measured from the end of the spigot, of approximately 3 inches for the entire circumferential length of the liner. Distortion in bending back the strip to expose the pipe joint during the laying and joint mortaring shall be avoided. All welding of joints is to be in strict conformance with liner plate manufacturer's specifications.

Type P-4 - The joint shall be made with a 4 inch weld strip. The 4 inch weld strip shall be centered over the joint and welded in place to the lining in adjacent joints of pipe. The weld strip shall lap over each liner plate in minimum of 1 inch.

741.5 TESTING AND REPAIRING DAMAGED LINER SURFACES:

After the pipe is installed in the trench, all surfaces covered with liner plate shall be tested with an approved electrical holiday or flaw detector set at a minimum of 20,000 volts. All welds shall be physically tested by a non-destructive probing method. All patches over nail and form tie holes, or repairs to the liner plate wherever damage has occurred, shall be done in conformance with the instructions and recommendations of the liner plate manufacturer.

Each transverse welding strip which extends to a lower edge of the liner plate shall be tested. The welding strips shall extend below the liner plate, providing a tab. A 10-pound pull will be applied normal to the face of the pipe by means of a spring balance. Liner plate adjoining the welding strip will be held against the concrete during application of the force. The 10-pound pull will be maintained if a weld failure develops, until no further separation occurs. Defective welds will be re-tested after repairs have been made. Tabs shall be trimmed away neatly after the weld strip has passed inspection. The Contractor shall provide all equipment required to test liner plate in the manner recommended by the manufacturer and as described above. The Contractor shall also provide personnel qualified to perform the testing. Testing shall be performed in the presence of a representative of the Contracting Agency.

- End of Section -

SECTION 742

PRECAST MANHOLE

742.1 GENERAL:

This specification covers requirements for precast manhole sections. All precast manhole manufacturers shall be NPCA (National Precast Association) certified and shall provide all NPCA certifications upon request. Loading criteria for the precast manholes shall meet or exceed the AASHTO H20 loading requirements. All precast manhole risers shall be monolithically cast to ensure water tightness and have a certified structural design and the manhole shall be cast in a fashion to achieve water tightness. This shall include a monolithic cast manhole or a multi section cast manhole which also shall have a certified structural design.

742.2 MATERIALS:

742.2.1 Concrete Materials: Concrete materials shall conform to the requirements of Section 725 and Table 725-1 for Class AA.

742.2.2 Precast Sections: Precast sections shall conform to ASTM [C478](#), AASHTO M199. The design shall be in accordance with ACI 318 and ASTM [C890](#) using traffic load A-16 (HS20-44).

742.2.3 Joints and Connections: Details of proposed joints and connections shall be submitted to the engineer for approval and shall conform to ASTM [C990](#), C993, or [C425](#) as applicable.

742.3 MANHOLE PENETRATIONS:

The location of penetrations shall be determined by the plans and specifications. Manhole penetrations may be formed or cut out. Cut outs of the precast base shall be done using a mechanical hole saw. After the core is removed from the casting, the precaster shall coat all exposed reinforcing with a corrosion inhibiting epoxy suitable for end use application. The thickness of the epoxy shall be per the epoxy manufacturer's recommendation. Knock outs shall be formed in the location noted on the plans or specifications.

742.4 REINFORCING:

Reinforcing steel shall meet the following specifications:

- Bars ASTM [A615](#) or [A706](#)
- Wire and wire fabric ASTM [A1064](#)

Design of the reinforcing shall be in accordance with ACI 318 and ASTM [C890](#)

742.5 GASKETS:

A flexible pipe to manhole connector shall be used whenever a pipe penetrates into a precast concrete manhole or structure. The design of the connector shall provide a flexible, watertight seal between the pipe and the concrete. The connector shall assure that a seal is made between the structure wall and the pipe by:

- Casting the connector integrally with the structure wall during the manufacturing process in a manner that will not pull out during pipe coupling.
- Compressing the connector against the inside circumference of the structure by means of wedge or toggle style connection, expansion ring or other means approved by the engineer.

The connector shall be made from materials that conform to the physical and chemical requirements in ASTM [C923](#) or [C425](#) as applicable. The connector shall be sized specifically for the type of pipe being used and shall be installed in accordance with the recommendations of the manufacturer.

The connection hardware shall be constructed of type 316 stainless steel meeting ASTM [A480](#). The hardware shall ensure a water tight connection between the concrete and the pipe material and shall provide an adequate seal enough to withstand the negative air pressure test per ASTM [C1244](#).

SECTION 742

742.6 LIFTING POINTS:

Lifting points shall be designed and evaluated by a registered professional engineer and have a minimum safety factor of four. There shall be a minimum of two lifting points on every precast manhole base. After base installation, the lifting holes shall be thoroughly packed with a pre-packaged non-shrink grout. Bent reinforcing steel bars shall not be used as lifting devices. Through lifting holes will not be allowed.

742.7 IMPERFECTIONS:

Any imperfections which in the opinion of the engineer may adversely affect the performance of the precast section shall be cause for rejection.

– End of Section –

SECTION 743

VITRIFIED CLAY PIPE

743.1 GENERAL:

Vitrified clay pipe, 30 inch diameter or less, shall be extra strength in accordance with the requirements set forth in ASTM [C700](#), except as modified herein. Pipe larger than 30 inches shall be of the type specified in the Special Provisions.

743.2 MANUFACTURING REQUIREMENTS:

743.2.1 Shape: Pipe ends shall be square with the longitudinal axis, and sockets shall be true, circular, and concentric with the barrel of the pipe.

The ends of the pipe shall be so formed that when the pipes are laid together and the joints made, they shall constitute a continuous and uniform line of pipe and shall have a smooth and regular interior surface.

743.2.2 Stoppers, Branches, Ends: Stoppers shall be used with all branch pipes that are to be left unconnected. Stoppers for branch pipes having flexible compression joints may be either clay discs with flexible compression joints, factory applied, that will mate with the branch joint; or, a resilient material of controlled design and dimensions for mating with the branch pipe to which it is to be applied; or, of other material approved by the Engineer. Wooden stoppers will not be accepted.

Branches shall be furnished with connections of the sizes specified, securely and completely fastened to the barrel of the pipe in the process of manufacture.

“T” branches shall have their axis perpendicular to the longitudinal axis of the pipe. “Y” branches shall have their axis 45 degrees (unless otherwise specified) from the longitudinal axis of the pipe, measured from the socket end.

All branches shall terminate in sockets. Barrel of the branch shall be of sufficient length to permit making proper joint when the connecting pipe is inserted in the branch socket.

743.2.3 Imperfections: The following additional imperfections in a pipe or fittings will be considered injurious and cause for rejection:

(A) Any surface fire crack in the ends of the spigot or bell which exceeds 1 inch in length.

(B) Any piece broken from the bell end of the pipe or fittings when it adversely affects the performance of the joint or connection.

743.2.4 Certification: A certificate from the manufacturer shall be furnished attesting that the pipe meets the requirements of this specification, including test reports for the hydrostatic pressure test and the loading test herein specified.

743.3 TESTS:

In addition to the required tests at the manufacturer's plant, the Engineer's representative may select specimens at random at the point of delivery or at the job site. Tests on these specimens shall be performed at a local testing facility under the supervision of the Engineer's representative. The cost of such supervision will be borne by the Contracting Agency and all other costs shall be borne by the Contractor.

When the pipe is subjected to an internal hydrostatic pressure of 10 psi for the time shown in Table [743-1](#), the accumulated moisture on the exterior surface shall not run down the sides in such quantity that will exceed 10 milliliters.

SECTION 743

TABLE 743-1	
TABLE OF TESTING TIME FOR PIPES	
Thickness of Wall Inches	Test Time Minutes
Up to and including 1	7
Over 1 and including 1 1/2	9
Over 1 1/2 and including 2	12
Over 2 and including 2 1/2	15
Over 2 1/2 and including 3	18
Over 3	21

The loading test shall conform in manner to that specified in ASTM [C301](#) for 3-edge bearing and shall be applied to all specimens selected for testing.

743.4 IDENTIFICATION MARKS:

Pipe and fittings shall be clearly marked with the name or trademark of the manufacturer, a code number identifying production control and plant location, and extra strength designation.

743.5 JOINTS:

Acceptable joints shall be flexible compression type for bell and spigot pipe or flexible compression couplings for plain-end pipe.

Compression joints and couplings shall conform to the requirements of ASTM [C425](#).

- End of Section -

SECTION 745

PVC SEWER PIPE AND FITTINGS

745.1 GENERAL:

This specification covers the requirements of polyvinyl chloride (PVC) plastic sewer pipe and fittings for gravity flow sewers and building connections. When noted on the plans or in the special provisions, gravity sanitary sewers may be constructed using PVC pipe for diameters not exceeding 15 inches. Pipe, fittings, couplings and joints shall be in conformance with the requirements of ASTM [D3034](#), SDR-35, except as modified herein.

745.2 MATERIALS:

745.2.1 Caps and Plugs: Caps and plugs for building connections may be molded or fabricated from rubber, polyurethane or other suitable compound.

745.2.2 Gaskets: Rubber gaskets shall be manufactured from a synthetic elastomer and shall comply in all respects with the physical requirements specified in ASTM [F477](#).

745.2.3 Lubricant: The lubricant used for assembly shall have no detrimental effect on the gasket or on the pipe.

745.3 JOINING SYSTEMS:

Joints for the piping system and fittings shall consist of an integral bell gasketed joint designed so that when assembled, the elastomeric gasket located within the bell is compressed radially on the pipe or fitting spigot to form a positive seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service.

All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configurations for the fittings shall be compatible to those used for the pipe.

Joints shall provide a permanent seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear shall be smooth and free of any imperfections which could adversely affect sealability.

The assembly of the joints shall be in accordance with the pipe manufacturer's recommendations.

745.4 FITTINGS:

Fittings for PVC pipe may include elbows, wyes, tee wyes, double bell couplings, manhole couplings, manhole adapter rings, plugs, caps, adapters and increasers.

Manholes couplings shall be manufactured from asbestos cement and incorporate an elastomeric gasket moisture barrier.

745.4.1 Manhole Connections: A manhole adapter gasket or approved equivalent method shall be provided at manhole entry or connection to prevent infiltration and exfiltration. Where precast manholes are used, entrance holes shall be large enough to allow for proper grouting around the manhole ring.

745.5 CERTIFICATION:

A certificate from the manufacturer shall be furnished certifying that the pipe and fittings meet the requirements of ASTM [D3034](#), SDR-35, F/ΔY 2.5% min. Y = 46 psi at 5% deflection.

745.6 IMPERFECTIONS:

Any imperfections which in the opinion of the Engineer may adversely affect the performance of the pipe or joints shall be cause for rejection.

- End of Section -

SECTION 750

IRON WATER PIPE AND FITTINGS

750.1 CAST IRON WATER PIPE:

All cast iron water pipe shall be designed in accordance with AWWA C-101.

Cast iron water pipe may be designed for either 18/40 or 21/45 physicals and shall conform to AWWA C-106 or AWWA C-108.

Except as otherwise provided cast iron or water pipe shall be designed to meet internal pressure of 150 psi, external cover of 5 feet, and standard Laying Condition B.

Cast iron pipe shall be nominal 18 foot lengths.

Pipe shall be cement mortar lined and seal coated in accordance with AWWA C-104.

750.2 DUCTILE IRON WATER PIPE:

All ductile iron water pipe shall be designed in accordance with AWWA C-150 and shall be manufactured in accordance with AWWA C-151. The class shall be as designated in the plans or special provisions.

Pipe shall be cement mortar lined and seal coated in accordance with AWWA C-104.

750.3 JOINT REQUIREMENTS:

Push-on joints for cast iron or ductile iron water pipe shall conform to AWWA C-111 and shall include synthetic rubber gaskets and lubricant.

Mechanical joints for cast iron or ductile iron water pipe shall conform to AWWA C-111 and shall include cast iron glands, synthetic rubber gaskets, and T-head bolts and nuts.

Flanged joints for cast iron or ductile iron water pipe shall be as detailed on the plans or as designated in the special provisions.

Restrained Joints:

When noted on plans or approved by the Engineer, joints for push-on or mechanical jointed ductile pipe may be modified to provide a fully restrained joint. These modifications to push-on and mechanical joints, including but not limited to segmented or special glands and split sleeves, shall conform to AWWA C-111. The Engineer shall review and/or approve each manufacturer's modifications to the joint. Upon request of the Engineer, the manufacturer of the modified joint shall provide test data showing compliance with AWWA C-111.

750.4 FITTINGS:

Iron fittings shall be either Gray-Iron or Ductile Iron conforming to AWWA C-110 or AWWA C-153 with a minimum pressure rating of 250 psi. Flanged ends shall conform to AWWA C-110. Push-on and mechanical joints ends shall conform to AWWA C-111.

Fittings shall be cement mortar lined and coal-tar coated in accordance with AWWA C-104.

- End of Section -

SECTION 752

ASBESTOS-CEMENT WATER PIPE AND FITTINGS

752.1 GENERAL:

These specifications cover asbestos-cement pressure pipe intended for use in supply lines and distribution systems that carry water under pressure.

752.2 CLASSES:

Asbestos-cement pipe shall be manufactured and tested in accordance with AWWA C-400, except as modified herein, for pipe intended for use in water service at maximum operating pressures of 100, 150, or 200 psi. Pipe shall be designated as Classes 100, 150, or 200 respectively, for the corresponding maximum operating pressures. Unless shown otherwise on the plans or specified in the special provisions the minimum acceptable shall be Class 150.

752.3 MANUFACTURE:

The joining ends of the pipe shall be of such design that they may be properly connected to cast iron fittings and valves which are manufactured within the continental United States that meet applicable AWWA specifications. Pipe in sizes less than 6 inches in diameter may be supplied in either 10 foot or 13 foot lengths, and pipe in sizes 6 inches or greater in diameter shall be supplied in 13 foot lengths, except for random and special short lengths in all sizes as permitted in AWWA C-400.

752.4 INSPECTING AND TESTING:

The uncombined calcium hydroxide in the pipe and couplings shall not exceed 1 percent when tested in accordance with AWWA C-400. Certification of all manufacturers' tests in accordance with AWWA C-400 shall be required. In addition, the Contracting Agency may require all inspection and testing to be performed at the manufacturer's plant or at an approved testing laboratory.

All pipe manufactured outside the United States of America will be subject to inspection and testing by the Contracting Agency at the plant site or at an approved testing laboratory. In addition, all pipes shall have the Underwriters Laboratory, Inc. seal of approval and certification that all tests were in accordance with AWWA C-400.

752.5 FITTINGS:

Fittings shall be cast iron or ductile iron and conform to AWWA C-110 or C-153 for 250 psi minimum working pressure rating cast on fittings. All fittings shall have Ring-Tite, Fluid-Tite, or Weld-Tite bells to fit the class of pipe specified. All fittings shall be cement lined in accordance with AWWA C-104.

752.6 RUBBER RINGS:

Each coupling shall have 2 synthetic rubber joint sealing rings conforming to the requirements of ASTM [D1869](#). This paragraph shall also apply to the rings furnished for use with fittings. Neoprene shall not be used.

- End of Section -

SECTION 753

GALVANIZED PIPE AND FITTINGS

753.1 GENERAL:

All galvanized pipe shall be new galvanized welded or seamless steel pipe, conforming to the requirements of ASTM [A53](#) standard weight, schedule 40.

753.2 CORROSION PROTECTION:

All buried galvanized pipe and fittings shall be protected from corrosion by the application of a tight fitting, extruded or wrapped coating. Coating shall be not less than 0.030 inches in thickness at any point. Extruded coatings shall be of polyethylene or polyvinyl chloride, Extrucoat or equal. Wrapped coatings shall be of polyethylene, polyvinyl chloride, coal tar or asphalt tape, Pretecto Wrap No. 200, Saft-t-Clad FOS No. 655, Tapecoat, Trantex VID-10 or E-12, Polyken No. 900, Scotchrap No. 50 or approved equal Tape shall be edge lapped no less than 1/4 inch.

753.3 FITTINGS:

All fittings for screwed galvanized pipes shall be 150 psi, banded, galvanized malleable iron screwed fittings.

753.4 VALVES:

Valves on galvanized pipelines shall be all bronze, double disc, nonrising stem with wheel handle on top, such as Jones, J373 or equal, with bodies, bonnets, yokes and wedges made of material conforming to ASTM [B62](#).

- *End of Section* -

SECTION 754

COPPER PIPE, TUBING AND FITTINGS

754.1 PIPE AND TUBING:

All copper pipe and tubing shall be new seamless copper pipes and tubes, designed for underground water services, plumbing purposes, etc. They shall conform to all the requirements of ASTM [B88](#), Type K.

All pipe or tubing shall be made of copper free from cuprous oxide, as determined by microscopic examination at a magnification of 75 diameters.

Type K tubing, when furnished in coil, shall be annealed after coiling.

754.2 FITTINGS:

All fittings used in connection with copper pipe or tubing, shall be copper or bronze fittings as shown on standard details.

Service Material containing Brass or Bronze must comply with the current NSF 61-8 Standards at the time the Project begins.

All Brass or Bronze service material must meet the current AWWA C-800 Standards.

- *End of Section* -

SECTION 755

POLYETHYLENE PIPE FOR WATER DISTRIBUTION

755.1 GENERAL:

This specification is intended to describe water service pipe with a hydrostatic design stress of 620 psi for water at 73.4 °F produced from a high density ultrahigh molecular weight polyethylene pipe compound. Polyethylene pipe used for water distribution shall conform to all the requirements of ASTM [D2239](#) and with the additional provisions listed herein. This specification describes pipe of the nominal I.D. and O.D. size as manufactured by Carlon, Celanese, Orangeburg, Phillips 66 Drisco pipe and Triangle Aycee and shall provide a water pressure tight joint when used with compression type fittings.

Service Material containing Brass or Bronze must comply with the current NSF 61-8 Standards at the time the project begins.

All Brass or Bronze service material must meet the current AWWA C-800 Standards.

Pipe may be rejected for failure to comply with any requirements of these specifications.

755.2 MATERIAL:

The polyethylene extrusion compound from which the pipe is extruded shall meet the requirements of Type III, Grade 34, Class C, material as described in ASTM [D1248](#), except that the melt index shall be determined under a higher temperature than ASTM [D1238](#). The test condition shall be as specified below under tests of pipe.

The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other defects. The pipe shall be uniform in color, opacity, density, and other physical properties.

755.3 PIPE DIMENSION AND TOLERANCES:

The average inside diameters, wall thickness, and respective tolerances shall be, for any cross-section, as shown in ASTM [D2239](#), when measured in accordance with ASTM [D2122](#).

The standard thermoplastic pipe dimension ratio (SDR), the ratio of the pipe diameter to wall thickness, shall not exceed 7 for 160 psi design pressure.

755.4 MINIMUM BURST PRESSURE:

The minimum burst pressure for pipe made from Type III, Grade 34, Class C, polyethylene compound, Designation Code: PE-3406, when determined with at least 5 specimens shall be at least equal to 630 psi for water at 73.4°F. Pressures shall be determined in accordance with ASTM [D1599](#).

755.5 SUSTAINED PRESSURE:

In addition to passing the sustained pressures given in ASTM [D2239](#) for a temperature of 100°F. and 73.4°F. the pipe shall withstand, without failing, ballooning, bursting or weeping for a period of at least 300 hours, at $194 \pm 2^\circ\text{F.}$, 113 psi test pressure for 3/4 inch pipe and 112 psi for 1 inch pipe. These test pressures have been calculated on a basis of a 450 psi fiber stress. The test procedure outlined in ASTM [D1598](#), shall be followed.

755.6 TESTS OF PIPE:

The pipe must be able to meet all tests that are specified in ASTM [D2239](#), and the following test for melt index, as determined in ASTM [D1238](#). Pellets of the original resin, placed into the testing device shall have flow rates as follows:

(A) Less than 0.5 grams per 10 minutes at 310°C with a plunger load of 27.5 pounds for pipe or tubing extruded by the Allied Chemical Process.

(B) Less than 3 grams per 10 minutes at 190°C with a plunger load of 47.65 pounds for pipe and tubing extruded by the Phillips Extrusion Process.

SECTION 755

755.7 CERTIFICATION BY MANUFACTURER:

Each Contractor must be able to furnish a certification from the manufacturer of the pipe that the polyethylene plastic pipe is of uniform quality and will fully comply with these specifications, and that the pipe is manufactured of virgin polyethylene, that no scrap material has been used, and that it is satisfactory for potable water, in accordance with the specifications of the National Sanitation Foundation Testing Laboratories, Inc.

The pipe manufacturer shall further supply a copy of certification from the manufacturer of the polyethylene extrusion compound used to make the pipe that the compound fully complies with these specifications.

The manufacturer must have adequate equipment and quality control facilities to be sure that each extrusion of pipe is uniform in texture, dimension and strength, and have so manufactured this class of pipe in sufficient quantities to be certain that it will meet all normal field conditions of usage.

755.8 PIPE IDENTIFICATION:

The pipe shall be permanently marked indicating size and pressure-temperature rating. The appropriate lettering shall occur on the pipe at least once in every 24 inches. The seal of approval or marking of the testing laboratory shall be included in the marking on all pipes that is intended for transporting potable water.

PE PIPE MARKINGS

REQUIRED MARKINGS, EXAMPLE

Size	—	Pressure	—	Temp Rating	—	Test Lab. Seal
3/4"		160 psi		PE 3406		NSF

OTHER MARKINGS(Not required by Spec. to be marked)
(However pipe must comply)

SDR-7 (Shall not exceed 7)

CS-255-63 (This is a commercial standard designation of the U.S. National Bureau of Standard. Any other number (CS——) is wrong)

NOTE: 3/4 inch Pipe has I.D. 0.824 inch, O.D. 1.060 inch and 3.328 inch circumference.
3/4 inch Tubing is not acceptable and has I.D. 0.681 inch, O.D. 0.875 inch, 2.747 inch circumference and an SDR-9 if shown.

- End of Section -

SECTION 756

DRY BARREL/FIRE HYDRANTS

756.1 GENERAL:

Fire Hydrants furnished by the Contractor shall be designed, manufactured, and tested in compliance with the latest edition of the American Water Works Association (AWWA) - C. 502 Standard for Dry-Barrel Fire Hydrants, supplemented as follows:

756.2 DRAWINGS:

Detail drawings or blue prints showing all components, principal dimensions, construction details and materials used shall be submitted to the Contracting Agency for approval. The Contracting Agency reserves the right to consider the quality, appearance and past performance of fire hydrants when reviewing drawings for approval.

756.3 HYDRANTS:

Fire hydrant makes and models (and approved alternates) shall be specified by the owner and designated on an approved products list, which will be maintained by the owner. Alternate hydrants by request only to Owner. The diameter of the main valve seat opening shall be not less than 5 inches in diameter. The entire valve assembly shall be effectively sealed against moisture.

All interior ferrous surfaces of the shoe exposed to fluid flow (including the valve plate and cap nut), shall be epoxy coated to a minimum dry thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C 550-81, NSF 61 approved, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

Style of inlet shoe connections shall be a restrained mechanical joint with accessories, gland, bolts, gaskets and having a 6 inch diameter inlet connection. Solid flange or ring tight "bump in" connections will not be allowed unless through exception by owner. Facing of the main valve against seats shall be rubber or synthetic rubber. The top of the stem or bonnet shall be equipped with the O ring seal. Hydrants shall be constructed so that extension sections in multiples of 6 inches, with rod and coupling, can be added to increase barrel length. The hose and streamer nozzle connections shall match the standard size and threads per inch of the Contracting Agency. Operating and outlet nozzle cap nuts shall be of solid pentagonal shape. The pentagon shall measure fifteen sixteenths to thirty one thirty seconds inch on side, 1 1/2 inch from point to flat. All barrels above ground shall have a prime coat and painted with two coats of fire hydrant yellow paint or as specified by owner. Hydrants shall be constructed so that the standpipe can be rotated 360 degrees to at least 8 different positions.

Hydrants shall be designed for a 250 psi working pressure and factory bench tested to a 500 psi hydrostatic pressure.

Hydrants shall be field tested consistent with the specified pressure ratings for the connecting pipes or as specified by AWWA.

Hydrants shall be of the break flange traffic model type with a replaceable breakable unit immediately above the ground line to minimize repairs necessary due to traffic damage. The breakable stem coupling will be made of a corrosion resistant material such as stainless steel or bronze, or have a permanently applied non corrosive finish such as nickel plating or fusion bonded epoxy coating.

Hydrants shall be of the compression type; constructed such that the main valve closes with the water pressure to assure no loss of water in the event of damage to the upper portion of the fire hydrant.

Main valve opening shall have a minimum diameter of 5-inches to assure optimum flow. Facing of the main valve against the seats shall be of rubber or synthetic rubber minimum of 1 inch in thickness. Plastic or Neoprene type main valves will not be allowed.

Hydrants shall be of the dry top design with o-ring seals to ensure that the operating threads will be protected from water entry. Dry top design to include factory- lubricated operating mechanism which allows supplemental lubricant to be added in the field without removal of the upper barrel.

SECTION 756

Standard lubricant shall be a NSF 61 approved oil or grease suitable for a temperature range of 20 degrees to 150 degrees F.

Hydrants shall have a cast iron weather shield at the operating nut to protect the clearance area between the top casting and the operating nut.

The operating nut shall be a one-piece bronze casting. Both the operating nut and the nozzle cap nuts shall be National Standard Pentagon in shape and measure 1-1/2 inches from point to flat at the base of the nut.

Hydrants shall have two hose nozzles, 2.5 inches in diameter, and one pumper nozzle approved by the Owner. Rubber gasket nozzle caps shall be provided. Screw Threads shall be per owner requirements.

Hydrant nozzle section shall be capable of rotation through 360 degrees to at least 8 points of rotation with respect to the standpipe to allow the positioning of the hose or pumper nozzles

Minimum distance allowable between the centerline of the lowest nozzle and ground / bury line is 18-inches. Bury line shall be visibly marked on lower barrel of hydrant.

Hydrants shall have markings indicating direction of opening right to left (counter-clockwise).

Hydrants shall have permanent markings identifying the manufacturer name, model identification, size of the main valve opening and the year of manufacture.

Hydrants shall have an automatic drain that is operated by the main valve rod. The drain valve is to open as the main valve is closed and close as the main valve is opened. The port and seat of the drain valve shall be bronze. Drain facings shall not be leather.

The outside of the hydrant top section shall be painted a minimum of one coat of non- lead base premium primer and two (2) finished coats of non-lead base premium durable paint. The surface will be properly prepared, smooth, clean, and dry before primer is applied. The primer coat will be applied to a DFT (Dry Film Thickness) of 3-4 mils. The final 2 coats will be applied to achieve a DFT of 6-8 mils on top of the primer coat. Paint will be a semi-gloss, bright chrome safety yellow in color or as specified by owner. Paint will have high color retention. Paint will be fade and UV resistant, rust resistant, resistant to abrasions and chipping and have flexibility qualities.

Hydrants shall have a bronze valve seat and shall be threaded into a bronze drain ring or shoe bushing to prevent electrolysis between these components

Hydrants shall be designed to permit the use of extension sections.

Hydrants shall be designed to allow all working parts to be removed through the bonnet/dome or upper nozzle section of the hydrant without removal of the entire upper barrel section.

Hydrants shall be suitable for installation in 36-inch to 72-inch trench depth or as specified by owner.

All nuts and bolts of the factory hydrant to be buried below ground will be a minimum of 304 stainless steel and coated for gall protection.

The friction loss must be guaranteed by the manufacturer to match statistics in Table [756-1](#).

756.4 MANUFACTURER:

The manufacturer shall guarantee that the hydrant is so constructed that the valve stem will not be bent when hydrant is damaged or broken at or near the grade level. A safety breaking flange or thimble, shall be provided. The friction loss must be guaranteed, by the manufacturer, to satisfy Table [756-1](#).

SECTION 756

TABLE 756-1

MAXIMUM PERMISSIBLE LOSS OF HEAD FOR HYDRANTS			
Number of Outlet Nozzles	Nominal Diameter of Outlet	Total Flow From Outlet Nozzles GPM	Maximum Permissible Head Loss PSI
2	2 1/2 inches	500	2.0
1	4 inches	600	2.5

756.5 WARRANTY:

All items shall be warranted by the manufacturer for a minimum period of five (5) years from date of acceptance by the Owner, against defects in material and workmanship. At any time during that period, if a defect should occur in any item, it shall be repaired or replaced by the manufacturer at no obligation to the Owner, except where it would be shown that the defect was caused by misuse and not by fault of manufacturer. The manufacturer shall make necessary repairs within the time frame specified by the owner or reimburse the owner if emergency repairs are required. The manufacturer expressly warrants all items to be new, free from defect in design, materials, and workmanship and to be fit and sufficient for their intended purpose. All warranties shall survive acceptance and payment by the city.

756.6 INSPECTION:

All items shall be inspected before acceptance by an authorized representative of the Owner for workmanship, acceptance and proper functioning of components, and conformance to all requirements of this specification.

Should deficiencies be found, it shall be the responsibility of the supplier to pack the item(s) in question, make necessary corrections, and then return to the Owner for re-inspection and acceptance at no additional expense or obligation to the Owner.

- End of Section -

SECTION 757

SPRINKLER IRRIGATION SYSTEM

757.1 GENERAL:

All materials and fittings shall be new, of the manufacturer's most current design, and shall bear the appropriate National Association seal of approval for example, NSF, UL, etc. Similar units shall be procured from the same manufacturer and internal parts shall be common and interchangeable. Parts listing and source of supply for replacement parts will be furnished to the Engineer.

757.2 PIPE AND FITTINGS:

The type of pipe material and fittings shall be as designated on the plans or in the special provisions. The type utilized shall comply with one of the following:

757.2.1 Steel Pipe: All steel pipes shall be newly galvanized, standard weight, Schedule 40 conforming with Section [753](#).

757.2.2 Plastic Pipe: Plastic pipe shall be rigid, unplasticized polyvinyl chloride, PVC 1120 or 1220, with an SDR of 26 or less, complying with ASTM [D1785](#). Schedule 40 or 315 psi pipe shall be used for the continuously pressurized run on the supplyside of Control Valves. PVC 1120 to 1220, SDR 26, pressure rated at not less than 125 psi shall be used on the discharge side of all control valves.

757.2.3 Pipe Fittings and Couplings:

(A) Steel Pipe Fitting and Couplings - Steel pipe fittings and couplings shall be galvanized, malleable iron, screwed fittings or couplings, conforming with Section [753](#).

(B) Plastic Pipe Fittings and Couplings - Plastic pipe fittings and couplings shall be either threaded type or slip fitting tapered socket solvent weld type. Schedule 80 pipe only will be used for threaded joints. Tapered solvent weld fittings may be either Schedule 80 or Schedule 40, but in any case, will be equal to or greater than the Schedule and Pressure Rating of the plastic pipe being joined. Tapered fittings shall be sized so that a dry, unsoftened taper cannot be inserted more than halfway into the socket. Plastic saddles and flange fittings are not permitted.

(C) Copper Pipe Fittings and Couplings - Copper pipe fittings and couplings shall conform with Section [754](#).

757.2.4 Solvent Cement: The solvent cement shall be a solution of Type 1, Grade 1, unplasticized, polyvinyl chloride molding or extrusion compound as specified in ASTM [D1784](#), or an equivalent PVC resin. The cement shall be free flowing and shall not contain lumps, microscopic undissolved particles or any foreign matter that will adversely affect the ultimate joint strength. It shall show no stratification or separation that cannot be removed by stirring. Container labeling shall be in accordance with ASTM [D2564](#).

757.3 VALVES AND VALVE BOXES:

757.3.1 General: Valves shall be of the size, type, and capacity designated on the plans or in the special provisions and shall comply with the requirements specified herein.

All valves except garden valves shall be capable of satisfactory performance at a working pressure of 200 psi. Valves shall be designed to permit disassembly to replace sealing components without removal of the valve body from the pipeline.

757.3.2 Gate Valves: Gate valves in size two inches and smaller shall be all bronze double disc wedge type with integral taper seats and non-rising stem. Sizes two and one-half inches and larger shall be iron body, brass trimmed, with the other features the same as for the two inch. Section [753](#) applies.

757.3.3 Manual Control Valves: Manual control valves shall be brass or bronze, and shall be straight or angle pattern glove valves, full opening; key operated with replaceable compression disc and ground joint union on the discharge end.

757.3.4 Electrical Remote Control Valves: Remote control valves shall be electrically operated, designed for a 24 volt, 60 cycle system. They shall be brass or bronze with accurately machined valve seat surfaces, equipped for flow control adjustment,

SECTION 757

and with the capability for manual operation. They shall be readily disassembled for repair and the internal parts shall be easily accessible for service even when installed in the line.

The internal valve shall be a normally closed, diaphragm type with slow opening and closing action as protection against surge pressures. Actuation shall be by an encapsulated type solenoid with the solenoid shunt band, tube, and plunger of stainless steel for corrosion protection. A removable and cleanable strainer shall be provided at the control chamber inlet to prevent debris from entering the solenoid operating section.

757.3.5 Garden Valves: Garden valves shall be brass or bronze except for the handle. They shall have a replaceable compression disc, and shall be 3/4 inch straight-nosed, key operated and pressure rated for operation at 150 psi.

757.3.6 Quick-Coupling Valves and Assemblies: Quick-coupling valves shall be brass or bronze with built-in flow control and self-closing valve and supplied in 3/4-inch size unless otherwise required. When a quick-coupler assembly is specified, it shall consist of the valve, quick-coupler connection and hose swivel. Keys and hose swivel ells shall be furnished as specified on the plans.

757.3.7 Valve Boxes: Valve boxes with locking covers shall be molded, non-corrosive plastic. Applicable ASTM references: [D638](#).

757.4 BACKFLOW PREVENTER ASSEMBLY:

The backflow preventer assembly shall consist of pressure type or reduced pressure type backflow preventer unit and associated components conforming to the governing code requirements and as shown on the plans. It shall be equal in quality and performance to a "Foundation for Cross-Connection Control and Hydraulic Research."

757.5 SPRINKLER EQUIPMENT:

Sprinkler heads, bubbler heads and spray nozzles shall be of the types and sizes as shown on the plans. All major components shall be brass, bronze, stainless steel, or high impact plastic.

Equipment of one type with similar flow characteristics shall be from the same manufacturer and shall bear the manufacturer's name and identification code in a position where they can be identified after installation.

Fixed head sprinklers shall have a one-piece housing with provisions for interior parts replacement. Pop-up sprinklers shall be designed to rise at least 2 inches during operation. Full or part circle sprinklers shall be interchangeable in the same housing.

Bubbler heads shall be of corrosion-resistant, durable bodies, injection molded out of cyclocac, and tapped for 1/2 inch I.P.S. threads. The bubbler shall be fully adjustable from 0 to 5 gallons per minute and shall have a minimum discharge of 1.7 gallons per minute under pressure of 15 pounds per square inch and a minimum discharge of 2.4 gallons per minute under pressure of 30 pounds per square inch supplied at the head.

757.6 ELECTRICAL MATERIAL:

All equipment and material shall comply with the requirements of the governing code and shall be listed by Underwriters' Laboratories, Inc.

757.6.1 Conduit: Conduit shall be galvanized steel conforming to Section [753](#).

757.6.2 Conductors: Service line conductors shall be supplied in the size shown on the plans and shall be THW 600 volts insulation rating conforming to ASTM [D2219](#) or [D2220](#). Low voltage control conductors shall be Type UF No. 14 AWG copper unless otherwise shown on the plan and shall be UL approved for direct burial installation.

757.6.3 Controller Unit: The controller unit shall be fully automatic, with provisions for manual operation, sized to accommodate the number of stations or control valves included in the system and designated on the plans or in the special provisions. Outdoor models shall be housed in a vandal-resistant, weatherproof enclosure which has a locking cover.

SECTION 757

The unit shall require a standard 117 volt, 60 cycle input and provide a 26.5 volt, 60 cycle output and shall incorporate a 14-day programming capacity. The unit shall have a "Master On-Off" switch which will deactivate the controller but allow the day and hour clocks to continue operation.

In addition, it shall include a resettable circuit breaker for unit protection.

Each station timing dial shall have an "Omit" or "Off" position and incremental dial settings for timing controls up to 30 minutes.

- End of Section -

SECTION 758

CONCRETE PRESSURE PIPE - STEEL CYLINDER TYPE

758.1 GENERAL:

These specifications apply to Concrete Pressure Pipe intended for use in water supply pipelines that carry water under pressure. Concrete pressure pipe is specified as follows:

(A) Reinforced concrete pressure pipe-steel cylinder type, pretensioned, shall be designed, manufactured and tested in accordance with AWWA C-303. With agreement by the purchaser and the manufacturer, pipe may be manufactured to larger sizes and for higher pressures than indicated herein.

Reinforced concrete pressure pipe may be furnished in pipe diameters of eighteen (18) inches through seventy-two (72) inches.

Pipe shall be designed by the methods described in Appendix A, AWWA C-303 to resist the internal pressures and external loading conditions designated on the approved plans or in the project specifications.

(B) Prestressed concrete pressure pipe steel cylinder type, shall be designed, manufactured and tested in accordance with AWWA C-301 and AWWA C-304.

Prestressed concrete pressure pipe may be furnished in pipe diameters forty-two (42) inches and larger.

Pipe shall be designed by the methods described in AWWA C-304 to resist the internal pressures and external loading conditions designated on the approved plans or in the project specifications.

758.2 MANUFACTURE:

The Contractor shall submit design calculations, a tabulated layout schedule, and details of specials and fittings to the Engineer for review and approval.

When specified in the project specifications, the manufacturer shall furnish all samples, test reports, test specimens and perform tests as provided in AWWA C-303 or AWWA C-301.

An approved rust inhibitor shall be applied on the exposed portions of the steel joint rings.

The Contractor shall submit an affidavit of compliance from the manufacturer that the pipe and fittings furnished comply with all applicable provisions of AWWA C-301 or AWWA C-303.

The Engineer or his representative shall be allowed access to the manufacturer's plant for the purpose of inspecting the pipe and fittings.

- End of Section -

SECTION 759

STEEL PIPE

759.1 GENERAL:

These specifications apply to Steel pipe intended for use in water supply pipelines that carry water under pressure. Steel pipe is specified as follows:

Steel pipe shall be designed, manufactured and tested in accordance with AWWA C-200.

Steel pipe and fittings may be furnished in pipe diameters of six (6) inches and larger.

Pipe shall be designed by the methods described in AWWA C-200 and AWWA Manual M11, to resist the internal pressures and external loading conditions designated on the approved plans or in the project specifications.

Trench excavation, backfilling and compaction shall be in accordance with Section [601](#) unless otherwise specified in the plans and specifications. For Steel Pipe with a flexible coating the backfill pipe zone material shall consist of Granular Material, maximum 3/4 inch size.

As an option, the backfill in the pipe zone may be Controlled low strength material (CLSM) in accordance with Section [728](#) and placement per Section [604](#).

759.2 LINING AND COATING OPTIONS:

(A) Cement mortar lining and cement mortar coating shall be in accordance with AWWA C-205.

(B) Polyurethane coatings for interior and exterior of steel pipe shall be in accordance with AWWA C-222. The MDFT shall be 20 mils. on the interior lining and 25 mils. on the exterior coating.

(C) Polyethylene tape coating shall be in accordance with AWWA C-214. The total thickness of the tape coating shall be minimum 50 mils for pipe up to 54 inches diameter and minimum 80 mils for pipe 54 inches diameter and larger.

(D) Liquid-Epoxy coating systems for the interior and exterior of steel water pipelines shall be in accordance with AWWA C-210. Interior lining will be applied in one or two coats MDFT of 16 mils.

All linings for potable waterlines shall be NSF approved.

759.3 MANUFACTURE:

The contractor shall submit design calculations, a tabulated layout schedule, and details of specials and fittings to the Engineer for review and approval.

When specified in the project specifications, the manufacturer shall furnish all samples, test reports, test specimens and perform tests as provided in AWWA C-200 or AWWA manual M11.

Standard pipe shall be furnished with rolled-groove bell and spigot rubber gasket joints. Restrained joints shall be lap-welded slip joints with the bell formed by cold formed expanded dies.

Unless otherwise specified, fabricated steel pipe shall be manufactured in uniform lengths to fit the pipeline alignment shown on the plans, subject to a maximum length of 40 feet. For Steel Pipe with flexible coatings the pipe length may be 60 foot maximum, subject to the Manufacturer's recommendations. Shorter lengths may be furnished to facilitate special conditions.

The Contractor shall submit an affidavit of compliance from the manufacturer that the pipe and fittings furnished comply with all applicable provisions of AWWA C-200 or AWWA Manual M11.

The Engineer or his representative shall be allowed access to the manufacturer's plant for the purpose of inspecting the pipe and fittings.

- End of Section -

SECTION 760

COATING CORRUGATED METAL PIPE AND ARCHES

760.1 GENERAL:

Corrugated metal pipe, pipe arches, and connectors to be used or furnished under this specification shall be manufactured and inspected in conformance with the requirements of AASHTO M-36, and as hereinafter specified. The size, type, and wall thickness of the pipe to be furnished shall be as specified on the project plans or specifications.

760.2 MATERIALS:

Corrugated metal products covered by this specification shall be plain galvanized conforming to the requirements of AASHTO M-36 as modified herein.

The types of bituminous coated pipe shall be as specified by the standard details or special provisions. In addition to the types listed in AASHTO M-190, there will be Type E.

Type E Pipe - Corrugated Metal Pipe with Smooth Metal Liner: The pipe shall be manufactured as per AASHTO M-36, Type 1A except that the lock seam shall be on the tangent of the helical corrugation. The ends of each pipe shall be reformed with two annular corrugations for joining the pipes with approved band couplers. The minimum thickness of the pipe shell shall be as required to support external load with no credit for load carrying support given to the liner. The minimum thickness for the liner shall be 22 gauge (0.034 inches).

760.3 BASE METAL, SHELTER AND FABRICATION:

The nominal pipe diameter shall meet the tolerances of this specification. Elliptical pipe, when specified, shall be shaped after fabrication and coating have been completed.

Helically Corrugated Metal Pipe: The pipe shall be fabricated from flat sheets in coils. The base metal, spelter coating, method of sampling, accepted brands of metal, sheet manufacturer's certified analysis and guarantee, workmanship, marking, inspection and rejection, shall meet the requirements of AASHTO M-36. Structures furnished shall be either full circle, or pipe-arch in accordance with Table 4 of AASHTO M-36, or other shape as shown on the plans. The pipe dimensions shall conform to AASHTO M-36 in all respects, except that the corrugations shall be helical instead of annular. The thickness of the galvanized metal shall be in accordance with project plans or specifications as otherwise specified. Pipe with helical corrugations shall have a continuous lock or weld seam extending from end to end of each length of pipe. The seams shall be fabricated in such a manner that they will not affect the shape or nominal diameter of the pipe and so that they will not create an element of weakness in the pipe.

Spiral Rib Metal Pipe: The pipe shall be fabricated from flat sheets in coils. The base metal, spelter coating, method of sampling, accepted brands of metal, inspection and rejection, shall meet the requirements of AASHTO M-36. Structures furnished shall be full circle on sizes of 18 inch and above as shown in Table 4 of AASHTO M-36. The pipe shall be fabricated with helical rectangular ribs projecting outwardly from the pipe wall with a continuous lock seam extending from end to end of each length of pipe. Spiral Rib Pipe shall consist of two rectangular ribs and one half-circle rib equally spaced between seams. Rectangular ribs shall be 3/4 inch wide by 1 inch high. The half-circle rib diameter shall be 1/2 inch and shall be midway between the rectangular ribs. Maximum rectangular rib spacing shall be 11 1/2 inches. The thickness (gage) of the metal shall be in accordance with project plans and/or specifications or as otherwise specified.

760.4 COUPLING BANDS:

Watertight joints shall be fabricated for corrugated metal pipe by the use of galvanized couplers or connecting bands, bituminous coated where required, with each band overlapping by at least 2 inches. Corrugated coupling bands shall be constructed and connected as specified in AASHTO M-36, except as otherwise required herein. The couplers or bands shall be manufactured of material 2 gages lighter than the gage specified for the pipe material, shall have corrugations or dimples to match the pipe corrugations or end treatment or may be flat, and shall be fastened with bolts. Dimpled coupling bands shall be 10 1/2 inches wide for diameters 12 through 60 inches, and 17 inches wide for diameters above 60 through 96 inches. The 10 1/2 wide bands shall have 2 rows of dimples of not less than 7 dimples per row, and the 17 inch wide bands shall have 4 rows of dimples of not less than 7 dimples per row. The dimple arrangements shall be such that a maximum spread can be attained.

SECTION 760

The shape of the dimple shall be such that it shall, in general conform to the standard pipe corrugation. The connecting angles for dimpled coupling bands may be riveted as for standard corrugated coupling bands, or may have slotted angles. The bands shall be attached by means of 1/2 inch nominal diameter carriage bolts. Two bolts are required for pipe up to 36 inches in diameter, 3 bolts for 36 through 60 inch diameters and 5 bolts for pipes above 60 inches in diameter. Plain flat coupling bands and spiral rib flange bands shall have the same width and number of bolts as specified above. Flat coupling bands having a single circumferential corrugation rolled in each edge to match a similar corrugation in the end of each pipe may be 10 1/2 inches wide regardless of pipe diameter and shall be fastened with 2 bolts.

When flanges are provided on the pipe ends, the coupling shall be made by interlocking the flanges with a preformed channel band or other band incorporating a locking channel not less than 3/4 inches in width. The depth of the channel shall be not less than 1/2 inch. The channel band shall have a minimum nominal thickness of 0.079 inches.

760.5 PERMISSIBLE VARIATIONS IN DIMENSION:

The internal diameter of 12 through 24 inch pipe shall not vary more than ± 1.5 percent from the design diameter. The internal diameter of 27 through 108 inch shall not vary more than ± 1 percent or 3/8 inch, whichever is greater from the design diameter.

Type D Pipe: The design diameter of the metal pipe before paving shall be the diameter shown on the plans plus 1/4 inch. The design diameter may vary as above.

- End of Section -

SECTION 761

STRUCTURAL PLATE PIPE, ARCHES, AND PIPE ARCHES

761.1 GENERAL:

Structural plate pipe, arches, and pipe arches shall be of the sizes, gages, and dimensions designated on the plans or in the special provision and as specified herein.

761.2 MATERIALS:

Plates, nuts and bolts shall conform to the specifications of AASHTO M-167.

Galvanized surfaces which are damaged shall be repaired in accordance with the provision in Section [771](#).

Bituminous coating shall conform to the provisions of AASHTO M-190.

Damaged bituminous coatings shall be repaired by the Contractor at his expense by applying bituminous material conforming to AASHTO M-190.

761.3 IDENTIFICATION:

The gages of structural plates will be identified on the plans in accordance with the following:

Each installation will be designated not only by size, but also by symbol indicating the number and gage of plates required. Thus, (412-18) will be used to designate an installation for 1 plate length composed of 4, 12 gage plates and 1, 8 gage plate, the heaviest to be placed in the invert.

761.4 DISTORTION:

In advance of placing backfill material around circular structural plate pipes, the pipe shall be distorted.

Distortion may be performed either at the fabricating shop or in the field.

If the plates are distorted in the fabricating shop, the plates shall be distorted to provide an increase in the vertical diameter of the pipe, after assembly, of approximately 5 percent for the full length. Plates shall be marked in order to assure that they will be placed in proper position.

If the pipes are distorted in the field the method of distortion shall conform to the details shown on the plans. The vertical diameter shall be increased the approximate percentages listed in the following table, throughout that portion of the pipe between shoulder lines.

Pipes using 1 or 3 gage top and side plates - 1 percent

Pipes using 5 or 7 gage top and side plates - 2 percent

Pipes using 8, 10, or 12 gage top and side plates - 3 percent

Between the shoulder lines and the outer ends of the pipe the distortion may decrease uniformly to zero.

- *End of Section* -

SECTION 770

STRUCTURAL AND RIVET STEEL, RIVETS, BOLTS, PINS, AND ANCHOR BOLTS

770.1 GENERAL:

All steel, unless otherwise designated on the plans or in the special provisions, shall conform to the requirements of ASTM [A36](#).

Report of Tests: Before fabrication, the Contractor shall furnish to the Engineer a certified mill report in triplicate, for each identifiable melt of steel or iron from which the material is to be fabricated. The report shall include the chemical and physical tests required by the ASTM specifications.

Additional Tests: The Contracting Agency reserves the right to require and to make additional mill and laboratory tests. The number of such additional tests will be limited as follows, except that in the case of failure of the material to comply with the ASTM requirements, more tests will be made:

Structural steel, 1 complete test for each heat or each 10 tons of identifiable stock. Rivets, 1 complete test for each size. Bolts, 1 complete test for each lot.

Identifiable stock is material for which authentic records of the chemical and physical properties are available.

Test specimens shall be furnished, cut, and machined in accordance with the ASTM specification, for the material to be tested, as referred to herein. Test specimens shall be furnished and machined by the Contractor at no additional cost to the Contracting Agency.

Mill Tolerances: Rolling and cutting tolerances, permissible variations in weight and dimensions, defects and imperfections shall not exceed the limits for structural steel contained in ASTM [A6](#).

Stock Material: When the Contractor proposes to use material already in stock, he shall notify the Engineer of such intention at least 10 days in advance of beginning fabrication, to permit sampling and testing.

770.2 STRUCTURAL STEEL:

Stock Materials: The Contractor shall select the material he wishes to use from stock. The Contractor shall furnish 3 certified mill reports for each of the heat numbers. Two samples shall be taken by a representative of the Engineer from each heat number, one for the tension test and one for the coldbend test. If the heat numbers cannot be identified, the representative of the Engineer shall select random test specimens from the unidentifiable heats. The number of such test specimens shall be at the discretion of the Engineer. The cost of all tests on stock material shall be borne by the Contractor.

High Strength Low-Alloy Structural Steel: The material shall conform to the requirements of ASTM, [A572](#), [A709](#) or [A992](#), as specified in the special provisions.

General Purpose Structural Steel: Structural steel shall conform to the requirements of ASTM [A36](#) with a minimum of 0.2 percent copper.

770.3 RIVETS:

Stock Material: Rivets taken from identifiable stock shall be accepted by the Engineer in accordance with this specification.

Rivets from unidentifiable stock, for which authentic records of the chemical and physical properties are not available, shall not be used except where shown on the plans or when approved by the Engineer.

High-Strength Structural Rivet Steel: The material shall conform to the requirements of ASTM [A502](#).

Structural Rivet Steel: The material shall conform to the requirements of ASTM [A502](#), except that the test specimen shall be bent upon itself when performing the bend test.

SECTION 770

770.4 BOLTS:

Unfinished Bolts: The bolts shall have square heads and square nuts unless otherwise specified. The bolts shall be long enough to extend entirely through the nut but not more than 1/4 inch beyond. Washers shall not be furnished unless specified.

Steel bolts shall conform to the requirements of ASTM [A307](#), except that steel manufactured by the acid Bessemer process shall not be used.

High Strength Bolts: High strength bolts shall conform to the provisions of the specification for the design, fabrication and erection of structural steel for buildings of the AISC.

770.5 ANCHOR BOLTS:

Anchor bolts shall be manufactured from steel conforming to ASTM [A36](#) or [A307](#).

770.6 MILD-STEEL FORGINGS FOR STRUCTURAL PURPOSES:

Steel forgings shall be made from steel of forging quality and shall conform to the requirements of ASTM [A668](#). They shall be Class C forgings with a maximum carbon content of 0.35 percent and shall be given a thorough annealing. The metal shall have a minimum Brinell hardness number of 130, and a maximum of 190, when tested in accordance with ASTM [E10](#).

- *End of Section* -

SECTION 771

GALVANIZING

771.1 GENERAL:

Materials shall be hot-dip galvanized and the weight and uniformity of coating determined in accordance with the standard specifications given in Table [771-1](#).

TABLE 771-1		
GALVANIZING SPECIFICATIONS		
Material	ASTM Spec.	Wt. of Coating Oz./Sq. Ft. (Min.)
Corrugated Metal Pipe	A929	1.80
Flat Steel or Iron Sheets	A653 , A924	1.25
Iron or Steel Wire	A116	.80
Chain Link Fabric	A392	1.20
Barbed Wire	A121	.50
Steel Pipe - Rails and Posts	A53	1.8
	F1043 IA	1.8
	F1043 IC Galvanized After Forming	0.9 oz. w/chromate and organic clearcoat
Structural Shapes, Tie Rods, Ornamental Iron Railings, Handrails, Manhole and Catch Basin Steps, and Curb Armor	A123	2.00
Bolts, Nuts, Washers, Anchor Bolts, Packing Spools, Gray Iron and Malleable Iron Castings and Steel Castings	A153	1.25

771.2 WORKMANSHIP:

The galvanizing shall be applied in such a manner that the spelter will not peel off. The finished product shall be free from blisters and excess spelter, and the coating shall be even, smooth, and uniform throughout. Machine work, die work, cutting, punching, bending, welding, drilling, thread cutting and other fabricating shall all be done as far as is practicable before the galvanizing. No member shall be galvanized which is out of alignment. All members (nuts, bolts, washers, etc.) shall be galvanized before a structural unit is assembled. All uncoated spots or damaged coatings due to poor workmanship, rough handling, or any other reason shall be cause for rejection.

771.3 TEST COUPONS:

Test coupons for determining the quality of the galvanizing shall be wired to the materials to be galvanized before immersion in such a manner as to represent the amount of coating deposited on the materials.

771.4 REPAIR OF GALVANIZED SURFACES:

Unless otherwise specified, where galvanized surfaces are field or shop cut, broken, burned or abraded, thus breaking the galvanizing, the locations thus damaged shall be repaired to the satisfaction of the Engineer with zinc dust-zinc oxide coating conforming to AASHTO M-36.

- End of Section -

SECTION 772

CHAIN LINK FENCE

772.1 GENERAL:

All material shall be new and, upon request, the Contractor shall furnish to the Contracting Agency, a certification of inspection stating that the materials have been manufactured, sampled, tested and inspected so as to meet the requirements for its type as specified below.

772.2 POSTS, RAILS AND BRACES:

Posts, rails and braces shall be constructed of pipe in conformance with types A, B or C below. Unless specifically designated by type in the plans or specifications, the Contractor may utilize any of the three types. The posts and rails in this section will cover fencing up to 12 feet in height with post spacing not to exceed 10 feet. The nominal outside dimensions and minimum weights shall be in accordance with Table [772-1](#). The manufacturer or his representative shall legibly mark each length of pipe by rolling, stamping or stenciling to identify the product by product name, ASTM standard, etc. and the country of manufacture.

Type A: Shall be manufactured in conformance to ASTM [F1043](#) IA-2 black steel pipe, welded or seamless, hot-dipped zinc coated, plain end, standard weight (schedule 40). The hot-dipped zinc coating (galvanized) shall be applied both inside and outside with not less than 1.8 ozs. per square foot ± 0.1 ozs.

Type B: Shall be manufactured in conformance to ASTM [F1043](#) IC Galvanized After Forming. Steel used in the manufacturing of the pipe shall be hot-rolled strip steel in compliance with ASTM [A1011](#) having a minimum yield strength of 50,000 psi. The pipe will be manufactured by electric welded cold-formed process per ASTM [A500](#). The exterior surface will be triple coated and the interior surface single coated. The triple coated external surface shall be hot-dipped zinc coated (galvanized) having a weight of not less than 1.0 ozs. per square foot ± 0.1 ozs., followed by a chromate conversion coating, having a weight not less than 1.05 micro ounces per square foot ± 0.353 micro ounces (30 micrograms per square inch ± 15 micrograms) and an acrylic coating having a thickness of 0.0005 inches ± 0.0002 inches. The internal surface shall be coated with a zinc base paint having a 90% zinc powder loading and having a minimum thickness of 0.0005 inches.

Type C: Shall be manufactured in conformance to ASTM [F1043](#) IC Galvanized Before Forming. Steel used in the manufacturing of the pipe shall be strip steel in compliance with ASTM [A653](#) Grade D having a minimum yield strength of 50,000 psi. Both sides of the strip shall be hot-dipped zinc coated (galvanized) per ASTM [A653](#) and A-924 having the weight of not less than 1.0 oz. per square inch ± 0.1 oz. The zinc coating will form the first coat of a triple coated external surface and the final coat of the interior surface. The pipe will be manufactured by electric welded cold formed process per ASTM [A789](#). After manufacturing, the final two external coatings shall be a chromate conversion having a weight of not less than 1.05 micro ounces per square inch ± 0.353 micro ounces and an acrylic coating having a thickness of 0.0005 inches ± 0.0002 inches.

772.3 CHAIN LINK FABRIC:

Chain link fabric shall conform to the requirements of ASTM [A392](#) (Zinc-Coated) or ASTM [A491](#) (Aluminum-Coated). The coating process must leave the fabric completely free of barbs, icicles, or other projections which might be hazardous. The wire used in the manufacture of the fabric shall be 11 gage for all fence 60 inches or less in height and shall be 9 gage for all fence over 60 inches in height unless otherwise specified.

All chain link fabric shall be woven into approximately 2 inch mesh. Fabric less than 60 inches wide shall have knuckled finish on the top edge, and twisted and barbed finish on the bottom edge. Fabric 60 inches or greater in width shall have twisted and barbed finish on both edges. Barbing shall be done by cutting the wire on the bias.

772.4 TENSION WIRES AND FABRIC TIES:

Tension wires shall be at least 7 gage galvanized coil spring steel wire per ASTM [A824](#). Ties used to fasten the fabric to posts, rails, and gate frames shall be not smaller than 11 gage galvanized steel, 6 gage aluminum wire, or approved non-corrosive metal bands.

Tension bars used in fastening fabric to end and corner posts and gate frames shall be galvanized high carbon steel bars not smaller than 3/16 inch x 3/4 inch.

SECTION 772

TABLE 772-1					
FENCE MEMBER SIZES & WEIGHTS					
USE	FENCE HEIGHT (Feet)	NPS DESIGNATOR	OUTSIDE DIAMETER (Inches)	WEIGHT (Lb/Lf Minimum)	
				TYPE A Schedule 40	TYPE B and C
FENCE POSTS					
End, corner, slope, pull and strain posts	Less than 6	2	2.375	3.65	3.12
	6 and over but less than 9	2 1/2	2.875	5.79	4.64
	9 and over but not over 12	3 1/2	4.000	9.11	6.56
Line posts	less than 6	1 1/2	1.900	2.72	2.28
	6 and over but less than 9	2	2.375	3.65	3.12
	9 and over but not over 12	2 1/2	2.875	5.79	4.64
GATE POSTS					
Single swing gates 6 feet or less in width or double swing gates 12 feet or less	less than 6	2	2.375	3.65	3.12
	6 and over but not over 12	3 1/2	4.000	9.11	6.56
Single swing gates over 6 feet but not over 13 feet in width or double swing gates over 12 feet but not over 26 feet in width	—	3 1/2	4.000	9.11	6.56
Single swing gates over 13 feet but not over 18 feet in width or double swing gates over 26 feet but not over 36 feet in width	—	6	6.625	18.97	—
Single swing gates over 18 feet in width or double swing gates over 36 feet in width	—	8	8.625	28.55	—
OTHER MEMBERS					
Top rail and braces	—	1 1/4	1.666	2.27	1.84
Frame for gates	—	1 1/2	1.900	2.72	2.28
Stiffeners for gates	—	1 1/4	1.666	2.27	1.84

Notes to Table [772-1](#):

- All unit weights shall be subject to the standard mill tolerance of ± 5 percent.
- Posts shall be fitted with tops designed so as to fit securely over the posts and carry a top rail where specified. They shall have a total length of not less than the depth of the concrete footings, as specified, plus the length required above ground. Where no top rail is required, pipe posts shall be fitted with suitable caps.
- Top rail shall be furnished in random lengths of approximately 20 feet where required.

SECTION 772

772.5 TRUSS OR TENSION RODS:

Truss or tension rods used in trussing gate frames and line posts adjacent to end, corner, slope or gate posts shall be adjustable 3/8 inch diameter galvanized steel rod. When used in trussing line posts, adjustment shall be provided by means of galvanized, turnbuckle or other suitable tightening devices.

772.6 FITTINGS:

Fittings shall conform to ASTM [F626](#).

Fittings, hardware, nuts and bolts shall be galvanized.

Couplings to connect the individual lengths of top rail shall be of the outside sleeve type at least 7 inches long. The bore of the sleeves shall be sufficiently true to maintain adjacent lengths of rail in alignment.

Extension arms for barbed wire on pipe posts shall be of 13 gage steel or heavier, single piece construction and a type that can be attached to the tops of the posts. Extension arms shall carry 3 wires at approximately 5 1/2 inch centers in a plane approximately 45 degrees from the vertical, inclined as shown on the plans or as directed by the Engineer.

772.7 BARBED WIRE:

Barbed wire shall be 4 point pattern; composed of 2 strands of 12 1/2 gage galvanized steel wire with barbs spaced 5 inches apart and shall conform to ASTM [A121](#).

- *End of Section* -

SECTION 775

BRICK AND CONCRETE MASONRY UNITS (BLOCKS)

775.1 BRICK:

Brick shall be whole, sound, and hard burned and shall give a clear ringing sound when struck together. They shall be uniform in quality and shall be culled or sorted before delivery to the work.

775.1.1 Manhole Brick: Agency approval is required prior to using brick within manholes. When approved, brick may be used for maintenance and adjustment of the existing manholes or rings and covers.

Manhole brick shall conform to Table [775-1](#).

TABLE 775-1			
MANHOLE BRICK DIMENSIONS			
Brick	Inches Depth	Inches Width	Inches Length
Standard Size	2 1/4	3 1/2	7 1/2
Allowable Variations	±1/8	±1/8	±1/4

The following paragraphs shall be added to the section on visual inspection:

No individual brick shall be rejected unless it shows visual evidence of major cracking. A major crack is defined as one that has at least one complete separation, for a distance of 1 3/4 inches, through the brick in any direction, including any cored area. Such a crack shall be regarded as affecting the serviceability of the brick and shall be rejected and not used in the structure.

Fifty bricks may be sampled at random intervals from any cube for visual inspection. Of the 50 samples, 45 must pass visual inspection for major cracks. Should less than 45 pass, the cube of brick shall be rejected and the brick must not be used in the structure.

775.1.2 Building Brick: Building brick shall conform to the requirements of ASTM [C62](#), grade MW.

775.1.3 Facing Brick: Facing brick shall conform to the requirements of ASTM [C216](#), Grade MW, Type FBS. The size, color, and texture shall be as specified on the plans or as approved by the Engineer.

775.2 CONCRETE MASONRY UNITS:

Unless otherwise noted on the plans or special provisions, concrete masonry units shall conform to ASTM [C90](#), Normal Weight, Type I with a minimum compressive strength of 1900 psi.

The units shall be fully cured and shall have been made not less than 28 days prior to delivery.

The moisture content at the time of delivery shall not exceed 30 percent of the minimum absorption value of the units. The Contractor shall provide any protection he deems necessary to maintain the units in this condition until time of use.

The linear change from saturated to cool oven dry shall not exceed 0.0054 inches per linear foot or 0.045 of 1 percent conducted in accordance with test method in ASTM [C426](#).

The units shall be made with normal weight aggregate conforming to ASTM [C33](#).

The nominal size of the units shall be as indicated on the plans. The overall dimensions for width, height and length shall differ by not more than ±1/8 inch from the specified standard dimensions. Standard dimensions of units are the manufacturer's designated dimensions. Nominal dimensions of units are equal to the standard dimensions plus the thickness of one mortar joint.

No less than 5 samples of the units shall be submitted to the Engineer for approval and to show the full variance of texture and full range of color. Units used in the work shall match the approved samples. These samples may be tested for strength.

SECTION 775

All units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or would significantly impair the strength or permanence of the construction. When units are to be used in an exposed setting, the face or faces that are to be exposed shall not show chips or cracks, not otherwise permitted, or other imperfections when viewed from a distance of not less than 6 feet under diffused lighting.

Units that are intended to serve as a base for plaster or stucco shall have a sufficiently rough surface to afford a good bond.

- End of Section -

SECTION 776

MASONRY MORTAR AND GROUT

776.1 GENERAL:

Masonry mortar and grout shall consist of a mixture of cementitious material and aggregate to which sufficient water has been added to bring the resulting mixture to the desired consistency.

Table [776-1](#) and [776-2](#) indicates the average compressive strength obtained when the cementitious material, aggregate, and water (the required amount to provide a flow of 110 ± 5 percent) are combined in the proportion shown in Table [776-3](#) and Table [776-4](#).

The mortar or grout to be used will be designated by class in the special provisions and the correct proportions of cementitious materials and aggregate will be combined with the minimum amount of water to provide a workable mixture.

Retempering of the mortar or grout will not be a standard practice and the Engineer's approval will be required for any exception.

TABLES 776-1 & 776-2			
MASONRY MORTAR AND GROUT COMPRESSIVE STRENGTH			
Table 776-1 Masonry Mortar		Table 776-2 Grout	
Type	Compressive Strength 28 Days (psi)	Type	Compressive Strength 28 Days (psi)
A	5500	Fine Grout	2500
B	5000	Coarse Grout	2500
C	4000		
D	3000		
M	2500		
S	1800		

TABLE 776-3			
MASONRY MORTAR PROPORTIONS BY VOLUME			
Type	Portland Cement	Hydrated Lime	Aggregate ASTM C144
A	1	0	1
B	1	0	1 1/2
C	1	0	2
D	1	0	2 1/2
M	1	1/4	2 1/4 to 3
S	1	1/2	2 1/4 to 3

*Masonry cement type S may be substituted for the cementitious material. Prior approval of the Engineer is required.

TABLE 776-4			
GROUT FOR REINFORCED MASONRY PROPORTIONS BY VOLUME FOR FIELD BATCHING			
Type	Portland Cement	Fine Aggregate (ASTM C404)	Coarse Aggregate (ASTM C404)
Fine Grout	1	2 1/4 to 3	0
Coarse Grout	1	2 1/2	1 to 2

SECTION 776

776.2 PORTLAND CEMENT:

The cement used shall conform with Section [725](#). For volumetric proportioning an unopened sack of cement weighing 94 pounds shall be considered as having a 1 cubic foot volume.

In proportioning the cement, it shall be measured loose, without shaking or compacting, in measuring devices of known capacity.

776.3 AGGREGATE:

All aggregate shall be approved by the Engineer prior to being utilized on the job.

Fine aggregate (sand) to be used in mortar shall be thoroughly and uniformly washed and shall be entirely free from oil and deleterious substances. The size and grading of fine aggregate shall conform to the applicable requirements of ASTM [C144](#).

Fine or coarse aggregate to be used in masonry grout shall be thoroughly and uniformly washed and shall be entirely free from oil and deleterious substances. The size and grading of fine or coarse aggregate shall conform to the applicable requirements of ASTM [C404](#).

The average value of sand equivalent determined on 3 successive samples shall not be less than 70 when tested in accordance with ASTM [D2419](#). No individual sample shall have a sand equivalent less than 65.

In proportioning the aggregate, it shall be measured damp, loose without shaking or compacting, in measuring devices of known capacity.

776.4 MASONRY CEMENT:

Masonry cement used shall conform to ASTM [C91](#) with the exception that the average compressive strength shall not be less than 2500 psi at 28 days.

776.5 HYDRATED LIME:

Hydrated lime used shall conform to ASTM [C207](#), Type S.

776.6 WATER:

The water used shall conform to Section [725](#).

776.7 ADMIXTURES:

Admixtures, unless prescribed in the special provisions, will not be used without prior approval of the Engineer.

776.8 TESTS:

776.8.1 Mortar: If in the opinion of the Engineer there is sufficient cause to question the quality of the mortar being utilized, random field test in accordance with ASTM [C780](#) Annex A-1 and A-6 will be performed. For this area, the penetration of the cone penetrometer correlating to a flow of 110 ± 5 percent is 40 ± 3 mm.

776.8.2 Grout: If required, tests shall be performed in accordance with Uniform Building Code Standard No. 24-23 Section 24.2301.

- End of Section -

SECTION 778

LUMBER

778.1 GENERAL:

Unless otherwise specified or shown on the plans, all lumber shall be Douglas Fir or graded pine and shall be selected as to grade and shall conform in all particulars to the standard grading and dressing rules of the West Coast Lumber Inspection Bureau.

Plywood shall be not less than 3 ply, manufactured and graded in accordance with the standard grading rules of the APA.

Lumber for uses listed shall not be lower than the following grades:

Uses	Grade
(A) Permanent Construction, such as bridges and cluverts.	Select Structural, for beams and stringers; Construction, for balance of structure.
(B) Minor permanent construction, such as fences, guard rails and posts, pavement headers, bulkheads, retaining structures, etc.	Construction.
(C) Falsework and studs, and wales for formwork.	Construction, for framing, beams, or timbers.
(D) Form sheeting for nonshowing surfaces of concrete.	Standard, for boards; shiplap; or any grade of plywood.
(E) Form sheeting for showing surfaces of ornamental concrete.	C and Better Industrial clear; concrete form grade of plywood; or overlay plywood.
(F) Form sheeting for curved soffits of bridge & tunnel arches, plastered or unplastered.	Select Merchantable, board; concrete form grade of plywood; or overlay plywood.
(G) Soffits of beams and girders and slabs between beams and girders; for beam and girder sides, except ornamental concrete; and for headwalls or endwalls of culverts or covered conduits.	Concrete form grade of plywood or overlay plywood.
(H) Form sheeting for showing surfaces of channel walls or interior surfaces, except floors; for covered conduit and all other showing surfaces not specified above.	Tongue and groove flooring equal to C and Better flat grain; concrete form grade of plywood; or overlay plywood.
(I) All other lumber.	Construction.

778.2 REDWOOD:

Redwood lumber shall be selected as to grade and shall conform in all particulars to the standard specifications for grades of California Redwood of the California Redwood Association.

Redwood lumber for the uses listed shall not be lower than the following grades:

Uses	Grade
(A) Bridges, culverts, and guardrail posts	Dense Structural
(B) All other Redwood Lumber	Foundation

SECTION 778

778.3 GRADE MARKING:

Lumber: Each piece of lumber shall bear an official grade mark which, unless authorized otherwise, shall be the grade mark adopted by one of the following associations:

(A) For Douglas Fir and Pine -The West Coast Lumber Inspection Bureau or other agency approved by the Engineer.

(B) For Redwood -The California Redwood Association.

Plywood: Each sheet of plywood shall bear the official stamp of the APA stating the grading of the sheet.

- *End of Section* -

SECTION 779

WOOD PRESERVATIVES

779.1 GENERAL:

This work shall consist of treating lumber, timber, and piling. Lumber, timber, and piling to be treated shall conform to the requirements of the specification of the AWP and as specified herein.

Where practical, lumber to be treated shall be cut to size and framed, prior to treatment. Proper allowance for shrinkage in the sizes of lumber shall be made by the Contractor where it is necessary to meet definite dimensions shown on the plans.

779.2 OIL TYPE PRESERVATIVE TREATMENT:

Preservatives under this specification shall be creosote, creosote-coal tar solutions, creosote petroleum solutions, or pentachlorophenol in petroleum oils, conforming to AWP specifications and as specified by the Engineer.

Treatment: The treating operations shall conform to the applicable requirements of the AWP specifications.

Unless indicated otherwise on the plans or in the special provisions, the amount of preservative to be retained and the treating process to be used for the various types of service shall conform to the appropriate AWP specification.

Incising: Unless otherwise specified, timber to be treated under this specification that is 3 inches or more in nominal thickness and 4 inches or more in nominal width, shall be incised before treatment as a means of securing penetration of the preservative. If such thickness is less than 4 inches, the material may be incised on the wide faces only; otherwise, all 4 faces shall be incised.

779.3 WATER BORNE SALT PRESERVATIVES TREATMENT:

Preservatives under this specification shall conform to the requirements of AWP specifications unless otherwise approved in writing by the Engineer, but restricted to the following preservatives:

Chromated Zinc Chloride (CZC)

Tanalith (Wolman Salts)

Ammoniacal Copper Aresnite (Chemonite)

Chromated Zinc Arsenate (Boliden Salt)

Chromated Copper Arsenate (Erdalith)

779.4 FIELD TREATMENT OF CUT SURFACES:

When sawing or drilling is necessary after plant treatment, the cut surfaces shall be thoroughly brushed with 2 coats of the same kind of preservative in conformance with AWP specification. The maximum protection requirement specified therein shall be met in all instances.

- End of Section -

SECTION 787

GRAY IRON CASTINGS

787.1 GENERAL:

The castings shall be true to pattern in form and dimension and free from pouring faults, spongings, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Castings shall be filleted boldly at angles, and the arises shall be sharp and true.

Before the castings are removed from the foundry, they shall be thoroughly cleaned and the parting lines, gates, and risers ground flush.

787.2 TEST SPECIMENS:

Test coupons shall be cast separately of the castings, using a mold as described in ASTM [A48](#). A representative of the Engineer may be present at the time a melt is poured to identify both coupons and castings.

Two test coupons are required for each melt poured. Additional coupons shall be cast for use as replacements or in case a retest is required.

A representative of the Engineer may discard and replace specimens which show obvious lack of continuity of metal or if the machining is defective.

The manufacturer shall machine the tension specimens to the dimension specified for specimen B of ASTM [A48](#), at no additional cost to the Contracting Agency.

When approved by the Engineer transverse tests may be made in lieu of tensile tests, in which case the castings shall meet the requirements of ASTM [A48](#).

787.3 MANHOLE FRAME AND COVER SETS:

Castings shall conform to ASTM [A48](#), Class 30. The bearing surfaces of the frames and covers shall be machined and the cover shall seat firmly onto the frame without rocking.

Covers shall be the types and shall be imprinted as shown on the plans or standard details.

787.4 RAILINGS, RAILING POSTS, AND WHEEL GUARDS:

Castings shall conform to ASTM [A48](#), Class 40.

787.5 ROCKERS, ROCKER PLATE BEARINGS, AND BEARING PLATES FOR BRIDGES:

Castings shall conform to ASTM [A48](#), Class 50.

Castings shall be machined and finished as specified on the plans provided that tool marks on sliding contact surfaces shall run in the direction of plate movement, or in the case of rocker plate bearings, perpendicular to the rocker movement. Tool marks shall be not more than 1/32 inch apart.

787.6 UNCLASSIFIED CASTINGS:

All castings not specifically classified, shall conform to the requirements of ASTM [A48](#), Class 30.

- End of Section -

SECTION 790

PAINT

790.1 GENERAL:

Paint shall be homogeneous, free of contaminants, and of a consistency suitable for the intended use. Finished paint shall be well-ground and the pigment shall be properly dispersed in the vehicle according to the requirements of the paint; and this dispersion shall be of such nature that the pigment does not settle appreciably, does not cake or thicken in the container, or become granular or curdled. Paint and paint materials shall be delivered to the job site in new, unopened air-tight containers appropriately identified with the manufacturer's name, date of manufacture, type of paint or paint material, specifications paint number, and lot or batch number. The container shall have a formula label.

No paint shall be used until at least 7 days have elapsed from the date of manufacture. Paint containing lead shall comply with Subsection [107.5.2](#).

790.2 PROPRIETARY BRANDS:

For the purpose of this specification, proprietary brands of paint and paint materials shall be construed to mean paint or paint materials conforming to the requirements of this specification and produced for distribution and consumption through regular wholesale and retail outlets. Whenever paint or paint materials are designated on the plans or special provision by a manufacturer's name or catalog reference, any proprietary brand of equal quality will be permitted, subject to the approval of the Engineer. Information required by the Engineer as proof of the comparative quality shall be furnished by the Contractor.

790.3 PAINT COATS:

The first coat of paint applied to an unpainted surface shall be called the prime coat. The paint applied to field connections, welds, rivets, and all damaged or defectively painted or rusty areas on a prime coated surface shall be called a touch-up coat. The paint applied over the prime coat and touch-up coat shall be called the second coat. The final coat of paint shall be called the finish coat.

790.4 MATERIALS:

Materials shall conform in all respects to the requirements of references specifications indicated for such material.

Upon request of the Engineer, the Contractor shall furnish a certification from the manufacturer that the material conforms with this specification.

(A) Vehicles: Raw Linseed Oil Boiled Linseed Oil Water-Resistant Spar Varnish Alkyd Resin Driers Thinners: Xylene Turpentine (shall be used in paints used for timber) Petroleum Spirits (Mineral Spirits)	Specification: ASTM D234 ASTM D260 Navy Department Specification 52V20 TT-R-266C ASTM D600 , Class A or Class B, as applicable TT-X-916B, Grade A ASTM D13, Gum Spirits ASTM D235
(B) Pigments Carbonblack Lampblack Red Lead Titanium Dioxide, Non-extended Titanium Dioxide, Extended (Titanium Calcium, Rutile) Titanium Dioxide	Specifications: TT-P-343 Form 1, Class B ASTM D209 ASTM D83 ASTM D476 , Type II, Class II ASTM D476 TT-P-422B, Type III, Class A

SECTION 790

White Lead Basic Carbonate	ASTM D81
Zinc Yellow (Zinc Chromate)	ASTM D478 , Type II
Zinc Oxide	ASTM D79
Iron Blue	TT-P-385
Iron Oxide, Yellow	TT-P-458A
Iron Oxide, Orange	ASTM D3721 , D3722 , D3724
Hansa Yellow G	MIL-H-10330
Organic Green Gold	Dupont YT 562-D or equal, specific gravity 161 ±0.05
Chromium Oxide, Green Graphite	TT-P-347

Graphite shall be natural amorphous material (American product) which shall contain not less than 35 percent nor more than 45 percent graphite carbon. The remainder shall be insoluble siliceous material containing a total of not more than 5 percent calcium and magnesium carbonate and sulfate. The pigment shall be ground to such a fineness that not less than 97 percent shall pass a No. 325 sieve. The graphite paste shall be made by grinding the pigment in pure raw linseed oil in the following proportions:

Amphorus Graphite	68.0 percent
Linseed Oil	32.0 percent

(C) **Inert Materials:**

Diatomaceous Silica
Magnesium Silicate

Specifications:

ASTM D604, Type A
ASTM [D605](#)

790.5 MIXED PAINTS:

All mixed paints shall, in general, be machine-mixed and shall consist of the pigment of the required fineness and composition, ground to the desired paste consistency in pure raw or boiled linseed oil, to which shall be added the remainder of the vehicle to make paint conforming to the required formula as herein specified.

Paint which has hardened and thickened in the container such that it cannot be readily broken up to a smooth uniform paint of good brushing consistency shall not be used.

All materials used in mixed paints shall conform to the requirements as herein specified. The paint shall be made to satisfactory workable consistency conforming to one of the following formulas for paint as required on the plans or in the special provisions. All percentages shown are by weight.

Any of the following paints which are too thick to have a satisfactory workable consistency shall be thinned with a suitable thinner from the group of thinners herein specified. In no case shall gasoline be used as a thinner.

Fineness of grind for enamel shall conform to Hegman 7 minimum.

The following paints shall conform to the latest ADOT standard specifications for Road and Bridge Construction. All paints, except Paint No. 10 (Aluminum), shall be shipped ready for use.

When Paint No. 1 is specified, it may be Paint No. 1-A or Paint No. 1-B. Paint No. 1-D shall be used only when specifically designated.

SECTION 790

Paint Number	Type
1-A	(Red Lead — Linseed Oil)
1-B	(Red Lead — Alkyd Resin)
1-D	(Zinc Chromate)
4	(Dull Black)
5	(Jet Black)
6	(Black — For Timber Primer Only)
7	(White — For Timber Primer Only)
8	(White)
9	(Light Grey)
10	(Aluminum)
11	(White Enamel)
15	(Zinc)

- *End of Section* -

SECTION 792

DUST PALLIATIVE

792.1 GENERAL:

Dust palliatives shall consist of various chemical dust suppressants which work by binding together lighter soil particles.

All materials must meet the environmental requirements of Section [792.3](#) and must be approved by the Engineer prior to their use.

792.2 TYPE OF MATERIALS AND APPLICATION RATES:

Emulsions shall be miscible with water in all proportions as noted in Table [792-1](#). The dilution ratio will vary based upon the local soil and weather conditions. The ratios shall be proposed by the Contractor and agreed upon by the Engineer.

The rate of application noted in Table [792-1](#) shall be for the treatment, method and use specified by the Contracting Agency, or as directed by the Engineer. To compensate for local conditions or changes in soil type, the Contractor may adjust the application rate within the ranges specified.

Products specifically formulated as tackifiers which prevent wind-blown erosion shall not be acceptable as dust palliatives for vehicular traffic, but may be used for their intended purposes.

TABLE 792-1				
DUST PALLIATIVE DILUTION RATIOS AND APPLICATION RATES				
Product Type	Use/Treatment ⁽¹⁾	Dilution Ratio ⁽²⁾		Application Rate ⁽³⁾ (gal/sy)
		Range	Typical	
Acrylic Copolymer And Polymers	Topical - Road or parking Lot	20:1 to 4:1	9:1	0.20 to 0.15
	Topical - Road Shoulder	20:1 to 4:1	15:1	0.16 to 0.12
	Surface Course (per inch of depth)	20:1 to 4:1	9:1	0.08 to 0.06
Lignin-Based Type (Lignosulfonate)	Topical - Road or parking Lot	1:1	1:1	0.10 to 0.05
	Topical - Road Shoulder	7:1 to 4:1	8:1	0.05 to 0.03
	Surface Course (per inch of depth)	1:1	1:1	0.30 to 0.10
Organic Resin	Topical - All	10:1 to 2:1	5:1	0.25 to 0.15
	Surface Course (per inch of depth)	2:1 to 1:1	1:1	0.15 to 0.10
Petroleum Resin	Topical - Road or parking Lot	4:1	4:1	0.15 to 0.10
	Topical - Road Shoulder	10:1 to 7:1	8:1	0.15 to 0.07
	Surface Course (per inch of depth)	4:1	4:1	0.11 to 0.07
Tall Oil Pitch Emulsion	Topical - Road or parking Lot	20:1 to 5:1	5:1	0.20 to 0.15
	Topical - Road Shoulder	20:1 to 3:1	3:1	0.16 to 0.12
	Surface Course (per inch of depth)	20:1 to 2:1	10:1	0.08 to 0.06
Other	As approved by the Engineer			

(1) Topical application rates shown are to obtain 1/2 to 1 inch penetration. Higher rates should be used if greater penetration is anticipated.

(2) The dilution ratio (water: product) is variable and shall be appropriate for the local soil and weather conditions, as proposed by the Contractor and agreed upon by the Engineer.

(3) Application rate of undiluted concentrate.

SECTION 792

Contractor shall submit proof of conformance in the form of test reports to verify that the dust palliative product proposed for use meets the minimum material requirements specified in this Section. Testing must be specific to the proposed product and not generic to similar type palliative products. Testing shall be performed by independent AASHTO accredited laboratories, and signed and sealed by Professional Engineers registered in the State of Arizona. The Contractor is responsible for any costs associated with the testing of soil and palliative product prior to the application of as specified herein.

(A) Acrylic Copolymer and Polymer Types:

The material shall be a white or clear emulsion that can penetrate, saturate and bond together treated soils to create a hard, dust-free and water resistant surface. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Composition	--	Acrylics, acrylates & acetates
pH	E70	4.0 – 9.5
Residue (active solids content), %	D2834	40 min.
Flash Point	D92	None
Absolute Viscosity (Brookfield), cP, 77°F	--	1500 max.
Specific Gravity, 60/60°F	D1298	1.00 – 1.15

(B) Lignin-Based Types:

Lignin-based dust palliative shall be an aqueous lignosulfonates (a residual co-product of wood pulping by the sulfite process in the manufacturer of cellulose products) that dispersed readily in water to yield a stable, brown-colored solution. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Absolute Viscosity (Brookfield), cP, 77°	--	<1000
Residue (total solids content), %	D2834	48 min.
Lignin sulfonate content (% of solids)	D2834	60 min.
pH	E70	5.0 - 7.0
Specific Gravity (liquid), 77/60°F	D1298	1.00 min.

(C) Organic Resinous Types:

The material shall be a tan emulsion designed specifically for dust control of unpaved roads, traffic surfaces, and road shoulders that utilize non-petroleum based organic esters and resins combined with other additives to penetrate, bond and coat treated soils. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Absolute Viscosity (Brookfield), cP, 77°	--	50 – 200
pH	E70	3.0 - 9.0
Residue (active solids content), %	D2834	45 min.
Flash Point	D92	None
Specific Gravity, 60/60°F	D1298	1.00 min.

(D) Petroleum Resinous Types:

The materials shall be a light yellow petroleum resinous emulsion suitable for use as agglomerate for soil particles. The material shall have the following properties in its undiluted emulsified state:

SECTION 792

Specification Designation	ASTM Test Method	Requirements
Kinematic Viscosity, SFS at 77°F	D244	188 min.
pH	E70	4.0 – 7.0
Residue, % wt ⁽¹⁾	D2834	60 min.
Sieve Test, % wt. Retained ⁽²⁾	D244	0.1 max.
Particle Charge Test	D244	Positive
Flash Point of base product, CO, °F.	D92	400 min.
Specific Gravity, 60/60°F	D1298	1.00 min.

- (1) ASTM test modified by heating 50 g of sample to 300 °F until foaming ceases, then cooling immediately and calculation results.
- (2) Replace 2% sodium oleate solution with distilled water in test.

The emulsion shall be stable, i.e., should not break when stored in clean closed containers at temperatures between 35°F and 200 °F for a minimum of 3 months. The sequestering agents shall make the preparation stable against hard water, thus permitting dilution of the emulsion with almost all types of water. The emulsion shall be non-corrosive to metal containers. The materials shall penetrate into the soil and not form a skin at the surface or a crusted surface.

(E) Tall Oil Pitch Emulsion:

The material shall be a light brown tree resinous emulsion produced from distilled tall oil and not associated with the use of chlorine-based chemicals to bleach pulp from the production of paper. The product shall be designed specifically for dust control of unpaved roads, traffic surfaces, and road shoulders that can penetrate, saturate and bond together soils to create a hard, dust-free and water repellant surface. The product shall be non-water soluble once cured. The emulsion shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
pH	E70	2.5 - 9.0
Residue (active solids content), %	D2834	35 min.
Flash Point	D92	None
Specific Gravity, 60/60°F	D1298	0.998 min.

(F) Other Types:

Other types of dust palliative may be approved for use by the Engineer. Test methods, requirements, dilution ratios and application rates shall be as specified by the manufacturer.

792.3 PERFORMANCE STANDARDS AND TEST METHODS:

Product shall be blended at the specified stabilizer content application rate with soil that is either representative of the site soils to be treated or be a local A-7 in accordance with AASHTO M-145 (as determined by the Engineer) and tested in accordance with ASTM [D1883](#). Results of treated soil must show a minimum 25% increase in CBR (California Bearing Ratio) value over the untreated soil for the product to be accepted for either topical dust suppression or soil stabilization.

Testing shall be in accordance with ASTM [D1883](#), as modified herein. Test reporting shall include all the information required by ASTM [D1883](#), Section 10.0 for both treated and untreated CBR samples. In addition, the penetration vs. stress plot for each test shall be included (ASTM [D1883](#), Fig. 2) along with the rate of product application and the percent stabilizer solids. CBR specimens, after molding, shall be left in their mold, on their sides and cured in the laboratory air for 7 days prior to being immersed in water for 96 hours and then tested for CBR. At least three CBR test specimens shall be compacted at the optimum moisture content, both treated and untreated (ASTM [D698](#), method C), with the result reported as the average value. The surcharge weight shall be 10 pounds.

SECTION 792

792.4 ENVIRONMENTAL CRITERIA:

Contractor shall submit proof to the Engineer in the form of test reports and certificates to verify that the dust palliative product is in environmental compliance. The Contractor is responsible for any costs associated with the testing of soil and palliative product prior to the application of as specified herein.

Products shall not contain or emit chlorinated fluorocarbons (CFC's or Freon's) and shall not contain or emit volatile organic compounds (VOC's) that exceed Federal, State or Local air quality limitations.

Products and their degradation products shall not be composed of elements, compounds, mixtures or produce runoffs with the characteristics identified under Arizona Revised Statutes 36-2822 of the Arizona Hazardous Waste Management Act, emit or off-gas during placement, use or degradation of any hazardous air pollutant listed under Section 112 of the Federal Clean Air Act [42 U.S.C. § 7412], be a hazardous chemical substance or mixture pursuant to Section 7 of the Federal Toxic Substances Control Act [15 U.S.C. § 2606], be designated by rule an extremely hazardous chemical substance pursuant to the Arizona Environmental Quality Act, be prohibited for use by the Arizona Department of Environmental Quality, the Environmental Protection Agency, or any applicable law, rule or regulation.

Product runoff and their degradation product runoffs shall not contain concentrations that exceed the parameters designated in Section 2.18 'Table 5' of the National Pollution Discharge Elimination System (NPDES) Multi-Sector General Permit for Industrial Activities (*see Note A*). Adequate proof can be shown by providing one of the following:

- (A) Complete aquatic toxicity test for lethal concentration at 50% (LC50).
- (B) Provide complete and accurate listing of all individual chemical constituents (including proprietary chemical information) and percentage of each in a given volume of pure chemical product.
- (C) Surface water runoff test. This test involves running distilled water over a treated soil area, collecting the test water, and submitting to a certified lab for analysis.

Contractor shall obtain from the dust palliative product manufacturer independent verification and certification of performance and environmental claims by a recognized agency of the United States, Canadian Precertification, Environmental Technology Verification, or EcoLogo Certification programs for chemical dust suppressants.

Products or their components and degradation products shall be tested and certified by the manufacturer not to be substances or composed of substances known to be, or reasonably anticipated to be carcinogenic or toxic by the U.S. Department of Health and Human Services.

Products must have hazardous Materials Identification System (HMIS) ratings equal to or less than the following for each category: H=1; F=1; R=1; PPE=X.

- End of Section -

Note A: Parameter benchmark values shall be provided by the Engineer and based on the Contracting Agency's Requirements.

SECTION 795

LANDSCAPE MATERIAL

795.1 GENERAL:

Material used for landscaping purposes shall be in conformance with this Section.

The common and scientific names of plants shall conform to the approved names in Standard Plants Names (SPN) or its successor, American Association of Nurserymen (ASN). For identification and inspection, durable, legible labels, bearing the plant's name in water-resistant ink, shall be attached to all nursery stock or container of stock delivered to the project site.

795.2 TOPSOIL:

Topsoil shall be a fertile, friable soil, obtained from well-drained arable land, and shall be free from nut grass, refuse, roots, heavy clay, clods, noxious weeds or any other material toxic to plant growth. At least 10 days prior to delivery of topsoil to the site, the Contractor shall furnish the Engineer at no additional cost, with a soil sample from each source for analysis and tests.

To be acceptable the pH factor shall not exceed 8.0 or be lower than 5.5, soluble salts shall not exceed 1500 PPM, the plasticity index shall be in the range of 3 and 15 inclusive, and it shall contain approximately 1 1/2%, by dry weight, or organic matter either natural or added. Gradation shall be in accordance with the following:

Sieve Size	Percent Passing
1 inch	100
1/2 inch	95-100
No. 4	90-100
No. 10	70-100
No. 200	15-70

795.3 SOIL FERTILIZING MATERIAL:

Fertilizing material shall comply with the applicable requirements of the State Agricultural Code. All fertilizing material shall be packaged, first grade, commercial quality products identified as to source, type of material, weight and manufacturer's guarantee analysis. It shall not contain toxic ingredients or fillers in quantities harmful to human life, animals or plants. It shall be delivered in unopened containers and shall have the chemical analysis as specified in the plans or specifications. Material which has become caked or otherwise damaged shall not be used.

795.4 ORGANIC SOIL CONDITIONERS:

In general, soil conditioners shall consist of a ground or processed wood product derived from redwood, ground or shredded fir, redwood or ponderosa bark. It shall have a nitrogen content of 1%, a pH not exceeding 7.5, and organic matter not less than 85%. Its gradation shall be such that at least 85% passes the 1/4 inch screen. In addition, it shall be treated with a non-toxic agent so as to be hygroscopic.

When manure is used as a soil conditioner, it shall be the product of yard fed cattle, free of weed seeds, straw or any other inert material and aged at least 3 months. This manure shall have been processed by grinding and screening and shall be of a consistency that will readily spread with a mechanical spreader.

795.5 CHEMICAL SOIL CONDITIONER:

Chemical soil conditioners such as soil sulfur, gypsum or iron additive shall be commercially approved brands designated for agricultural use. Material which has become caked or otherwise damaged shall not be used.

SECTION 795

795.6 SEEDS:

Seeds shall be fresh, clean seeds, pre-mixed to the specified proportion. They shall be delivered to the site in original, unopened containers bearing the dealer's guaranteed analysis and germination percentage. They shall have a certificate or a stamp or a release accomplished by an agricultural commission.

795.7 PLANTS, TREES, AND SHRUBS:

795.7.1 General: All landscape stock shall be grown in nurseries approved by the State Department of Agriculture. They shall have a growth habit normal to the specie. Stock shall be sound, healthy, and vigorous; free from insect pests, sun scald, excessive bark abrasions and other objectionable disfigurements. They shall have normal, well-developed branch systems and vigorous, fibrous root systems which are neither root nor pot-bound and are free of kinked or girdling roots.

All stock shall have been grown in pots, cans, tubs, or boxes for a minimum of three months and a maximum of one year. They shall have sufficient roots to hold earth together after removal from the containers. This earth shall be free from noxious weeds including Bermuda grass.

Stock shall be inspected and approved by the Engineer at the Contractor's storage site prior to delivery to the project.

795.7.2 Flatted Plants: Flatted plants shall be grown and remain in the flats until transported to the project site. The soil and spacing of the plants in the flats shall insure the minimum disturbance of the root system at transplanting.

795.7.3 Trees: Trees shall be of the specified height, spread and caliper and shall stand erect without support. The height shall be measured from the root crown to the last division of the terminal leader with the branches in a normal position and the caliper shall be measured 12 inches above the crown roots. For palm trees only, the height shall be measured from the ground line to the base of the growing bud.

795.7.4 Shrubs: Shrubs shall be of the specified type, height and spread. They shall be selected from high quality, well-shaped nursery stock.

795.8 MISCELLANEOUS MATERIAL:

795.8.1 Headers and Stakes: Lumber for landscaping shall be construction heart, rough-sawn redwood in the sizes specified; splicing will not be permitted. Stake used with header boards shall be 2 x 4 inches, pointed and at least 18 inches long.

795.8.2 Tree Stakes: Unless otherwise specified, tree stakes shall be 2 x 2 inch redwood posts, free of knots and reasonably straight, and of sufficient length to properly support the tree.

795.8.3 Tie Wires: Tie wire shall be No. 12 AWG zinc coated wire and the cover for this wire shall be 1/2 inch garden hose.

795.8.4 Decomposed Granite: All material used for a specific project or location shall be from a single source and shall present a uniform appearance. The gradation shall be as shown below. If a specific color or type is required, it will be so indicated in the Contracting Agency's specifications.

Sieve Size	Percent Passing
3/4 inch	100%
1/2 inch	60-70
No. 40	5-20

- End of Section -

SECTION 796

GEOSYNTHETICS

796.1 GENERAL:

This section defines the requirements for geosynthetic fabrics, grids and membranes typically used as pavement fabric beneath asphalt concrete overlays, filtration/drainage separation between soil/aggregate layers, erosion control filter/separators for riprap protection, and soil or base reinforcement to improve the stability of weak soils or reinforce aggregate bases.

796.2 MATERIALS AND REQUIREMENTS:

Identification, packaging, delivery, storage and handling of geosynthetic materials shall be in accordance with manufacturer's recommendations and ASTM [D4873](#). Each roll shall be labeled or tagged to provide product identification sufficient to determine the product type, manufacturer, quantity, lot number, roll number date of manufacture, and shipping date.

Geosynthetic materials shall be inert to commonly encountered chemicals, resistant to rot and mildew, and shall have no tears or defects which adversely affect or alter its physical properties.

Geosynthetic materials shall be packaged with material that will protect the geosynthetic (including ends of rolls) from damage due to shipment, water, sunlight and contaminants. During storage, geosynthetic materials shall be elevated off the ground and protected from the following: site construction damage, precipitation, extended ultraviolet radiation, strong acid or strong base chemicals, flames (including welding sparks), temperatures in excess of 160°F, and any other environmental condition that may damage geosynthetic material property values. Protection shall be in accordance with manufacturer's specifications and shall be maintained during periods of shipment and storage.

Materials required for complete and proper installation of geosynthetic materials that are not specifically described herein (such as pins, nails, washers, etc.) shall conform to the manufacturer's recommendations and be as selected and supplied by Contractor subject to final approval by the Engineer.

Requirements represent minimum average roll values in the weaker principal direction. Average of test results from any sampled roll in a lot shall meet or exceed the minimum values noted herein. Lot sampling shall be in accordance with ASTM [D4354](#).

796.2.1 Pavement: Pavement fabric geosynthetics are non-woven polyester or polypropylene fabrics that are field saturated with an asphalt binder and placed as an interlayer beneath a pavement overlay or between pavement layers. When placed, the fabric becomes an integral part of the roadway section, forming a barrier to water infiltration and absorbing stresses to reduce reflective and fatigue cracking of the new pavement surface layer.

Pavement fabric shall be constructed of at least 95 percent (by weight) nonwoven synthetic fibers of polyester or polypropylene, thermally bonded on one side. The fabric material shall additionally conform to the physical properties shown in Table [796-1](#).

TABLE 796-1			
PAVEMENT GEOSYNTHETIC PROPERTIES			
Property	Class A	Class B	Test Method
Weight: oz/yd ²	4.1 min.	4.0 min.	ASTM D3776
Grab tensile strength: lbs.	100 min.	90 min.	ASTM D4632
Elongation at break: %	50 min.	50 min.	ASTM D4632
Melting point: degree F	300 min.	300 min.	ASTM D276
Asphalt retention: gal/yd ²	0.25 min. ⁽¹⁾	0.20 min.	ASTM D6140

(1) May be reduced within street intersections, on steep grades or in other zones where vehicle braking is common, but not less than 0.20 gal/yd², when approved by the Engineer.

796.2.2 Filtration (Drainage) and Separation: Filtration and separation fabrics are nonwoven or woven polypropylene or polyester fabrics with specified strength characteristics used as permeable separators to restrain soil or other particles subjected

SECTION 796

to hydrodynamic forces while allowing the passage of fluids into or across a geotextile and to prevent inter-migration of adjacent soil layers of vastly different particle sizes and particle distributions.

Filtration and separation fabrics shall be nonwoven or woven fabric consisting only of long chain polymeric filaments such as polypropylene or polyester formed or woven into a stable network such that the filaments retain their relative position to each other. The fabric material shall additionally conform to the physical properties shown in Table [796-2](#).

TABLE 796-2			
FILTRATION & DRAINAGE GEOSYNTHETIC PROPERTIES			
Property	Class A ⁽¹⁾	Class B ⁽²⁾	Test Method
Grab tensile strength: lbs.	180 min.	80 min.	ASTM D4632
Seam strength: lbs.	160 min.	70 min.	ASTM D4632
Puncture strength: lbs.	80 min.	25 min.	ASTM D4833
Trapezoidal tear: lbs	50 min.	25 min.	ASTM D4533
Apparent opening size: US Standard sieve size	>50	>50	ASTM D4751
Ultraviolet Stability: %	50 min.	50 min.	ASTM D4355

- (1) Class A - Use where installation stresses are more severe than for Class B application (i.e. very coarse sharp angular aggregate or high compaction requirements).
- (2) Class B – Use with smooth graded surface having no sharp angular projections and sharp angular aggregate.

796.2.3 Erosion Control: Erosion control fabrics are used below areas to receive aggregate or riprap slope protection and act as filter/separators to provide sustained permeability while maintaining structural stability.

Erosion control fabrics shall be a woven monofilament fabric or a nonwoven fabric consisting only of long chain polymeric filaments such as polypropylene or polyester formed into a stable network that the filaments retain their relative position to each other. The fabric material shall additionally conform to the physical properties shown in Table [796-3](#).

TABLE 796-3			
EROSION CONTROL GEOSYNTHETIC PROPERTIES			
Property	Class A	Class B	Test Method
Grab tensile strength: lbs.	270 min.	200 min.	ASTM D4632
Elongation at break: %	45min., 115 max.	15 min., 115 max.	ASTM D4632
Puncture strength: lbs.	110 min	75 min.	ASTM D4833
Burst strength: psi	430 min.	320 min.	ASTM D3786
Trapezoidal tear: lbs	75 min.	50 min.	ASTM D4533
Permittivity: second ⁻¹	0.07 min.	0.07 min.	ARIZ-730 ⁽¹⁾
Apparent opening size: US Standard sieve size	30 – 140	30 - 140	ASTM D4751
Ultraviolet Stability: %	70 min.	70 min.	ASTM D4355

- (1) Arizona Department of Transportation test method.

796.2.4 Soil or Base Reinforcement: Geogrid geosynthetic materials are used for improving the stability of weak soils or reinforcing aggregate bases. Geogrids are defined as biaxial or triaxial polymeric grids formed by a regular network of integrally connected polymer tensile elements with apertures of sufficient size to permit significant mechanical interlock with the surrounding soil, aggregate, or other fill materials to function primarily as reinforcement.

SECTION 796

The geogrid structure shall be dimensionally stable and able to retain its geometry under manufacture, transport and installation. Geogrids shall be integrally formed and deployed as a single layer; comprised of 100 percent polypropylene or high-density polyethylene. Geogrids shall additionally conform to the physical properties shown in Table [796-4](#).

TABLE 796-4			
REINFORCEMENT GEOGRID PROPERTIES			
Property	Type 1	Type 2	Test Method
Aperture size: inches	1 min.	1-3/8 min.	ID callipered
Ultimate Tensile Strength: lb/ft	850 min.	1300 min.	ASTM D4945
Flexural Rigidity: Mg-cm	250,000 min.	750,000 min.	ASTM D1388
Tensile Strength @ 2% Strain: lb/ft MD ⁽¹⁾	270 min.	410 min.	ASTM D6637
Tensile Strength @ 2% Strain: lb/ft CMD ⁽²⁾	380 min.	620 min.	ASTM D6637
Tensile Strength @ 5% Strain: lb/ft MD ⁽¹⁾	550 min.	810 min.	ASTM D6637
Tensile Strength @ 5% Strain: lb/ft CMD ⁽²⁾	720 min.	1340 min.	ASTM D6637
Junction Efficiency: % Ultimate Tensile Strength	75 min.		GRI-GG2 ⁽³⁾
Ultraviolet Stability: % Retained Strength	70 min.		ASTM D4355

(1) MD = Test in the machine direction along roll length

(2) CMD = Test in the cross-machine (transverse) direction across roll width

(3) Geosynthetic Research Institute test method

796.3 TEST AND CERTIFICATION REQUIREMENTS:

Certificates of compliance shall be submitted to the engineer upon delivery of material for use on a specified project. Samples of materials shall be submitted for testing. Each geosynthetic material lot or shipment must be approved by the Engineer before the materials may be incorporated in the work.

Testing methods and results shown in the certificate of compliance shall conform to the listed specifications for the proposed geosynthetic use. Manufacturer's supporting documentation including, but not limited to, product information sheets, installation procedures and recommendations, recommended use, and project references shall be submitted to the Engineer for product evaluation and approval.

- End of Section -

INDEX

- Abbreviations and Definitions, [101-1](#)
- Acceptance, [105-6](#)
 - Final Acceptance, [105-6](#)
 - Partial Acceptance, [105-6](#)
- Access to Property, [340-2](#)
- Actual Cost Work, [109-3](#)
- Addendum, [101-4](#)
- Adjusting Frames, Covers, Valve Boxes, [345-1](#)
 - Frames, [345-1](#)
 - Manhole and Valve Covers, [345-1](#)
 - Valve Boxes, [345-1](#)
 - Water Meter Boxes, [610 6](#)
- Aggregate, [701-1](#)
 - Coarse, [701-1](#)
 - Fine, [701-1](#)
 - Mineral, [714-1](#)
 - Reclaimed Concrete Material, [701-11](#)
 - Reclaimed Asphalt Pavement, [701-1](#)
- Aggregate Base , [310-2](#), [342-1](#), [350-2](#), [355-1](#), [601-4](#), [601-6](#), [702-1](#), [702-2](#), [728-1](#), [796-1](#), [796-2](#)
- Aggregate Paving
 - Exposed, [343-1](#)
- Air Release and Vacuum Valves, [610-5](#), [630-1](#), [630-7](#)
- Air Test
 - Sewer Lines, [615-3](#)
- Alley Entrances, [301-2](#), [336-1](#), [336-4](#), [340-1](#)
- Aluminum Handrails, [520-1](#)
- Anti-Stripping Agent, [710-2](#)
- Approval of
 - Bonds and Insurance, [109-5](#)
 - Contract, [103-4](#)
 - Proposal, [102-1](#), [103-1](#)
 - Shop Drawings, [101-8](#), [105-1](#)
 - Subcontracts, [108-1](#)
 - Subletting, [108-1](#)
 - Substitutes, [106-2](#)
- Archaeological Reports, [107-1](#)
- Arizona Test Method, [101-4](#)
- Asbestos-Cement Pipe and Fittings for Storm Drain and Sanitary Sewer, [737-1](#)
- Asbestos-Cement Water Pipe and Fittings, [752-1](#)
- Asphalt
 - Concrete, [710-1](#)
 - Emulsified, [333-1](#), [713-1](#)
 - Liquid, [320-1](#), [320-2](#), [321-5](#), [330-1](#), [330-2](#), [330-3](#), [711-1](#), [712-1](#), [712-2](#)
 - Milling, [317-1](#)
 - Paving, [711-1](#)
 - Rubber, [717-1](#)
- Asphalt Chip Seal, [330-1](#)
- Asphalt Concrete, [710-1](#)
 - Preservative Seal, [334-1](#), [718-1](#)
- Asphalt Concrete Pavement, [321-1](#)
 - Curbs, [324-2](#)
- Asphalt Distributing Equipment, [330-3](#)
- Asphalt Emulsion
 - Slurry Seal Coat, [332-1](#)
 - Asphalt Pavement Core Bonding Materials, [708-1](#)
- Asphalt Milling, [317-1](#)
- Asphalt-Rubber Asphalt Concrete, [717-1](#)
- Assignment of
 - Contract, [108-1](#)
 - Payments, [109-2](#)
- Authority of the
 - Engineer, [109-5](#)
 - Inspector, [105-4](#)
- Award and Execution of Contract, [103-1](#)
 - Cancellation of, [103-1](#)
 - Execution, [103-1](#)
 - of Contract, [103-1](#)
- Backfill
 - Structure, [206-1](#)
- Barricades and Warning Signs, [107-2](#)
- Base Materials, [702-1](#)
- Beginning Work, [108-1](#)
- Bench Marks, [105-4](#)
- Bid Guarantee
 - Amount of, [103-1](#)
 - Forfeiture of, [103-4](#)
 - Proposal, [103-4](#)
 - Return of, [103-1](#)
- Bidding Requirements and Conditions, [102-1](#)
 - Disqualification, [102-3](#)
 - Eligibility and Preference, [102-1](#)
 - Successful, [102-3](#)
- Bidding Requirements and Conditions, [102-1](#)
- Bituminous Prime Coat, [315-1](#)
- Blasting
- Discontinue [107-3](#)
 - Operations, [107-3](#)
- Bolts
 - Anchor, [770-1](#)
- Bonds
 - Acceptable to, [103-1](#)
 - Amount, [103-2](#)
 - Executed by, [103-2](#)
 - Proposal Guarantee, [103-1](#)
 - Requirement of, [103-1](#)
- Borrow Excavation, [210-1](#)
 - Local and Imported, [210-1](#)
 - Placing and Compacting, [210-1](#)
- Brick and Concrete Masonry Units (Blocks), [775-1](#)
 - Building, Facing and Manhole, [775-1](#)
 - Concrete Paving, [342-1](#)
- Brick Masonry, [511-1](#)
 - Bricklaying, [511-1](#)
 - Curing, Grouting and Reinforcing, [511-1](#)
- Bridges
 - Concrete, [505-1](#)
 - Steel, [515-1](#)

INDEX

- Cable
 - Installation, [360-1](#)
- Cancellation of
 - Award, [103-1](#)
 - Contract, [108-3](#)
- Carrier Pipe Placement [602-2](#)
- Cast Iron Water Pipe, [750-1](#)
- Castings
 - Gray Iron, [787-1](#)
- Cast-in-Place Concrete Pipe, [620-1](#)
 - Construction Methods, [620-1](#)
 - Excavation, [620-1](#)
 - Materials, [620-1](#)
 - Methods of Tests, [620-3](#)
 - Placement, [620-2](#)
- Catch Basins, [505-1](#), [601-2](#)
- Cement Concrete
 - Cement, [725-1](#)
- Cement Mortar and Grout, [776-1](#)
- Cement Treated Base, [312-1](#)
- Certificate of
 - Compliance or Analysis, [106-1](#)
 - Insurance, [103-2](#)
 - Weighmaster's, [109-1](#)
- Chain Link Fences, [420-1](#), [772-1](#)
- Change Order
 - Alteration of Work, [104-2](#), [109-2](#)
 - Extension of Time, [108-3](#)
 - Extra Work, [104-3](#), [109-3](#)
 - Payment, [104-2](#)
 - Unreasonable Circumstances, [109-7](#)
- Changed Conditions
 - Additional Compensation, [110-2](#)
 - Additional Time, [110-2](#)
 - Dispute Resolution, [110-1](#)
 - Notification, [110-1](#)
- Channels
 - Open, [215-1](#)
- Chip Seal, [330-1](#)
 - Application, [330-1](#)
 - Materials, [330-1](#)
 - Weather Conditions, [330-1](#)
- Chlorine
 - Disinfecting Water Mains, [611-2](#)
- City Sealer of Weights, [109-1](#)
- Classes, Grades and Types
 - Liquid Asphalt, [712-1](#)
 - Pavement, [710-1](#)
 - Paving Asphalts, [711-1](#)
- Clay Pipe Vitrified, [743-1](#)
- Clean Up
 - During Construction, [104-2](#)
 - Final, [104-2](#)
- Clearing and Grubbing, [201-1](#)
- Coating Corrugated Metal Pipe and Arches, [760-1](#)
- Collusion
 - Evidence of, [107-1](#)
- Commencement, Prosecution and Progress, [108-1](#)
- Compensation for
 - Alteration of Work, [109-2](#)
 - Change Orders, [104-2](#)
 - Extra Work, [109-3](#)
- Concrete Block Masonry, [510-1](#)
- Concrete Crub, Gutter, Sidewalk, Curb Ramps, Driveway and Alley Entrance, [340-1](#)
 - Alley Entrance, [340-1](#)
 - Asphalt, [710-1](#)
 - Blocks, [775-1](#)
 - Curb, [340-1](#)
 - Curb Ramps, [340-1](#)
 - Curing Materials, [726-1](#)
 - Driveway, [340-1](#)
 - Gutter, [340-1](#)
 - Masonry Units, [775-1](#)
 - Non-Renforced Pipe, [736-1](#)
 - Paving Stone or Brick, [342-1](#)
 - Portland Cement, [725-1](#)
 - Pressure Pipe, [758-1](#)
 - Sidewalk, [340-1](#)
- Concrete Block Masonry, [510-1](#)
 - Construction, [510-1](#)
 - Curing, [510-2](#)
 - Mortar and Grout, [510-2](#)
 - Reinforcing, [510-1](#)
 - Tests, [776-2](#)
- Concrete Curing Materials, [726-1](#)
- Concrete Pipe
 - Cast-in-Place, [505-12](#), [620-1](#),
 - Lining, [741-1](#)
 - Non-Reinforced Concrete, [736-1](#)
 - Reinforced, [735-1](#)
- Concrete Pressure Pipe-Steel Cylinder Type, [758-1](#)
- Concrete Structures, [505-1](#)
 - Concrete Deposited Underwater, [505-9](#)
 - Curing, [505-9](#)
 - Dimensional Tolerances, [505-12](#)
 - Falsework, [505-3](#)
 - Finishing Concrete, [505-10](#)
 - Forms, [505-1](#)
 - Placing Concrete, [505-6](#)
 - Placing Reinforcement, [505-4](#)
 - Subgrade, [505-1](#)
- Conformity with Plans and Specifications, [105-2](#)
- Construction
 - Cleanup and Dust Control, [104-2](#)
 - Contractor's Schedule, [108-1](#)
 - Fill, [211-1](#)
 - Maintenance During, [105-5](#)
 - Manhole, [625-1](#)
 - Reclaimed Water Line, [616-1](#)
 - Riprap, [220-1](#)
 - Stakes, Lines and Grades, [105-4](#)

INDEX

- Storm Drain, [618-1](#)
- Contract
 - Approval, [103-4](#)
 - Assignment, [109-2](#)
 - Award and Execution of, [103-1](#)
 - Bonds Requirement, [103-1](#)
 - Execution, [103-4](#)
 - Failure to Complete, [108-4](#)
 - Failure to Execute, [103-4](#)
 - Final Acceptance, [105-6](#)
 - Final Payment, [109-6](#)
 - Insurance, [103-2](#)
 - Labor Requirements, [107-1](#), [108-2](#)
 - Partial Acceptance, [105-6](#)
 - Partial Payments, [109-5](#)
 - Subletting of, [108-1](#)
 - Termination, [108-5](#)
 - Time Extension, [108-3](#)
 - Time of Completion, [108-1](#)
- Contractor's
 - Accident Prevention Requirements, [107-3](#)
 - Construction Schedule, [108-1](#)
 - Correspondence to, [108-1](#)
 - Default, [108-5](#)
 - Eligibility and Preference, [102-1](#)
 - Examine Site Prior to Bidding, [102-1](#)
 - Liability, [103-2](#), [103-3](#)
 - Marshaling Yard, [107-2](#)
 - Notice to Proceed, [108-1](#)
 - Notify Public Utilities, [105-3](#), [107-5](#)
 - Personnel and Equipment, [108-2](#)
 - Requested Changes, [104-2](#)
 - Responsibilities, [107-5](#)
 - Superintendent, [105-2](#), [105-5](#)
- Control of Work, [105-1](#)
 - Control of Materials, [106-1](#)
 - Work, [105-1](#)
- Controlled Low Strength Material, [728-1](#)
 - Mixtures and Production Tolerances, [728-1](#)
 - Payment, [604-2](#)
 - Performance Testing, [604-2](#)
 - Placement of, [604-1](#)
- Cooper Pipe, Tubing and Fittings, [754-1](#)
- Cooperation
 - Between Contractors, [105-4](#)
 - with Utilities, [105-3](#)
- Coordination of Plans and Specifications, [105-2](#)
- Corrugated Metal Pipe and Arches, [621-1](#)
 - Coating, [760-1](#)
 - Installation, [621-1](#)
 - Test Specimens, [621-2](#)
- Cover Material, [716-1](#)
- Crack Sealing, [337-1](#)
 - Application, [337-1](#)
 - Cleaning and Preparing Cracks or Joints, [337-2](#)
 - Equipment, [337-1](#)
 - Materials, [337-1](#)
 - Opening to Traffic, [337-2](#)
 - Pavement Temperatures, [337-2](#)
- Curbs
 - Concrete, [340-1](#)
 - Precast Safety, [410-1](#)
- Curb Ramps, [340-1](#)
- Curing
 - Cast-in-Place Concrete Pipe, [620-2](#)
 - Concrete block Masonry, [511-1](#)
 - Concrete Curbs, Gutters and Sidewalks, [340-3](#)
 - Concrete Structures, [505-7](#), [505-9](#)
 - Gunite, [525-2](#)
 - Materials, [726-1](#)
 - Precast Prestressed Concrete Members, [506-1](#)
- Damages
 - Liquidated, [108-4](#)
- Decomposed Granite, [430-2](#), [795-2](#)
- Decorative Asphalt, [322-1](#)
- Decreased Quantities, [109-1](#), [610-8](#)
- Definitions, [101-1](#)
- Definitions and Terms, [101-4](#)
- Delays
 - Asbestos, [107-2](#)
 - Between Contractor's, [105-4](#)
 - Beyond the Control of Contractor, [108-3](#)
 - Contracting Agency, [108-4](#)
 - Extension of Time, [108-3](#)
 - Utility Owners, [105-3](#)
- Discontinue Blasting, [107-3](#)
- Disinfecting Water Mains, [611-1](#)
 - Application of Liquid Chlorine, [611-2](#)
 - Chlorinating Valves and Hydrants, [611-3](#)
 - Chlorine Residual, [611-2](#)
 - Chlorine-Bearing Compounds in Water, [611-2](#)
 - Cleaning and Treating Pipe, [611-1](#)
 - Final Flushing, Sampling and Testing, [611-3](#)
 - Flushing Completed Pipe Lines, [611-1](#)
 - Laying Pipe, [611-1](#)
 - Methods of Applying Chlorine, [611-2](#)
 - Packing Material, [611-1](#)
 - Point of Application, [611-2](#)
 - Preventing Reverse Flow, [611-3](#)
 - Preventing Trench Water from Entering Pipe, [611-1](#)
 - Rate of Application, [611-3](#)
 - Repetition of Chlorination Procedure, [611-4](#)
 - Retention Period, [611-3](#)
- Disposal of Surplus Material, [205-2](#)
- Dispute Resolution, [110-1](#)
 - Administrative Process, [110-2](#)
 - Amount of Dispute, [110-4](#)
 - Arbitration, [110-4](#)
 - Dispute Review Board, [110-4](#)
 - Final Documentation, [110-5](#)
 - Mediation, [110-3](#)

INDEX

- Disqualification of Bidders, [102-3](#)
- Drawings
 - Shop, [105-1](#)
- Driveways
 - Access, [107-4](#), [340-2](#), [401-1](#)
- Drop Sewer Connections, [625-1](#)
- Dry Barrel/Fire Hydrants, [756-1](#)
- Ductile Iron Water Pipe, [750-1](#)
- Dust Control, [230-1](#)
- Dust Palliative, [792-1](#)
- Dust Palliative Application, [230-1](#)
 - Application, [230-3](#), [792-1](#)
 - Curing, [230-3](#)
 - Deficiencies and Warranty, [230-4](#)
 - Environmental Criteria, [792-4](#)
 - Materials, [792-1](#)
 - Measurement, [230-4](#)
 - Performance Standards and Test Methods, [792-3](#)
 - Quality Control, [230-4](#)
 - Weather Conditions, [230-3](#)
- Duties of Inspector, [105-4](#)
- Earthwork for Open Channels, [215-1](#)
 - Excavation, [215-1](#)
 - Fill and Backfill, [215-2](#)
 - for Open Channels, [215-1](#)
 - Grading, [215-2](#)
 - Stripping, [215-1](#)
- Eligibility of Contractor, [102-1](#)
- Emergency
 - Contractor's Representative, [105-2](#)
 - Defects, [108-3](#)
 - Services for Public, [104-1](#)
- Emulsified Asphalt Materials, [713-1](#)
- Engineer
 - Authority of, [105-1](#)
 - Decisions, [105-1](#)
 - Suspension of Work, [104-2](#), [108-3](#)
- Equipment
 - Approval of, [106-2](#)
 - Asphalt Distributors, [330-3](#)
 - Rental Rate, [109-4](#)
 - Storage of, [106-2](#)
- Examination of
 - Plans, [102-1](#)
 - Site of Work, [102-1](#)
 - Special Provisions, [102-1](#)
- Excavation
 - Borrow, [210-1](#)
 - Roadway, [205-1](#)
 - Structure, [206-1](#)
 - Trenches, Backfilling, and Compaction [601-1](#)
- Execution of Contract, [103-4](#)
- Exfiltration Test, Sewer Lines, [611-4](#)
- Existing Improvements Removal of, [350-1](#)
- Expansion Joint Filler, [729-1](#)
 - Application, [729-2](#)
 - Pour Type, [729-1](#)
 - Premolded, [729-1](#)
 - Test Report and Shipment Certificate, [729-2](#)
- Explosives
 - Discontinue use of, [107-3](#)
 - Use of, [107-3](#)
- Exposed Aggregate Paving, [343-1](#)
- Extension of Time, [108-3](#)
- Extra Work
 - Actual Cost, [109-3](#)
 - Claims for, [104-3](#)
- Extruded
 - Galvanized Pipe, [753-1](#)
 - Polyethylene Pipe, [755-1](#)
- Failure to
 - Complete on Time, [108-4](#)
 - Execute Contract, [103-4](#), [108-5](#)
 - Maintain Construction, Roadway or Structure, [105-5](#)
- Federal Aid Projects, [401-2](#)
- Fence
 - Chain, [772-1](#)
- Fill Construction, [211-1](#)
 - Compacting, [211-1](#)
 - Placing, [211-1](#)
 - Tests, [211-2](#)
- Final
 - Acceptance, [105-5](#), [105-6](#)
 - Cleaning Up, [104-2](#)
 - Inspection, [105-6](#)
- Fire Hydrants, [756-1](#)
 - Installation, [756-2](#)
- Flagmen or Pilot Cars, [401-1](#)
- Flexible Metal Guardrail, [415-1](#)
- Fog Seal Coats, [333-1](#)
 - Application, [333-1](#)
 - Asphalt Emulsion Application, [333-1](#)
 - Materials, [333-1](#)
 - Preparation of Surfaces, [333-1](#)
 - Protection for Adjacent Property, [333-2](#)
 - Protection of Treated Surface, [333-2](#)
 - Sand Blotter, [333-1](#), [701-1](#)
 - Test Reports and Certification, [333-1](#)
 - Weather Conditions, [333-1](#)
- Forfeiture of
 - Contract, [108-5](#)
 - Proposal Guarantees, [103-4](#)
- Foundation Data
 - Test Holes, [601-6](#)
- Foundation Material Treatment, [206-1](#)
- Furnished Materials, [106-3](#)
- Galvanized Pipe and Fittings, [753-1](#)
- Galvanizing, [771-1](#)

INDEX

- Geogrid Reinforcement, [306-1](#)
 - Placement, [306-1](#)
 - Placing and Compacting Aggregate Fill, [306-2](#)
 - Repair, [306-2](#)
- Geosynthetic, [796-1](#)
 - Requirements, [796-1](#)
 - Test and Certification Requirements, [796-3](#)
- Grade
 - Trench, [601-1](#)
- Grading
 - Crushed Aggregate, [702-2](#)
 - Earthwork for Open Channels, [215-2](#)
 - Parkway, [424-1](#)
 - Paving Asphalt, [711-1](#)
 - Subgrade, [605-1](#)
 - Under Pavements, [301-2](#)
- Granular Material, [601-6](#)
- Gray Iron Castings, [787-1](#)
- Ground Water, [102-1](#), [505-1](#)
- Grout
 - Bonding, [506-5](#)
 - Concrete Block Masonry, [510-2](#)
 - Masonry Mortar, [776-1](#)
 - Reinforced Brick Masonry, [511-1](#)
- Grubbing and Clearing, [201-1](#)
- Guarantee
 - Bid, [102-2](#)
 - Forfeiture of, [103-4](#)
 - Proposal, [102-2](#)
 - Provisions, [108-3](#)
 - Return of, [103-1](#)
 - Workmanship and Materials, [108-3](#)
- Guardrail, Flexible Metal [415-1](#)
- Gutter, [340-1](#)
- Handrail
 - Aluminum and Steel, [520-1](#)
- Health, Safety and Sanitation, [107-1](#)
- High Density Polyethylene Pipe and Fittings for Storm Drain and Sanitary Sewer, [738-1](#)
- Holes
 - Tests, [601-6](#),
- Horizontal Directional Drilling, [608-1](#)
- Hot In-Place Recycling, [327-1](#)
- Hydrants, Fire, [610-5](#), [756-1](#)
 - Installation, [610-4](#)
 - Types, [756-1](#)
 - Working Around, [107-5](#)
- Inspection
 - of Materials, [106-1](#)
 - of Plant, [106-1](#)
 - of Trees and Shrubs, [430-2](#)
 - of Work, [105-5](#)
 - Section to be Notified, [108-1](#)
- Inspector
 - Authority of, [105-5](#)
 - Duties of, [105-4](#)
- Cable, [360-1](#)
- Monuments, [405-1](#)
- Sprinkler Irrigation System, [440-2](#)
- Telecommunications, [360-1](#)
- Insurance
 - Approval of, [103-2](#)
 - Contractor's, [103-2](#)
 - Damage Claims, [103-2](#)
 - Fire and Extended Coverage, [103-3](#)
 - Property Damage, [103-2](#)
 - Public Liability, [103-2](#)
 - Worker's Compensation, [103-2](#)
- Iron Water Pipe and Fittings, [750-1](#)
 - Cast Iron, [750-1](#)
 - Ductile Iron, [750-1](#)
- Irregular Proposals, [102-2](#)
- Irrigation Structures, [350-2](#)
- Interlocking Concrete Paver Installations, [342-1](#)
- Jetting
 - for Settling Trench Backfill, [601-5](#)
- Joint Filler, [729-1](#)
- Joints
 - Cast-in-Place Concrete Pipe, Stoppage, [620-2](#)
 - Concrete Structures, [505-7](#)
 - Concrete, Curb, Gutter and Sidewalks, [340-2](#)
 - Corrugated Metal Pipe, [621-1](#)
 - High Density Polyethylene Pipe, [738-1](#)
 - Iron Water Pipe, [750-1](#)
 - Mortar, Brick, [511-1](#)
 - Mortar, Concrete Block, [510-1](#)
 - Non-Reinforced Concrete Pipe, [736-1](#)
 - Pneumatically Placed Mortar, [525-2](#)
 - Portland Cement Concrete, [324-5](#)
 - Reinforced Concrete Pipe, [735-1](#)
 - Sewer Lines, [615-2](#)
 - Subdrainage Systems, [605-1](#)
 - Vitrified Clay Pipe, [615-2](#)
 - Water Lines, [610-7](#)
- Labor and Materials
 - Payment Bond, [103-2](#)
- Labor Requirements, [107-1](#), [108-2](#)
- Laboratory Tests, [106-1](#)
- Landscape and Property Protection and Restoration, [107-3](#)
- Landscaping and Planting, [430-1](#)
 - and Planting, [430-2](#), [795-2](#)
 - Landscape Materials, [795-1](#)
- Laws
 - Contractor's Responsibility to Observe, [107-4](#)
- Legal Regulations and Responsibility to Public, [107-1](#)
- Legal Rights
 - No Waiver of, [107-5](#)
- Lime Slurry Stabilization or Modification of Subgrade, [309-1](#)
- Limitation of Operations, [108-2](#)
- Lining for Reinforced Concrete Sanitary Sewer Pipe,

INDEX

- [741-1](#)
 - Installation, [741-1](#)
 - Sanitary Sewer Pipe, [741-1](#)
 - Testing and Repairing, [741-3](#)
- Liquid Asphalt, [712-1](#)
- Liquidated Damages, [108-4](#)
- Location of Underground Utilities
 - Expose All Underground Utilities, [107-5](#)
 - Notify Utility Companies, [105-2](#), [107-1](#)
 - Protection Thereof, [107-4](#)
 - That Differ From Those Shown, [105-3](#)
- Lumber, [778-1](#)
- Maintenance
 - During Construction, [105-5](#)
 - of Traffic, [104-1](#)
 - Unsatisfactory, [105-2](#), [105-5](#)
- Manhole Construction and Drop Sewer Connection, [625-1](#)
- Marshaling Yard, [107-2](#)
- Marshall Mix Design, [710-3](#)
- Masonry Mortar and Grout, [776-1](#)
- Materials
 - Approval, [108-1](#)
 - Control of, [106-1](#)
 - Equal, [106-2](#)
 - Furnished, [106-3](#)
 - Handling, [106-3](#)
 - Landscape, [795-1](#)
 - Payment of, [109-4](#)
 - New and Unused, [106-1](#)
 - Patented, [106-2](#)
 - Quality, [106-1](#)
 - Reasonably Acceptable, [105-2](#)
 - Rejection, [105-5](#), [106-1](#)
 - Samples and Tests, [106-1](#)
 - Source of, [106-1](#)
 - Storage of, [106-2](#)
 - Substitutions, [106-2](#)
 - Unacceptable, [106-3](#)
- Measurements and Payments, [109-1](#)
 - Actual Cost Work, [109-3](#)
 - Assignment of Payments, [109-2](#)
 - Compensation for Alteration of Work, [109-2](#)
 - Dollar Value of Major Item, [109-7](#)
 - Payment, Scope of, [109-1](#)
 - Payment for Bond Issue and Budget Projects, [109-5](#)
 - Payment for Delay, [109-7](#)
 - Payment for Improvement District Projects, [109-5](#)
 - Payment for Mobilization/Demobilization, [109-7](#)
 - Quantities, [109-1](#)
- Mechanically Stabilized Subgrade-Geogrid
 - Reinforcement, [306-1](#)
- Meter Services Connections
 - Water, [631-1](#)
- Methods and Equipment, [108-2](#)
- Microsurfacing Materials, [714-1](#)
- Microsurfacing Specification, [331-1](#)
 - Application, [331-4](#)
- Microsurfacing Specifications, [331-1](#)
 - Equipment, [331-2](#)
 - Mix Design, [331-1](#)
 - Proportioning, [331-1](#)
 - Testing, [331-2](#)
- Mill Reports
 - Steel Reinforcement, [727-1](#)
 - Structural Steel, [515-1](#)
 - Handrails, Steel and Aluminum, [520-1](#)
- Mineral
 - Filler, [714-1](#)
- Mineral Admixture, [710-2](#)
- Modification of Subgrade, [306-1](#)
- Monthly Payments, [109-6](#)
- Monuments, [405-1](#)
 - Construction, [405-1](#)
 - Installation, [405-1](#)
 - Protection, [107-3](#)
- Name Stamped in Concrete, [340-3](#)
- Noise, [107-2](#)
- Non-Reinforced Concrete Pipe, [736-1](#)
 - Care of Pipe and Materials, [736-2](#)
 - Curves, Bends and Closures, [736-1](#)
 - Materials, [736-1](#)
 - Pipe Joints, [736-1](#)
 - Tests, [736-2](#)
- Notice
 - Award of, [103-1](#)
 - to Contractor, [108-1](#)
 - to Engineer, [104-3](#), [105-2](#)
 - to Proceed, [108-1](#)
- Notification of Changed Conditions and Dispute Resolution, [110-1](#)
 - Administrative Process for Dispute Resolution, [110-2](#)
 - Arbitration, [110-4](#)
 - Dispute Resolution, [110-1](#)
 - Dispute Review Board, [110-4](#)
 - Final Documentation, [110-5](#)
 - Initial Notification, [110-1](#)
- Notify
 - Inspection Section, [108-1](#)
 - Survey Section, [105-4](#), [108-1](#)
- Occupational Safety and Health Act, [107-1](#)
- Open Channels, Earthwork, [215-1](#)
- Open Trench, [601-3](#)
- Opening Sections to Traffic, [104-3](#), [108-2](#)
 - or Equal, Substitutions, [106-2](#)
- Overtime
 - Contractor, [108-2](#)
- Paint, [790-1](#)

INDEX

- Painting, [530-1](#)
 - Application, [530-1](#)
 - Surface Preparation, [530-2](#)
 - Testing, [530-3](#)
 - Weather Conditions, [530-1](#)
- Parkway Grading, [424-1](#)
- Partial Payments, [109-5](#)
- Partial Use or Occupancy, [105-6](#)
- Patented Devices, Materials and Processes, [107-1](#)
- Pavement
 - Asphalt Concrete, [321-1](#), [711-1](#)
 - Decorative, [342-1](#)
 - Exposed Aggregate [343-1](#)
 - Geosynthetics, [796-1](#)
 - Portland Cement Concrete, [324-1](#)
 - Sewer Line, [615-4](#)
- Pavement Matching and Surfacing Replacement, [336-1](#)
- Paving Asphalt, [711-1](#)
 - Temperatures, [711-1](#)
 - Test Report and Certification, [711-2](#)
- Payments
 - Actual Cost Work, [109-3](#)
 - Assignments, [109-2](#)
 - Final, [109-6](#)
 - for Delay, [109-7](#)
 - Improvement District Projects, [109-5](#)
 - Mobilization/Demobilization, [109-7](#)
 - Partial, [109-5](#)
 - Scope of, [109-1](#)
- Permits, [107-1](#)
- Pilot Cars or Flagman, [401-1](#)
- Pipe
 - Cast-in-Place Curing and Backfill, [620-2](#)
- Pipe Installation for
 - Sewer Lines, [615-1](#)
 - Sprinkler Irrigation System, [440-2](#)
 - Storm Sewers, [618-1](#)
 - Subdrainage, [605-1](#)
 - Water Lines, [610-1](#)
- Placement and Construction of Aggregate Base Course, [310-1](#)
- Placement and Construction of Asphalt Concrete Pavement, [321-1](#)
 - Acceptance, [321-6](#)
 - Application of Tack Coat, [321-1](#)
 - Materials and Manufacture, [321-1](#)
 - Measurement, [321-12](#)
 - Mix Design, [321-1](#)
 - Mix Production, [321-2](#)
 - Placement, [321-3](#)
 - Quality Control, [321-6](#)
 - Referee, [321-12](#)
 - Transportation, [321-3](#)
 - Weather and Moisture Conditions, [321-1](#)
- Placement and Construction of Asphalt Emulsion
 - Slurry Seal Coat, [332-1](#)
 - Equipment, [332-1](#)
 - Mixing and Application, [332-2](#)
 - Preparation of the Surface, [332-1](#)
 - Protection of Uncured Surface, [332-2](#)
 - Rolling, [332-2](#)
 - Weather Limitations, [332-2](#)
- Placement and Construction of Asphalt-Rubber
 - Asphalt Concrete, [325-1](#)
 - Acceptance, [325-5](#)
 - Application of Tack Coat, [325-2](#)
 - Materials, [325-1](#)
 - Mix Production, [325-2](#)
 - Placement, [325-3](#)
 - Quality Control, [325-4](#)
 - Transportation, [325-3](#)
 - Weather and Moisture Conditions, [325-1](#)
- Placement, Construction. of Cement Treated Subgrade, [311-1](#)
 - Construction Methods, [311-1](#)
 - Equipment, [311-1](#)
 - Materials, [311-1](#)
- Placement, Construct.of Hot Asphalt-Rubber Seal, [335-1](#)
 - Construction, [335-1](#)
 - Equipment, [335-1](#)
 - Materials, [335-1](#)
 - Measurement, [335-2](#)
 - Mixing, [335-1](#)
- Placement of Controlled Low Strength Material, [604-1](#)
- Plans
- Materials [604-1](#)
- Performance Testing [604-2](#)
- Placement [604-1](#)
- Planting
 - and Landscaping, [430-1](#)
- Pneumatically Placed Mortar, [525-1](#)
 - Curing, [525-2](#)
 - Dry Mix Process, [525-1](#)
 - Equipment, [525-2](#)
 - Finishing, [525-2](#)
 - Forms and Ground Wires, [525-2](#)
 - Joints, [525-2](#)
 - Reinforcing Steel, [525-1](#)
 - Surface Preparation, [525-2](#)
 - Testing, [525-2](#)
 - Wet Process, [525-1](#)
- Polyethylene Pipe
 - High Density, [738-1](#)
- Polypropylene Pipe & Fittings for Gravity Storm Drain & Sanitary Sewer, [740-1](#)
- Polypropylene Pipe and Fittings for Storm Drain, Irrigation and Sanitary Sewer, [740-1](#)
- Polyethylene Pipe for Water Distribution, [755-1](#)
- Portland Cement Concrete Street Pavement, [324-1](#)

INDEX

- Portland Cement Concrete, [725-1](#)
 - Pavement, [324-1](#)
- Portland Cement Treated Base, [705-1](#)
- Power of Attorney, [103-2](#)
- Precast Prestressed Concrete Members, [506-1](#)
 - Anchorage and Distribution, [506-3](#)
 - Bonding and Grouting, [506-5](#)
 - Concrete, [506-1](#)
 - Enclosures, [506-3](#)
 - Handling, [506-6](#)
 - Prestressing, [506-4](#)
 - Prestressing Steel, [506-2](#)
 - Samples for Testing, [506-5](#)
- Precast Safety Curbs, [410-1](#)
- Precoated Chip Seal
 - Asphalt Grade, [330-2](#)
 - Construction Methods, [330-1](#)
 - Temperatures, [330-2](#)
- Preservative Seal for Asphalt Concrete [334-1](#), [718-1](#)
- Preservatives
- Prime Coat, [756-1](#)
 - Wood, [779-1](#)
- Property and Landscape Protection and Restoration, [107-3](#)
- Property Marks and Monuments, [107-3](#)
- Proposal
 - Addenda, [102-2](#)
 - Consideration of, [103-1](#)
 - Disqualified Bidders [102-3](#)
 - Irregular, [102-2](#)
 - Preparation, [102-2](#)
 - Public Opening, [102-3](#)
 - Rejected, [102-2](#)
 - Revision of, [102-3](#)
 - Submission of, [102-3](#)
 - Successful Bidders [102-3](#)
 - Withdrawal of, [102-3](#)
- Proposal Guarantee
 - Amount, [103-2](#)
 - Forfeiture of, [102-2](#), [103-4](#)
 - Return of, [103-1](#)
- Public
 - Convenience, [107-2](#)
 - Property, [107-1](#)
 - Safety, [107-2](#)
- Public Officials
 - Personal Liability of, [107-5](#)
- PVC Sewer Pipe and Fittings, [745-1](#)
- Quantities
 - in Proposal, [102-1](#)
 - Increase or Decrease, [109-3](#)
 - Measurement of, [109-1](#)
 - Payment, [109-5](#)
- Reclaimed Water Line Construction, [616-1](#)
 - Above Ground Pipe, [616-2](#)
 - Below Ground Pipe, [616-2](#)
 - Identification, [616-1](#)
 - Installation, [616-1](#)
 - Valve and Manhole Covers, [616-3](#)
 - Valves and Risers, [616-2](#)
- Reinforced Concrete Pipe, [735-1](#)
 - Acceptance Mark, [735-4](#)
 - Curing of Pipe, [735-2](#)
 - Curves, Bends and Closures, [735-1](#)
 - Downgrading of Pipe, [735-4](#)
 - Manufacturer's Qualifications, Equipment Require., [735-2](#)
 - Materials, [735-1](#)
 - Quality, [735-1](#)
 - Sanitary Sewer Pipe, [735-4](#)
 - Tests and Acceptance, [735-2](#)
- Reinforcing Steel, [727-1](#)
- Rejected Materials, [106-1](#)
- Removal of
 - Defective Materials, [105-5](#)
 - Salvage Items, [201-2](#)
 - Unacceptable Work, [105-5](#)
 - Unauthorized Work, [105-5](#)
- Removal of Existing Improvements, [350-1](#)
- Rental Equipment, [109-2](#)
- Reports
 - Archaeological, [107-1](#)
 - Blasting Survey, [107-3](#)
 - Extra Work, [109-3](#)
 - Final Payments, [109-6](#)
 - Partial Payments, [109-5](#)
 - Site Conditions, [109-3](#)
- Responsibility, Contractor's, [107-5](#)
- Retaining Walls, [505-1](#)
- Revision of Proposal, [102-3](#)
- Right-of-Way
 - and Traffic Control, [401-1](#)
 - Railroad, [105-3](#)
- Riprap, [703-1](#)
 - Riprap Construction, [220-1](#)
 - Rivets, [770-1](#)
- Road-Mixed Surfacing, [320-1](#)
 - Application of Liquid Asphalt, [320-1](#)
 - Materials, [320-1](#)
 - Mixing, [320-1](#)
 - Prime Coat, [320-1](#)
 - Spreading Aggregate, [320-1](#)
 - Spreading and Compaction, [320-2](#)
- Roadway Excavation, [205-1](#)
 - Overshooting, [205-1](#)
 - Slides and Slipouts, [205-1](#)
 - Slopes, [205-1](#)
 - Surplus Material, [205-2](#)
 - Unsuitable Material, [205-2](#)
- Roadway, Failure to Maintain, [105-5](#)
- Rolling, Pavements

INDEX

- Chip Seal, [330-2](#)
- Temporary, [336-2](#)
- Rubber, Asphalt, [717-1](#)
- Rubber Gaskets, [735-2](#), [736-1](#), [738-1](#), [745-1](#)
- Safety and Public Convenience, [107-2](#)
 - Curbs, [410-1](#)
 - Employees, [107-1](#)
 - for Workman, [105-1](#)
 - Health and Sanitation, [107-1](#)
 - OSHA, [336-3](#)
 - Public, [107-2](#)
- Samples and Tests of Material, [106-1](#)
- Sand, [324-1](#), [333-1](#), [342-1](#), [342-2](#)
- Sanitary Conditions, [107-1](#)
- Sanitary Sewer
 - Fittings for, [738-2](#)
- Saw Cut
 - Pavement, [336-1](#)
 - Portland Cement Concrete, [324-1](#)
- Schedule, Construction, [108-1](#)
- Scope of Work, [104-1](#)
- Seal Coats
 - Fog, [333-1](#)
- Sewer Line Construction, [615-1](#)
 - Air Test, [615-3](#)
 - Exfiltration Testing, [615-3](#)
 - Fittings, [615-2](#)
 - Jointing, [615-2](#)
 - Laying Pipe, [615-1](#)
 - Sanitary Sewer Cleanouts, [615-2](#)
 - Sanitary Sewer Service Taps, [615-2](#)
 - Separation, [615-1](#)
 - Testing, [615-2](#)
 - Trenching, [615-1](#)
- Sewer Connections, [625-1](#)
- Sewer Pipe
 - Fittings for, [745-1](#)
- Shop Drawings
 - Approved by, [105-1](#)
 - Cost of, [105-1](#)
- Sidewalk, [340-1](#)
- Signs
 - Barricades and Warning, [107-2](#)
 - Blasting Operations, [107-3](#)
- Site of Work
 - Clean up, [104-2](#)
 - Examination, [102-1](#)
- Slurry Seal Materials, [715-1](#)
- Source of Materials and Quality, [106-1](#)
- Specifications
 - Conformity with, [105-2](#)
 - Coordination with, [105-2](#)
 - Examination, [102-1](#)
- Sprinkler Irrigation System, [757-1](#)
- Sprinkler Irrigation System Installation, [440-1](#)
- Stakes, Construction, [105-4](#)
- State Inspector of Weights, [109-1](#)
- Steel and Aluminum Handrails, [520-1](#)
- Steel Casing Wall Thickness, [602-1](#)
- Steel Pipe, [759-1](#)
- Steel Plates for Street Crossings, [601-3](#)
- Steel Reinforced Polyethylene Pipe and Fittings for Storm Drain, Irrigation and Sanitary Sewer, [739-1](#)
- Steel Reinforcement, [727-1](#)
 - Wire Mesh Reinforcement, [727-1](#)
 - Wire Reinforcement, [727-1](#)
 - Wire Ties, [727-1](#)
- Steel Structures, [515-1](#)
 - Buildings, [515-1](#)
 - Computed Weights, [515-2](#)
 - Painting, [515-3](#)
 - Workmanship, [515-2](#)
- Storage of
 - Equipment, [106-2](#)
 - Explosive, [107-3](#)
 - Materials, [106-2](#)
 - Paid Materials, [109-6](#)
- Storm Drain
 - Fittings for, [738-1](#)
- Storm Drain Construction, [618-1](#)
 - Construction Methods, [618-1](#)
 - Jacking Pipe, [618-2](#)
 - Video Inspection of New Mainline Storm Drains, [618-3](#)
- Structural and Rivet Steel, Rivets, Bolts, Pins, and Anchor Bolts, [770-1](#)
- Structural Plate Pipe, Arches, and Pipe Arches, [761-1](#)
- Structure Excavation and Backfill, [206-1](#)
 - Foundation Material Treatment, [206-1](#)
 - Inspection, [206-1](#)
- Structure, Failure to Maintain, [105-5](#)
- Structures
 - Concrete, [505-1](#)
 - Steel, [515-1](#)
- Subcontractor's
 - List of, When Required, [102-2](#)
- Subcontractor's
 - Eligibility and Preference, [102-1](#)
 - Employment of Labor, [108-1](#)
 - Insurance, [103-2](#)
 - Personnel, [108-2](#)
- Subcontracts
 - Approval of, [108-1](#)
 - in Accordance With, [108-1](#)
 - Liability, [108-1](#)
- Subdrainage, [605-1](#)
 - Filter Material, [605-1](#)
 - Pipe, [605-1](#)
 - Placement, [605-2](#)
 - Tests, [605-2](#)
- Subgrade Preparation, [301-1](#)

INDEX

- Curbs, Drive, Gutters, Sidewalks, Curb Ramps, [340-1](#)
- Grading of Areas Not to Be Paved, [301-2](#)
- Preparation, [301-1](#)
- Protection of Existing Facilities, [301-2](#)
- Relative Compaction, [301-1](#)
- Tolerances, [301-1](#)
- Substitutions, [106-2](#)
- Surety, Power of Attorney, [103-2](#)
- Survey
 - Monuments, [405-1](#)
 - Section to be Notified, [108-1](#)
- Suspend the Work, [104-2](#), [105-1](#), [108-3](#)
- Tack Coat, [329-1](#)
 - Equipment, [329-1](#)
 - Preparation of Surface, [329-1](#)
 - Protection for Adjacent Property, [329-1](#), [333-2](#)
- Tapping Sleeves and Valves and Valve Boxes on Water Lines, [630-1](#)
 - Air Release and Vacuum Valves, [630-7](#)
 - Butterfly Valves, [630-5](#)
 - Gate Valves, [630-1](#)
- Telecommunications Installation, [360-1](#)
 - Cable Installation, [360-1](#)
 - Cable Locating (Fiber Optic), [360-1](#)
- Temperatures
 - Asphalt, Paving, [711-1](#)
 - Emulsified Asphalts, [330-2](#)
 - Expansion Joint Filler, [729-1](#)
 - Liquid Asphalts, [330-2](#)
- Temporary Pavement Replacement, [336-2](#)
- Termination of Contract, [108-5](#)
- Testing
 - Asbestos-Cement Pipe, [737-2](#), [752-1](#)
 - Asphalt Pavement Core Bonding Material, [708-1](#)
 - Cast-in-Place Concrete Pipe, [620-3](#)
 - Concrete Block Masonry, [776-2](#)
 - Controlled Low Strength Material, [604-2](#)
 - Dust Palliative Performance, [792-3](#)
 - Fill Construction, [211-2](#)
 - Final Flushing Water Mains, [611-3](#)
 - Fog Seal Coats, [333-1](#)
 - Galvanized Materials, [771-1](#)
 - Geosynthetic, [796-3](#)
 - Gray Iron Castings, [787-1](#)
 - Lining for Concrete Pipe, [741-3](#)
 - Liquid Asphalt, [712-1](#)
 - Microsurfacing Specifications, [331-2](#)
 - Non-Reinforced Concrete Pipe, [736-2](#)
 - Painting, [530-3](#)
 - Pavement Asphalts, [711-1](#)
 - Pneumatically Placed Mortar, [525-2](#)
 - Polyethylene Pipe, [755-1](#)
 - Precast Prestressed Concrete, [506-5](#)
 - Reinforced Concrete Pipe, [735-2](#)
 - Samples of Materials, [106-1](#)
 - Sewer Lines, [615-2](#)
 - Sprinkler Irrigation System, [440-4](#)
 - Subdrainage System, [605-2](#)
 - Vitrified Clay Pipe, [743-1](#)
 - Water Lines, [610-8](#)
 - Water Taps and Meter Service Connections, [631-2](#)
- Topsoils, [425-1](#), [795-1](#)
- Trade Names and Substitutions, [106-2](#)
- Traffic Control, [401-1](#)
 - Barricade Manual, [401-1](#)
 - Control Devices [401-1](#)
 - Control Measures, [401-1](#)
 - Flagmen or Pilot Cars, [401-1](#)
 - General Traffic Regulations, [401-1](#)
 - Maintenance, [430-2](#)
 - Tree and Shrub Planting, [430-2](#)
- Trench Excavation, Backfilling and Compaction, [601-1](#)
 - Contractor Certification of Installation Procedures, [601-6](#)
 - Densities, [601-5](#)
 - Excavation, [601-1](#)
 - Foundation, Bedding, Backfilling and Compaction, [601-4](#)
 - Trench, [601-3](#)
 - Pavement Replacement, [601-7](#)
 - Protection of Existing Utilities, [601-3](#)
 - Surface Restoration, [601-7](#)
 - Trench Widths, [601-1](#)
- Trenchless Installation of Steel Casing, [602-1](#)
- Trenchless Installation of Smooth Wall Jacking Pipe, [607-1](#)
- Trenchless Operation [602-1](#)
- Unacceptable
 - Materials, [106-3](#)
 - Work, [105-5](#)
- Uniformed Off-Duty Law Enforcement Officer, [401-1](#)
- Use or Occupy, [105-6](#)
- Utilities
 - Cooperation with, [105-3](#)
 - Moved by the Owners, [105-3](#)
 - Notify Before Blasting, [107-3](#)
 - Protection of, [107-3](#)
- Utility Potholes Keyhole Method, [355-1](#)
 - Backfill and Compaction, [355-1](#)
 - Deficiencies, [355-2](#)
 - Excavation, [355-1](#)
 - Pavement Restoration, [355-2](#)
 - Surface Tolerances, [355-2](#)
- Valves
 - Air Release and Vacuum, [630-7](#)
 - Butterfly, [630-5](#)
 - Gate, [630-1](#)
 - Tapping, [630-2](#)
- Vitrified Clay Pipe, [743-1](#)

INDEX

- Warranties, [108-3](#)
- Water Line Construction, [610-1](#)
 - Blocking, [610-8](#)
 - Cleanup, [610-9](#)
 - Connection to Existing Mains, [610-5](#)
 - Construction Methods, [610-1](#)
 - Couplings, Joints, Gaskets and Flanges, [610-7](#)
 - Disinfecting, [610-9](#)
 - Fire Hydrants, [610-5](#)
 - Fire Line Service Connections, [610-6](#)
 - Manholes and Vaults, [610-5](#)
 - Meter Service Connections, [610-6](#)
 - Polyethylene Corrosion Protection, [610-4](#)
 - Separation, [610-2](#)
 - Testing, [610-8](#)
 - Valve Boxes on Water Lines, [630-1](#)
 - Valves, [610-5](#)
- Water Taps and Meter Service Connections, [631-1](#)
- Weather
 - Asphalt Chip Seal Coat, [330-1](#)
 - Concrete Structures, [505-7](#)
 - Dust Palliative, [230-3](#)
 - Fog Seal Coat, [333-1](#)
 - Microsurfacing Specifications, [331-4](#)
 - Painting, [530-1](#)
- Weighmaster's Certificate, [109-1](#)
- Wire Reinforcement, [727-1](#)
- Withholding Assignments, [109-2](#)
- Wood Preservatives, [779-1](#)
 - Field Treatment of Cut Surfaces, [779-1](#)
 - Oil Type Preservative Treatment, [779-1](#)
 - Water Borne Salt Preservatives Treatment, [779-1](#)
- Work
 - Actual Cost, [109-3](#)
 - Alteration of, [104-2](#)
 - Compensation for Alteration, [109-2](#)
 - Contractor's Responsibility, [107-4](#)
 - Control of work, [105-1](#)
- Emergency [104-1](#)
 - Extra, [104-3](#)
 - Final Acceptance, [105-5](#)
 - Hours, [109-5](#)
 - Inspection of, [105-5](#)
 - Overtime, [108-2](#)
 - Rejected, [106-2](#)
 - Scope of, [104-1](#)
 - Suspension of, [104-2](#),
to be Done, [104-1](#)
 - Unacceptable, [105-5](#)
 - Unauthorized, [105-5](#)
 - Weekend or Holiday, [108-2](#), [108-3](#)
- Workmen
 - Character of, [108-2](#)
 - Compensation Insurance, [103-3](#)
 - Safety, [105-1](#)
 - Suspend [105-1](#)

This Page is Reserved for Future Use

UNIFORM STANDARD DETAILS

for

PUBLIC WORKS CONSTRUCTION

SPONSORED and DISTRIBUTED
by the



2016 REVISION TO THE 2015 EDITION

 ARIZONA

100 SERIES: GENERAL INFORMATION

Detail	Revised	Title
101	2011	GENERAL INFORMATION
110-1	2011	PLAN SYMBOLS (SYMBOLS)
110-2	2011	PLAN SYMBOLS (LINE TYPES)
112	1998	DIMENSIONING FOR ROAD IMPROVEMENT PLANS
120	2015	SURVEY MARKER
122	2011	PAVEMENT MARKER FOR FIRE HYDRANTS
130	2003	BARRICADES
131	1998	STREET SIGN BASE
140	2009	BOLLARD
141	2009	HAZARD MARKER
145	2016*	SAFETY RAIL
150	1998	PRECAST SAFETY CURB
160	2013	6' CHAIN LINK FENCE AND GATE

200 SERIES: STREET INFORMATION

Detail	Revised	Title
200-1	2016*	TRENCH BACKFILL AND SURFACE REPLACEMENT
200-2	2016*	TRENCH BACKFILL AND SURFACE REPLACEMENT
201	2014	ASPHALT PAVEMENT EDGE DETAILS
202	1998	ALLEY DETAILS (PAVED AND UNPAVED)
203	1998	SCUPPERS
204	1998	EQUIPMENT CROSSING
205	2006	PAVED TURNOUTS
206-1	2007	CONCRETE SCUPPER
206-2	2007	CONCRETE SCUPPER
206-3	2007	CONCRETE SCUPPER (ISOMETRIC VIEW)
210	2012	RESIDENTIAL SPEED HUMP
211	1998	STANDARD TRENCH PLATING DETAIL
212	2015	UTILITY POTHOLE REPAIR
220-1	2007	CURB AND GUTTER TYPES A, B, C AND D
220-2	2007	CURB AND GUTTER TYPES E AND F
221	2014	CURB AND GUTTER TRANSITION TYPE A TO TYPE C, INTEGRAL ROLL CURB, GUTTER AND SIDEWALK
222	2008	SINGLE CURB - TYPES A, B AND TERMINATION
223	1998	MEDIAN NOSE TRANSITION
224	1998	JOINT FOR DRAINAGE INLETS AND MANHOLE COVERS
225	2016*	INTERLOCKING CONCRETE PAVERS
230	2014	SIDEWALKS
234	2012	CURB MODIFICATION AT DETECTABLE WARNING
235-1	2012	CURB RAMPS (TYPE A)
235-2	2012	CURB RAMPS (TYPE B)
235-3	2012	CURB RAMPS (TYPE C)
235-4	2011	CURB RAMPS (TYPE D)
235-5	2011	CURB RAMPS (TYPE E)

200 SERIES: STREET INFORMATION (CONTINUED)

Detail	Revised	Title
240	2010	VALLEY GUTTER
250-1	2014	DRIVEWAY ENTRANCES WITH DETACHED SIDEWALK
250-2	2013	DRIVEWAY ENTRANCES WITH SIDEWALK ATTACHED TO CURB
251	2003	RETURN TYPE DRIVEWAYS
252	2005	BUS BAYS
260	2013	ALLEY ENTRANCE (WITH VERTICAL CURB AND GUTTER)
262	2012	WING TYPE ALLEY ENTRANCE (WITH COMBINED CURB AND GUTTER)
263	2002	WING TYPE ALLEY ENTRANCE (WITH ROLL TYPE CURB AND GUTTER)
270	2016*	FRAME AND COVER (AND GRADE ADJUSTMENT)

300 SERIES: WATER INFORMATION

Detail	Revised	Title
301	1998	BLOCKING FOR WATER GATE AND BUTTERFLY VALVES
302-1	1998	JOINT RESTRAINT WITH TIE RODS (DRAWING)
302-2	1998	JOINT RESTRAINT WITH TIE RODS (NOTES)
303-1	1998	JOINT RESTRAINT FOR DUCTILE IRON AND POLYETHYLENE WRAPPED DUCTILE IRON WATER PIPES (DRAWING)
303-2	1998	JOINT RESTRAINT FOR DUCTILE IRON AND POLYETHYLENE WRAPPED DUCTILE IRON WATER PIPES (TABLES)
310	1998	CAST IRON WATER METER BOX COVER NO. 1
311	1998	CAST IRON WATER METER BOX COVER NO. 2
312	1998	CAST IRON WATER METER BOX COVER NO. 3
313	1998	CAST IRON WATER METER BOX COVER NO. 4
314	1998	CAST IRON WATER METER BOX COVER NO. 5
320	1998	CONCRETE WATER METER BOXES
321	1998	STANDARD WATER METER VAULT
340	2002	INSTALLING TAPPING SLEEVES AND VALVES
342	1998	CONCRETE PRESSURE PIPE TAPPING SLEEVE
345-1	1998	3", 4", 6" WATER METER
345-2	1998	4", 6" WATER METER WITH ON-SITE HYDRANTS
346	1998	FIRE LINE DETECTOR CHECK VAULT
360-1	2013	DRY BARREL FIRE HYDRANT INSTALLATION
360-2	2013	WET BARREL FIRE HYDRANT INSTALLATION
360-3	2013	FIRE HYDRANT INSTALLATION DETAILS
362	1999	LOCATIONS FOR NEW FIRE HYDRANTS
370	1998	VERTICAL REALIGNMENT OF WATER MAINS
380	1998	THRUST BLOCKS FOR WATER LINES
381	1998	ANCHOR BLOCKS FOR VERTICAL BENDS
389	2001	CURB STOP WITH VALVE BOX AND COVER
390	1998	CURB STOP WITH FLUSHING PIPE
391-1	2015	VALVE BOX INSTALLATION AND GRADE ADJUSTMENT
391-2	2015	VALVE BOX INSTALLATION AND GRADE ADJUSTMENT
392	2015	DEBRIS CAP INSTALLATION

* NEWLY REVISED.

DETAIL NO.

100-1STANDARD DETAIL
ENGLISH**INDEX (PAGE 1 OF 2)**

REVISED

01-01-2016

DETAIL NO.

100-1

400 SERIES: SEWER INFORMATION

Detail	Revised	Title
403-1	1998	PIPE SUPPORT ACROSS TRENCHES
403-2	1998	PIPE SUPPORT ACROSS TRENCHES
403-3	1998	ALTERNATIVE TO PIPE SUPPORT
404-1	2006	WATER AND SANITARY SEWER SEPARATION/PROTECTION
404-2	2006	WATER AND SANITARY SEWER SEPARATION/PROTECTION
404-3	2006	WATER AND SANITARY SEWER SEPARATION/PROTECTION
405	1998	BROKEN SEWER LINE REPLACEMENT
420-1	2015	CONCRETE SANITARY SEWER MANHOLE
420-2	2015	PRE-CAST CONCRETE MANHOLE BASE
420-3	2015	CONCRETE MANHOLE BASE
421	2015	OFFSET MANHOLE 8" TO 30" PIPE
422	2015	MANHOLE FRAME AND COVER ADJUSTMENT
423-1	2012	24" CAST IRON MANHOLE FRAME AND COVER
423-2	2012	30" CAST IRON MANHOLE FRAME AND COVER
424-1	2012	24" CAST IRON WATERTIGHT MANHOLE FRAME AND COVER
424-2	2012	30" CAST IRON WATERTIGHT MANHOLE FRAME AND COVER
425	1998	24" ALUMINUM MANHOLE FRAME AND COVER
426	2007	DROP SEWER CONNECTIONS
427	1998	STUB OUT AND PLUGS
429	2015	INDUSTRIAL WASTE CONTROL VAULT WITH MANHOLE
440-1	2007	TYPE 'A' SEWER BUILDING CONNECTION - ELECTRONIC BALL MARKERS (STANDARD)
440-2	2007	TYPE 'B' SEWER BUILDING CONNECTION - TWO-WAY CLEANOUT AND METER BOX AT R/W
440-3	2007	TYPE 'C' SEWER BUILDING CONNECTION - ONE-WAY CLEANOUT AND METER BOX
440-4	2006	SEWER SERVICE CURB CROSSING STAMP DETAIL
441	2001	SEWER CLEANOUT

500 SERIES: IRRIGATION AND STORM DRAIN INFORMATION

Detail	Revised	Title
501-1	2012	HEADWALL
501-2	2012	HEADWALL
501-3	1998	HEADWALL 42" TO 84" PIPE
501-4	1998	HEADWALL IRRIGATION 18" TO 60" PIPE
501-5	2014	HEADWALL DROP INLET
502-1	1998	TRASH RACK
502-2	2004	TRASH RACK
503	1998	IRRIGATION STANDPIPE
504	1998	CONCRETE BLOCK JUNCTION BOX
505	1998	CONCRETE PIPE COLLAR
506	1998	IRRIGATION VALVE INSTALLATION
507	1998	ENCASED CONCRETE PIPE (FOR SHALLOW INSTALLATION)
510	1998	CORRUGATED METAL PIPE AND INSTALLATION

500 SERIES: IRRIGATION AND STORM DRAIN INFORMATION (CONTINUED)

Detail	Revised	Title
520	1998	STORM DRAIN MANHOLE BASE (48" AND SMALLER)
521	1998	STORM DRAIN MANHOLE BASE (51" OR LARGER)
522	2015	STORM DRAIN MANHOLE SHAFT
523-1	1998	PRESSURE MANHOLE
523-2	1998	PRESSURE MANHOLE
524	1998	STORM DRAIN LATERAL PIPE CONNECTIONS
530	1998	3'-6" CURB OPENING CATCH BASIN - TYPE 'A'
531	1998	5'-6" CURB OPENING CATCH BASIN - TYPE 'B'
532	1998	8'-0" CURB OPENING CATCH BASIN - TYPE 'C'
533-1	1998	CATCH BASIN TYPE 'D'
533-2	1999	APRON FOR TYPE 'D' CATCH BASIN
533-3	2007	FRAME AND GRATE FOR TYPE 'D' CATCH BASIN
533-4	2007	7'-0" CURB OPENING CATCH BASIN TYPE 'D' - GRATE DETAILS
534-1	1998	CATCH BASIN TYPE 'E'
534-2	1998	CATCH BASIN TYPE 'E' (DETAILS)
534-3	1998	CATCH BASIN TYPE 'E' (DETAILS)
534-4	1998	CATCH BASIN TYPE 'E' (DETAILS)
534-5	1998	ALTERNATE GRATE STYLES, SUMP LOCATION
535	2009	CATCH BASIN TYPE 'F' (FOR USE WITHOUT CURB)
536-1	1999	COMMON DETAILS AND SECTIONS FOR CURB OPENING CATCH BASINS
536-2	1998	ALTERNATIVE COVER FOR CURB OPENING CATCH BASINS
537	2002	CATCH BASIN TYPE 'G'
538	1998	CATCH BASIN TYPE 'H'
539	1998	GRATES FOR CATCH BASINS, TYPE G AND H
540-1	1998	CATCH BASIN GRATES
540-2	1998	CATCH BASIN GRATES
541	2005	CATCH BASIN SUBGRADE DRAIN
545	1998	END SECTION - REINFORCED CONCRETE PIPE
550	1998	SPILLWAY INLET AND OUTLET
552	2015	FORD CROSSING WITH CUT-OFF WALLS
555	2010	EROSION PROTECTION/GABIONS

DETAIL NO.

100-2STANDARD DETAIL
ENGLISH**INDEX (PAGE 2 OF 2)**

REVISED

01-01-2016

DETAIL NO.

100-2

1. THESE DETAILS HAVE BEEN PREPARED IN AN EFFORT TO STANDARDIZE THE CONSTRUCTION DETAILS USED BY VARIOUS CONTRACTING AGENCIES IN MARICOPA COUNTY. THEY ARE TO BE USED IN CONJUNCTION WITH THE CURRENT EDITION OF THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION" SPONSORED AND DISTRIBUTED BY THE MARICOPA ASSOCIATION OF GOVERNMENTS.
2. MANY NOTES WITHIN THESE DETAILS REFER TO VARIOUS SECTIONS OF THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION." WHERE THIS REFERENCE IS MADE, ONLY THE ABBREVIATION "SECT." IS USED. AN EXAMPLE OF THIS REFERENCE WOULD BE: "CLASS 'A' CONCRETE PER SECT. 725."
3. MANY NOTES WITHIN THESE DETAILS REFER TO OTHER DETAILS WITHIN THIS BOOK. WHERE THIS REFERENCE IS MADE, THE ABBREVIATION "DETAIL" IS USED. AN EXAMPLE OF THIS WOULD BE: "SEE DETAIL 391 FOR VALVE BOX INSTALLATION."
4. MANY DETAILS COVER MORE THAN ONE SHEET. THESE SHEETS HAVE BEEN GIVEN THE SAME NUMBER WITH A SUFFIX NUMBER, EXAMPLE: 391-1 AND 391-2.
5. AN EFFORT HAS BEEN MADE TO INCLUDE THE MOST COMMONLY USED CONSTRUCTION DETAILS IN THIS BOOK. ITEMS WHICH REQUIRE DESIGN CONSIDERATION BY THE DESIGNING ENGINEER HAVE NOT BEEN INCLUDED.
6. SOME OF THE DETAILS PRINTED HEREIN MAY BE USED BY SOME OF THE AGENCIES BUT NOT OTHERS. THE DESIGNING ENGINEER SHOULD THEREFORE CONTACT THE AGENCY WITHIN WHOSE JURISDICTION HE IS WORKING FOR DIRECTION AS TO WHICH DETAIL OR PORTIONS OF DETAILS SHOULD BE USED.
7. DETAIL DRAWINGS ARE NOT TO SCALE.

SEWER CLEANOUT



FIRE HYDRANT



WATER METER



UTILITY MANHOLE



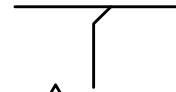
IRRIGATION STANDPIPE



UTILITY VALVE



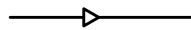
SEWER SERVICE CONNECTION



MONITORING WELL



REDUCER



WOOD UTILITY POLE



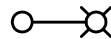
STEEL UTILITY POLE



CONCRETE UTILITY POLE



STREET LIGHT ON MAST ARM



POLE MOUNTED LIGHT



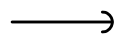
ELECTRIC, GAS METER



TRANSFORMER



DOWN GUY & ANCHOR



SURVEY MONUMENT



SURVEY MONUMENT IN HANDHOLE



MAIL BOX



SIGNAL POLE



SINGLE POST SIGN



DOUBLE POST SIGN



STREET NAME SIGN



VIDEO DETECTION CAMERA



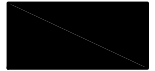
PULL BOX



CELLULAR TOWER



BITUMINOUS (SECTION)



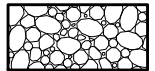
CONCRETE (SECTION)



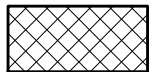
AGGREGATE BASE COURSE (SECTION)



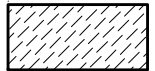
RIPRAP (PLAN & SECTION)



OBLITERATE PAVEMENT



TAPERED MILL



UNIFORM MILL



EARTH (SECTION)

**NOTES:**

1. PLAN SYMBOLS FOR EXISTING FEATURES ARE TO BE DASHED, GRAY SCALED, OR DRAWN USING THIN LINEWORK.
2. ADD LABELS TO PLAN SYMBOLS AS NEEDED FOR CLARITY.

DETAIL NO.

110-1

STANDARD DETAIL
ENGLISH

PLAN SYMBOLS

REVISED

01-01-2011

DETAIL NO.

110-1

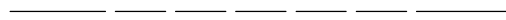
SECTION LINE



R/W



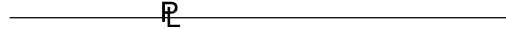
EASEMENT



PROPERTY LINE (OPTION 1)



PROPERTY LINE (OPTION 2)



JURISDICTIONAL BOUNDARY
(OPTION 1)



JURISDICTIONAL BOUNDARY
(OPTION 2)



ROADWAY CENTERLINE



UNDERGROUND ELECTRIC BURIED CABLE



UNDERGROUND ELECTRIC CONDUIT



UNDERGROUND ELECTRIC DUCT BANK



OVERHEAD ELECTRIC



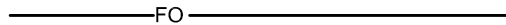
UNDERGROUND TELEPHONE LINE



OVERHEAD TELEPHONE LINE



FIBER OPTIC



CABLE TELEVISION



OVERHEAD CABLE TELEVISION



TELEPHONE DUCT BANK



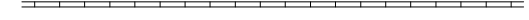
CHAIN LINK FENCE



BARBED WIRE FENCE



BLOCK WALL



WOOD FENCE



GAS LINE
(12" & SMALLER)



GAS LINE *
(GREATER THAN 12")



SEWER LINE
(12" & SMALLER)



SEWER LINE *
(GREATER THAN 12")



NEW STORM DRAIN PIPE *



STORM DRAIN *
(GREATER THAN 12")



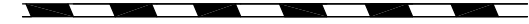
IRRIGATION LINE
(12" & SMALLER)



IRRIGATION LINE *
(GREATER THAN 12")



NEW IRRIGATION LINE *



WATER LINE
(12" & SMALLER)



WATER LINE *
(GREATER THAN 12")



* SCALE TO ACTUAL WIDTH

DETAIL NO.

110-2



STANDARD DETAIL
ENGLISH

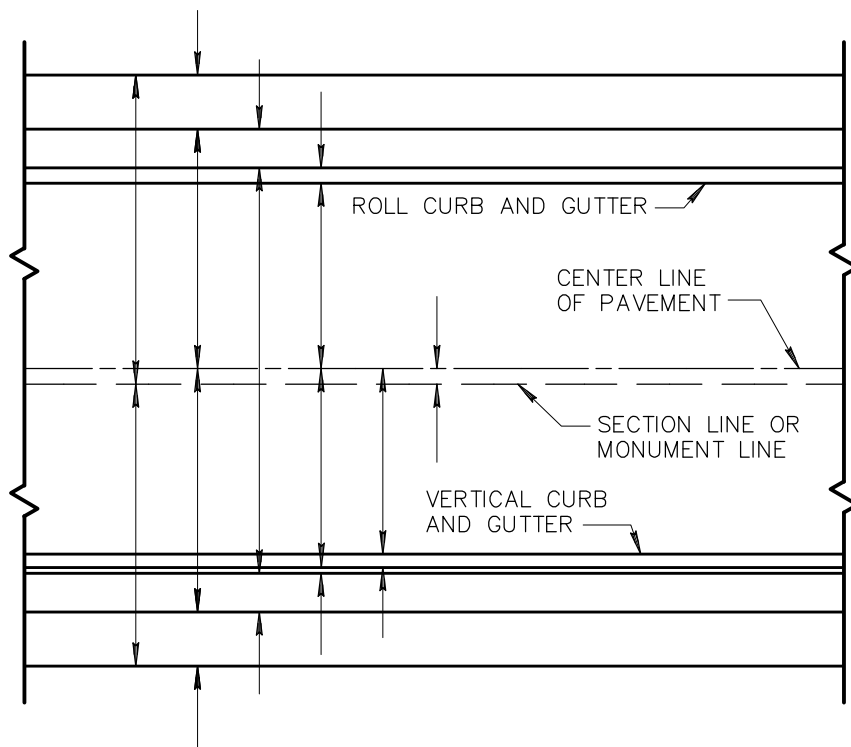
PLAN SYMBOLS

REVISED

01-01-2011

DETAIL NO.

110-2



DIMENSION SHOULD BE GIVEN ONCE ON EACH SHEET AND SHOULD BE PLACED NEAR THE CENTER OF THE SHEET. IF ANY OF THE GIVEN CONDITIONS CHANGE, THEY SHOULD BE REDIMENSIONED AT THE POINT OF CHANGE.

GIVEN DIMENSIONS IN ORDER STARTING WITH THE LONGEST AND ENDING WITH THE SHORTEST, AS SHOWN IN THE SKETCH.

GIVE COMPLETE DIMENSIONS.

IF THE CENTERLINE OF PAVEMENT DOES NOT FALL ON THE SECTION LINE OR MONUMENT LINE OF THE STREET, DIMENSION AS ABOVE AND SHOW THE DIFFERENCE BETWEEN THE SECTION OR MONUMENT LINE AND THE CENTERLINE.

DETAIL NO.

112



STANDARD DETAIL
ENGLISH

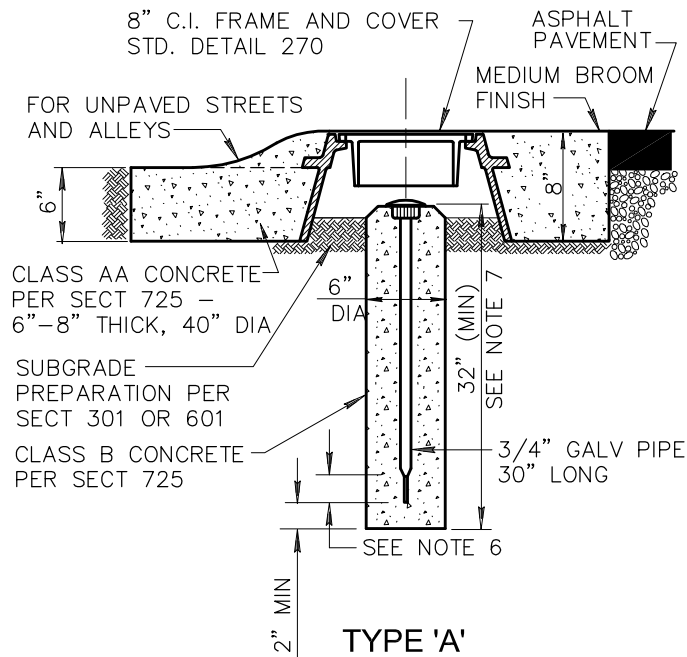
DIMENSIONING FOR ROAD IMPROVEMENT PLANS

REVISED

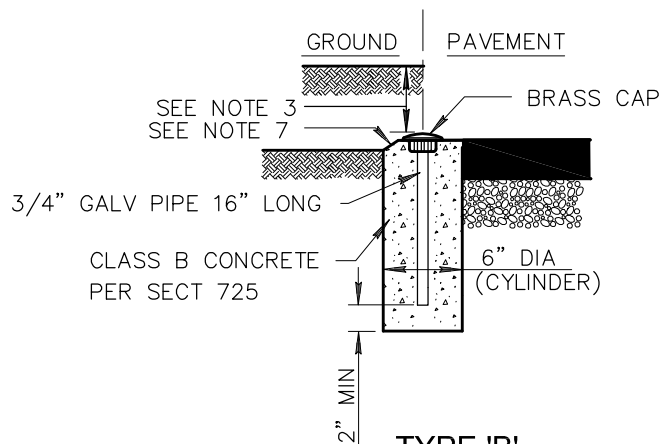
01-01-1998

DETAIL NO.

112



TYPE 'A'
(WITH FRAME)

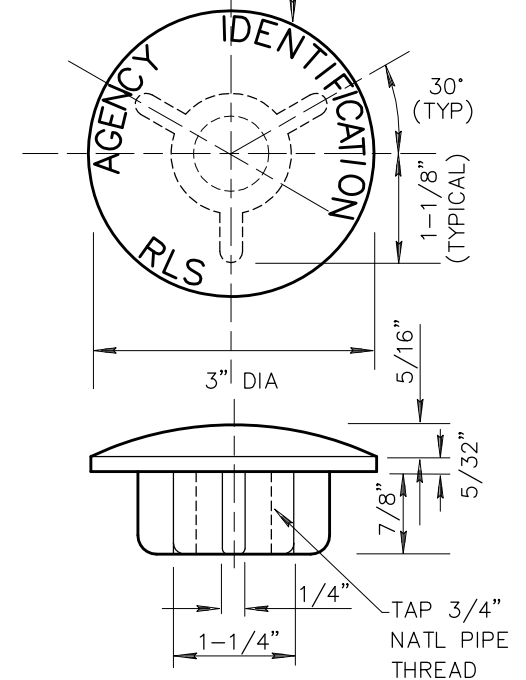


TYPE 'B'
(WITHOUT FRAME)

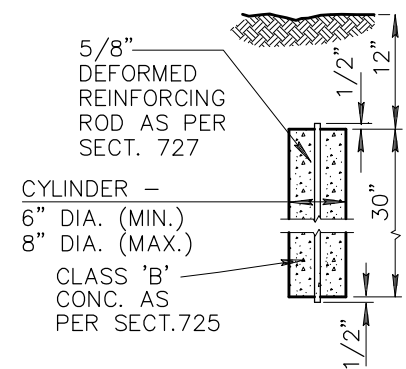
NOTES:

1. TYPE 'A' TO BE USED AT INTERSECTIONS OF MAJOR STREETS & COLLECTOR STREETS, SECTION CORNERS, SECTION 1/4 CORNERS, CENTER OF SECTIONS, AND AT OTHER POINTS AS SHOWN ON PLANS.
2. TYPE 'B' TO BE USED (EXCEPT WHERE TYPE 'A' IS SPECIFIED) AT INTERSECTION OF STREET CENTERLINES, PC'S, PT'S AND PI'S OF CURVES, SECTION 1/16 CORNERS, SUBDIVISION CORNERS, CHANGE IN ALIGNMENT OF SUBDIVISION BOUNDARIES, AND AT OTHER POINTS AS SHOWN ON PLANS.
3. FOR UNPAVED STREETS AND ALLEYS SET TOP OF MARKER SIX INCHES BELOW FINISHED GRADE.
4. CAP TO BE CONSTRUCTED OF RED BRASS OR BRONZE.
5. LETTERS TO BE APPROX. 1/32" WIDE & 1/32" DEEP.
6. FLATTENING THE BOTTOM 2" OF THE GALVANIZED PIPE IS OPTIONAL.
7. TOP OF CONCRETE POST IS CHAMFERED 3/4" EXCEPT WHEN SET FLUSH WITH PAVEMENT.
8. THE CAP SHALL SHOW THE POINT SURVEYED BY A PUNCH MARK OR SCRIBED CROSS AND THE CAP SHALL BE STAMPED WITH THE YEAR AND THE REGISTERED LAND SURVEYOR'S (RLS) REGISTRATION NUMBER.
9. WHEN APPLICABLE, THE CAP SHALL BE STAMPED WITH THE APPROPRIATE PUBLIC LAND MARKING PER CURRENT MANUAL OF INSTRUCTIONS FOR THE SURVEY OF PUBLIC LANDS OF THE UNITED STATES, PREPARED BY THE BUREAU OF LAND MANAGEMENT.
10. SUBMIT TO THE ENGINEER A COPY OF THE RECORDED CORNER RECORD OR RESULTS OF SURVEY TO DOCUMENT COMPLIANCE WITH THE ARIZONA BOARD OF TECHNICAL REGISTRATION REQUIREMENTS.

1/16" BORDER FROM
EDGE OF CAP TO TOP
OF 1/4" LETTERING.



CAP DETAIL



TYPE 'C'

DETAIL NO.

120



STANDARD DETAIL
ENGLISH

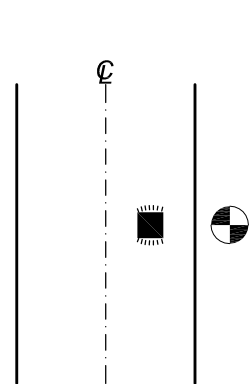
SURVEY MARKER

REVISED

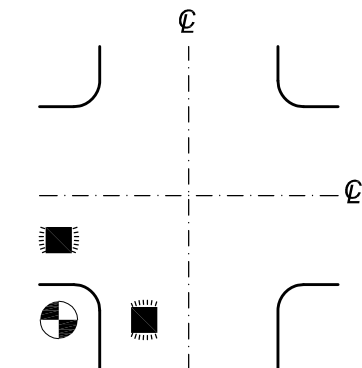
01-01-2015

DETAIL NO.

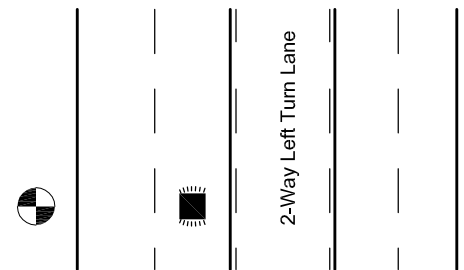
120



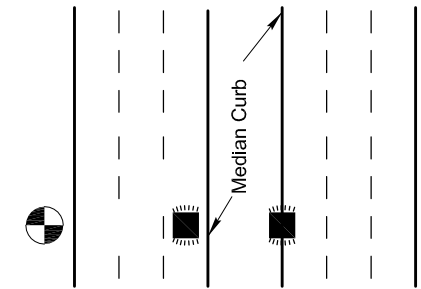
LOCAL STREET



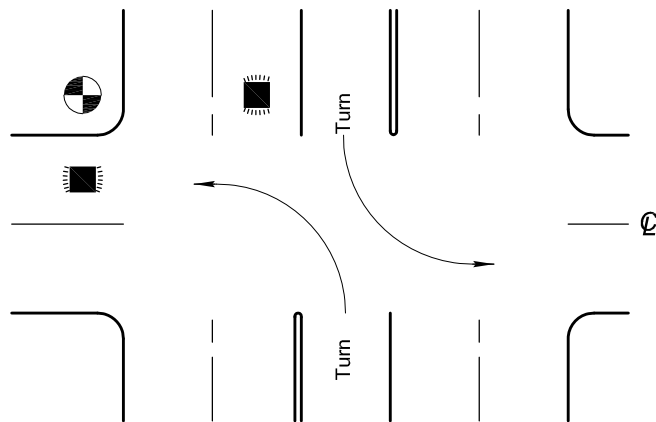
LOCAL CROSS
STREET INTERSECTION



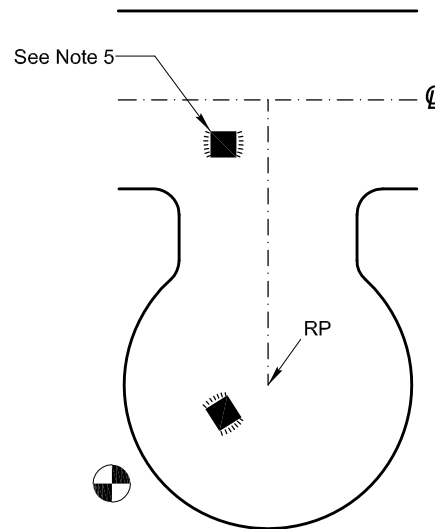
MULTI-LANE STREET
W/ TWO WAY LEFT TURN LANE



MULTI-LANE STREET
W/ RAISED MEDIAN



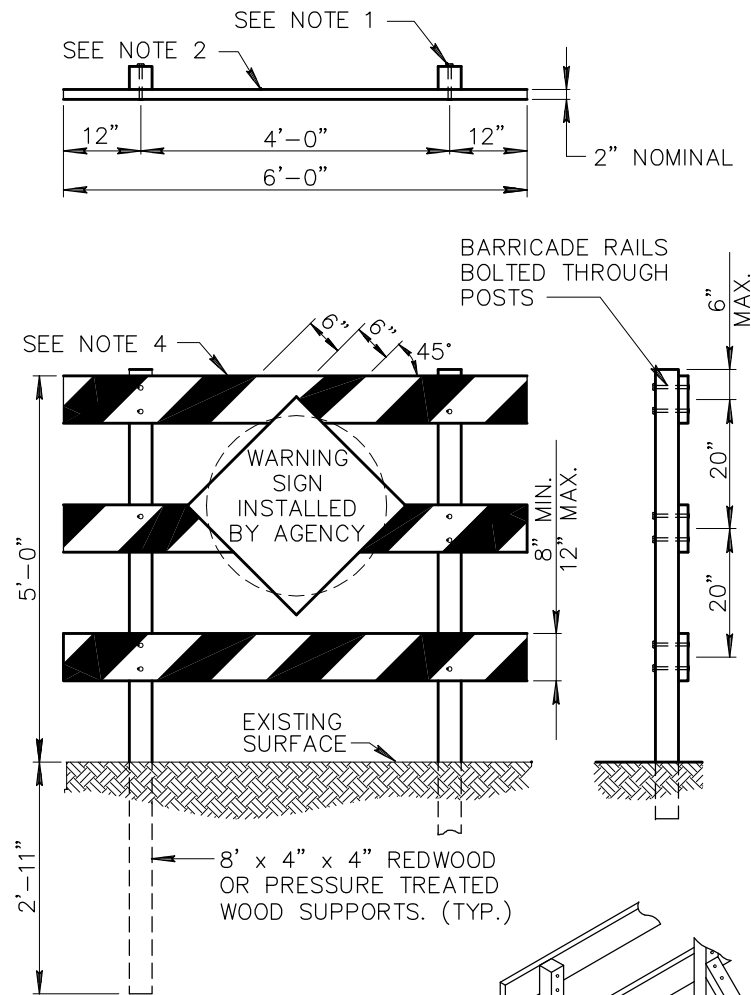
FOUR LANE STREET
WITH TURN LANE AT INTERSECTION



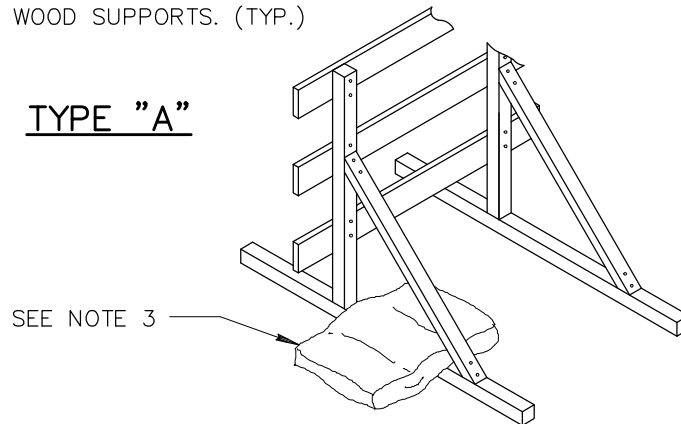
CUL-DE-SAC

NOTES:

1. LOCATE PAVEMENT MARKER IN CENTER OF TRAVEL LANE AND ALIGN WITH HYDRANT.
2. FOR MULTIPLE LANE ROADS LOCATE PAVEMENT MARKER IN LEFT MOST THROUGH TRAFFIC LANE.
3. ADJUST MARKER LOCATION TO BE LOCATED OUTSIDE OF ANY DELINEATED CROSSWALK AREA.
4. FOR HYDRANT LOCATED ON FAR SIDE OF RAISED MEDIAN, LOCATE PAVEMENT MARKER ON TOP OF MEDIAN CURB ALIGNED WITH HYDRANT.
5. OMIT FOR CUL-DE-SAC GREATER THAN 250' IN LENGTH.
6. FIRE HYDRANT PAVEMENT MARKERS SHALL BE 2-WAY RETROREFLECTIVE BLUE: ADOT TYPE BB, 911A-BLUE BY FIRE LITE AMERACE CORPORATION, OR APPROVED EQUAL.



TYPE "A"



NOTES:

1. FASTEN WITH 1/2" x 5" LAG SCREWS WITH 2 FLAT WASHERS OR (2) 5/8" BOLTS, WITH 4 FLAT WASHERS.
2. 2" x 8" DOUGLAS FIR PLANK (LENGTH TO BE DETERMINED ON PLANS.)
3. WHEN BARRICADE (TYPE "A") IS CONSTRUCTED ON BASES INSTEAD OF POSTS SET INTO THE GROUND, IT MAY BE DESIRABLE TO BALLAST THE BASES WITH SAND BAGS OR BY STAKING TO PROVIDE RESISTANCE TO OVERTURNING DURING PERIODS OF HIGH WINDS.
4. TWO COATS OF WHITE PAINT PER SECTION 790 SHALL BE APPLIED TO ALL EXPOSED SURFACES OF THE BARRICADE. AN ADDITIONAL TWO COATS OF ORANGE PAINT PER SECTION 790 SHALL BE APPLIED TO CREATE THE ALTERNATE ORANGE AND WHITE STRIPES FOR TEMPORARY BARRICADES AND TWO COATS OF RED PAINT PER SECTION 790 SHALL BE APPLIED TO CREATE ALTERNATE RED AND WHITE STRIPES FOR PERMANENT BARRICADES. HIGHWAY SAFETY SPHERES (BEADS) PER ADOT 708-2.02 SHALL BE APPLIED BY HAND TO ALL CROSS MEMBERS, FRONT AND BACK AND ON BOTH COLORS, IMMEDIATELY AFTER PAINTING. THE STRIPES SHALL SLOPE DOWNWARD IN THE DIRECTION TRAFFIC IS TO PASS.

FLANGED STEEL 'U'
CHANNEL (2 LBS. OR 3 LBS.
PER SQUARE FOOT
AS SPECIFIED)

2-1/2" DIA. STANDARD
PIPE GALVANIZED OR
2-3/8" O.D. STANDARD
PIPE GALVANIZED
(AS SPECIFIED)

2" DIA.
STANDARD PIPE
GALVANIZED

NOTES

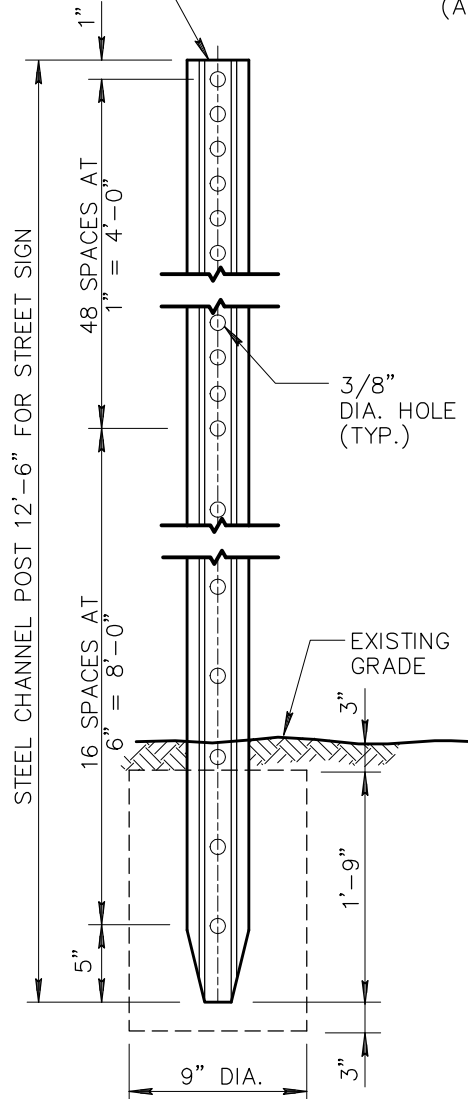
TYPE 'A'

USE DRIVING HEAD FOR DRIVING ALL
FLANGED STEEL 'U' CHANNEL POSTS.

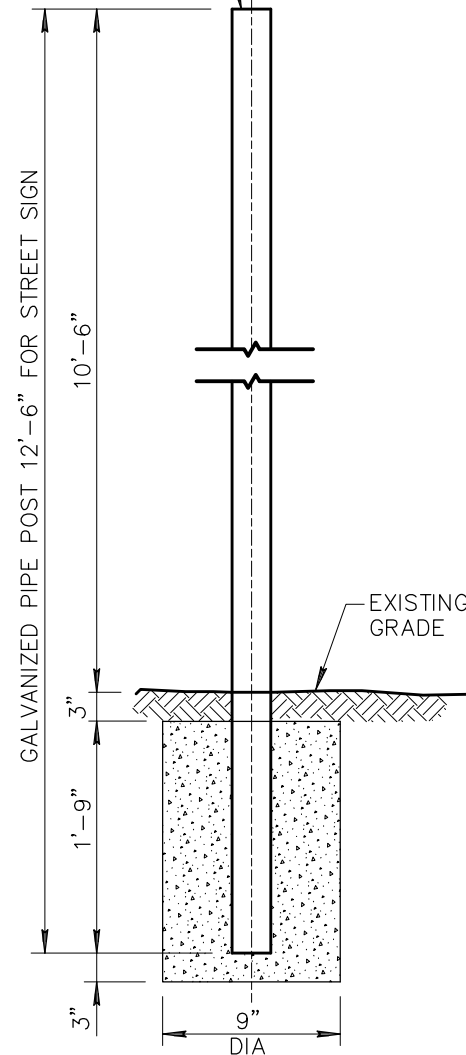
IN LIEU OF DRIVING FLANGED STEEL
'U' CHANNEL POSTS MAY BE SET IN
CONCRETE BASE FOUNDATION AS
PER TYPE 'B' BASE.

TYPE 'B' & TYPE 'C'

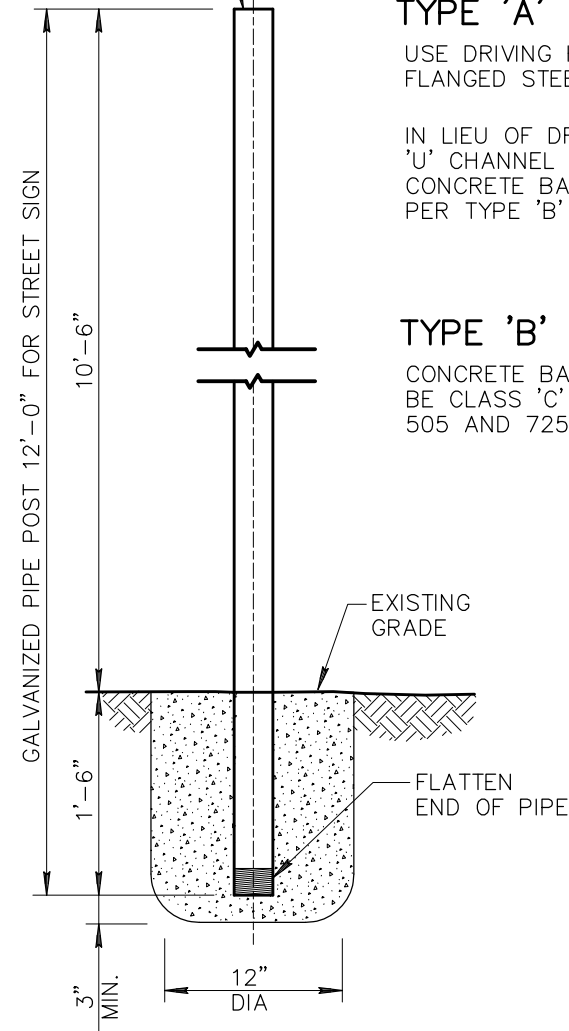
CONCRETE BASE FOUNDATIONS SHALL
BE CLASS 'C' CONCRETE AS PER SECT.
505 AND 725.



TYPE 'A'



TYPE 'B'



TYPE 'C'

DETAIL NO.

131



STANDARD DETAIL
ENGLISH

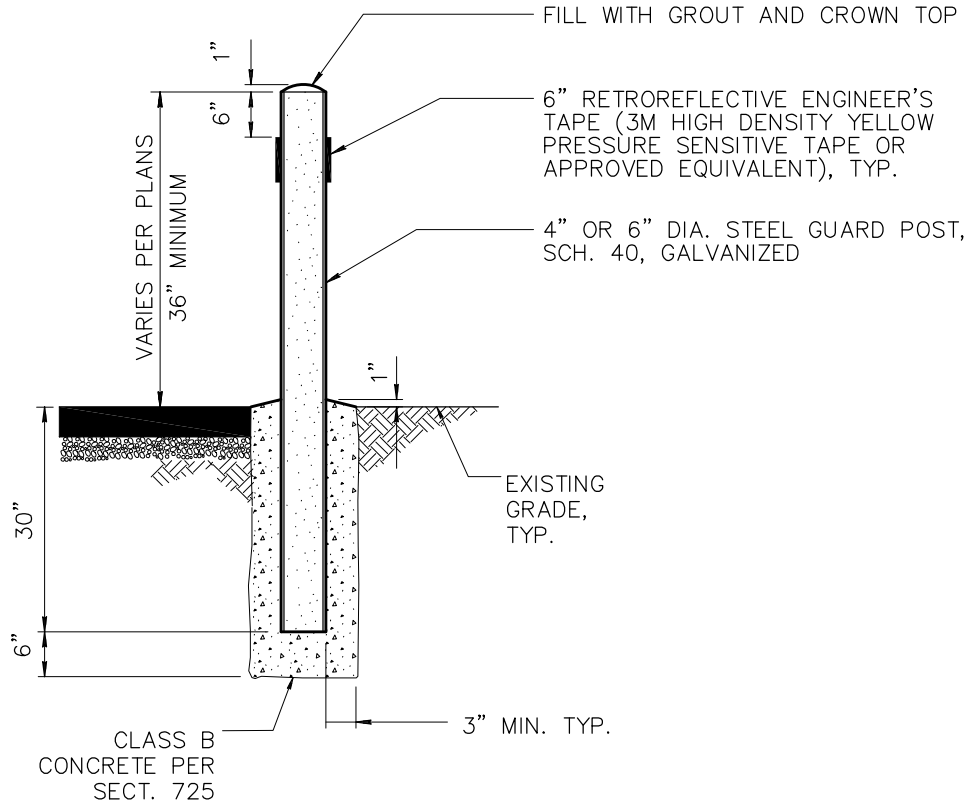
STREET SIGN BASE

REVISED

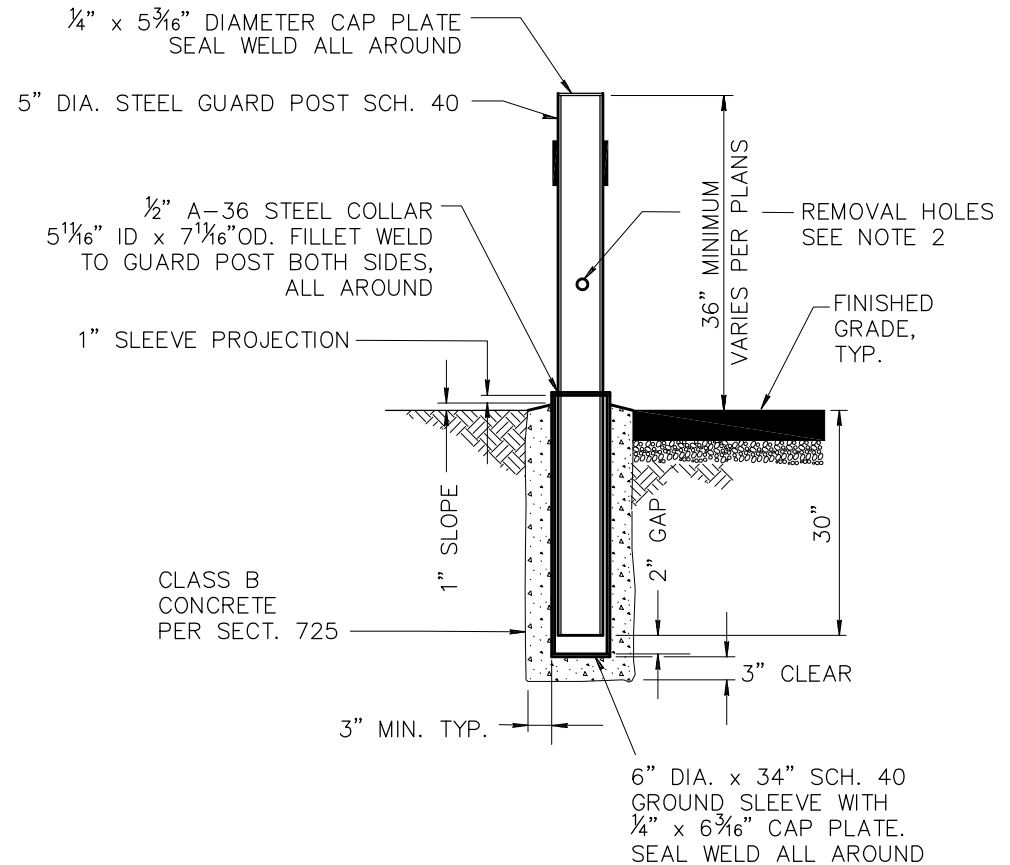
01-01-1998

DETAIL NO.

131



TYPE 1 PERMANENT



TYPE 2 REMOVABLE

NOTES

1. BOLLARDS SHALL HAVE A HEIGHT OF 3 FEET OR BE EQUAL TO THE HEIGHT OF THE BACK SCREEN WALL OF BIN ENCLOSURES. POSTS SHALL BE PLACED A MINIMUM OF 4" FROM THE WALL.
2. REMOVABLE POSTS SHALL HAVE 1" DIA. HOLES DRILLED THROUGH AT A DISTANCE $\frac{1}{3}$ THE OVERALL POST LENGTH FROM TOP.
3. REMOVABLE POST – GRIND SMOOTH ALL SHARP EDGES PRIOR TO GALVANIZATION. GALVANIZE PER ASTM A54 AFTER FABRICATION.

DETAIL NO.

140



STANDARD DETAIL
ENGLISH

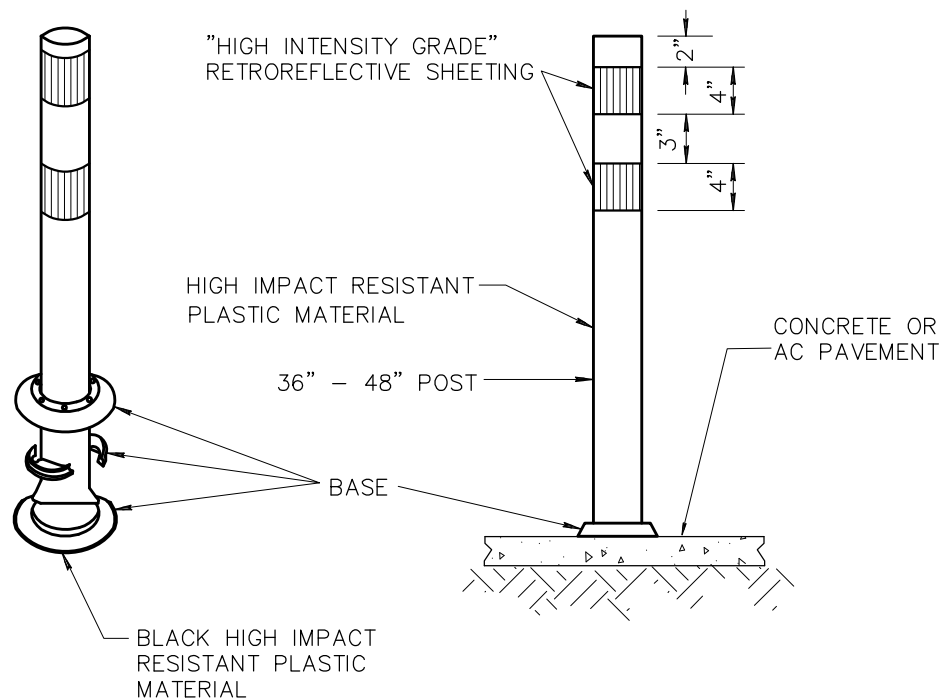
BOLLARD

REVISED

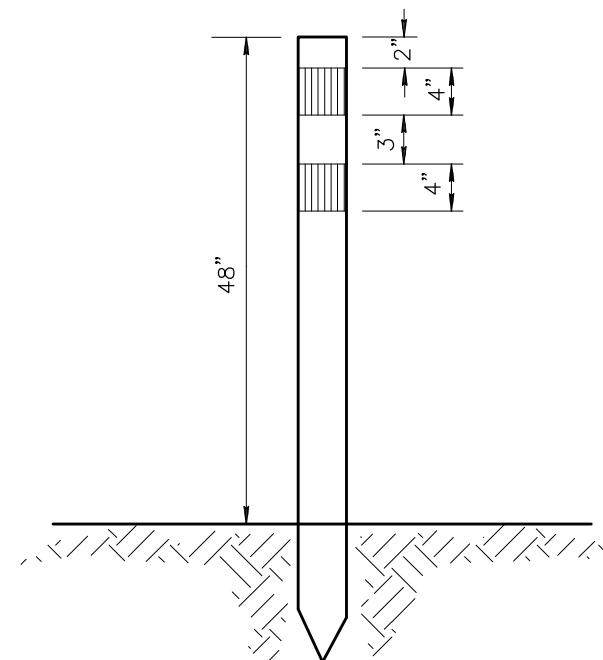
01-01-2009

DETAIL NO.

140



TYPE 1 SURFACE MOUNT



TYPE 2 GROUND MOUNT

NOTES

1. CONTRACTOR SHALL CLEAN ROADWAY SURFACE PRIOR TO PLACEMENT OF FLEXIBLE TUBULAR MARKER.
2. FLEXIBLE TUBULAR MARKERS SHALL BE CEMENTED TO THE PAVEMENT SURFACE WITH AN EPOXY ADHESIVE IN ACCORDANCE WITH THE TUBULAR MARKER MANUFACTURER'S SPECIFICATIONS.
3. YELLOW TUBULAR MARKERS SHALL HAVE A YELLOW POST AND YELLOW "HIGH INTENSITY GRADE" RETROREFLECTIVE SHEETING. ORANGE TUBULAR MARKERS SHALL HAVE AN ORANGE POST AND WHITE HIGH INTENSITY RETROREFLECTIVE SHEETING.
4. POST SHALL BE FLEXIBLE, HIGH IMPACT RESISTANT PLASTIC MATERIAL.

DETAIL NO.

141



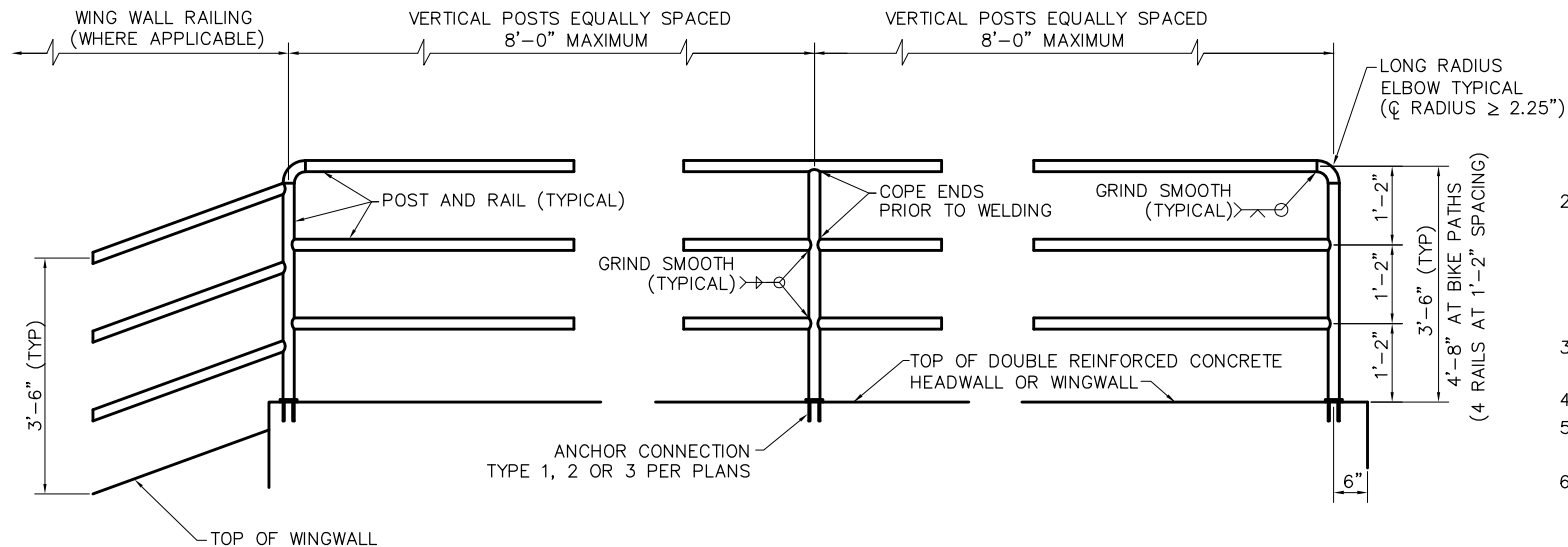
STANDARD DETAIL
ENGLISH

HAZARD MARKER

REVISED
01-01-2009

DETAIL NO.

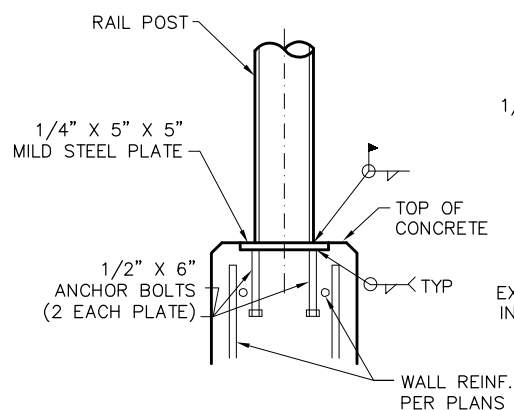
141



ELEVATION

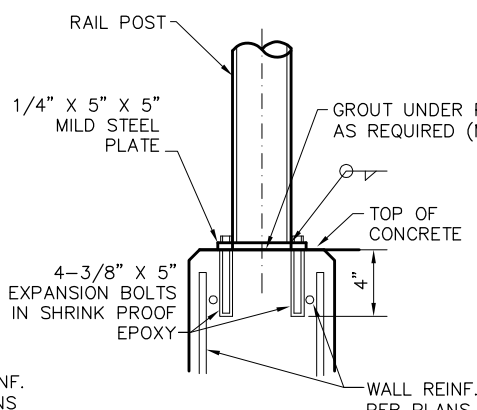
NOTES:

1. POSTS AND RAILS SHALL BE 1.90 INCH OUTSIDE DIAMETER HIGH STRENGTH HEAVY INDUSTRIAL STEEL PIPE CONFORMING TO ASTM F1043 MATERIAL GROUP 1A-2 (2.72 LB/FT, MINIMUM YIELD STRENGTH = 50 KSI) OR MATERIAL GROUP 1C GALVANIZED AFTER FORMING (2.28 LB/FT, MINIMUM YIELD STRENGTH = 50 KSI).
2. PAINT RAIL PER MAG SPECIFICATIONS SECTION 530 WHEN REQUIRED BY PLANS. SHOP PRIME WITH RUST INHIBITING PRIMER (FIELD REPAIR PRIMER AS NEEDED). COLOR PER PLANS.
3. VERTICAL POSTS TO BE EVENLY SPACED.
4. REMOVE ALL SHARP EDGES.
5. INSTALL SAFETY RAIL AS REQUIRED BY PLANS OR SPECIFICATIONS.
6. THE EMBEDMENT FOR ANCHOR TYPES 1, 2 AND 3 SHALL BE LOCATED INSIDE THE WALL REINFORCEMENT CAGE.
7. SAFETY RAIL IS NOT TO BE USED AS A PEDESTRIAN BRIDGE RAIL.



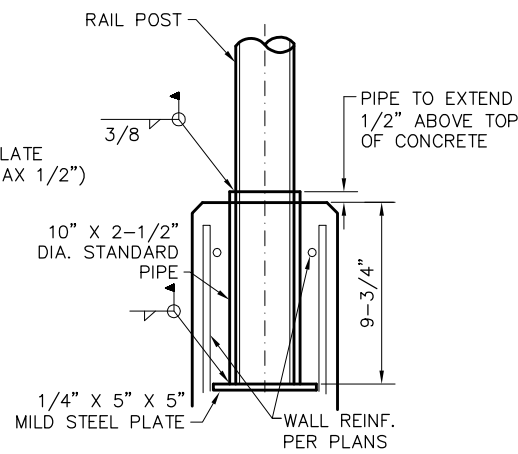
TYPE 1

ANCHOR PLATE DETAIL



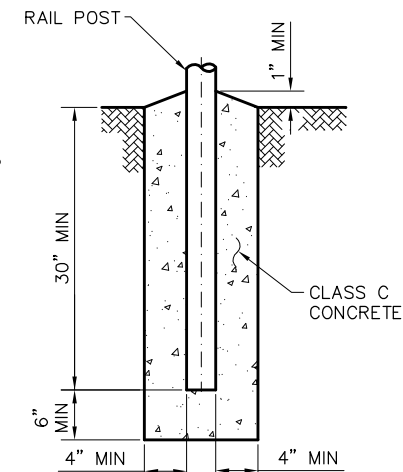
TYPE 2

EXPANSION BOLT DETAIL



TYPE 3

PIPE SLEEVE DETAIL



TYPE 4

GROUND INSTALLATION DETAIL

NOTE: SEE PLANS FOR ANCHORAGE DETAILS FOR ATTACHMENT TO SINGULARLY REINFORCED AND NON-REINFORCED WALLS.

DETAIL NO.

145



STANDARD DETAIL
ENGLISH

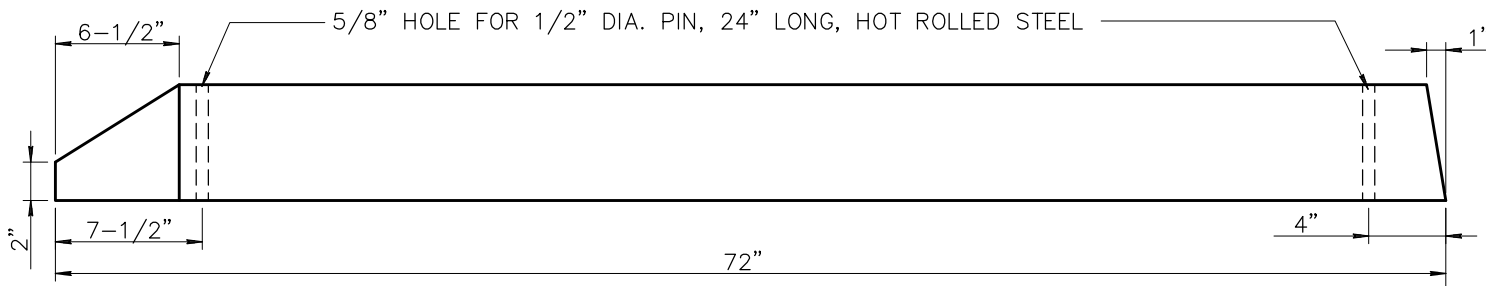
SAFETY RAIL

REVISED

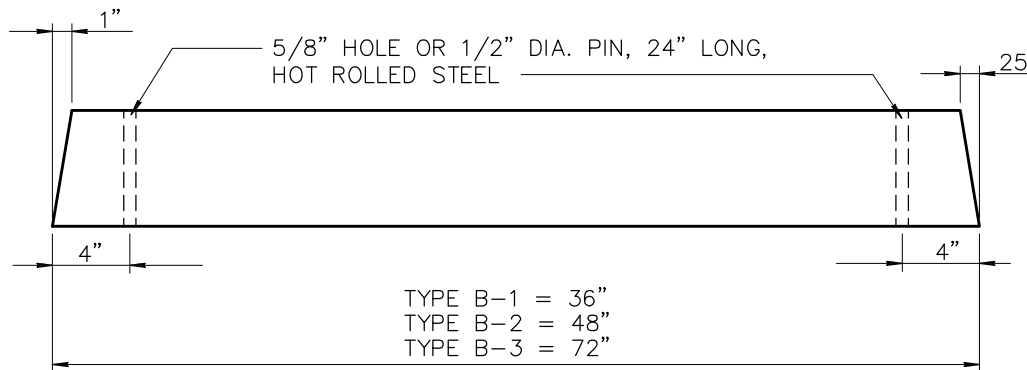
01-01-2016

DETAIL NO.

145



TYPE A

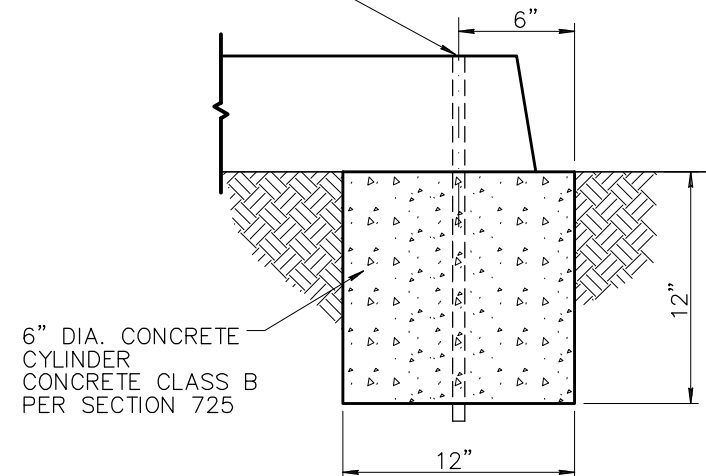


TYPE B-1, B-2, AND B-3

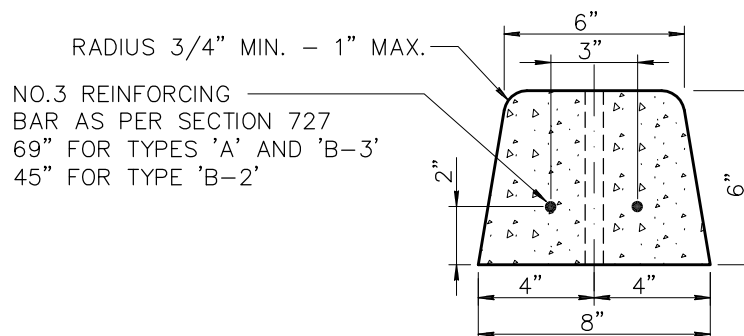
NOTES:

1. DIMENSIONAL AND REINFORCEMENT CHANGES WILL BE PERMITTED UPON PRIOR WRITTEN APPROVAL OF THE ENGINEER.
2. UNLESS OTHERWISE NOTED, CONCRETE SHALL BE CLASS 'A' PER SECTION 725.

1/2" DIA. PINS -
24" LONG, HOT
ROLLED STEEL



SAFETY CURB
INSTALLATION ON DIRT



TYPICAL SECTION

DETAIL NO.

150



STANDARD DETAIL
ENGLISH

PRECAST SAFETY CURB

REVISED

01-01-1998

DETAIL NO.

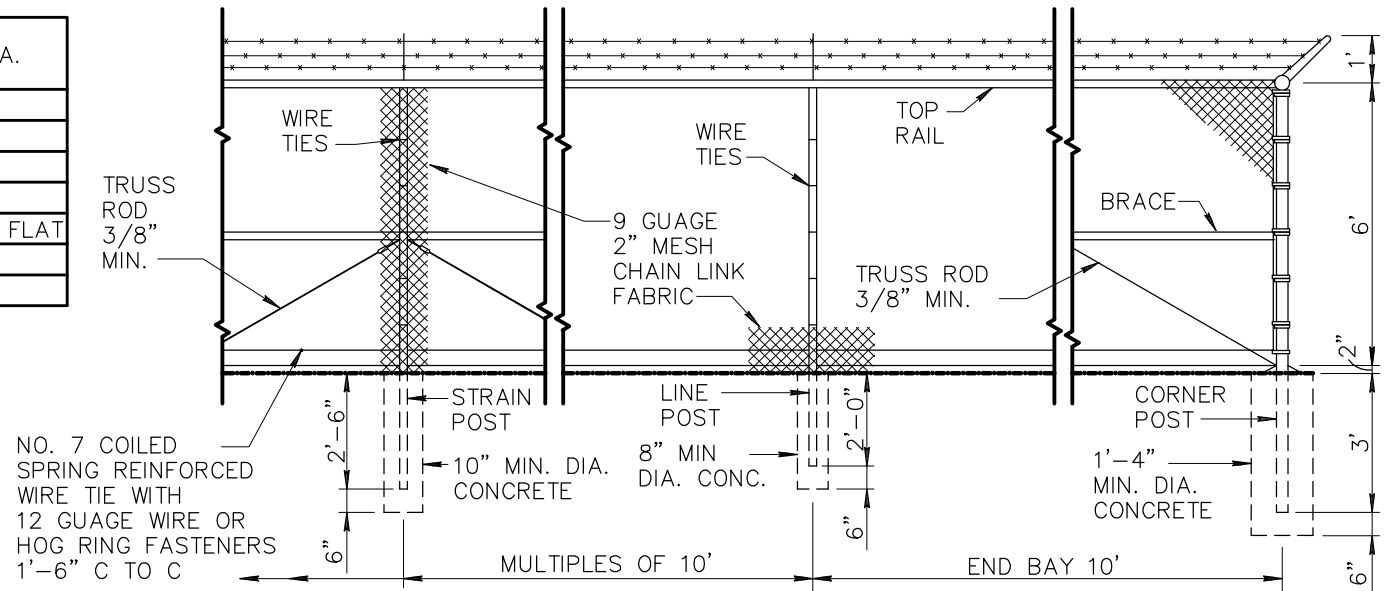
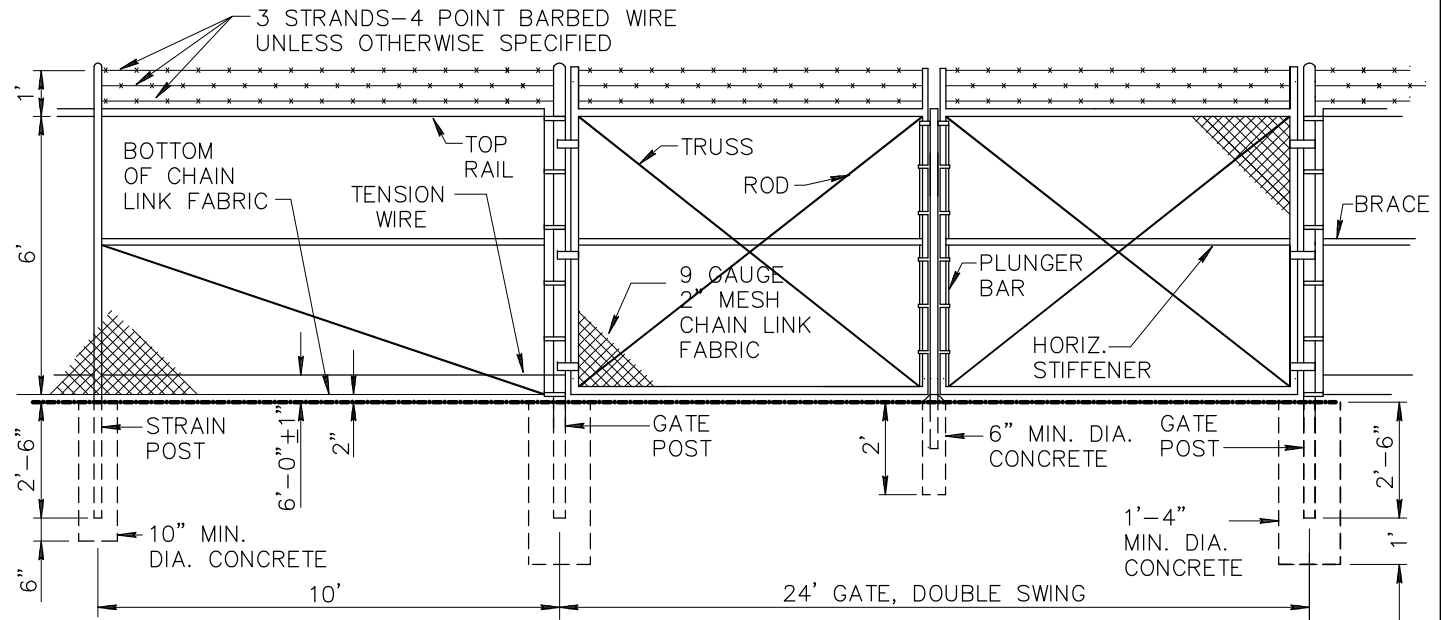
150

NOTES

1. ALL CONCRETE SHALL BE CLASS 'C' PER SECT. 725.
2. FITTINGS NOT SPECIFICALLY DETAILED SHALL BE HEAVY DUTY DESIGN.
3. STRAIN POSTS SHALL BE SPACED AT 500' MAXIMUM SPACING.
4. BOTH CORNER AND STRAIN POSTS SHALL HAVE STRAIN PANELS.
5. ALL POSTS SHALL BE CAPPED.
6. MEMBER SIZES SHALL BE THE FOLLOWING:

MEMBER	AISC SIZE	OUTSIDE DIA.
CORNER POST	2-1/2"	2.875"
LINE POST	1-1/2"	1.900"
STRAIN POST	1-1/2"	1.900"
BRACE	1-1/4"	1.666"
STRETCH BAR	3/16"x3/4" FLAT	3/16"x3/4" FLAT
GATE POST	3-1/2"	4.000"
TOP RAIL	1-1/4"	1.666"

7. CONSTRUCTION AND MATERIALS SHALL CONFORM TO SECT. 420 AND 772, RESPECTIVELY. SEE TABLE 772-1 FOR WEIGHTS OF MEMBERS.



DETAIL NO.

160



STANDARD DETAIL
ENGLISH

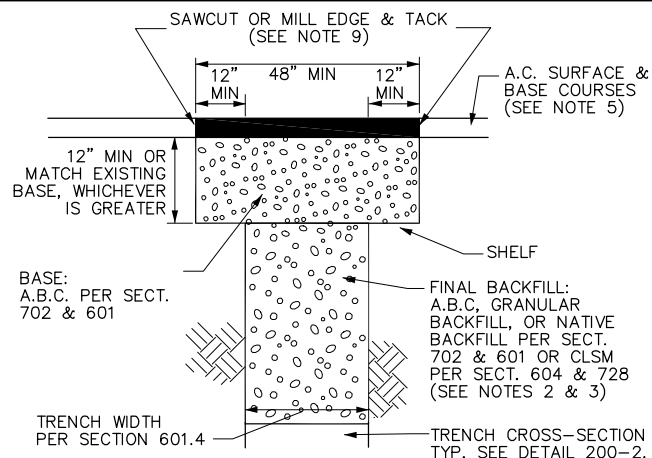
6' CHAIN LINK FENCE AND GATE

REVISED

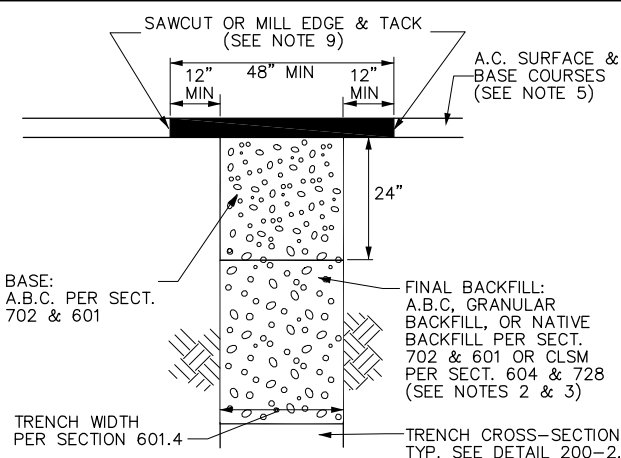
01-01-2013

DETAIL NO.

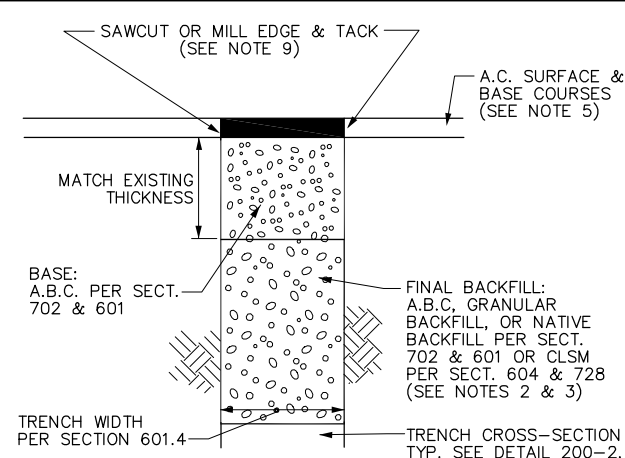
160



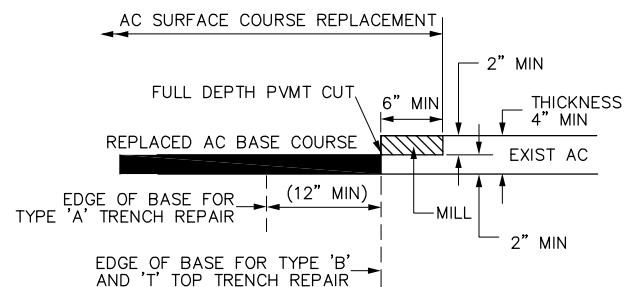
"T TOP" TRENCH REPAIR



TYPE "A" TRENCH REPAIR

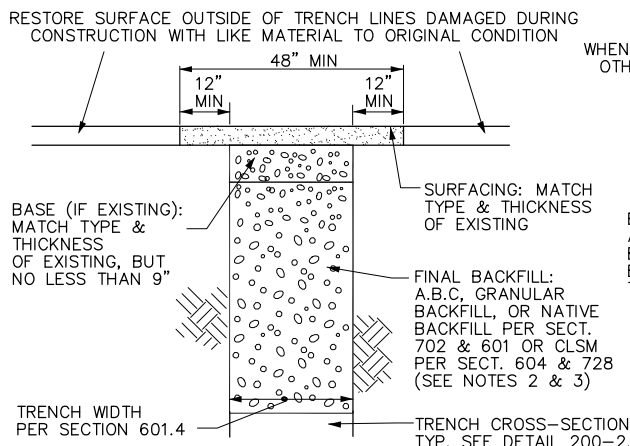


TYPE "B" TRENCH REPAIR



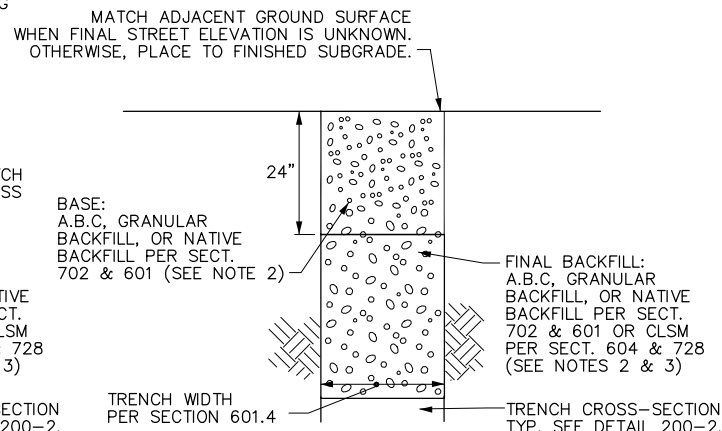
OFFSET JOINT

(FOR PAVEMENT $\geq 4"$ THICK)



TYPE "D" TRENCH REPAIR

(TRENCH NOT UNDER CONCRETE OR ASPHALT PAVEMENT)



TYPE "E" TRENCH REPAIR

(TRENCH IN FUTURE ROADWAY PRISM OR ALLEY)

NOTES:

1. PAVEMENT MATCHING AND SURFACE REPLACEMENT SHALL BE IN ACCORDANCE WITH SECTION 336.
2. MATERIAL FOR FINAL BACKFILL AND BASE (IF APPLICABLE) SHALL BE AS NOTED HEREIN UNLESS OTHERWISE SPECIFIED IN CONTRACT DOCUMENTS. CLSM SHALL BE 1/2-SACK OR 1-SACK PER SECTIONS 604 AND 728.
3. FINAL BACKFILL SHALL BE 1/2-SACK OR 1-SACK CLSM PER SECTIONS 604 AND 728 FOR TRENCH DEPTHS GREATER THAN 4 FEET UNLESS A SAFE (OHS COMPLIANT) WORKING SPACE AT LEAST 30" WIDE IS PROVIDED TO CONDUCT COMPACTION TESTING.
4. BASE, FINAL BACKFILL, AND PIPE EMBEDMENT ZONE COMPACTION SHALL BE IN ACCORDANCE WITH SECTION 601.
5. ASPHALT CONCRETE SURFACE AND BASE COURSES SHALL COMPLY WITH SECTION 336.2.4.1 UNLESS OTHERWISE SPECIFIED IN CONTRACT DOCUMENTS.
6. USE TYPE "A" FOR LONGITUDINAL TRENCH REPAIR AND USE "T-TOP" FOR TRANSVERSE TRENCH REPAIR (SEE DETAIL 200-2) UNLESS OTHERWISE SPECIFIED IN CONTRACT DOCUMENTS. TYPE "B" TRENCH REPAIR MAY BE USED FOR TRANSVERSE TRENCH REPAIR IF SPECIFIED BY THE AGENCY.
7. PROVIDE MINIMUM 12" WIDE SHELF AS SHOWN IN "T-TOP" TRENCH REPAIR AT ENDS OF TYPE "A" TRENCH REPAIR EXCEPT WHERE EDGE ABUTS EXISTING CONCRETE.
8. USE "T-TOP" PAVEMENT REPLACEMENT WHERE A TRENCH IS NOT PARALLEL TO A STREET OR GOES THROUGH AN INTERSECTION.
9. THE JOINT LOCATION OR JOINT CONFIGURATION MAY VARY FROM THAT SHOWN TO ELIMINATE REMNANTS, TO ELIMINATE FULL DEPTH SAWCUT JOINTS FROM BEING LOCATED WITHIN A WHEEL PATH AS REQUIRED BY SECTION 336, OR WHEN AN OFFSET JOINT IS CONSTRUCTED.
10. SEE DETAIL 200-2 FOR REMNANT PAVEMENT REMOVAL REQUIREMENTS.
11. EXPOSED COPPER OR POLYETHYLENE WATER PIPE UP TO 2" IN DIAMETER IN TRENCHES TO BE BACKFILLED WITH CLSM SHALL BE WRAPPED WITH MINIMUM 3/4" THICK PREFORMED PIPE-COVERING FOAM INSULATION BEFORE PLACING CLSM.

DETAIL NO.

200-1



STANDARD DETAIL
ENGLISH

TRENCH BACKFILL AND
SURFACE REPLACEMENT

PROPOSED

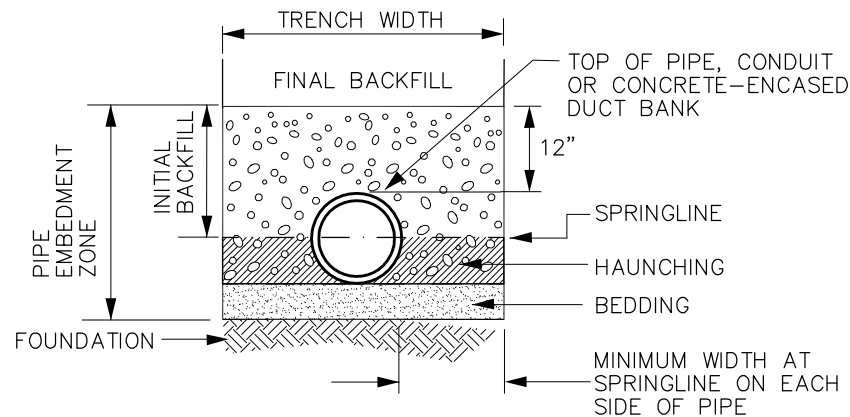
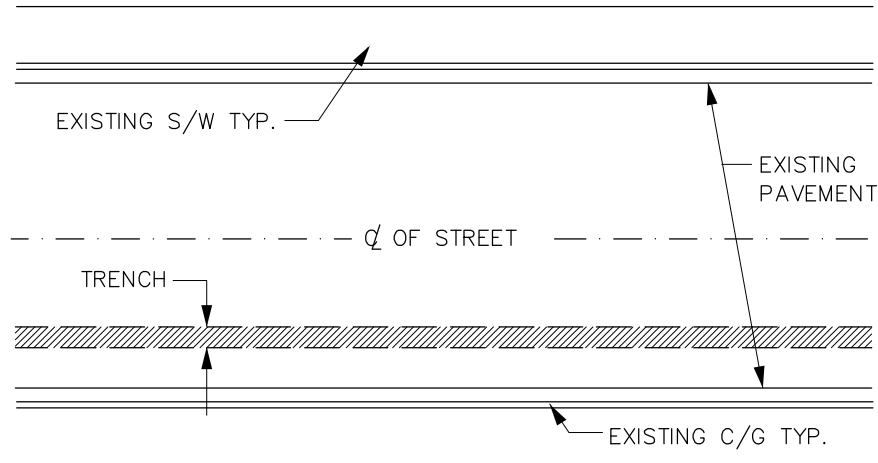
01-01-2016

DETAIL NO.

200-1

LONGITUDINAL TRENCH

(TRENCH IN PAVEMENT PARALLEL TO TRAFFIC)



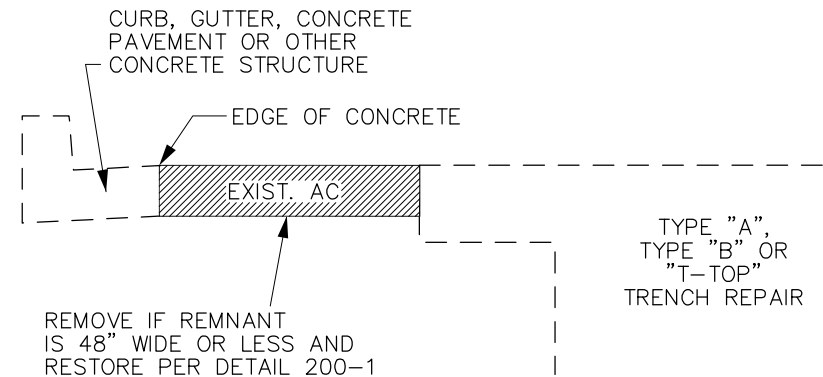
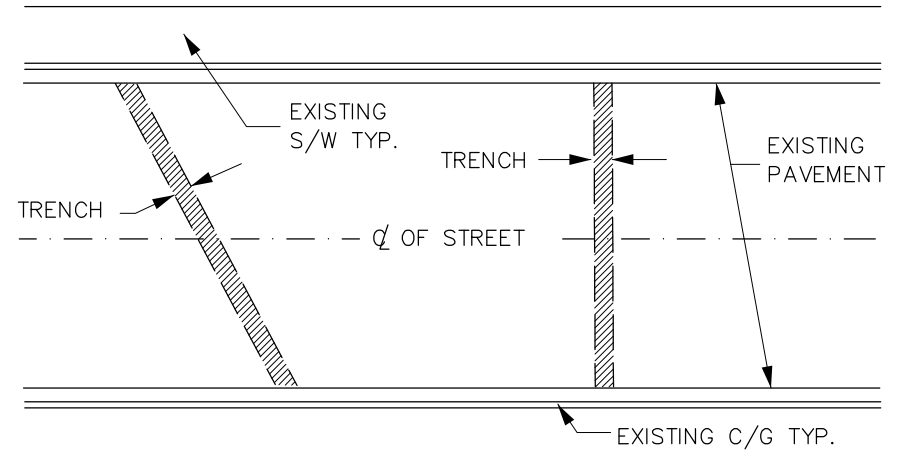
TRENCH CROSS-SECTION DETAIL

NOTES:

1. SEE SECTION 601 FOR TRENCH EXCAVATION, BACKFILLING AND COMPACTION REQUIREMENTS.
2. SEE DETAIL 200-1 FOR DETAILED TRENCH REPAIR REQUIREMENTS FOR TRENCH TYPES NOTED HEREIN.
3. SEE DETAIL 211 FOR REQUIREMENTS REGARDING THE USE OF PLATING TRANSVERSE TRENCHES. USE OF STEEL PLATES SHALL NOT EXCEED 72 HOURS AFTER COMPLETION OF BACKFILL AND PRIOR TO FINAL PATCHING.

TRANSVERSE TRENCH

(TRENCH IN PAVEMENT NOT PARALLEL TO TRAFFIC)



REMNANT PAVEMENT REMOVAL

DETAIL NO.

200-2



STANDARD DETAIL
ENGLISH

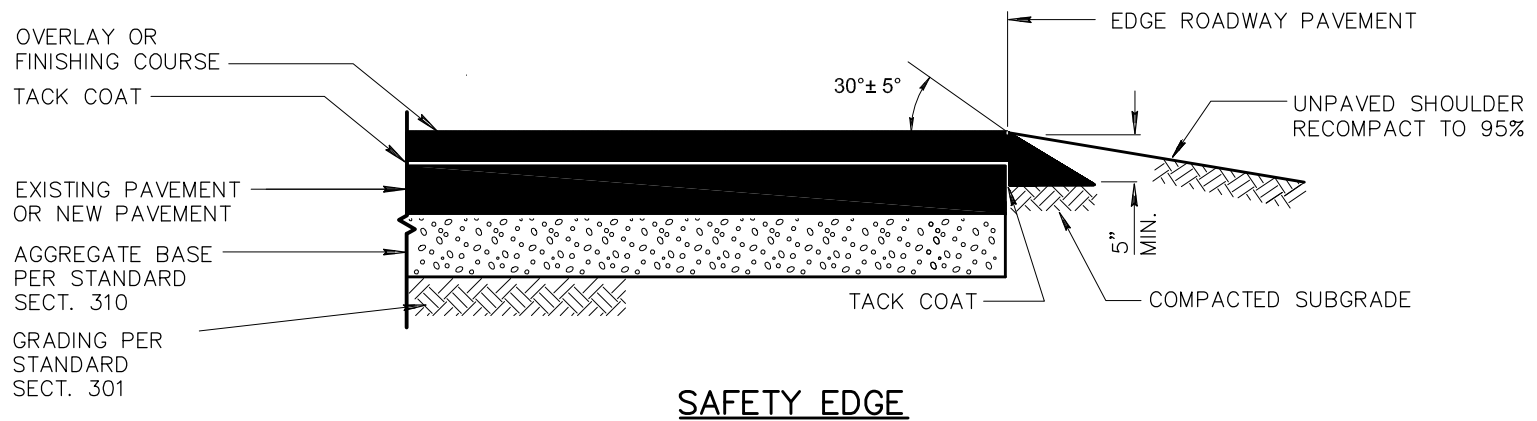
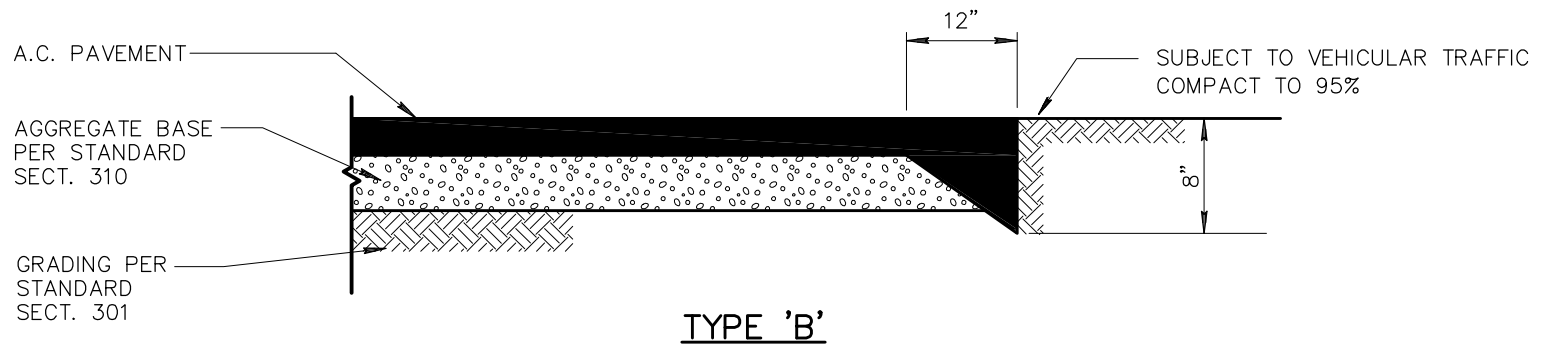
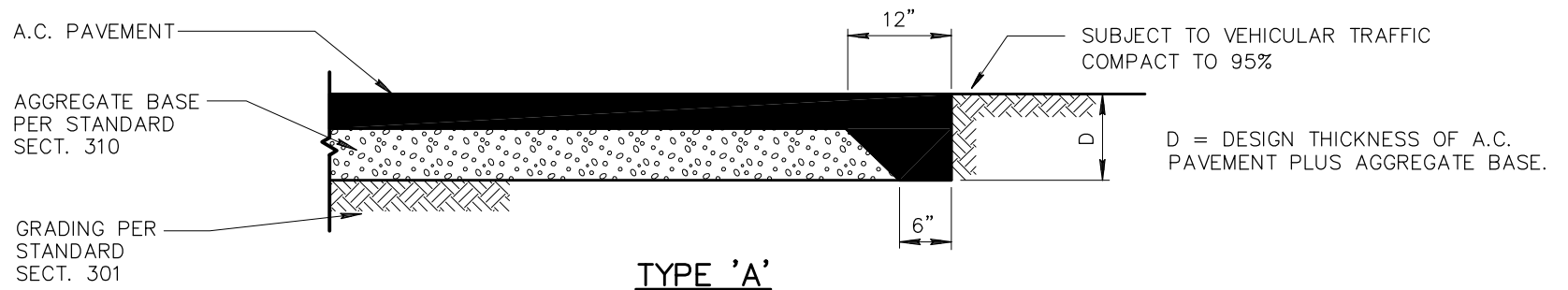
TRENCH BACKFILL AND
SURFACE REPLACEMENT

PROPOSED

01-01-2016

DETAIL NO.

200-2



DETAIL NO.

201



STANDARD DETAIL
ENGLISH

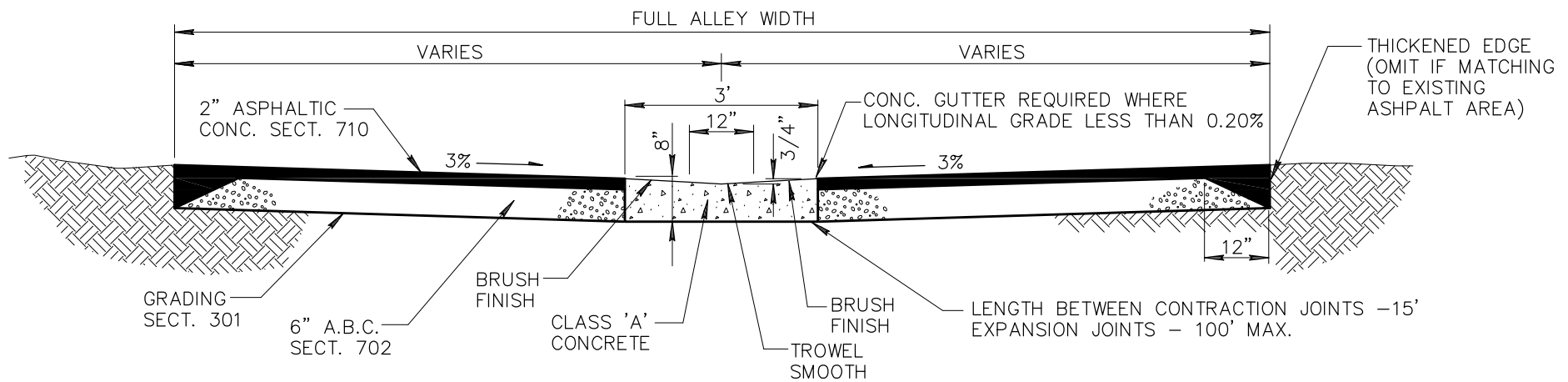
ASPHALT PAVEMENT EDGE DETAILS

DATE

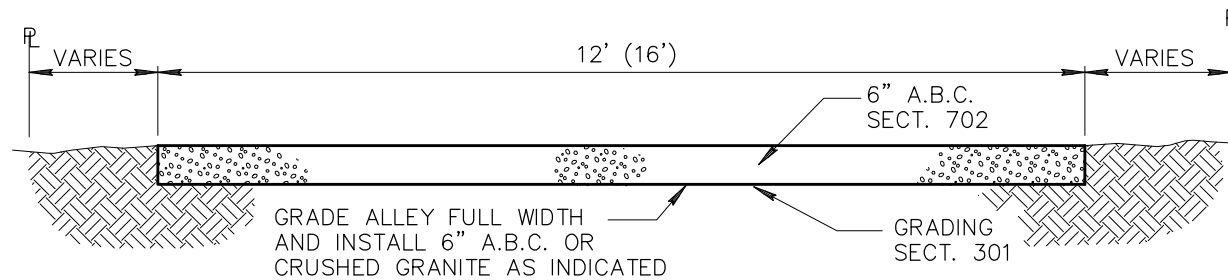
01-01-2014

DETAIL NO.

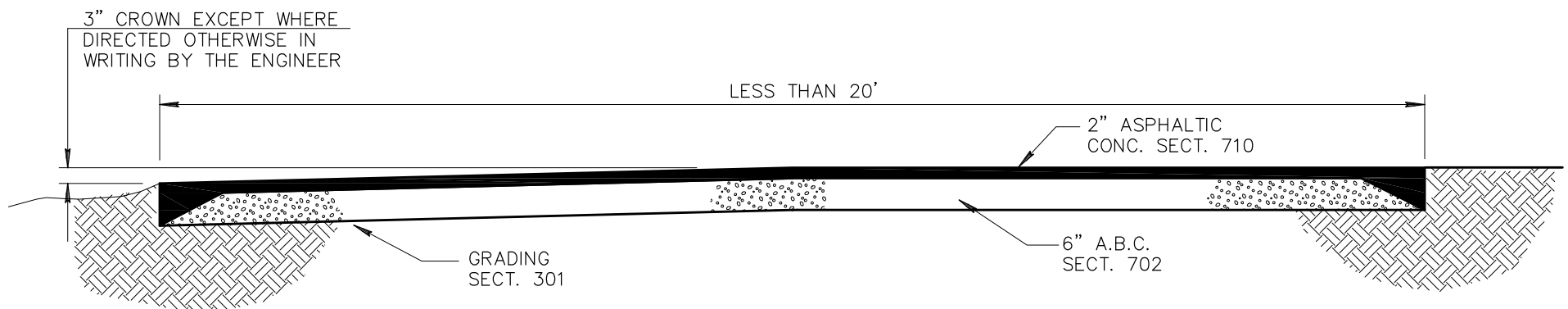
201



PAVED ALLEY DETAIL

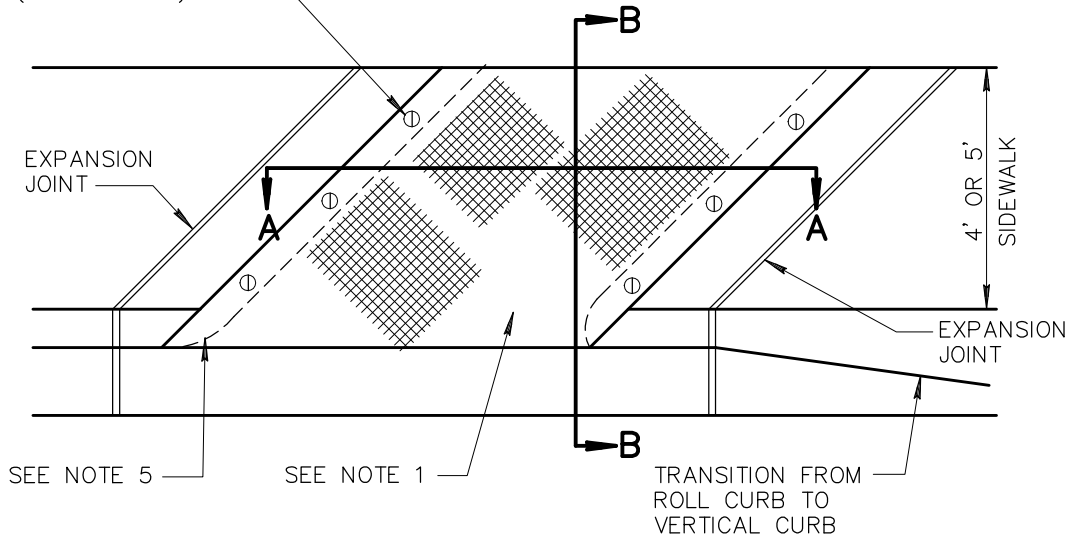


UNPAVED ALLEY DETAIL



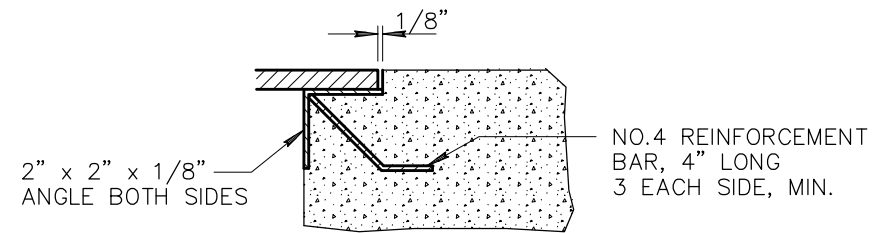
RESIDENTIAL ALLEY DETAIL

3/8" FLATHEAD STAINLESS STEEL
CAP SCREW COUNTERSINK
(6 EACH MIN.)

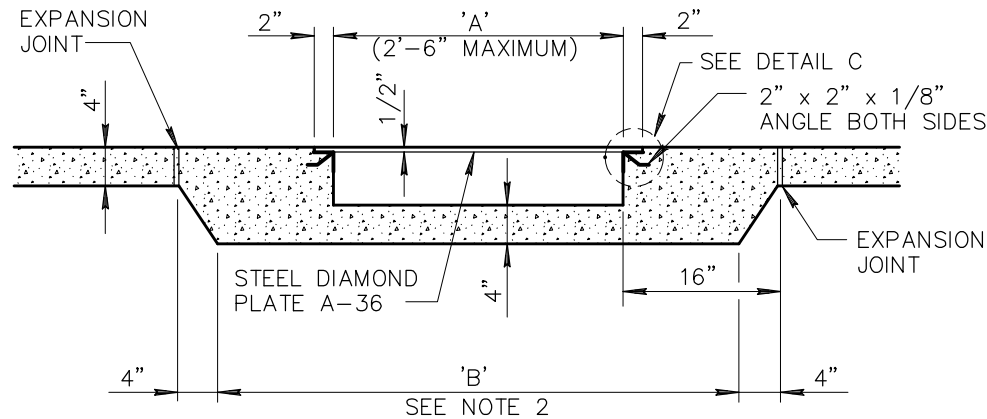


NOTES:

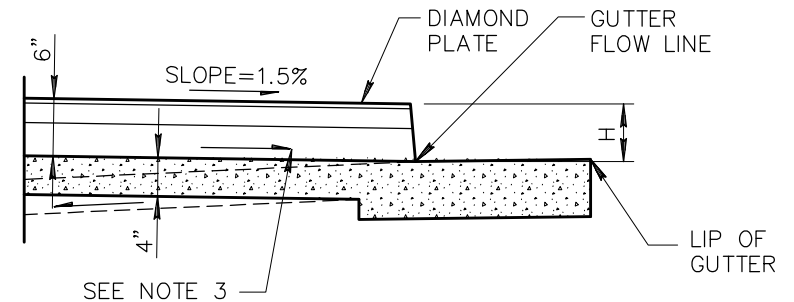
1. ANGLE EQUALS 45° UNLESS SPECIFIED ON PLAN.
2. DIMENSION 'B' EQUALS 'A' + 2'
3. (———>) INDICATES DIRECTION OF FLOW.
4. PAINT STEEL ACCORDING TO SECTION 790.
PAINT NUMBER 1-A OR 1-B.
5. R EQUALS 1" UNLESS OTHERWISE DIRECTED.
6. H EQUALS CURB FACE HEIGHT.
7. FOR ROLL CURB AND GUTTER, USE 2'
TRANSITIONS TO VERTICAL CURB.
8. CONCRETE SHALL BE CLASS B PER SECT. 725
AND INSTALLED PER SECT. 505.



DETAIL C



SECTION 'A-A'



SECTION 'B-B'

DETAIL NO.

203



STANDARD DETAIL
ENGLISH

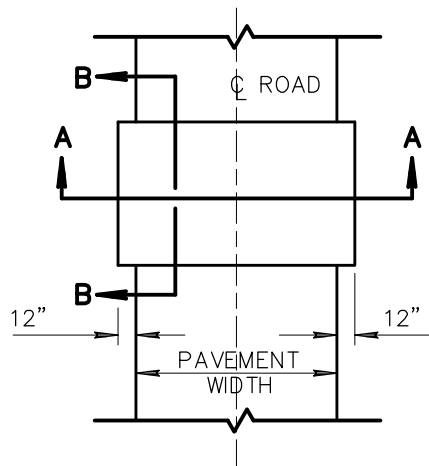
SCUPPERS

REVISED

01-01-1998

DETAIL NO.

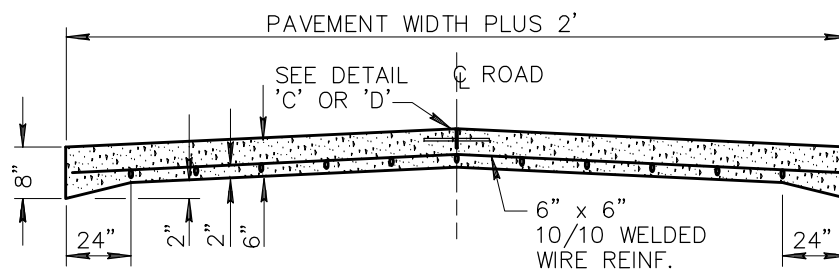
203



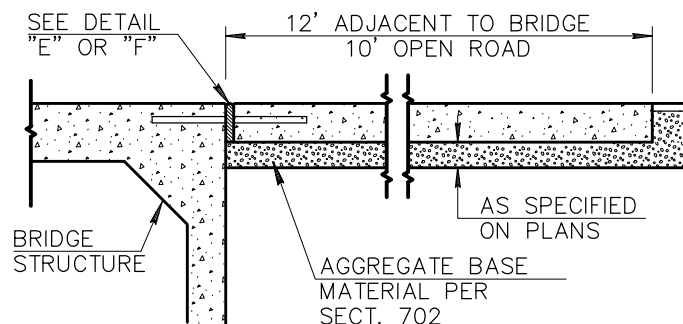
PLAN OF CONCRETE EQUIPMENT CROSSING

NOTES:

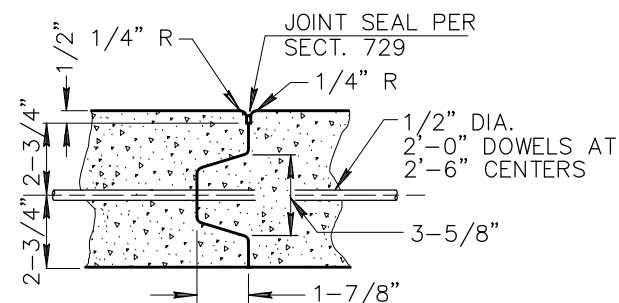
1. WHEN EQUIPMENT CROSSING LIES ADJACENT TO BRIDGE OR BOX CULVERT, CONSTRUCT THE EQUIPMENT CROSSING TO WIDTH OF BRIDGE ROADWAY.
2. ALL DOWELS IN CENTER JOINTS SHALL BE DEFORMED BARS AND SHALL HAVE UNBROKEN BOND. THEY SHALL BE HELD SECURELY IN PLACE, PARALLEL TO THE SUBGRADE AND PERPENDICULAR TO THE CENTER LINE OF THE ROAD.
3. THE EDGING TOOL USED FOR ALL LONGITUDINAL JOINTS SHALL BE SO CONSTRUCTED AS TO PROVIDE A SMOOTH TROWELED SURFACE 3" WIDE ON EACH SIDE OF THE JOINT.
4. IF APPROVED BY THE ENGINEER, OTHER DEFORMATIONS MAY BE USED IN LONGITUDINAL JOINT - DETAIL 'C'.
5. DETAIL 'C' TO BE USED ONLY WHEN FULL WIDTH CAN NOT BE POURED IN ONE POUR. USE DETAIL 'D' IF FULL WIDTH IS POURED IN ONE POUR.



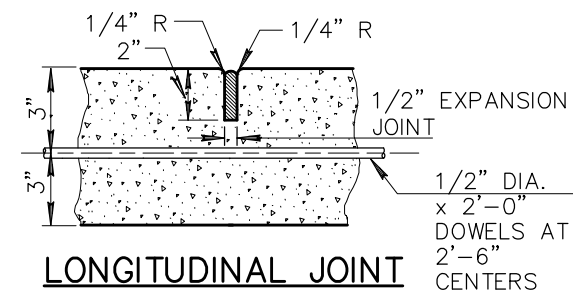
SECTION A-A



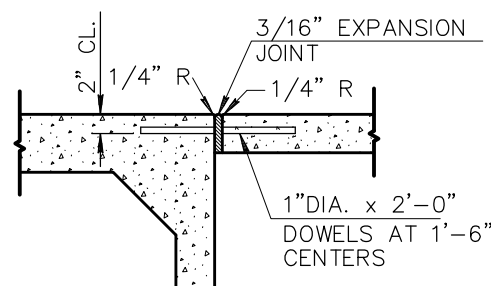
SECTION B-B



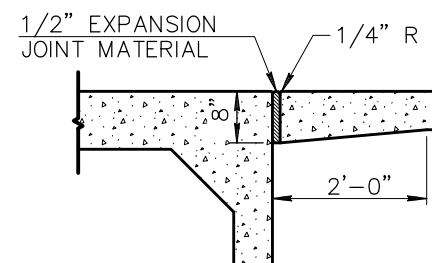
**LONGITUDINAL JOINT
DETAIL 'C'**



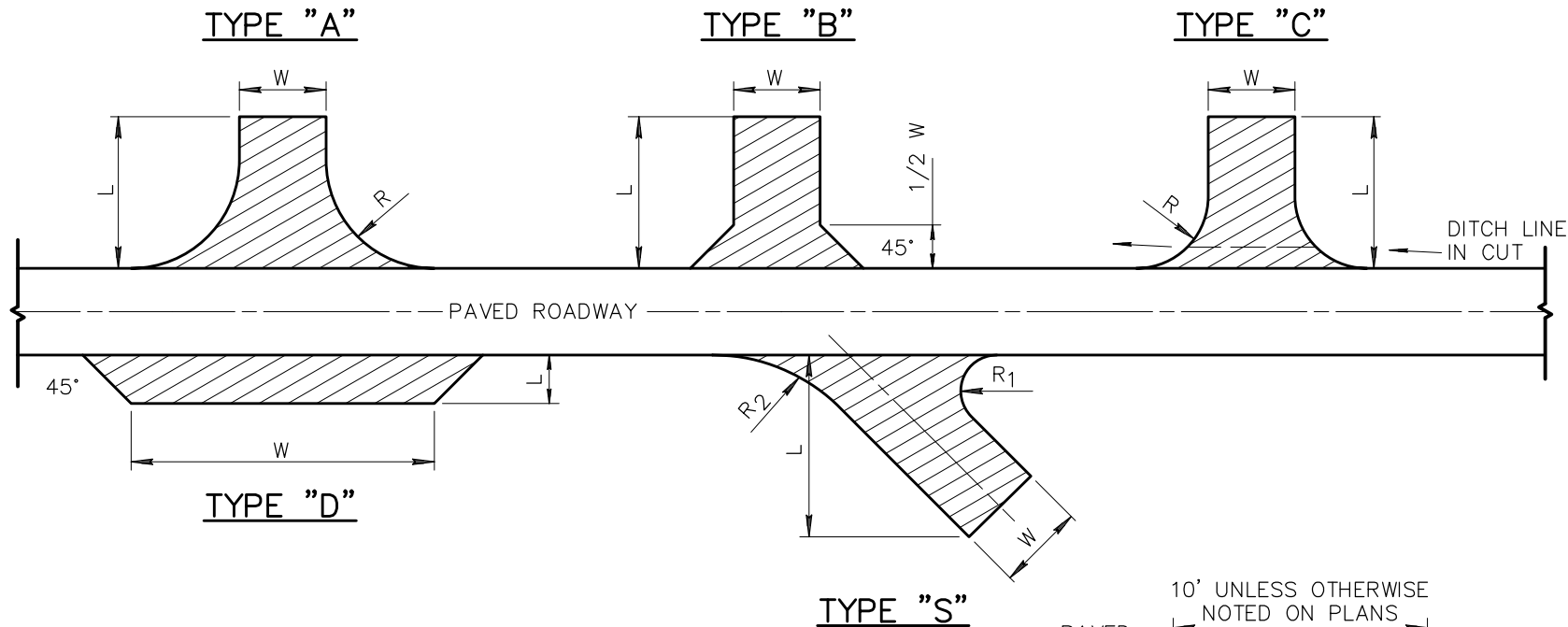
**LONGITUDINAL JOINT
DETAIL 'D'**



**JOINT AT NEW BRIDGE
DETAIL 'F'**

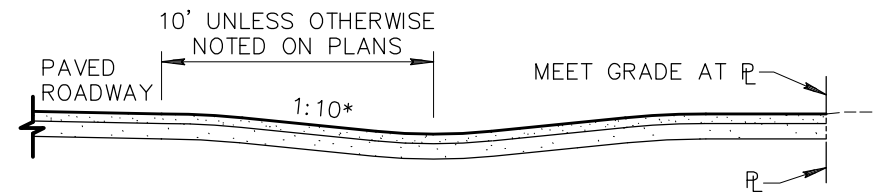


**JOINT AT EXISTING BRIDGE
DETAIL 'E'**



NOTES:

1. W - INDICATES WIDTH OF PAVED SURFACE OF TURNOUT.
L - INDICATES LENGTH OF PAVED SURFACE OF TURNOUT.
R - RADIUS.
2. SIZE AND TYPE OF TURNOUT SHALL BE NOTED ON PLANS AS FOLLOWS:
90° - NO RADIUS: WxL-SURFACE-TYPE; (12' x 30'-A.C.-TYPE "B" TURNOUT).
90° - WITH A RADIUS: WxLxR-SURFACE-TYPE; (12' x 20' x 15'-A.C.-TYPE "C" TURNOUT). OTHER THAN 90° WITH 2 RADII-TYPE "S": WxLxR₁xR₂-SURFACE-TYPE; (12' x 20' x 15'-A.C.-TYPE "S" TURNOUT).
OR IT MAY BE NOTED ON PLANS IN CONVENTIONAL TERMS.
3. TURNOUTS TO BE STRAIGHT TYPE UNLESS OTHERWISE NOTED ON PLANS.
4. A.C. AND BASE MATERIAL THICKNESS FOR TURNOUTS SHALL BE THE SAME AS SHOWN ON THE ROADWAY SECTION, UNLESS OTHERWISE NOTED.
5. ANY EXCAVATION OR EMBANKMENT FOR TURNOUTS IS INCLUDED IN THE ROADWAY QUANTITIES.
6. TURNOUTS ARE TO BE PLACED WHERE SHOWN ON PLANS, OR AS DIRECTED BY THE ENGINEER.



TYPICAL VALLEY GUTTER TURNOUT



TYPICAL STRAIGHT TURNOUT

* UNLESS OTHERWISE NOTED ON PLANS

DETAIL NO.

205



STANDARD DETAIL
ENGLISH

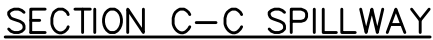
PAVED TURNOUTS

REVISED

01-01-2006

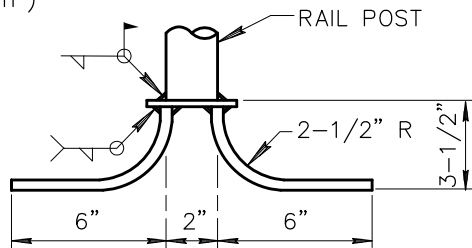
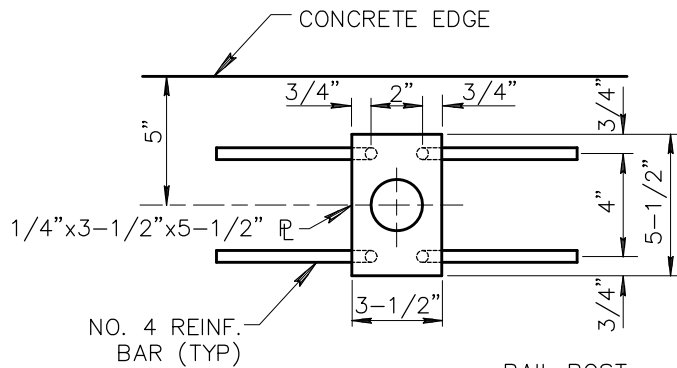
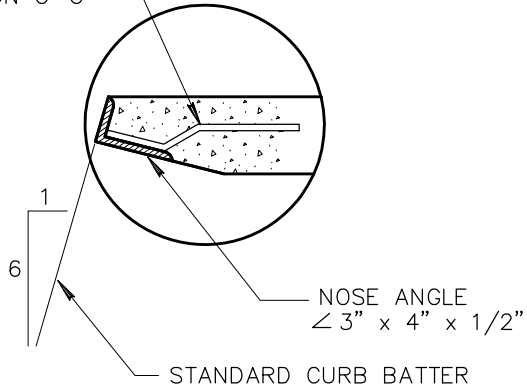
DETAIL NO.

205

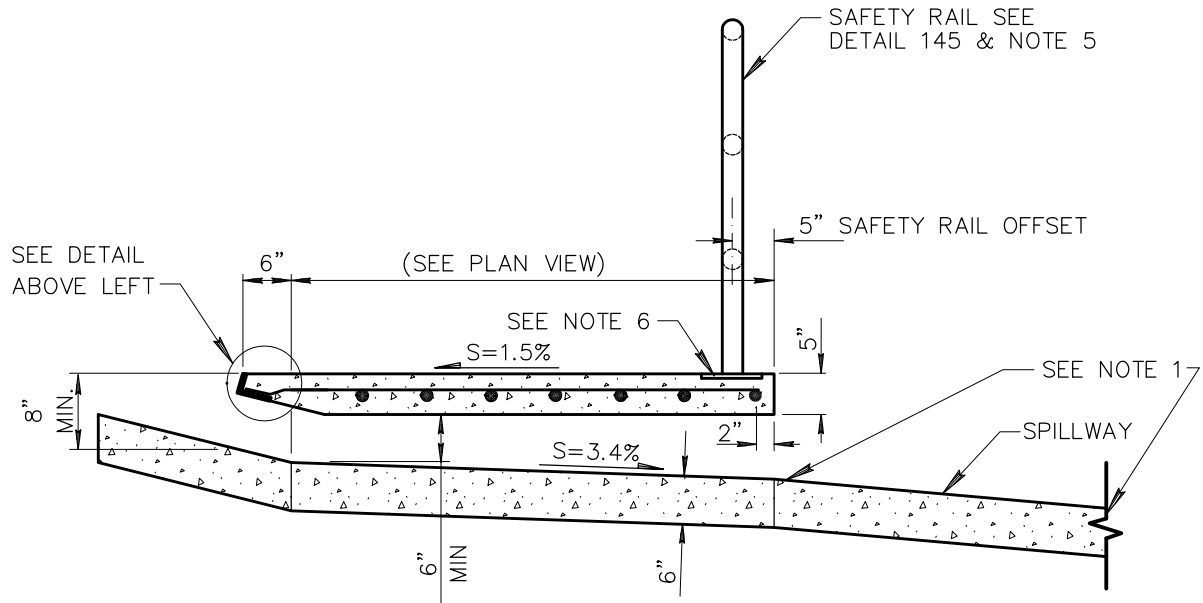


1. TRANSITION TO SPILLWAY/CHANNEL AS PER APPROVED PLANS.
2. A CENTER WALL SHALL BE INSTALLED IN SCUPPERS WIDER THAN 4' OR IF MORE THAN 1 SCUPPER IS BUILT IN SERIES.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, ASTM D-1751.
4. CONCRETE FOR THE SCUPPER SHALL BE CLASS 'A' PER SECTION 725. CONCRETE FOR THE SPILLWAY SHALL BE CLASS 'A' OR CLASS 'B'.
5. 12" OFFSET DISTANCE SHALL BE INCREASED TO 2'-6" FOR DESIGNATED BICYCLE PATHS.

NO. 4 REINFORCEMENT
WELDED TO ANGLE SEE
DETAIL 536-1,
SECTION C-C



WELD PLATE



SECTION D-D

NOTES:

1. TRANSITION TO SPILLWAY/CHANNEL AS PER APPROVED PLANS.
2. A CENTER WALL SHALL BE INSTALLED IN SCUPPERS WIDER THAN 4' OR IF MORE THAN 1 SCUPPER IS BUILT IN SERIES.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, ASTM D-1751.
4. CONCRETE FOR THE SCUPPER SHALL BE CLASS 'A', PER SECTION 725. CONCRETE FOR THE SPILLWAY SHALL BE CLASS 'A' OR CLASS 'B'.
5. SAFETY RAIL SHALL BE CONTINUOUS BETWEEN THE SPILLWAY EXTERIOR WALLS.
6. USE WELD PLATES FOR SAFETY RAIL ANCHORS LOCATED IN THE 5" THICK CONCRETE.

DETAIL NO.

206-2



STANDARD DETAIL
ENGLISH

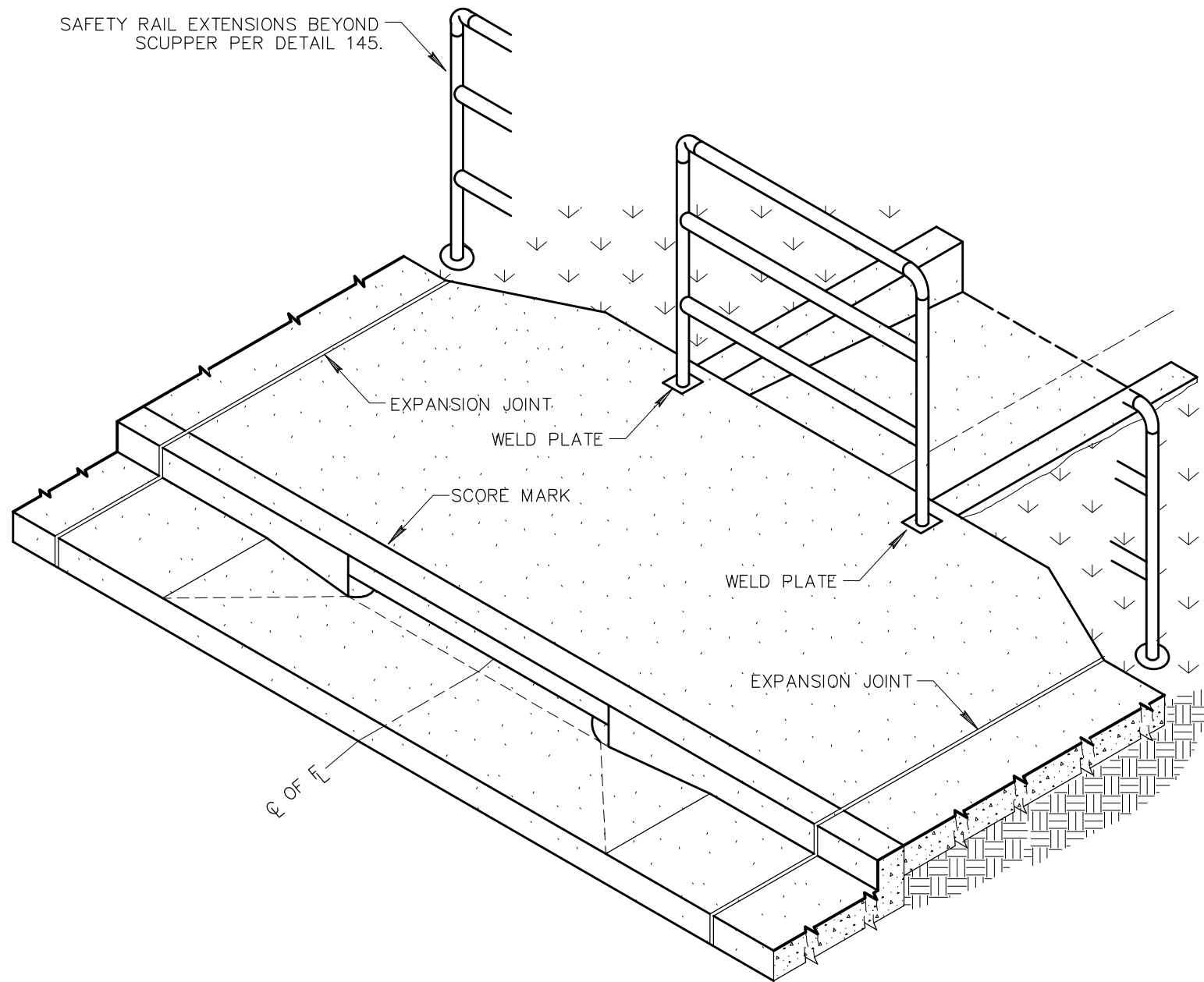
CONCRETE SCUPPER

REVISED

01-01-2007

DETAIL NO.

206-2



DETAIL NO.

206-3



STANDARD DETAIL
ENGLISH

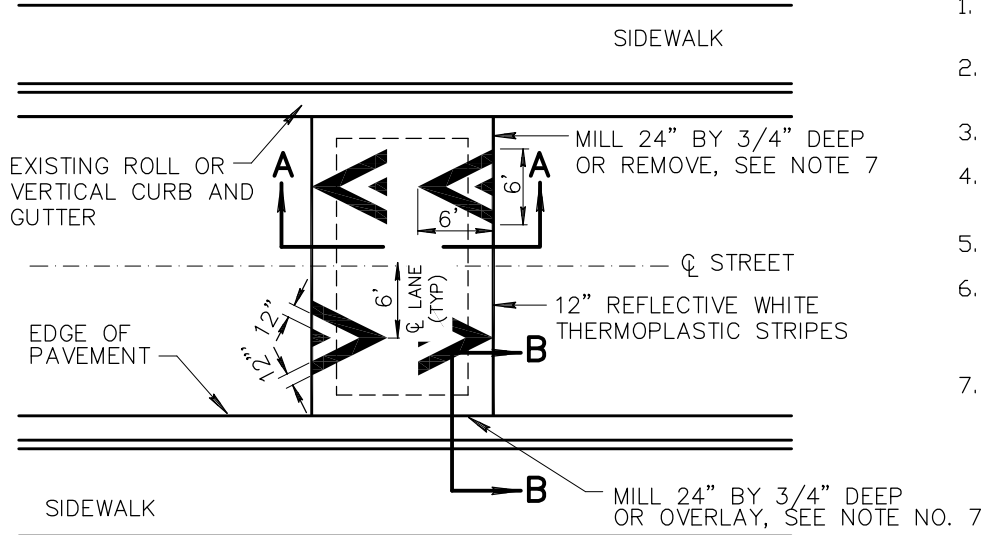
CONCRETE SCUPPER

REVISED

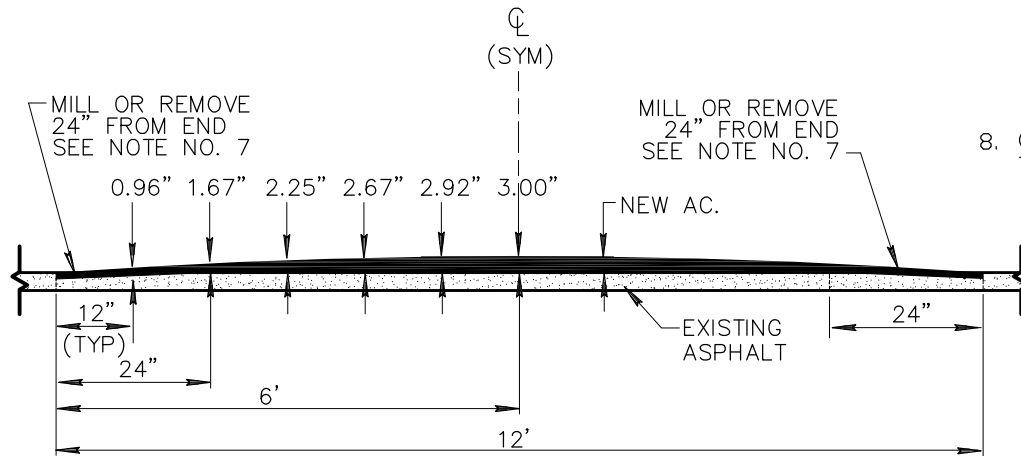
01-01-2007

DETAIL NO.

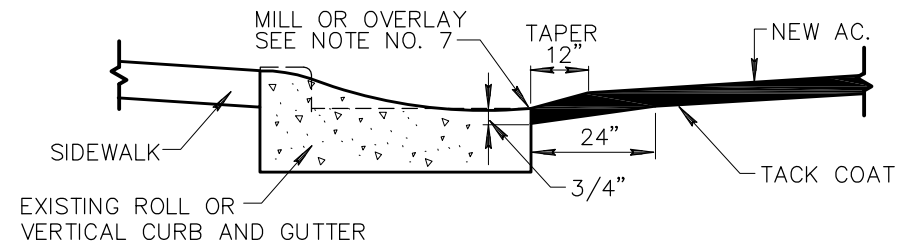
206-3



PLAN VIEW



SECTION A-A



SECTION B-B

NOTES:

1. HUMPS MUST BE THE FULL 3" FOR MAXIMUM EFFECT BUT SHALL NOT EXCEED 3.25".
2. HUMPS CONSTRUCTED OVER 3.25" OR LESS THAN 3.00" SHALL BE REMOVED AND REPLACED AT THE CONTRACTOR'S EXPENSE.
3. CROSS-SECTION ELEVATIONS SHALL HAVE A MAXIMUM TOLERANCE OF +0.25".
4. SPEED HUMPS SHALL NOT BE PLACED OVER MANHOLES, WATER VALVES, SURVEY MONUMENTS, JUNCTION CHAMBERS, ETC. OR IN CONFLICT WITH DRIVEWAYS.
5. SPEED HUMPS MUST BE PLACED AT LOCATIONS APPROVED BY THE AGENCY.
6. HUMP TO BE CONSTRUCTED WITH ASPHALT MIX APPROVED BY THE AGENCY. ASPHALT COMPACTION SHALL BE PER SECTION 321. A TACK COAT PER SECTION 713 SHALL BE APPLIED PRIOR TO APPLICATION OF PAVEMENT.
7. INSTALLATION JOINTS:
 - A. STANDARD INSTALLATION:
THE EXISTING ROADWAY SHALL BE MILLED TO A MINIMUM DEPTH OF 3/4" AROUND THE PERIMETER. CROSS SECTION DIMENSIONS DO NOT INCLUDE THE 3/4" MILLING. CONTRACTOR MUST PROVIDE VERIFICATION OF CROSS-SECTION DIMENSIONS.
 - B. ALTERNATIVE INSTALLATION:
FOR TRANSVERSE JOINTS (CROSS ROADWAY), THE EXISTING ASPHALT SHALL BE SAW CUT AND REMOVED FOR A WIDTH OF 24". THE ASPHALT SHALL BE REPLACED WITH THE SAME ASPHALT AND AT THE SAME TIME AS THE HUMP ASPHALT. FOR LONGITUDINAL JOINTS, THE EXISTING ASPHALT SHALL BE OVERLAID AND TAPERED IN 12". CROSS-SECTION DIMENSIONS REFLECT DISTANCES FROM THE SURFACE OF EXISTING ASPHALT.
8. CONTACT THE AGENCY (OR INSPECTOR) ONE WEEK PRIOR TO INSTALLATION TO COORDINATE PAVEMENT MARKINGS AND SIGNING.

DETAIL NO.

210



STANDARD DETAIL
ENGLISH

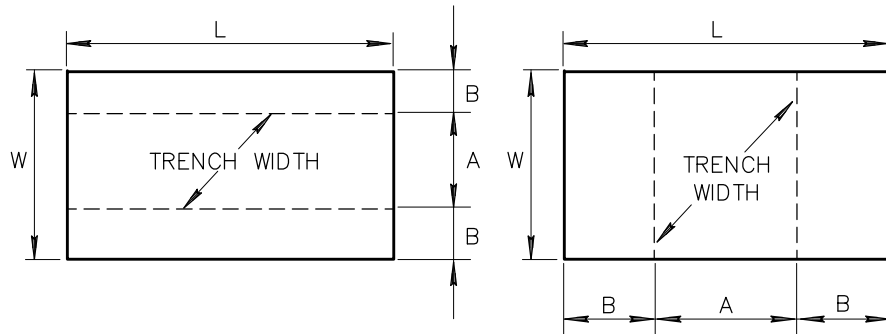
RESIDENTIAL SPEED HUMP

REVISED

01-01-2012

DETAIL NO.

210



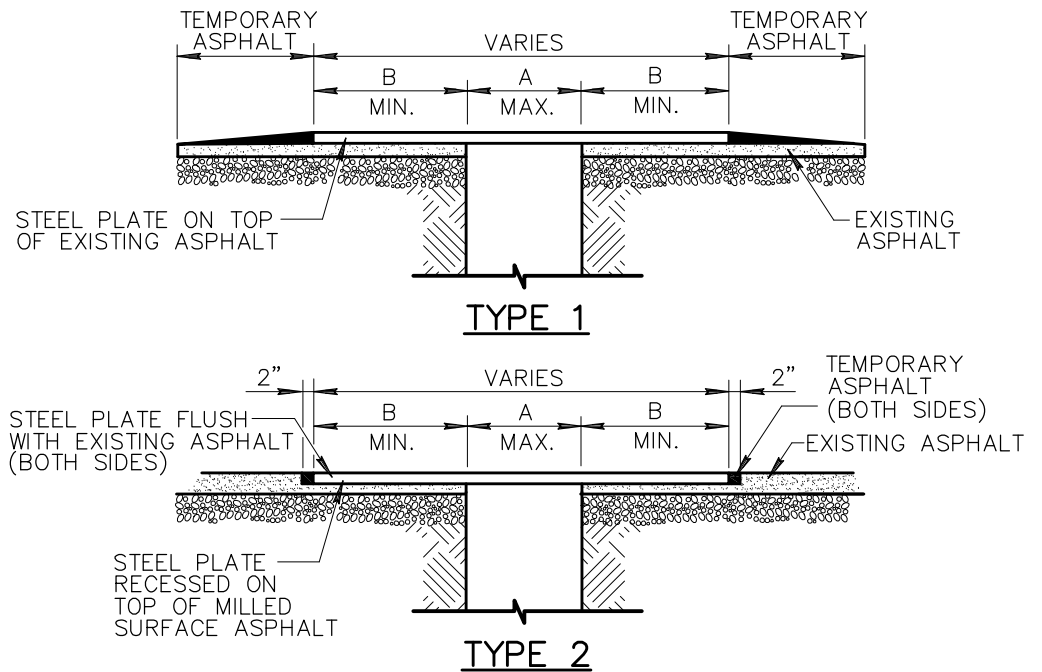
LONGITUDINAL
STEEL PLATE

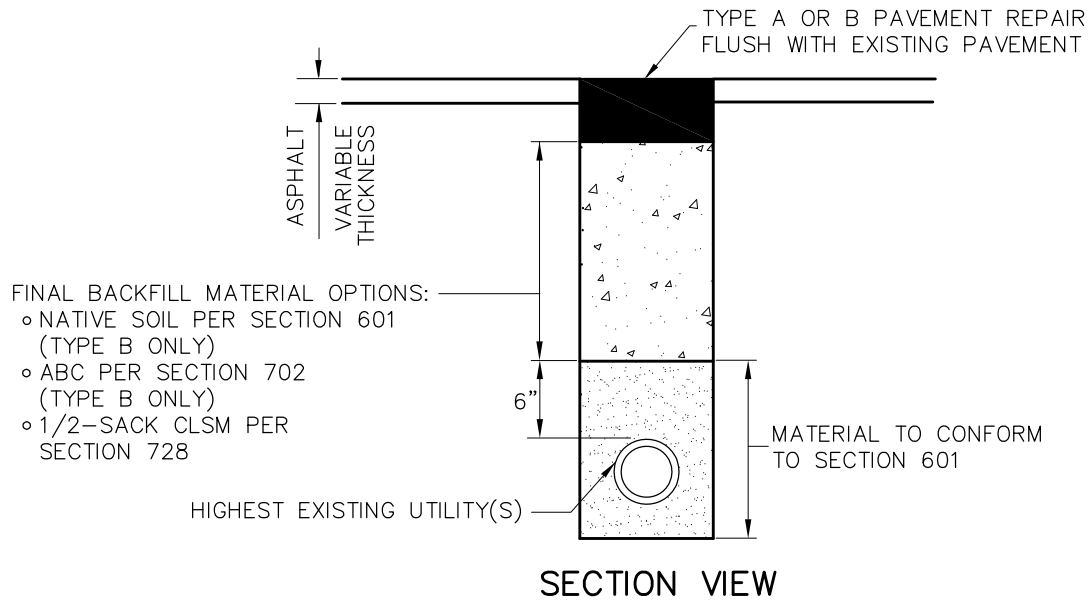
TRANSVERSE
STEEL PLATE

PLATE SIZE						
LONGITUDINAL					TRANSVERSE	
(A)	(B)	THICKNESS	(W)	(L)	(A)	(B)
12"	18"	1"	4'	8'	58"	19"
12"	18"	1"	4'	10'	58"	31"
24"	18"	1"	5'	10'	70"	25"
36"	18"	1"	6'	10'	44"	38"
48"	18"	1"	7'	10'	52"	34"
60"	18"	1"	8'	10'	58"	31"
12"	18"	1-1/4"	4'	15'	88"	47"
24"	18"	1-1/4"	5'	12'	104"	20"
36"	18"	1-1/4"	6'	12'	66"	39"
36"	18"	1-1/4"	6'	16'	66"	63"
48"	18"	1-1/4"	7'	12'	76"	33"
48"	18"	1-1/4"	7'	16'	76"	58"
60"	18"	1-1/4"	8'	12'	86"	29"
60"	18"	1-1/4"	8'	15'	86"	47"
60"	18"	1-1/4"	8'	16'	86"	63"
60"	18"	1-1/4"	8'	20'	86"	77"
60"	18"	1-3/8"	8'	20'	102"	69"

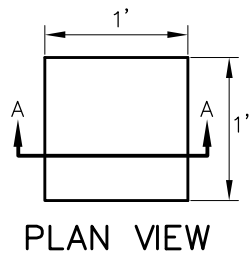
NOTES:

1. USE TYPE 1 PLATE INSTALLATION WHERE POSTED SPEED LIMIT IS LESS THAN 30 MPH. USE TYPE 2 PLATE INSTALLATION WHERE POSTED SPEED LIMIT IS 30 MPH OR GREATER.
2. FOR TYPE 2 PLATE INSTALLATION, THE STEEL PLATE SHALL BE RECESSED BY MILLING INTO THE EXISTING ASPHALT TO SET FLUSH WITH THE SURFACE OF THE EXISTING ASPHALT. FULL DEPTH CUTTING OF PAVEMENT SECTION OUTSIDE OF TRENCH IS NOT PERMITTED. MILLING DEPTH SHALL MATCH THICKNESS OF PLATE. THE GAP BETWEEN THE EDGE OF THE PLATE AND THE ADJACENT EXISTING ASPHALT PAVEMENT MUST BE FILLED WITH TEMPORARY ASPHALT.
3. TRENCH WIDTHS ARE BASED ON AN ANALYSIS PER THE 14TH EDITION OF STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES BY AASHTO. AN ASSUMED AXLE LOADING OF 12 TONS WITH A 30% IMPACT FACTOR WAS USED. THE AXLE LENGTH IS 6 FEET; THEREFORE THE NUMBER OF WHEELS CARRIED BY A PLATE DEPENDS ON THE ROADWAY WIDTH.
4. STEEL PLATE MUST BE ABLE TO WITHSTAND H-20 TRAFFIC LOADINGS WITHOUT ANY MOVEMENT.
5. PLATES SHALL BE FABRICATED FROM ASTM A36 STEEL (MIN).
6. PLATES SHALL BE SECURED FROM LATERAL MOVEMENT AND VERTICAL VIBRATION (ASSOCIATED NOISE) WHILE IN USE BY TEMPORARY ASPHALT (COLD MIX.)

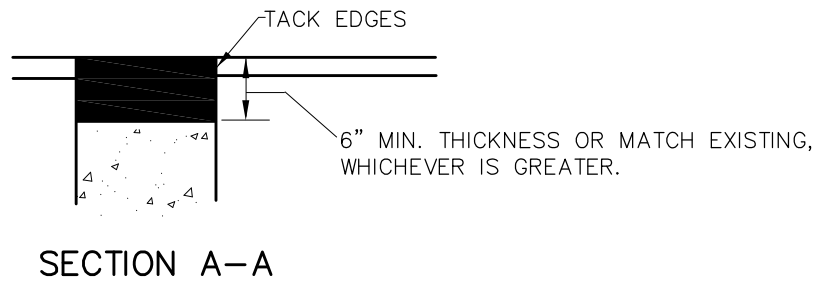




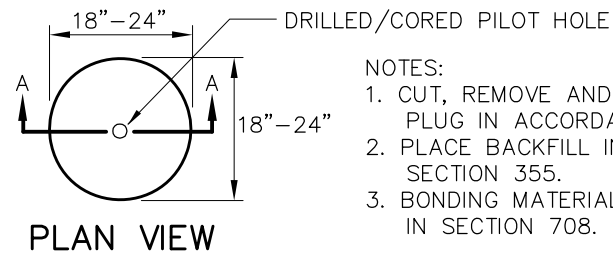
TYPE A PAVEMENT REPAIR



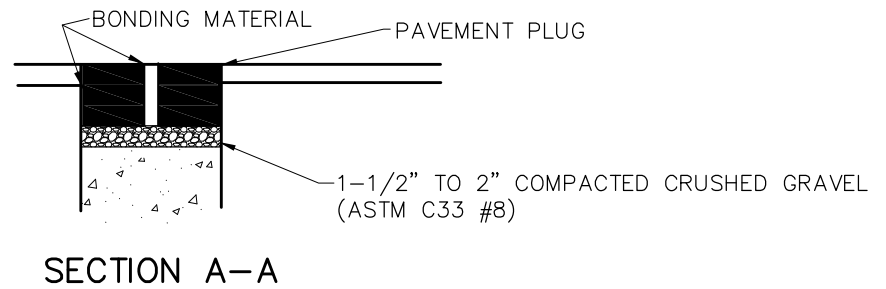
- NOTES:
1. DIMENSIONS ARE NOMINAL.
 2. EDGES SHALL BE CUT TO A NEAT VERTICAL FACE.
 3. PLACE CLSM BACKFILL IN ACCORDANCE WITH SECTION 604.
 4. PLACE AGENCY-APPROVED ASPHALT CONCRETE IN MAXIMUM 2" LIFTS.



TYPE B PAVEMENT REPAIR



- NOTES:
1. CUT, REMOVE AND REPLACE PAVEMENT. PLUG IN ACCORDANCE WITH SECTION 355.
 2. PLACE BACKFILL IN ACCORDANCE WITH SECTION 355.
 3. BONDING MATERIAL SHALL BE AS SPECIFIED IN SECTION 708.



DETAIL NO.

212



STANDARD DETAIL
ENGLISH

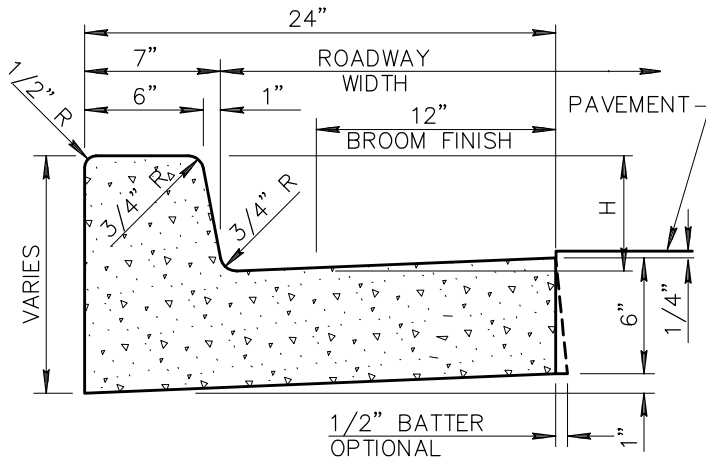
UTILITY POTHOLE REPAIR

REVISED

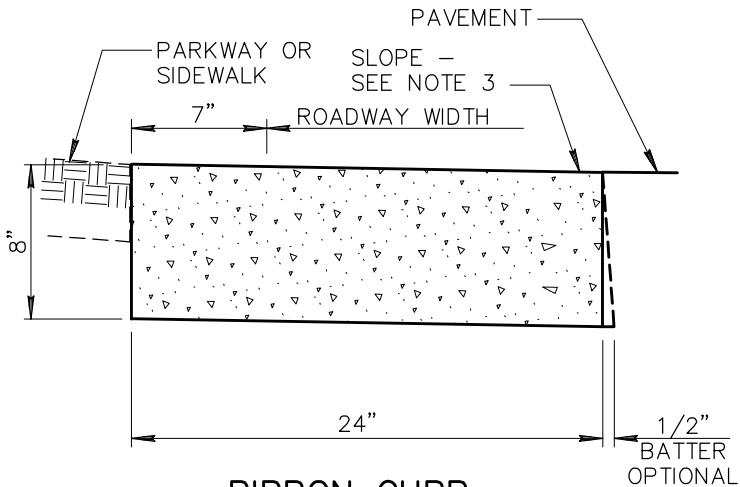
01-01-2015

DETAIL NO.

212



**VERTICAL CURB AND GUTTER
(TYPE A)**



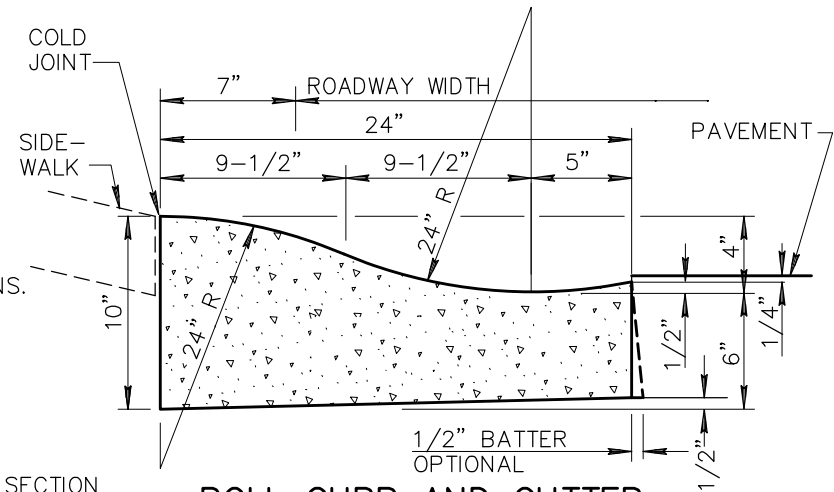
**RIBBON CURB
(TYPE B)**

NOTES: (TYPE A)

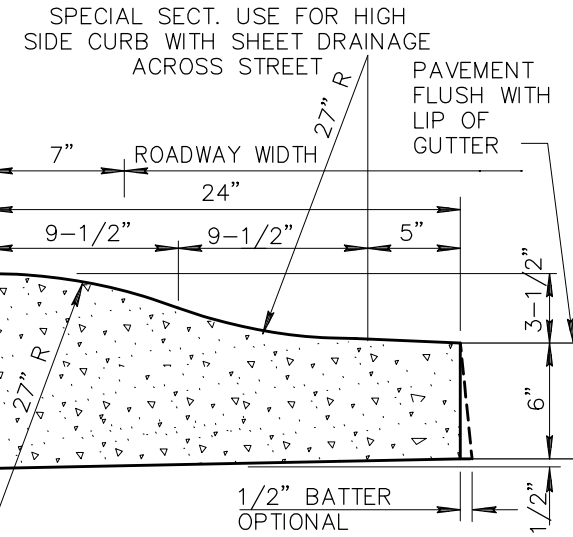
1. ALL EXPOSED SURFACES TO BE TROWEL FINISHED EXCEPT AS SHOWN. SEE SECT. 340.
2. H=6" OR AS SPECIFIED ON PLANS.
3. CONTRACTION JOINT SPACING 10' MAXIMUM.
4. EXPANSION JOINTS AS PER SECT. 340.
5. CLASS 'B' CONCRETE PER 725.
6. WHEN THE ADJACENT PAVEMENT SECTION SLOPES AWAY FROM THE GUTTER, THE SLOPE OF THE GUTTER PAN SHALL MATCH PAVEMENT CROSS SLOPE.

NOTES: (TYPE B)

1. CONSTRUCT CURB AND INSTALL 1/2" MASTIC EXPANSION JOINTS, A.S.T.M. D-1751. SECT. 340.
2. BROOM FINISH ALL SURFACES.
3. RIBBON CURB MAY SLOPE TOWARDS PAVEMENT OR PARKWAY AS INDICATED ON PLANS.
4. CONTRACTION JOINT SPACING 10' MAXIMUM.
5. CONCRETE SHALL BE CLASS 'B' PER SECT. 725 AND INSTALLED PER SECT. 505.



**ROLL CURB AND GUTTER
(TYPE C)**



(TYPE D)

NOTES: (C & D)

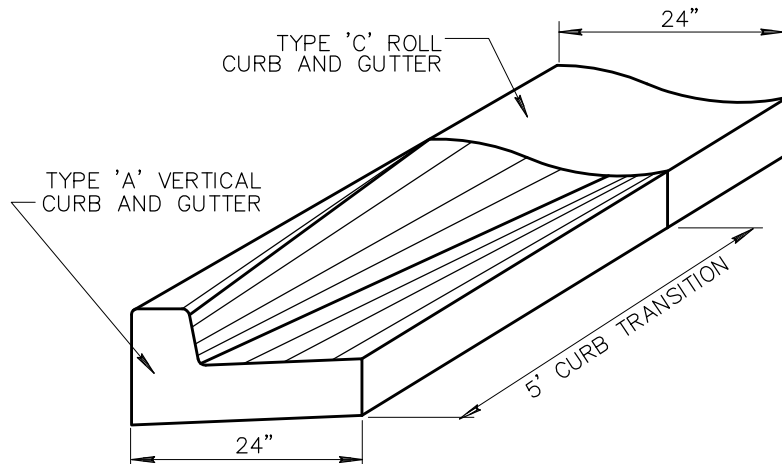
1. ALL WORK AND MATERIALS SHALL CONFORM TO SECT. 304, 505 AND 725. BROOM FINISH TO EXPOSED SURFACE.
2. CONTRACTION JOINT SPACING 10' MAXIMUM.
3. EXPANSION JOINTS AS PER SECT. 340.
4. CLASS 'B' CONCRETE PER 725.



NOTES: (E & F)

1. ALL EXPOSED SURFACES TO BE TROWEL FINISHED EXCEPT AS SHOWN. SEE SECT. 340.
2. CONTRACTION JOINT SPACING 10' MAXIMUM.
3. EXPANSION JOINTS PER SECT. 340.
4. CLASS 'B' CONCRETE PER SECT. 725.
5. WHEN THE ADJACENT PAVEMENT SECTION SLOPES AWAY FROM THE GUTTER, THE SLOPE OF THE GUTTER PAN SHALL MATCH THE PAVEMENT CROSS SLOPE.

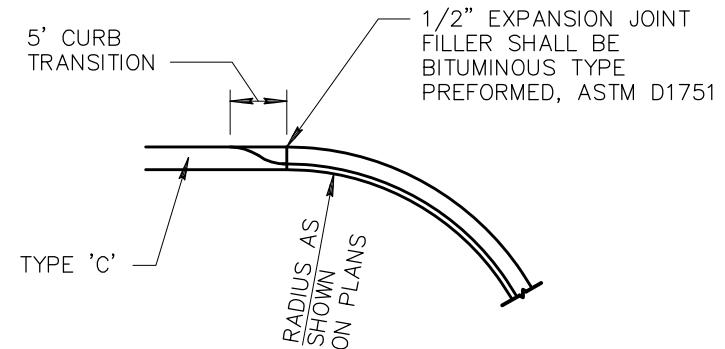
CURB TRANSITION TYPE 'A' TO TYPE 'C'



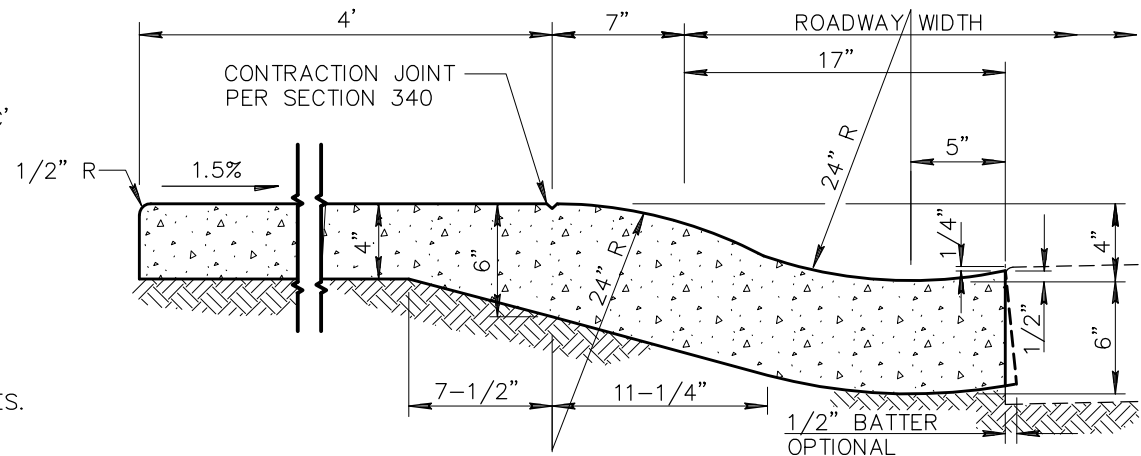
NOTES: (CURB AND GUTTER TRANSITIONS)

1. TRANSITIONS WILL BE PAID FOR AS THE PREDOMINANT TYPE OF CURB AND GUTTER BEING TRANSITIONED. WHEN TYPE 'A' CURB AND GUTTER ARE USED AT CURB RETURNS AND TYPE 'C' CURB AND GUTTER IS PREDOMINANTLY USED ELSEWHERE, THE TYPE 'A' TO TYPE 'C' TRANSITIONS SHALL BE MEASURED AND PAID FOR AS TYPE 'C' CURB AND GUTTER.
2. WHERE PROPOSED CONSTRUCTION IS TO BE CONNECTED TO EXISTING CURB AND GUTTER, THE TRANSITION SHALL BE INDICATED ON PLANS.
3. CLASS 'B' CONCRETE PER SECTION 725.
4. TRANSITION BETWEEN TYPICAL SECTIONS SHALL BE ACCOMPLISHED BY THE USE OF DIRECT STRAIGHT LINE TRANSITIONS OF THE FLOW LINE AND OTHER SURFACE FEATURES.

CURB AND GUTTER TRANSITION



INTEGRAL ROLL CURB, GUTTER AND SIDEWALK



NOTES: (INTEGRAL ROLL CURB, GUTTER AND SIDEWALK)

1. CONCRETE TO BE MONOLITHIC POUR. EXPOSED SURFACE FINISH AS PER SIDEWALK AND GUTTER DETAIL.
2. CONTRACTION JOINT SPACING 5' MAXIMUM.
3. EXPANSION JOINTS PER SECTION 340.
4. CLASS 'B' CONCRETE PER SECTION 725.

DETAIL NO.

221



STANDARD DETAIL
ENGLISH

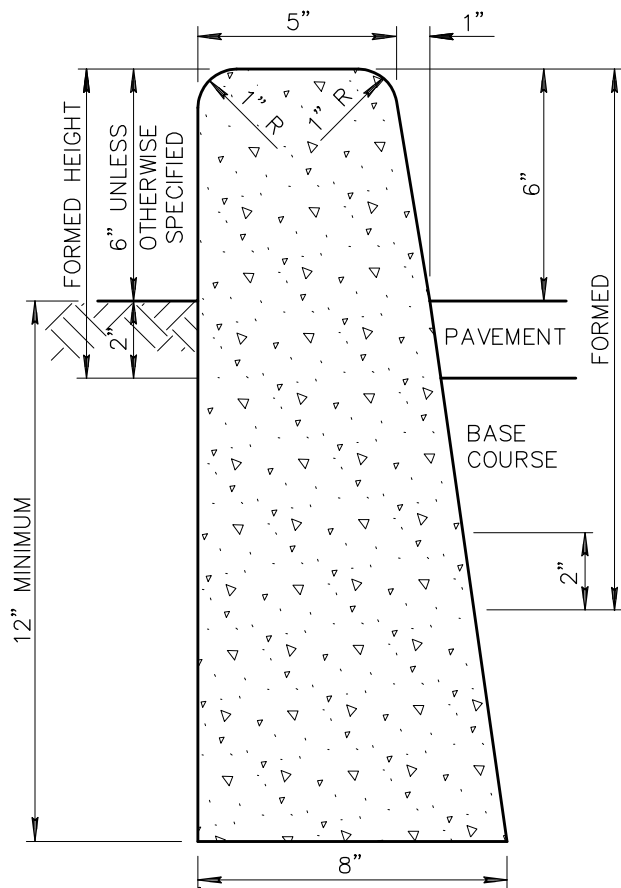
CURB AND GUTTER TRANSITION TYPE A TO TYPE C
INTEGRAL ROLL CURB, GUTTER AND SIDEWALK

REVISED

01-01-2014

DETAIL NO.

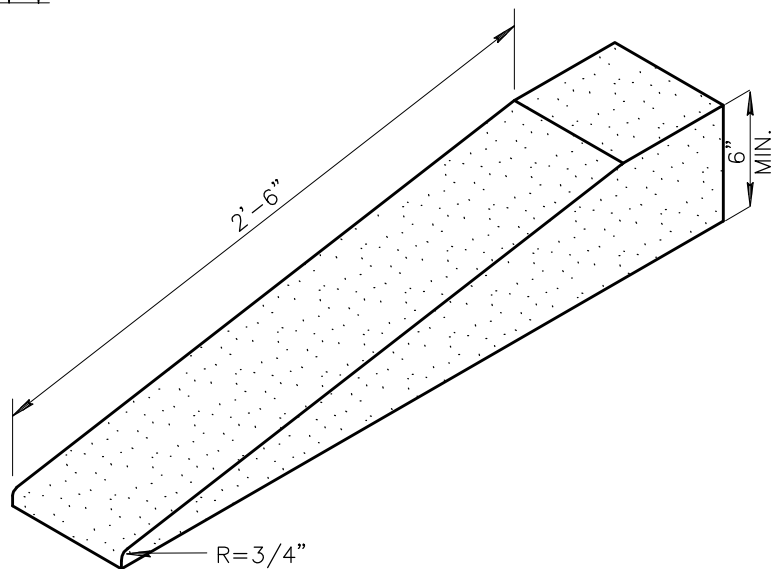
221



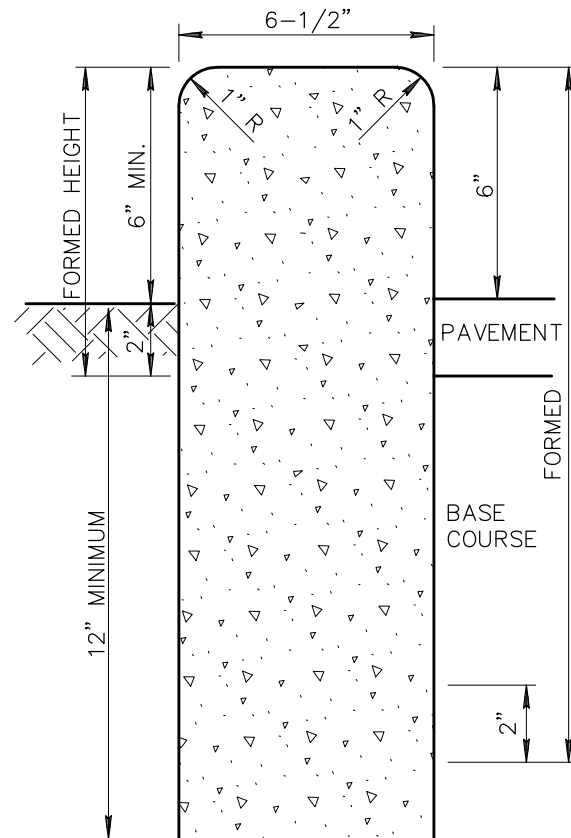
TYPE 'A'

NOTES:

1. ALL VERTICAL SURFACES TO BE FORMED.
2. VERTICAL SURFACES DOWN FROM 2" BELOW UNDISTURBED SOIL MAY BE PLACED AGAINST NEAT CUT IF APPROVED BY THE ENGINEER AND CONCRETE WILL NOT EXTEND MORE THAN 1" BEYOND THEORETICAL FACE.
3. ALL EXPOSED SURFACES TO BE STRIPPED GREEN AND TROWEL FINISHED.
4. CONCRETE CURBS CONFORM TO SECT. 340.
5. MAXIMUM SPACING OF CONTRACTION JOINTS IS 10'.
6. CONCRETE TO BE CLASS 'B' PER SECT. 725.
7. WHEN PAVEMENT AND BASE COURSE EQUALS OR EXCEEDS 10" IN DEPTH, THE ENTIRE ROADWAY SIDE OF THE CURB SHALL BE FORMED. THE TOTAL CURB HEIGHT REMAINS 18" UNLESS NOTED OTHERWISE.



TYPICAL CURB TERMINATION



TYPE 'B'

DETAIL NO.

222



STANDARD DETAIL
ENGLISH

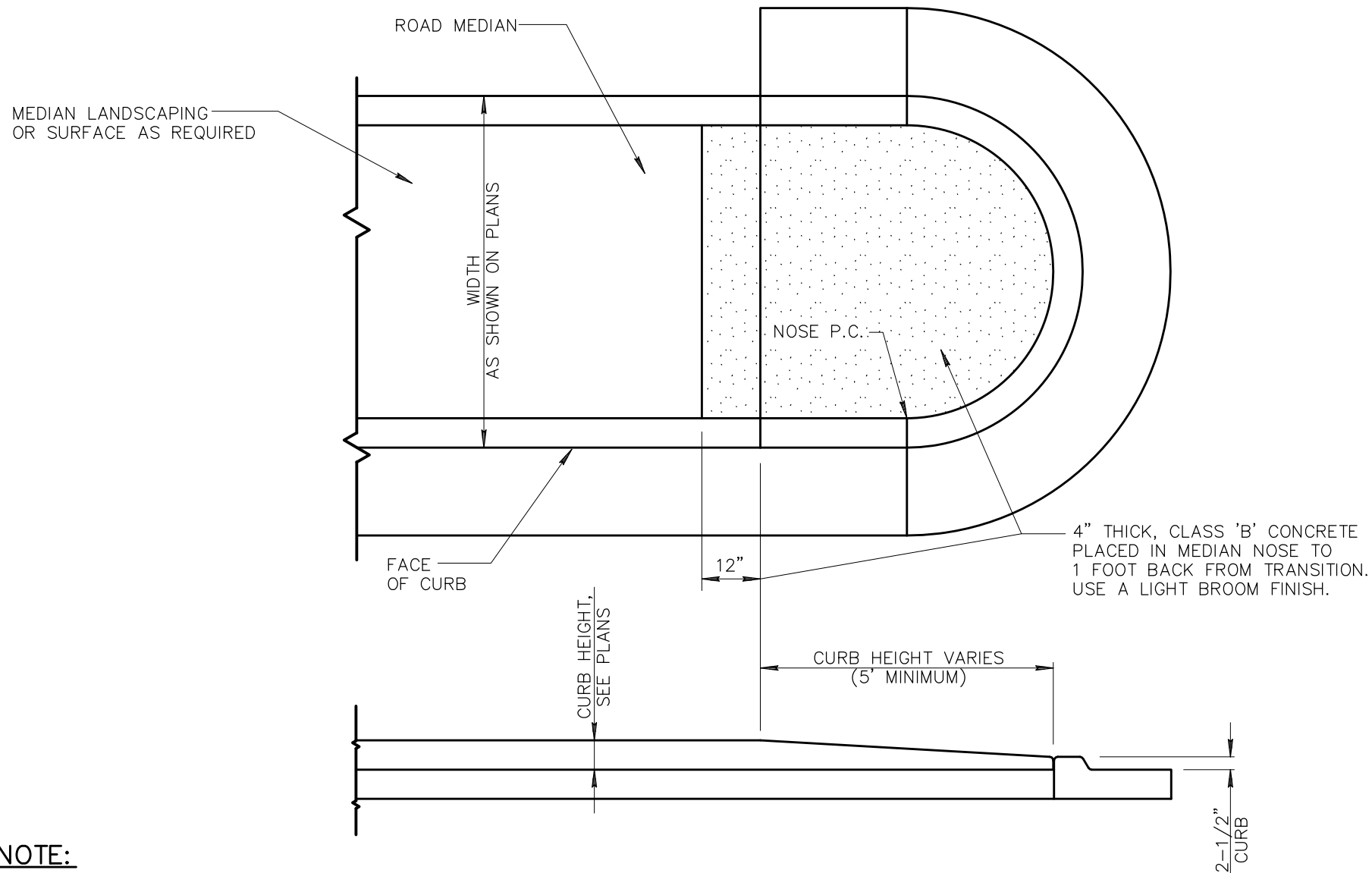
**SINGLE CURB –
TYPES A, B AND TERMINATION**

REVISED

01-01-2008

DETAIL NO.

222



NOTE:

LENGTH OF TRANSITION SHALL BE
EQUAL TO RADIUS OF MEDIAN NOSE,
(5' MINIMUM). FOR LOCATION
SEE PLANS.

DETAIL NO.

223



STANDARD DETAIL
ENGLISH

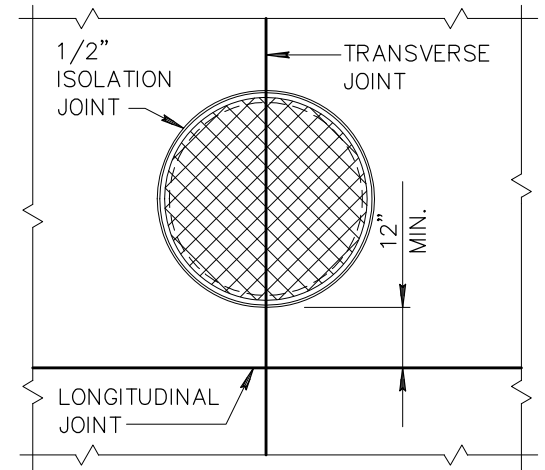
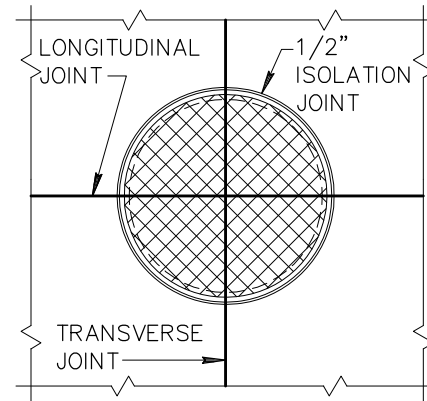
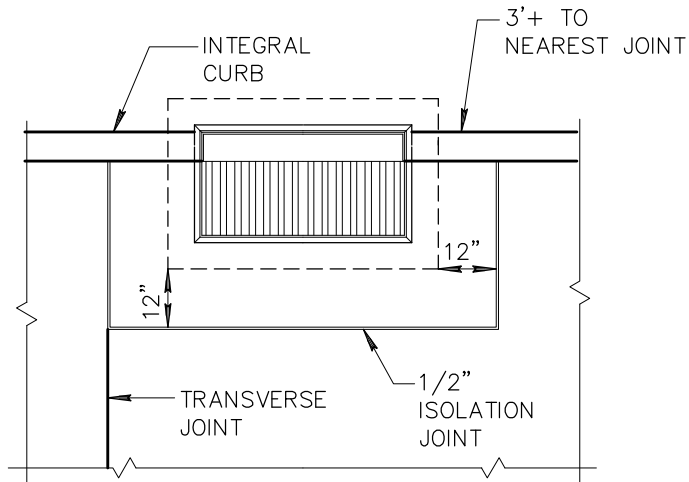
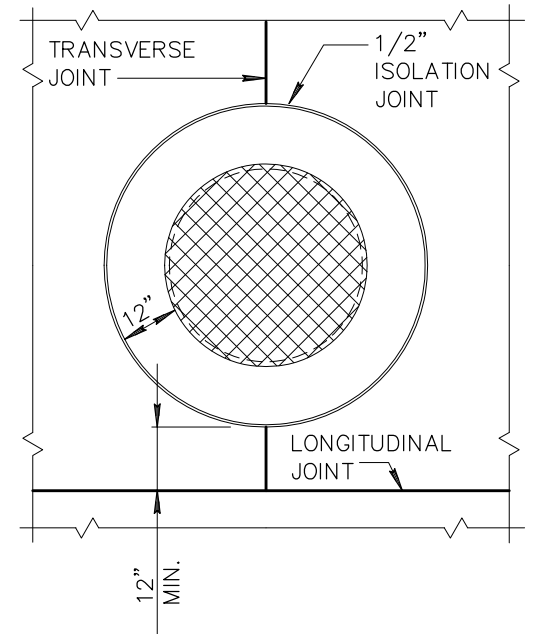
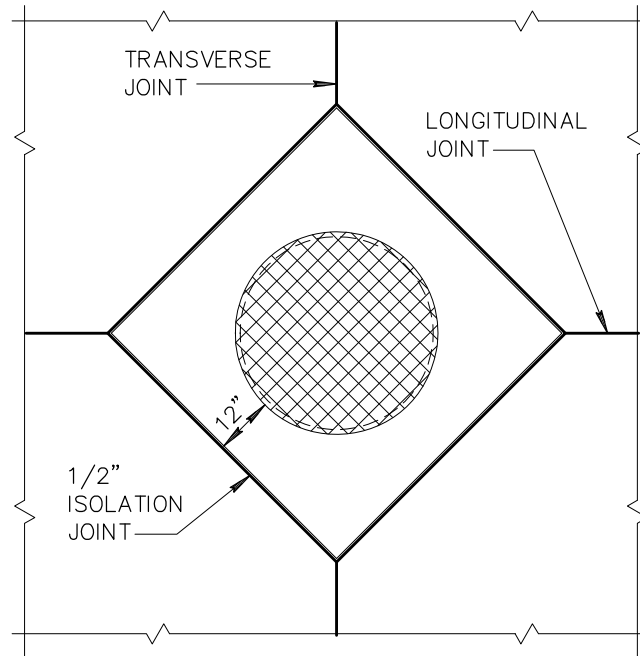
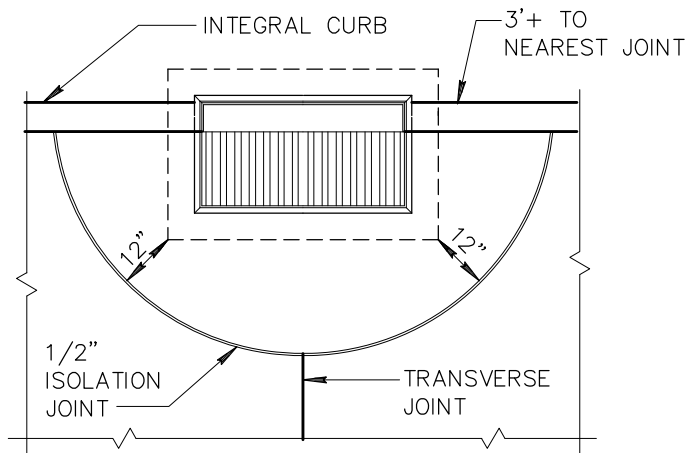
MEDIAN NOSE TRANSITION

REVISED

01-01-1998

DETAIL NO.

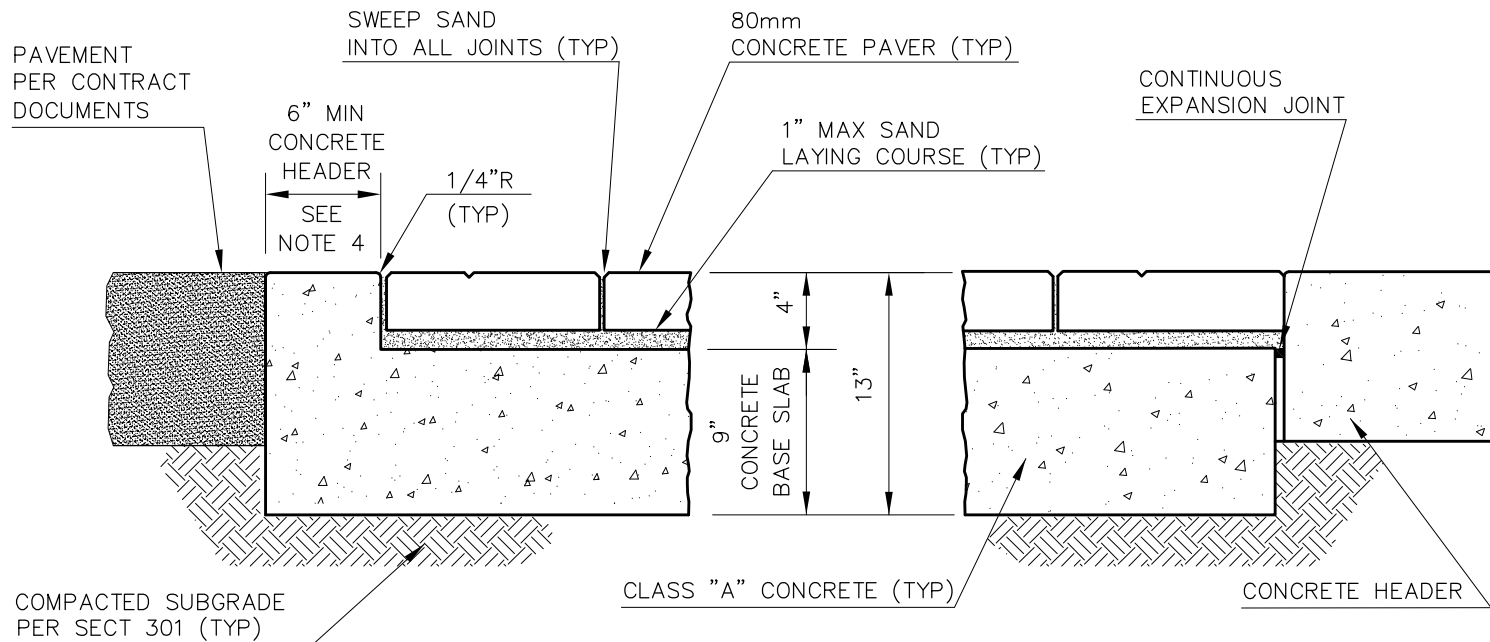
223



DRAINAGE INLET

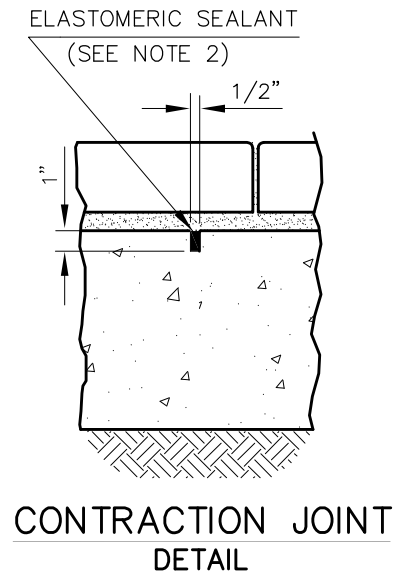
MANHOLE COVERS

MANHOLE COVERS



**TYPICAL SECTION
(AGAINST PAVEMENT)**

**TYPICAL AT END OR ALTERNATE SECTION
(AGAINST CONCRETE)**

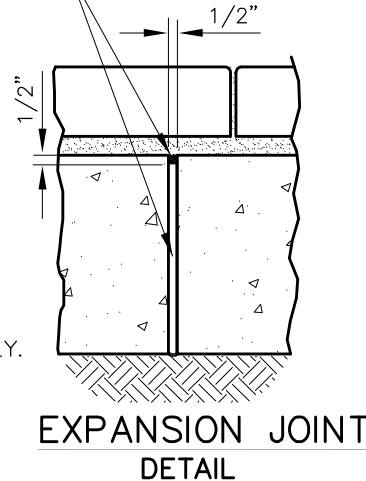


**CONTRACTION JOINT
DETAIL**

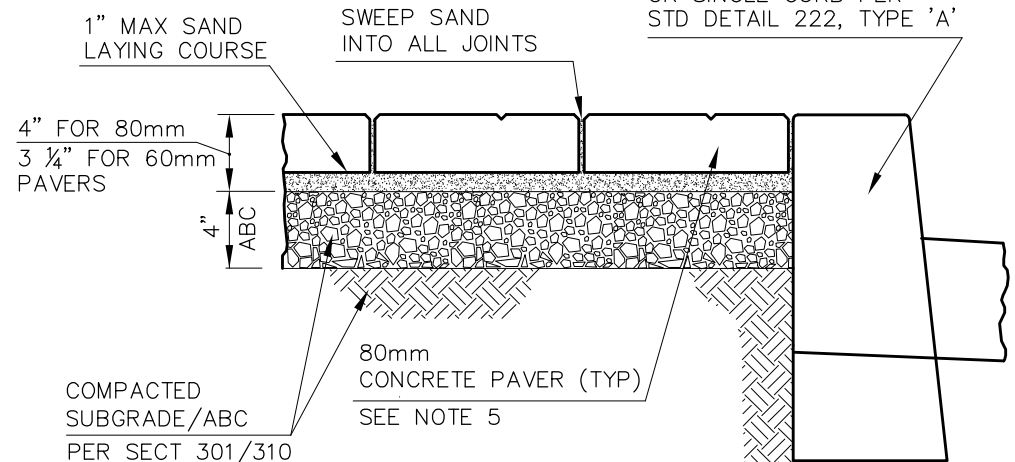
NOTES:

1. EXPANSION JOINTS PER SECT 342, EVERY 50'.
2. CONTRACTION JOINTS PER SECT 342, EVERY 10'.
3. MATERIALS AND CONSTRUCTION PER SECT 342.
4. HEADERS SHALL BE 12" AT CROSSWALKS.
5. 60mm PAVERS MAY BE ACCEPTED WITH AGENCY APPROVAL IN NON TRAFFIC AREAS ONLY.

ELASTOMERIC SEALANT
AND EXPANSION JOINT FILLER
(SEE NOTE 1)



**EXPANSION JOINT
DETAIL**



**TYPICAL SECTION
(RAISED MEDIAN)**

DETAIL NO.

225



STANDARD DETAIL
ENGLISH

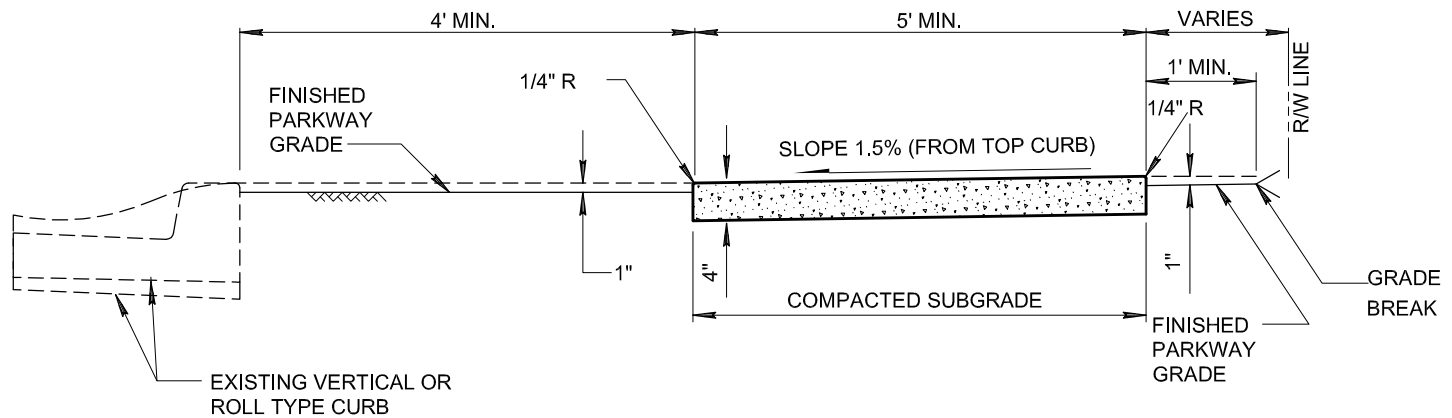
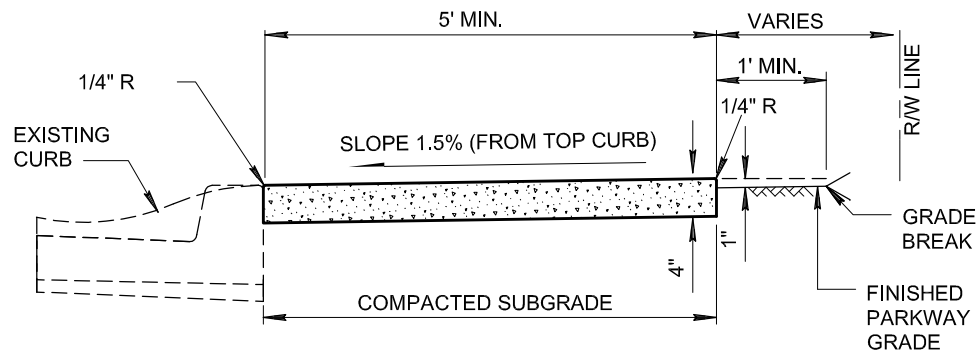
INTERLOCKING CONCRETE PAVERS

REVISED

01-01-2016

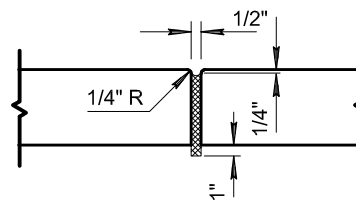
DETAIL NO.

225

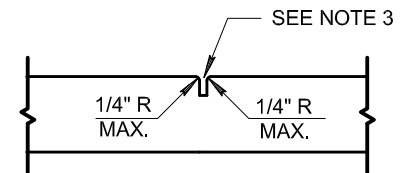


NOTES:

1. SIDEWALK CONSTRUCTION SHALL CONFORM TO SECTION 340.
2. EXPANSION JOINTS SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, PER SECTION 729.
3. LARGE AGGREGATE, IN CONTRACTION JOINT SHALL BE SEPARATED TO A DEPTH OF 1", FINISH DEPTH SHALL BE A MINIMUM OF 3/4".
4. EXPANSION JOINTS SHALL CONFORM TO SECTION 340, BE INSTALLED PRIOR TO CONCRETE PLACEMENT, AND AT A MAXIMUM SPACING OF 50'.
5. CONCRETE SHALL BE CLASS 'B' PER SECTION 725.
6. WHEN SIDEWALK AND ADJACENT CURB ARE CONSTRUCTED MONOLITHICALLY, ALL EXPANSION AND CONTRACTION JOINTS SHALL EXTEND ACROSS THE CURB.



EXPANSION JOINT



CONTRACTION JOINT

DETAIL NO.

230



STANDARD DETAIL
ENGLISH

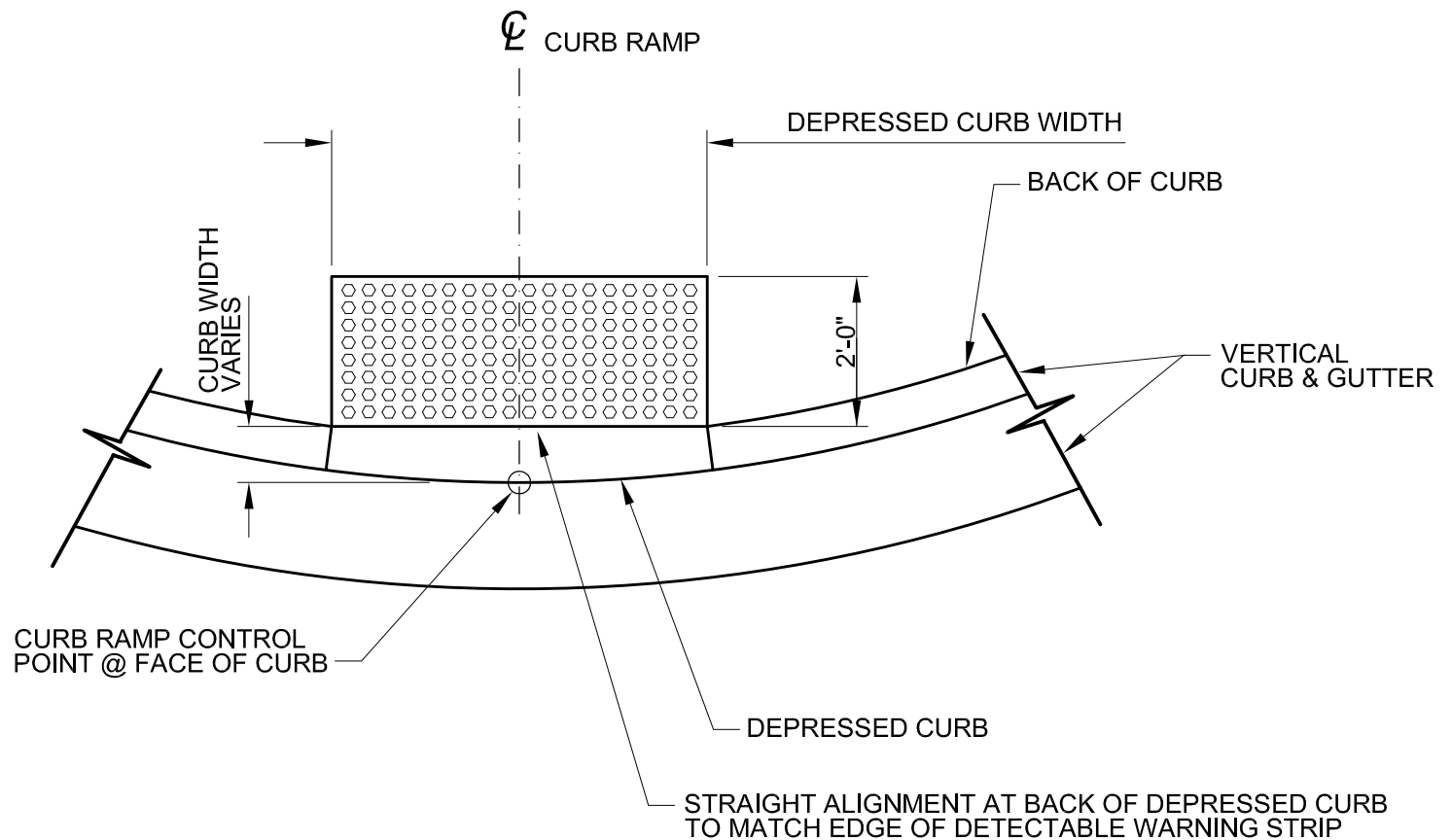
SIDEWALKS

REVISED

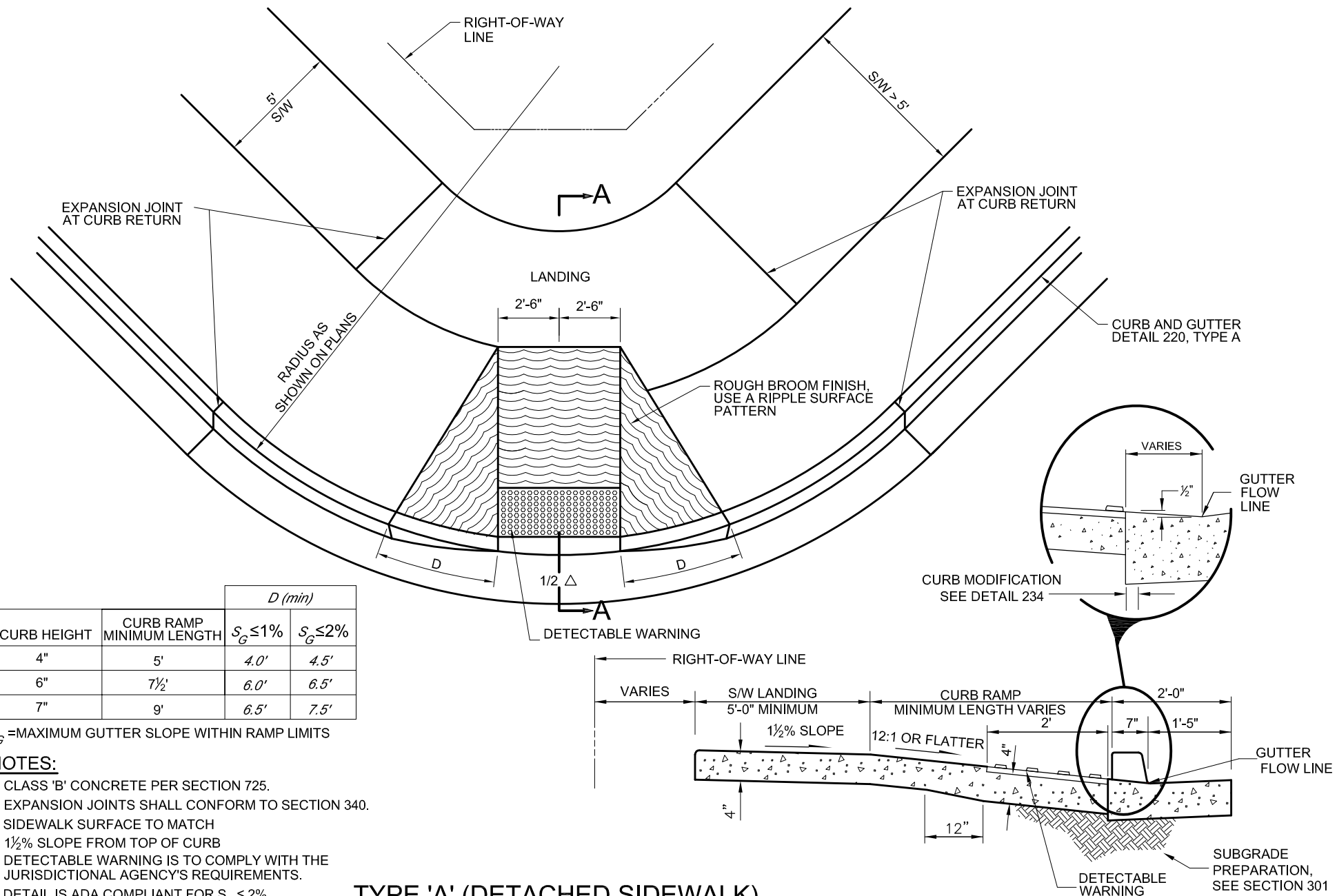
01-01-2014

DETAIL NO.

230



PLAN VIEW



TYPE 'A' (DETACHED SIDEWALK)

SECTION A-A

DETAIL NO.

235-1



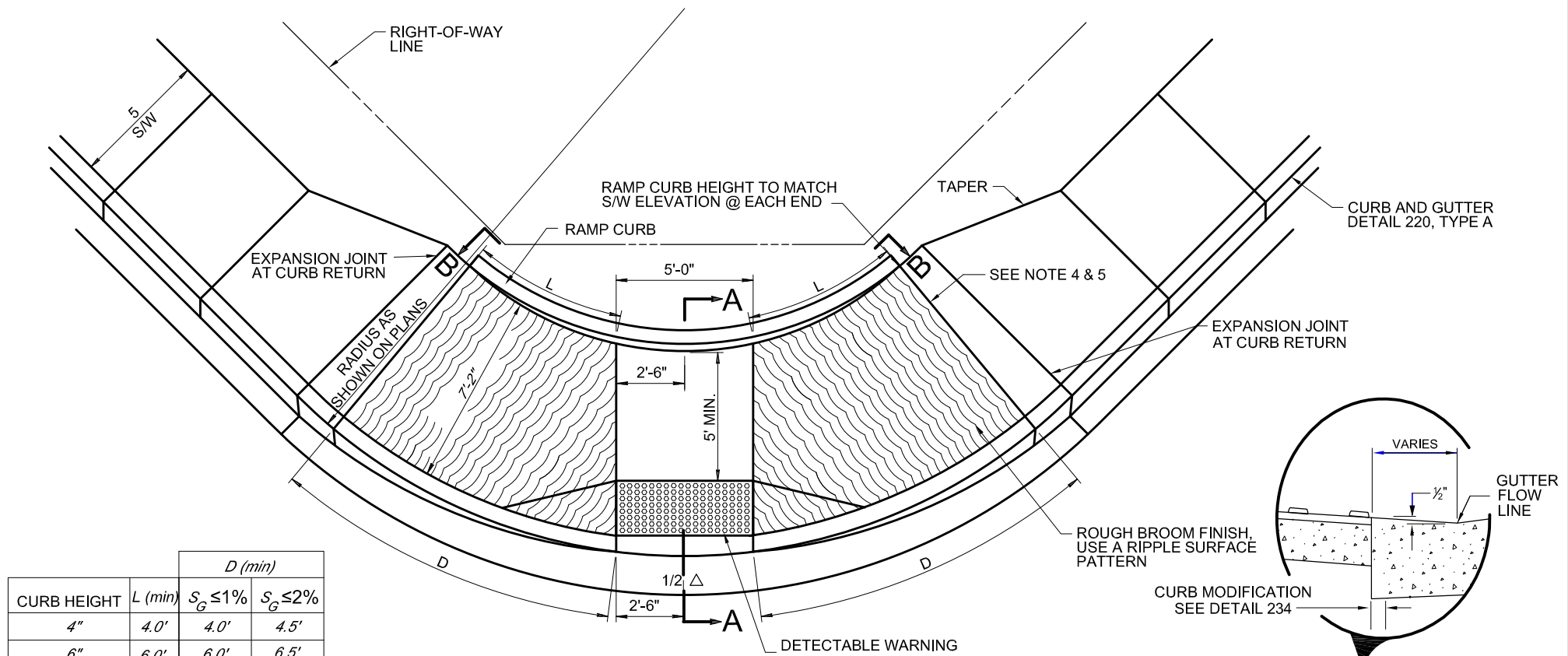
STANDARD DETAIL
ENGLISH

CURB RAMPS

REVISED
01-01-2012

DETAIL NO.

235-1

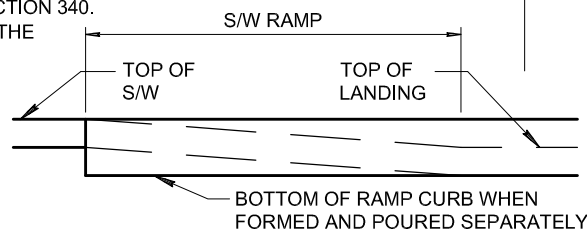


CURB HEIGHT	L (min)	D (min)	
		$S_G \leq 1\%$	$S_G \leq 2\%$
4"	4.0'	4.0'	4.5'
6"	6.0'	6.0'	6.5'
7"	7.0'	6.5'	7.5'

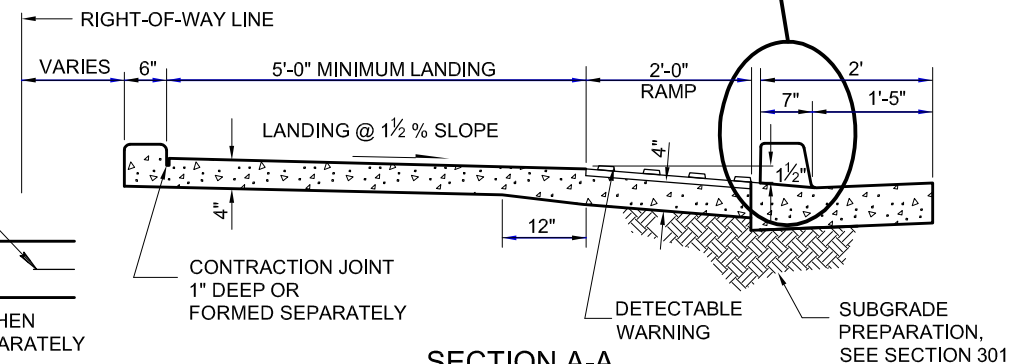
S_G = MAXIMUM GUTTER SLOPE WITHIN RAMP LIMITS

NOTES:

1. CLASS 'B' CONCRETE PER SECTION 725.
2. EXPANSION JOINTS SHALL CONFORM TO SECTION 340.
3. DETECTABLE WARNING IS TO COMPLY WITH THE JURISDICTIONAL AGENCY'S REQUIREMENTS.
4. INCREASE 'L' OR 'D' AS NEEDED TO HAVE THE TOP OF RAMP FORM A RADIAL LINE.
5. WHEN TOP OF RAMP IS LESS THAN 4' FROM CURB RETURN, EXTEND RAMP TO THE CURB RETURN.
6. DETAIL IS ADA COMPLIANT FOR $S_G \leq 2\%$.



SECTION B-B



TYPE 'B'

SECTION A-A

DETAIL NO.

235-2



STANDARD DETAIL
ENGLISH

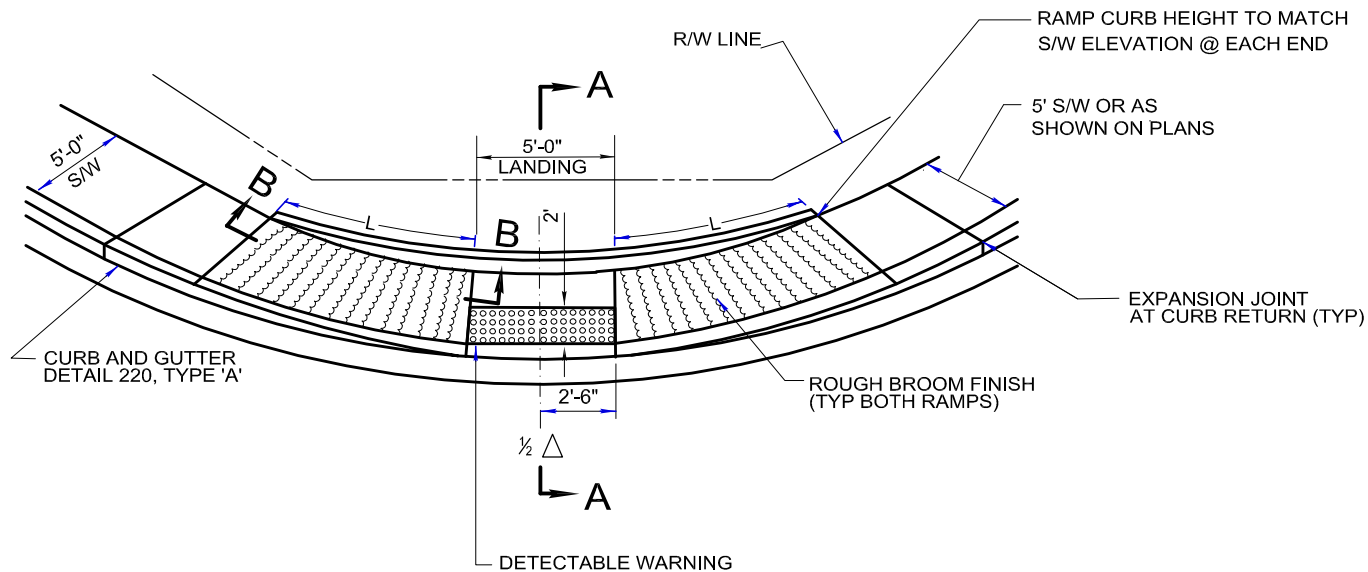
CURB RAMPS

REVISED

01-01-2012

DETAIL NO.

235-2

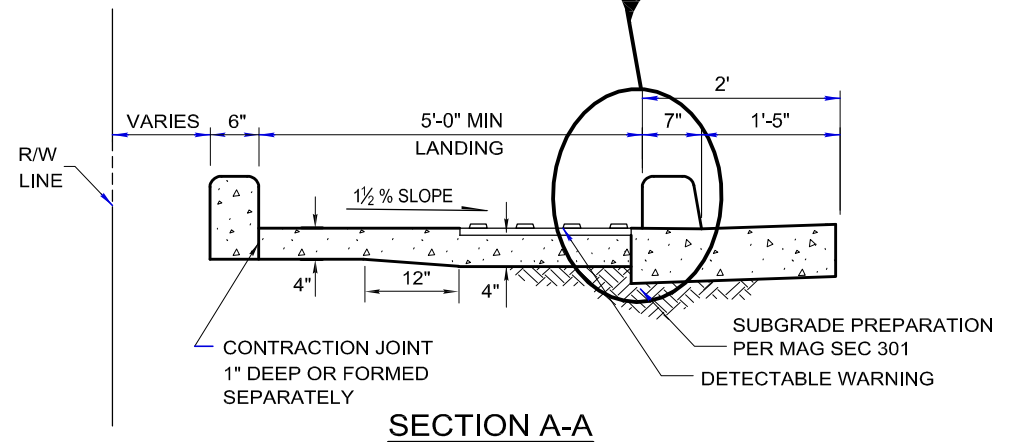
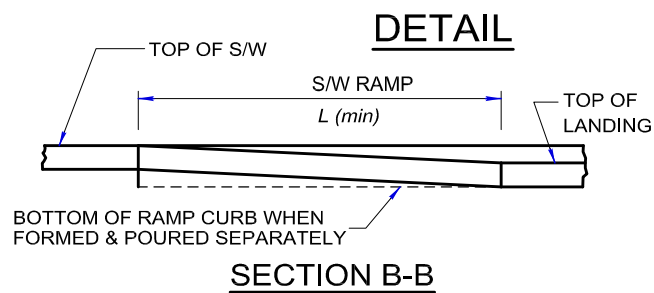


NOTES:

1. CLASS 'B' CONCRETE CONSTRUCTION PER SECTION 725.
2. DETECTABLE WARNING IS TO COMPLY WITH THE JURISDICTIONAL AGENCY'S REQUIREMENT.
3. RAMP LONGITUDINAL SLOPE SHALL BE 12:1 OR FLATTER.
4. RAMP CROSS SLOPE SHALL BE 1½%.
5. DETAIL IS ADA COMPLIANT FOR CURB RADII ≥ 20' AND GUTTER SLOPE ≤ 2.0%.

CURB HEIGHT	L (min)	
	$S_G \leq 1\%$	$S_G \leq 2\%$
4"	5.0'	6.0'
6"	7.0'	8.5'

S_G = MAXIMUM GUTTER SLOPE WITHIN RAMP LIMITS



TYPE 'C'

DETAIL NO.

235-3



STANDARD DETAIL
ENGLISH

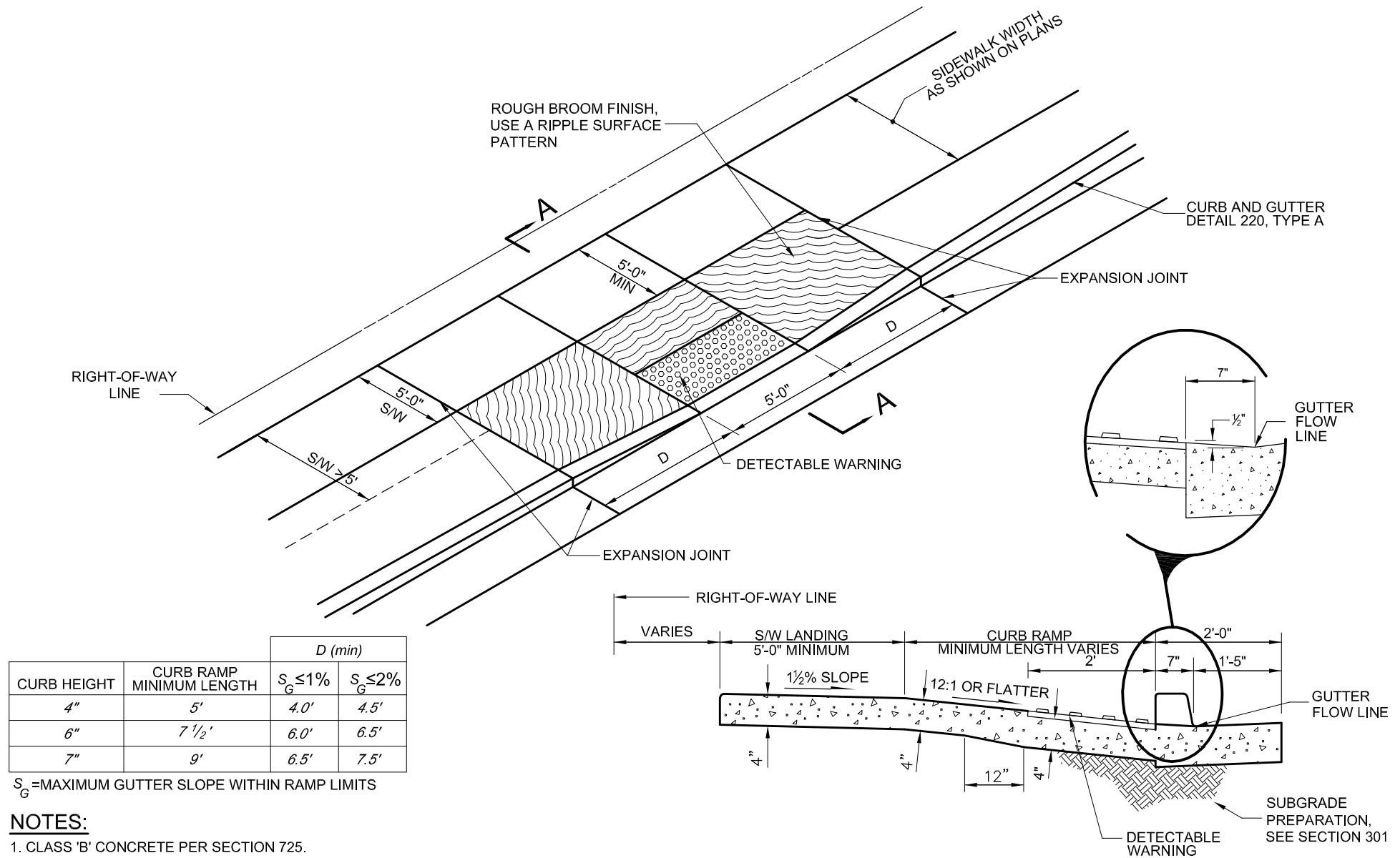
CURB RAMPS

REVISED

01-01-2012

DETAIL NO.

235-3



NOTES:

1. CLASS 'B' CONCRETE PER SECTION 725.
2. EXPANSION JOINTS SHALL CONFORM TO SECTION 340.
3. SIDEWALK SURFACE TO MATCH 1 1/2 % SLOPE FROM TOP OF CURB.
4. DETECTABLE WARNING IS TO COMPLY WITH THE JURISDICTIONAL AGENCY'S REQUIREMENTS.
5. DETAIL IS ADA COMPLIANT FOR $S_G \leq 2\%$.

SECTION A-A

TYPE 'D' DETACHED SIDEWALK

DETAIL NO.

235-4



STANDARD DETAIL
ENGLISH

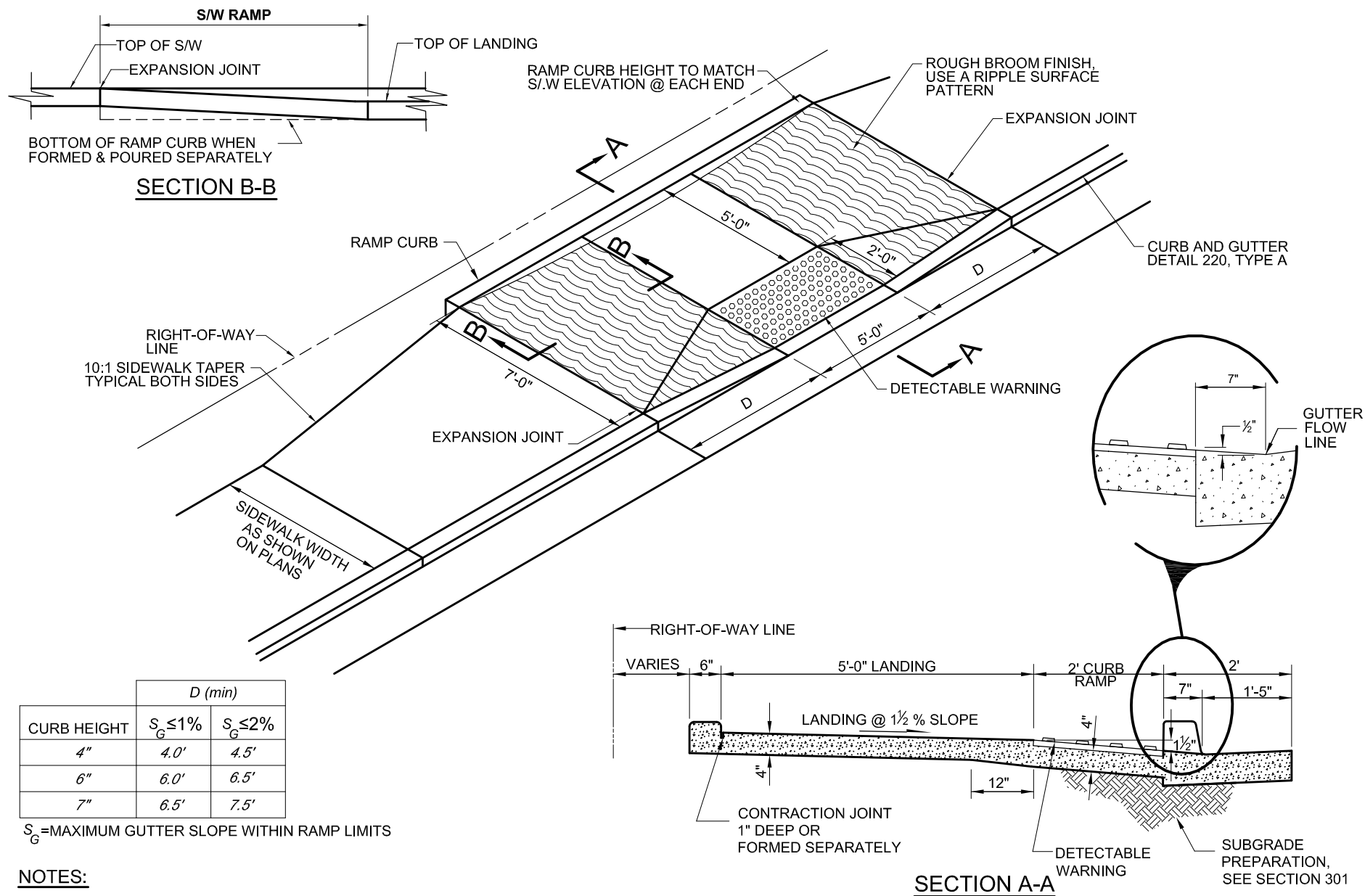
CURB RAMPS

REVISED

01-01-2011

DETAIL NO.

235-4



TYPE 'E'

DETAIL NO.

235-5



STANDARD DETAIL
ENGLISH

CURB RAMPS

REVISED

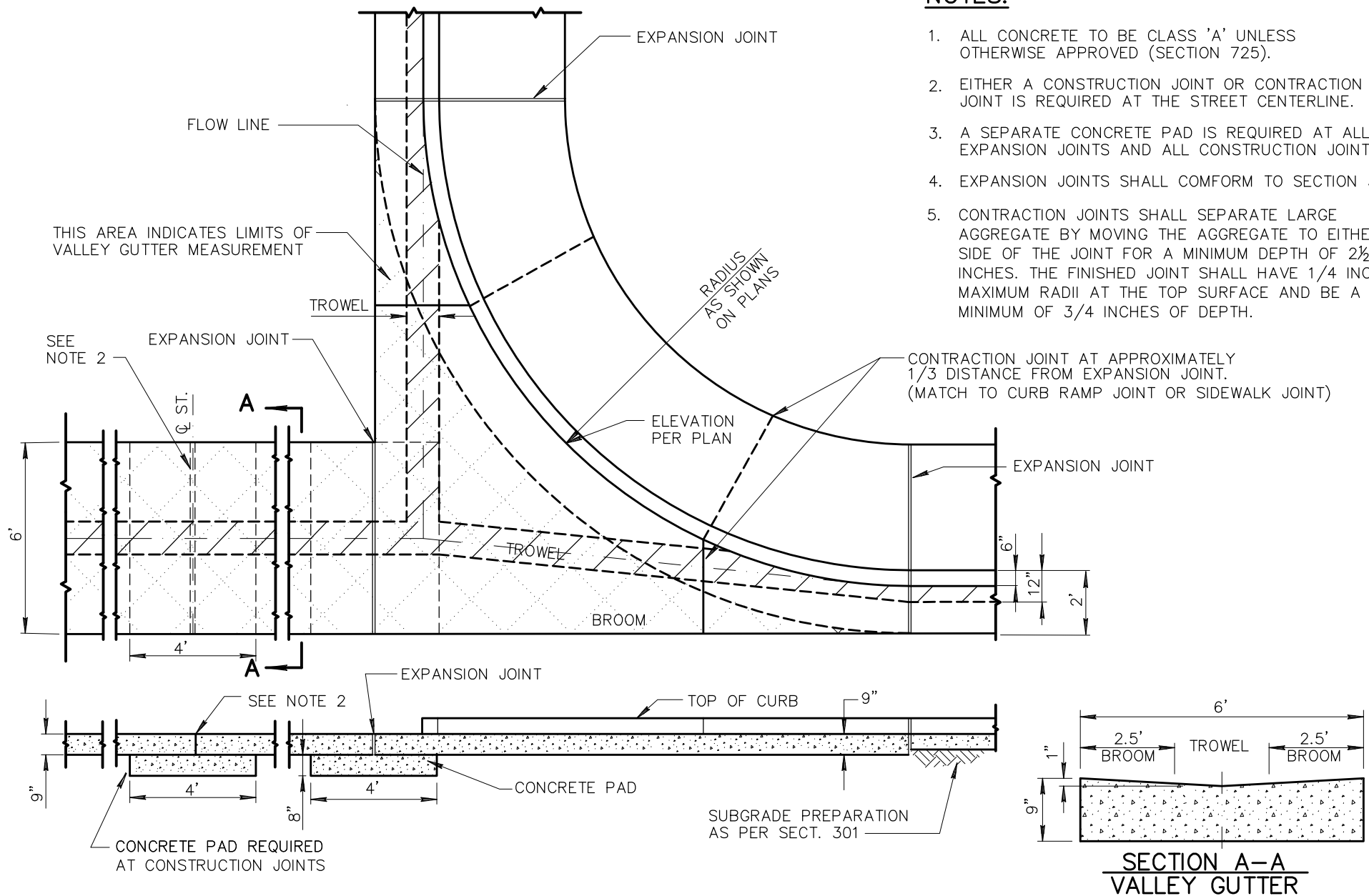
01-01-2011

DETAIL NO.

235-5

NOTES:

1. ALL CONCRETE TO BE CLASS 'A' UNLESS OTHERWISE APPROVED (SECTION 725).
2. EITHER A CONSTRUCTION JOINT OR CONTRACTION JOINT IS REQUIRED AT THE STREET CENTERLINE.
3. A SEPARATE CONCRETE PAD IS REQUIRED AT ALL EXPANSION JOINTS AND ALL CONSTRUCTION JOINTS.
4. EXPANSION JOINTS SHALL COMFORM TO SECTION 340.
5. CONTRACTION JOINTS SHALL SEPARATE LARGE AGGREGATE BY MOVING THE AGGREGATE TO EITHER SIDE OF THE JOINT FOR A MINIMUM DEPTH OF 2½ INCHES. THE FINISHED JOINT SHALL HAVE 1/4 INCH MAXIMUM RADII AT THE TOP SURFACE AND BE A MINIMUM OF 3/4 INCHES OF DEPTH.



DETAIL NO.

240



STANDARD DETAIL
ENGLISH

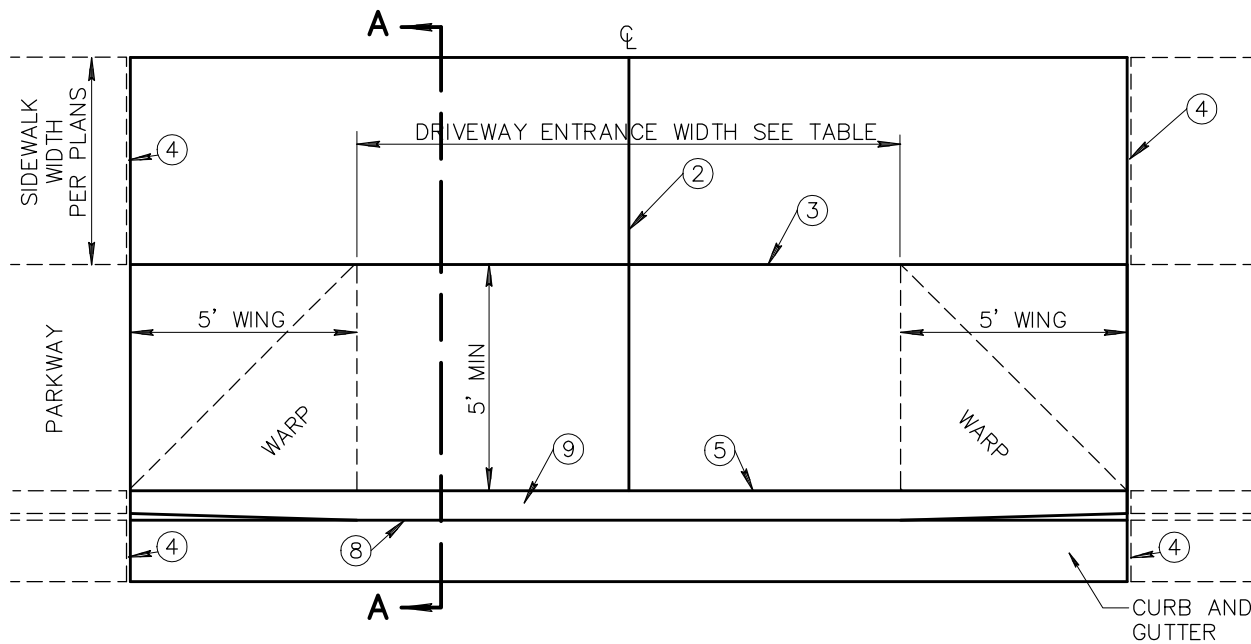
VALLEY GUTTER

REVISED

01-01-2010

DETAIL NO.

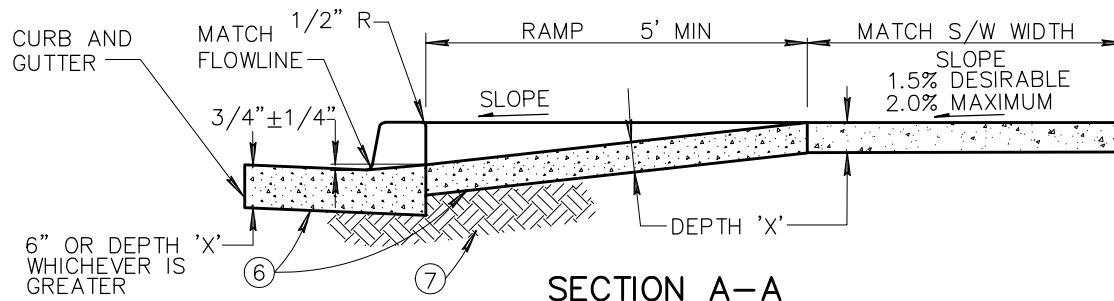
240



DRIVEWAY WITH DETACHED SIDEWALK

NOTES:

1. DEPRESSED CURB SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE FOR THE TYPE OF CURB USED AT THAT LOCATION.
2. CONTRACTION JOINT ON D/W CENTERLINE.
3. CONTRACTION JOINT.
4. 1/2-INCH EXPANSION JOINTS SHALL COMPLY WITH SECTION 340.
5. BACK OF CURB – CONSTRUCTION JOINT.
6. CONCRETE CLASS AS NOTED IN TABLE. CONCRETE PER SECTION 725.
7. SUBGRADE PREPARATION, SECT. 301.
8. FLOW LINE OF GUTTER.
9. DEPRESSED CURB.
10. SECT. A-A AND ELEVATION: D/W SHOWN WITH VERTICAL CURB AND GUTTER, ROLL TYPE CURB AND GUTTER TREATED SIMILARLY.
11. ROUGH BROOM FINISH FULL WIDTH OF RAMP AND WINGS.
12. TROWEL AND USE LIGHT HAIR BROOM FINISH FOR WALKWAY AREA.
13. 'DRIVEWAY ENTRANCE WIDTH' IS THE DRIVEWAY WIDTH PLUS ADDITIONAL WIDENING REQUIRED BY THE LOCAL JURISDICTION.
14. ELEVATION AT TOP OF DRIVEWAY RAMP SHALL BE EQUAL TO OR HIGHER THAN NORMAL CURB ELEVATION.



SECTION A-A

COMMERCIAL AND INDUSTRIAL

DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'
COMMERCIAL	* 16'	40'	A	9"
INDUSTRIAL	* 16'	40'	A	9"
* 24' MIN. FOR TWO WAY TRAFFIC				

RESIDENTIAL

DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'
MAJOR STREET	16'	30'	B	5"
COLLECTOR STREET	* 12'	30'	B	5"
LOCAL STREET	12'	30'	B	5"
* 16' DESIRABLE				

DETAIL NO.

250-1



STANDARD DETAIL
ENGLISH

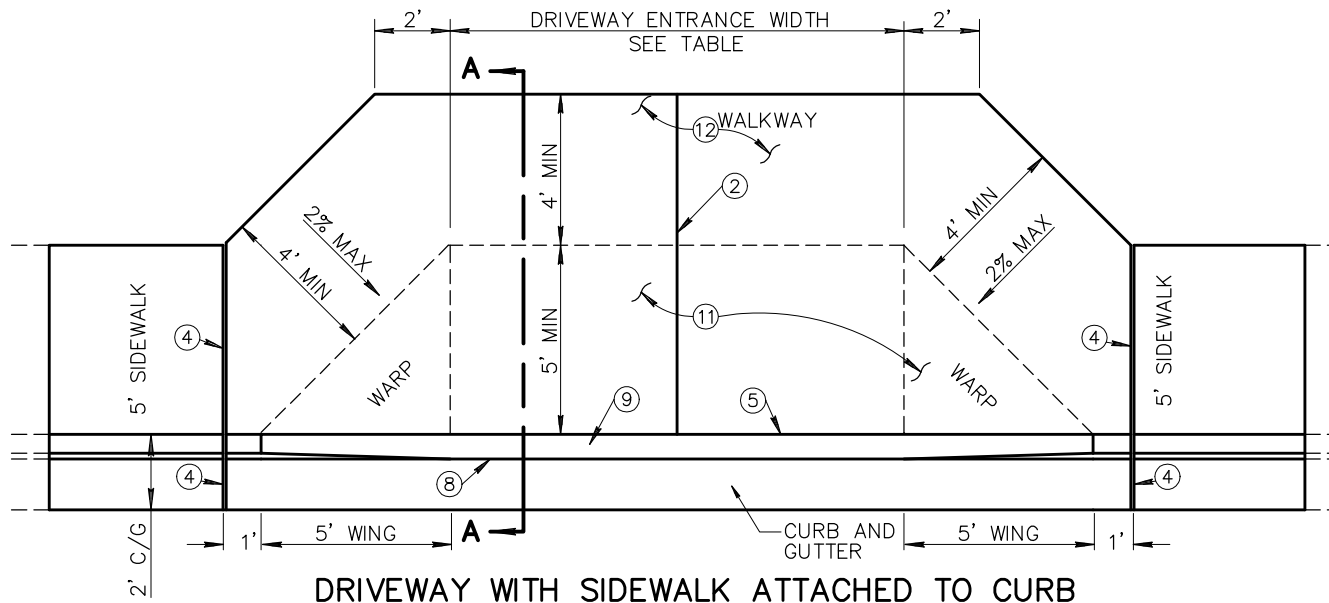
**DRIVEWAY ENTRANCES WITH
DETACHED SIDEWALK**

REVISED

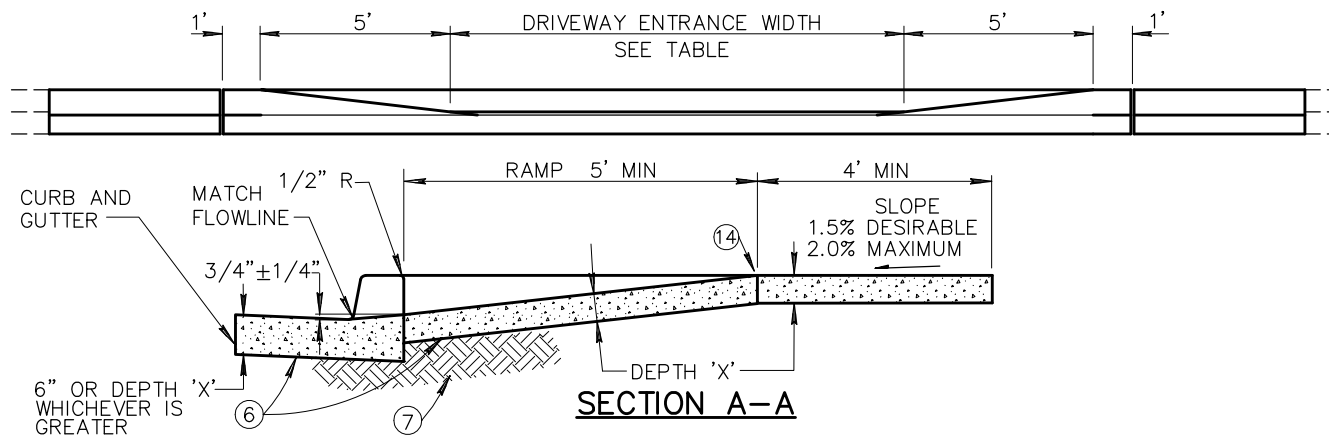
01-01-2014

DETAIL NO.

250-1



DRIVEWAY WITH SIDEWALK ATTACHED TO CURB



SECTION A-A

COMMERCIAL AND INDUSTRIAL					RESIDENTIAL				
DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'	DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'
COMMERCIAL	* 16'	40'	A	9"	MAJOR STREET	16'	30'	B	5"
INDUSTRIAL	* 16'	40'	A	9"	COLLECTOR STREET	* 12'	30'	B	5"
* 24' MIN. FOR TWO WAY TRAFFIC					LOCAL STREET	12'	30'	B	5"
					* 16' DESIRABLE				

NOTES:

- DEPRESSED CURB SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE FOR THE TYPE OF CURB USED AT THAT LOCATION.
- CONTRACTION JOINT(S) FOR DRIVEWAY ENTRANCE: WIDTH LESS THAN 22' NONE REQUIRED; WIDTH GREATER THAN 22' AND LESS THAN 30' LOCATE SINGLE JOINT ON D/W CENTERLINE; WIDTH OF 30' OR GREATER LOCATE TWO JOINTS TO EQUALLY DIVIDE THE DRIVEWAY ENTRANCE WIDTH.
- DETAIL GEOMETRICS ARE BASED ON A CURB HEIGHT OF SIX INCHES (6"), AN ATTACHED SIDEWALK WIDTH OF FIVE FEET (5'), AND A DRIVEWAY RAMP LENGTH NOT EXCEEDING SIX FEET (6'). GEOMETRIC MODIFICATIONS MAY BE REQUIRED WHEN CONDITIONS ARE MODIFIED.
- 1/2-INCH EXPANSION JOINTS SHALL COMPLY WITH SECTION 340.
- BACK OF CURB – CONSTRUCTION JOINT.
- CONCRETE CLASS AS NOTED IN TABLE. CONCRETE PER SECTION 725.
- SUBGRADE PREPARATION, SECT. 301.
- FLOW LINE OF GUTTER.
- DEPRESSED CURB.
- SECT. A-A AND ELEVATION: D/W SHOWN WITH VERTICAL CURB AND GUTTER, ROLL TYPE CURB AND GUTTER TREATED SIMILARLY.
- ROUGH BROOM FINISH FULL WIDTH OF RAMP AND WINGS.
- TROWEL AND USE LIGHT HAIR BROOM FINISH FOR WALKWAY AREA.
- 'DRIVEWAY ENTRANCE WIDTH' IS THE DRIVEWAY WIDTH PLUS ADDITIONAL WIDENING REQUIRED BY THE LOCAL JURISDICTION.
- ELEVATION AT TOP OF DRIVEWAY RAMP SHALL BE EQUAL TO OR HIGHER THAN NORMAL CURB ELEVATION.

DETAIL NO.

250-2



STANDARD DETAIL
ENGLISH

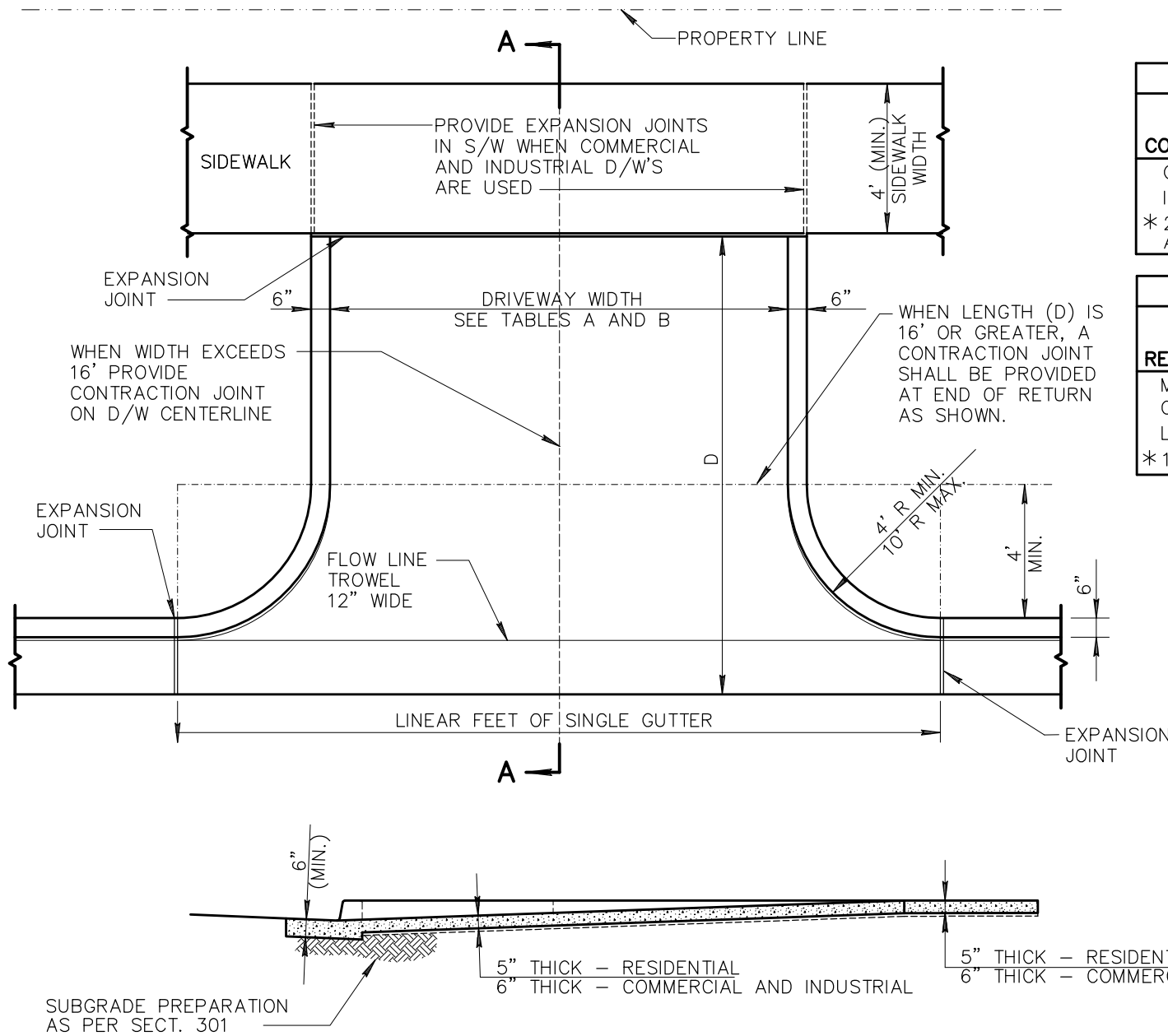
DRIVEWAY ENTRANCES WITH SIDEWALK ATTACHED TO CURB

REVISED

01-01-2013

DETAIL NO.

250-2



SECTION A-A

TABLE A		
ZONING	DRIVEWAY WIDTH	
	MIN.*	MAX.
COMMERCIAL AND INDUSTRIAL		
COMMERCIAL	16'	40'
INDUSTRIAL	16'	40'
* 24' WHERE 2-WAY TRAFFIC IS ANTICIPATED		

TABLE B		
ZONING	DRIVEWAY WIDTH	
	MIN.*	MAX.
RESIDENTIAL		
MAJOR STREET	16'	30'
COLLECTOR STREET	12'	30'
LOCAL STREET	12'	30'
* 16' WIDTH IS DESIRABLE		

NOTES:

1. EXPANSION JOINTS SHALL COMPLY TO SECTION 340.
2. THIS TYPE D/W TO BE USED ONLY UPON APPROVAL OF ENGINEER.
3. CLASS 'B' CONCRETE CONSTRUCTION AS PER SECT. 725

DETAIL NO.

251



STANDARD DETAIL
ENGLISH

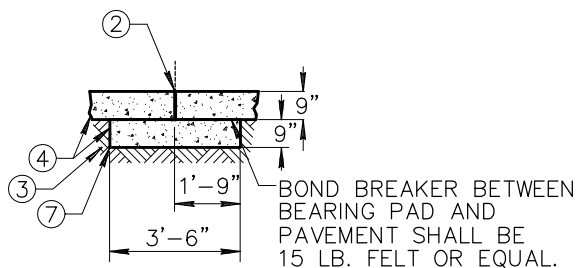
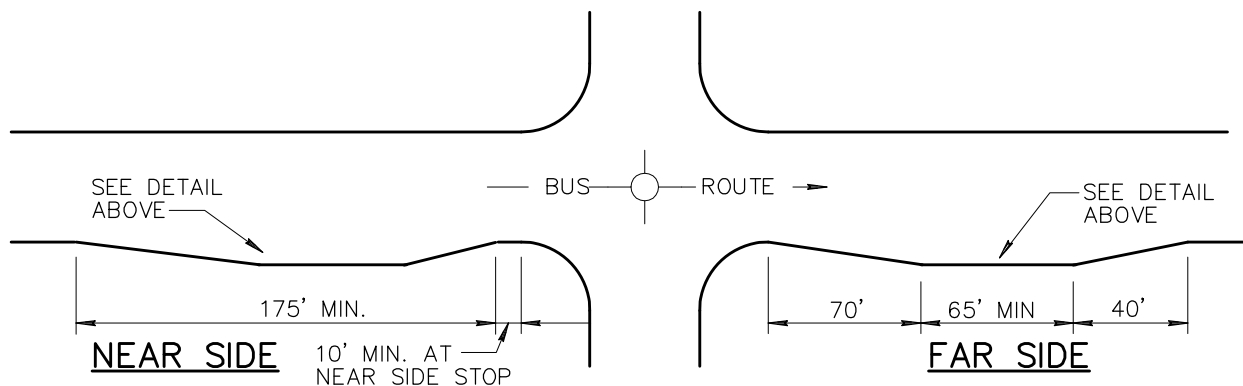
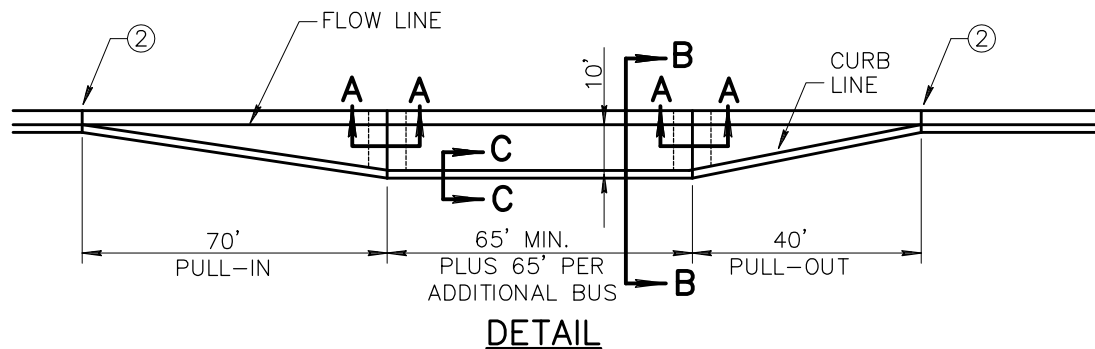
RETURN TYPE DRIVEWAYS

REVISED

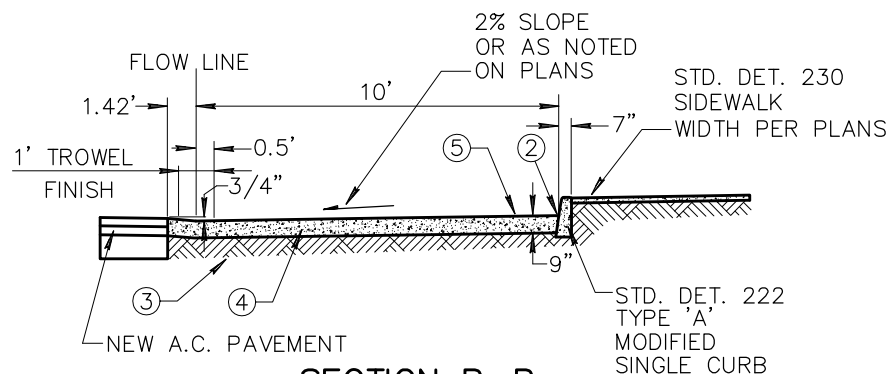
01-01-2003

DETAIL NO.

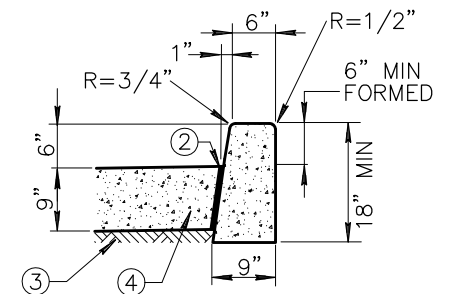
251



SECTION A-A



SECTION B-B



SECTION C-C

STD. DET. 222 TYPE 'A' MODIFIED SINGLE CURB

NOTES:

1. SUFFICIENT RIGHT-OF-WAY MUST BE AVAILABLE TO CONSTRUCT THE BUS BAY.
2. 1/2" BITUMINOUS PREFORMED EXPANSION JOINT FILLER ASTM D-1751 PER SPECIFICATION SECTION 729.
3. SUBGRADE PREPARATION PER SPECIFICATION SECTION 301 COMPACTED TO 95% MINIMUM DENSITY.
4. CONCRETE SHALL BE CLASS 'A' PER SPECIFICATION SECTION 725.
5. CONCRETE BUS BAY PAVEMENT SHALL BE BROOM FINISHED, EXCEPT WHERE OTHERWISE NOTED.
6. CONTRACTION JOINTS IN THE BUS BAY PAVEMENT SHALL MATCH THOSE IN THE CURB, 15 FT. MAXIMUM SPACING.
7. CONCRETE BEARING PAD (SECTION A-A) TO BE POURED SEPARATELY FROM CONCRETE BUS BAY PAVEMENT.

DETAIL NO.

252



STANDARD DETAIL
ENGLISH

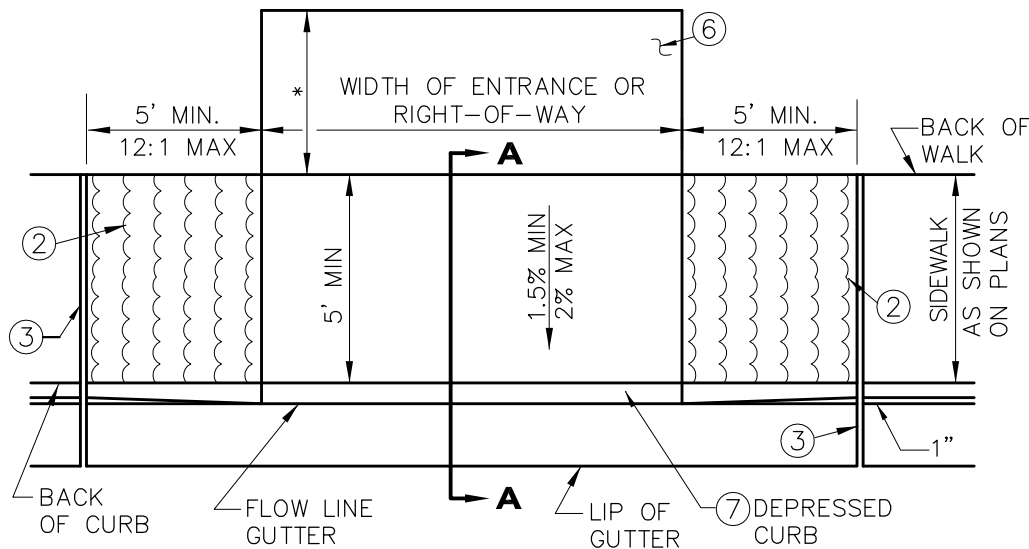
BUS BAYS

REVISED

01-01-2005

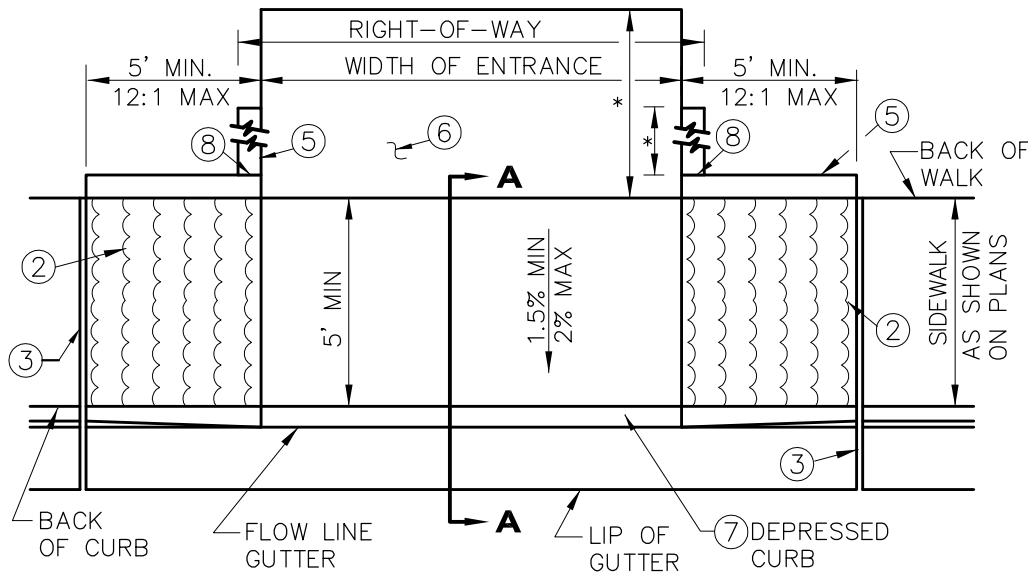
DETAIL NO.

252



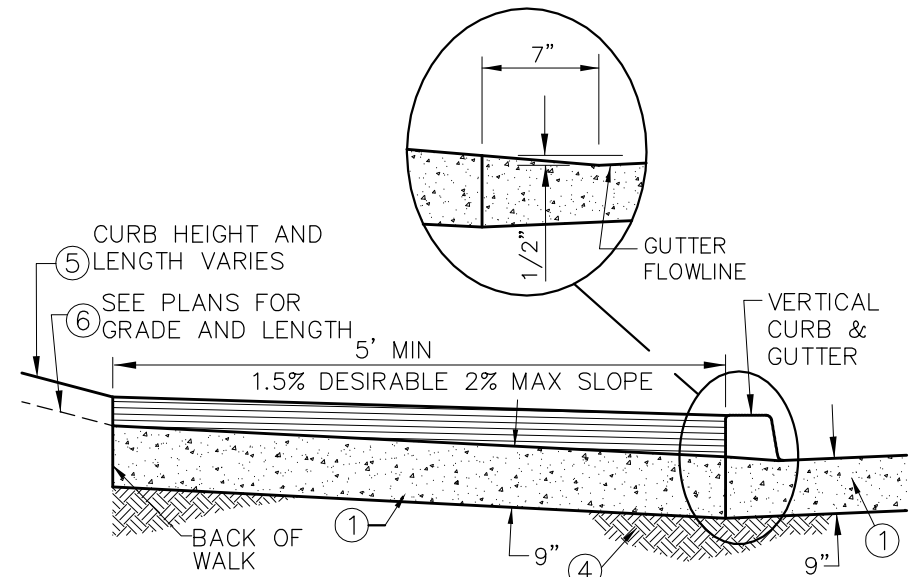
TYPE A - WITHOUT RETAINING CURB

* SEE PLANS FOR ALLEY SURFACING REQUIREMENTS



TYPE B - WITH RETAINING CURB

* SEE PLANS FOR RETAINING CURB LENGTHS, TOP OF CURB ELEVATIONS, AND ALLEY SURFACING REQUIREMENTS



SECTION A-A



ELEVATION

NOTES:

- (1). CLASS "A" CONCRETE PER SECTION 725.
- (2). LIMITS OF HEAVY ROUGH BROOM FINISH.
- (3). EXPANSION JOINTS PER SECTION 340.
- (4). SUBGRADE PREPARATION PER SECTION 301.
- (5). SINGLE CURB PER DETAIL 222, TYPE "B".
- (6). ALLEY SURFACING PER PLANS.
- (7). DEPRESSED CURB SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE FOR THE TYPE OF CURB USED AT THAT LOCATION.
- (8). CONTROL JOINT.

DETAIL NO.

260



STANDARD DETAIL
ENGLISH

ALLEY ENTRANCE
(WITH VERTICAL CURB AND GUTTER)

REVISED
01-01-2013

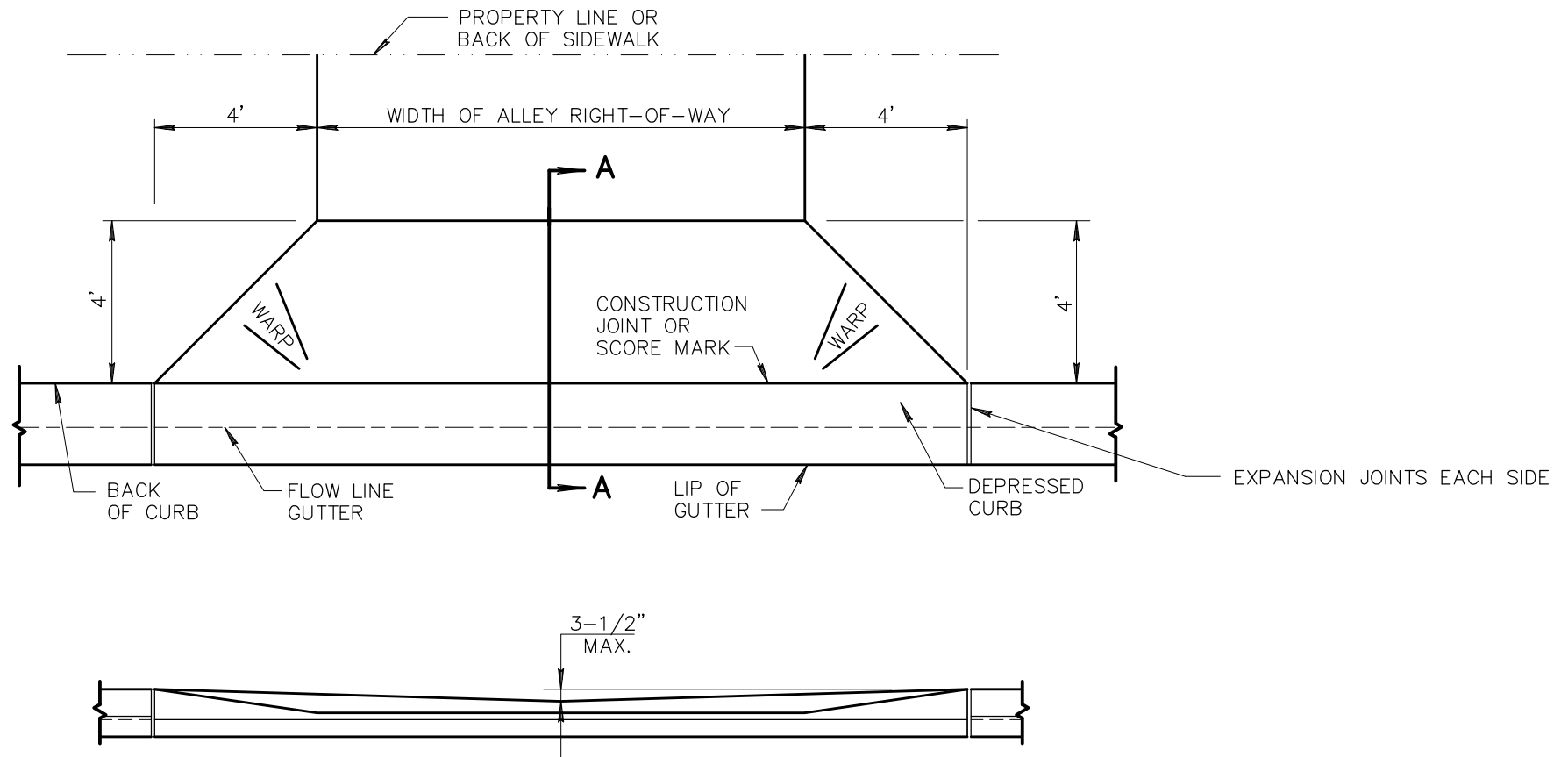
DETAIL NO.

260

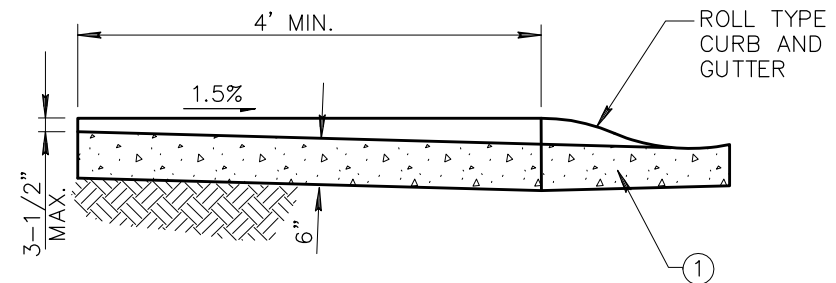


-

ELEVATION



ELEVATION



SECTION A-A

NOTES:

1. CLASS 'B' CONCRETE CONSTRUCTION PER SECT. 725.
2. EXPANSION JOINTS SHALL CONFORM TO SECT. 340.
3. SUBGRADE PREPARATION PER SECTION 301.

DETAIL NO.

263



STANDARD DETAIL
ENGLISH

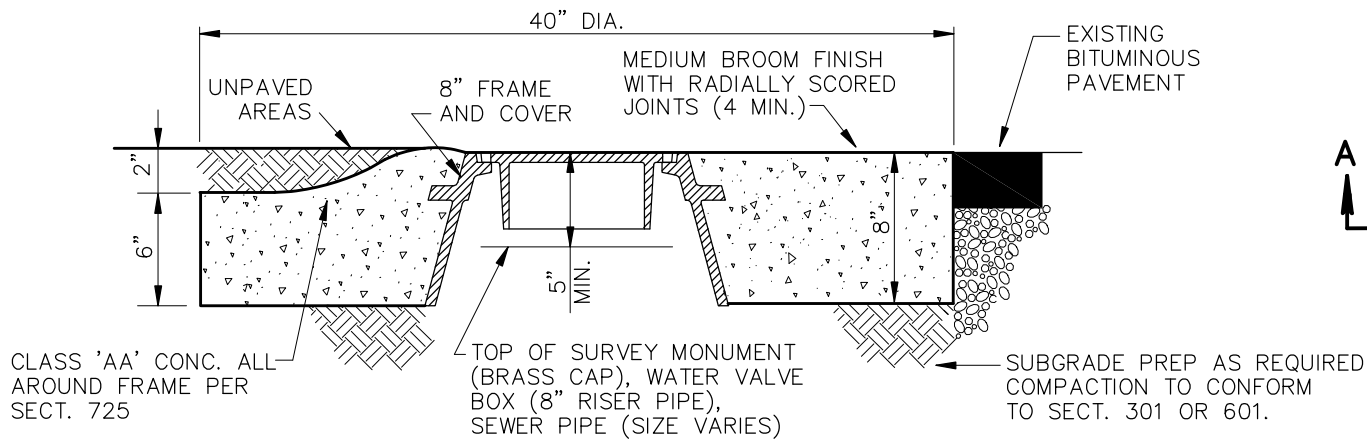
**WING TYPE ALLEY ENTRANCE
(WITH ROLL TYPE CURB AND GUTTER)**

REVISED

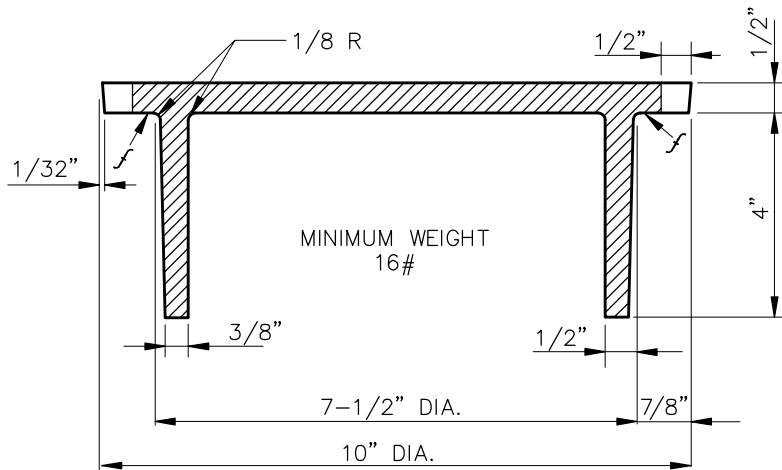
01-01-2002

DETAIL NO.

263



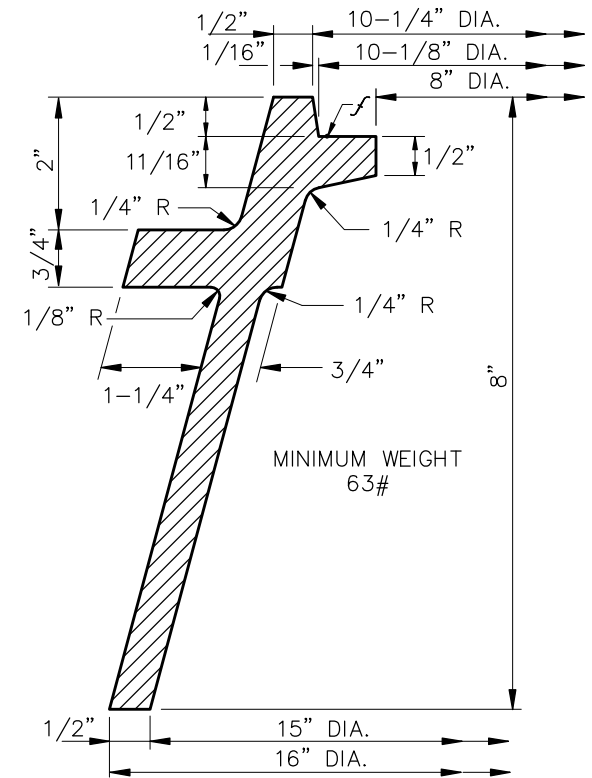
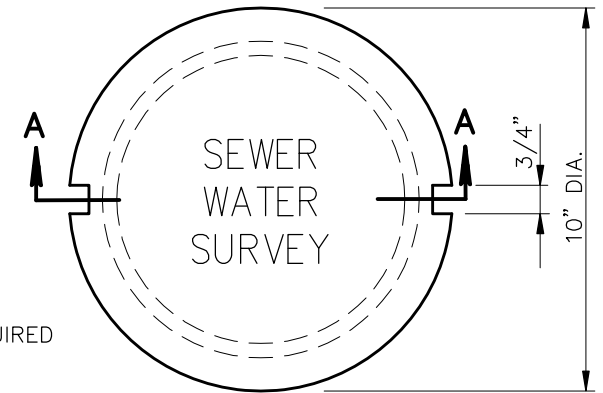
GRADE ADJUSTMENT FOR FRAME AND COVER



COVER SECTION A-A

NOTES:

1. CASTING TO CONFORM TO SECT. 787.
2. LETTERS ON COVER TO BE AS FOLLOWS:
"SEWER", "WATER", OR "SURVEY" AS DIRECTED TOTAL WIDTH OF WORD "SEWER" OR "WATER" 3-3/4". TOTAL WIDTH OF WORD "SURVEY" 4-1/2". LETTER SIZE 5/8" x 3/4", RAISED 1/16" ABOVE LEVEL OF COVER, TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL.
3. \nearrow INDICATES MACHINE FINISHED SURFACE.



8" C.I. FRAME AND COVER

DETAIL NO.

270



STANDARD DETAIL
ENGLISH

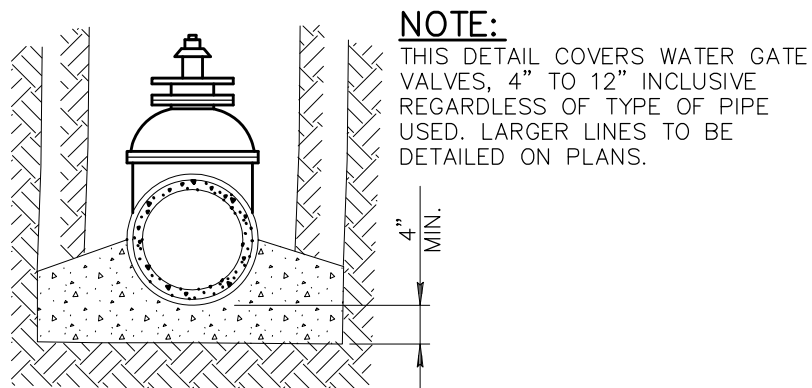
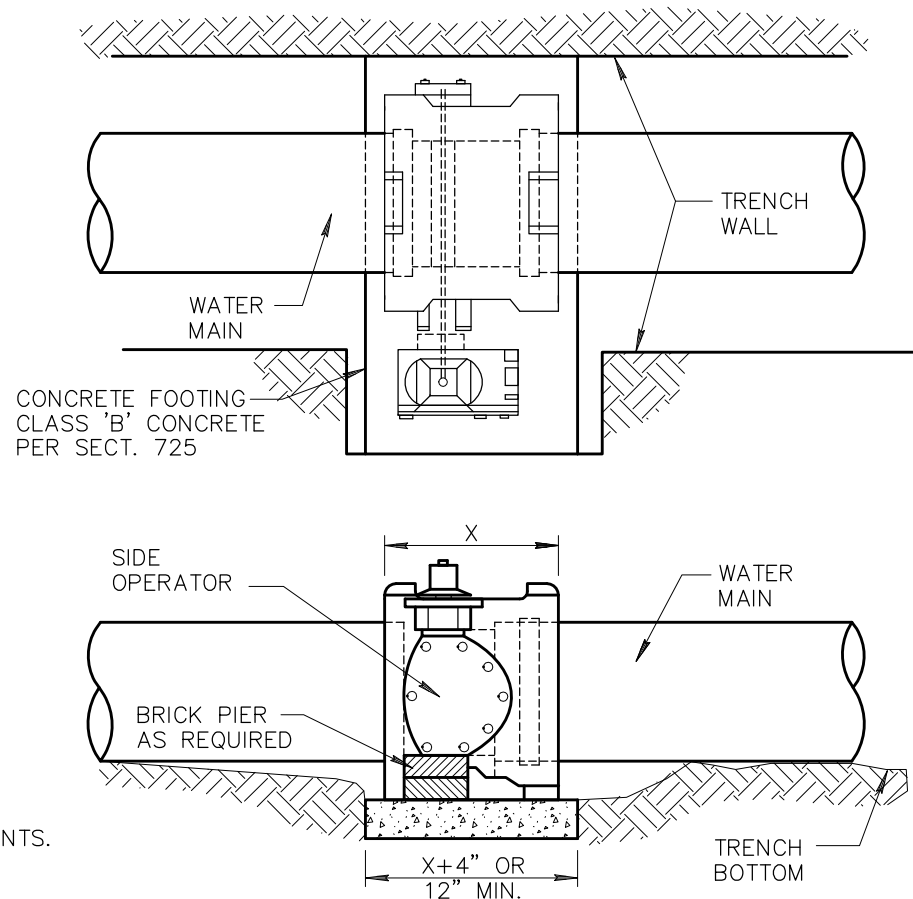
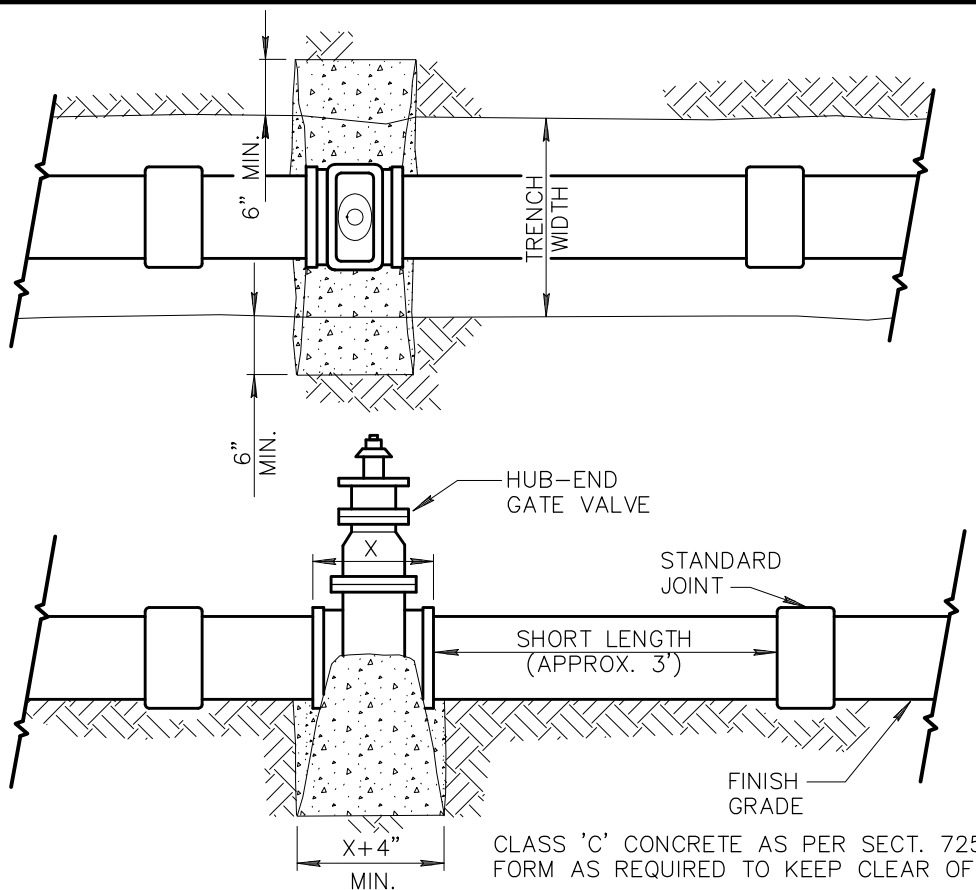
FRAME AND COVER
AND GRADE ADJUSTMENT

REVISED

01-01-2016

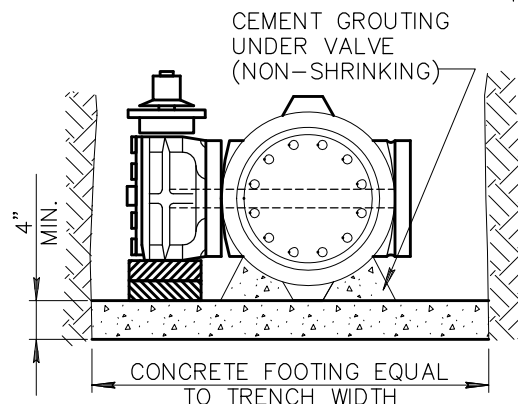
DETAIL NO.

270



WATER GATE VALVE

NOTE:
THIS DETAIL COVERS WATER GATE VALVES, 4" TO 12" INCLUSIVE REGARDLESS OF TYPE OF PIPE USED. LARGER LINES TO BE DETAILED ON PLANS.



BUTTERFLY VALVE

NOTES:

1. THIS DETAIL COVERS BUTTERFLY VALVE INSTALLATION, 3" TO 12" INCLUSIVE, REGARDLESS OF TYPE OF PIPE OR JOINT USED. LARGER LINES TO BE DETAILED ON PLANS.
2. VALVE BOX AND COVER REQUIRED PER DETAILS 270 AND 391.

DETAIL NO.

301



STANDARD DETAIL
ENGLISH

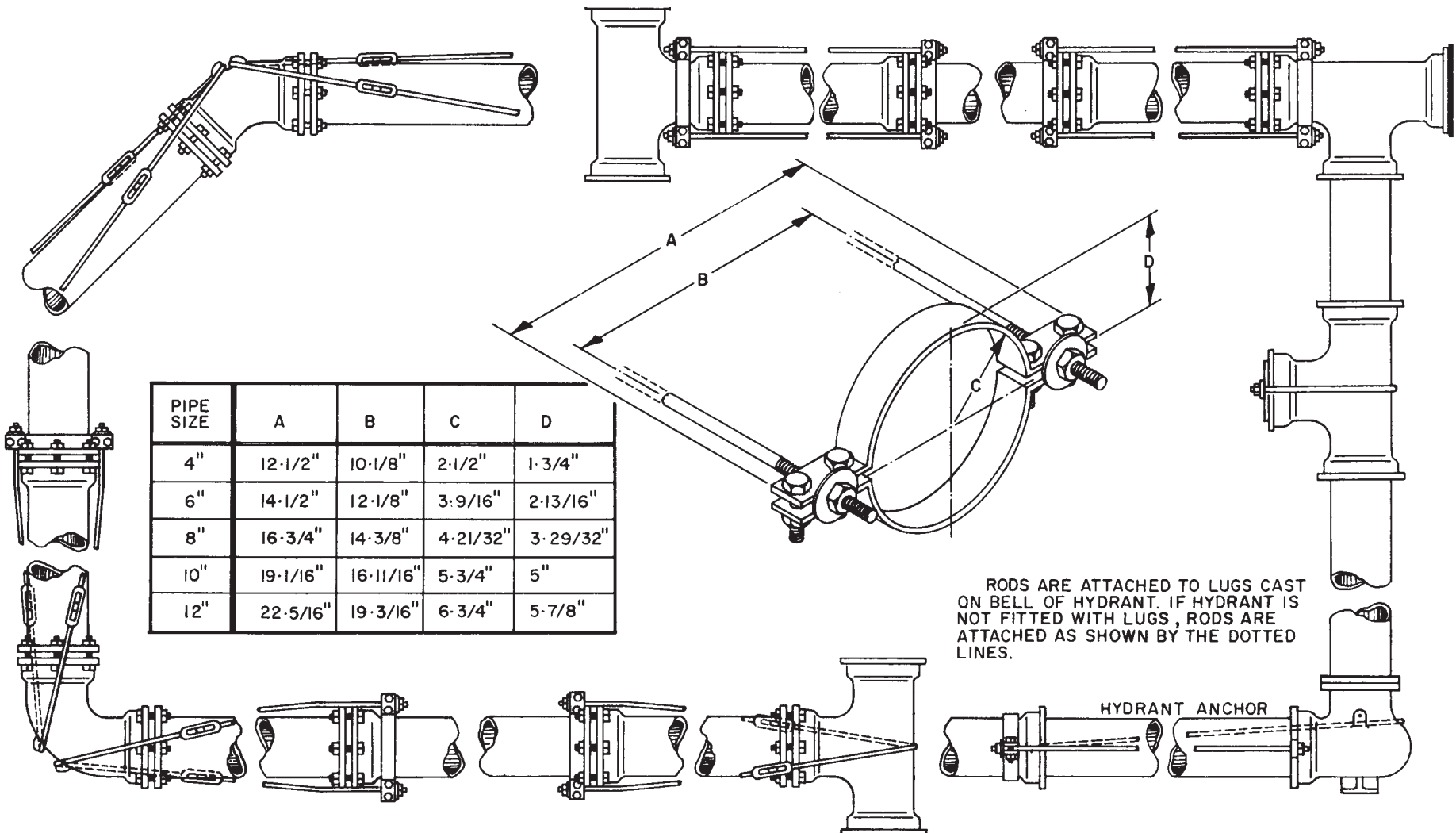
BLOCKING FOR
WATER GATE AND BUTTERFLY VALVES

REVISED

01-01-1998

DETAIL NO.

301



SHEET 1 OF 2

DETAIL NO.

302-1



STANDARD DETAIL
ENGLISH

JOINT RESTRAINT WITH TIE RODS

REVISED

01-01-1998

DETAIL NO.

302-1

THIS DETAIL IS FOR USE ONLY ON UNDERGROUND INSTALLATIONS WHERE THE USE OF CONCRETE THRUST BLOCKING PER DETAIL 380 CANNOT BE USED BECAUSE OF OBSTRUCTIONS, OR REQUIREMENTS OF THE SPECIFICATIONS...

- * CLAMPS SHALL BE 1/2 BY 2 INCHES FOR PIPE 4 AND 6 INCHES IN DIAMETER; 5/8 BY 2-1/2 INCHES FOR PIPE 8 AND 10 INCHES; 5/8 BY 3 INCHES FOR PIPE 12 INCHES. BOLT HOLES SHALL BE 1/16 INCH IN DIAMETER LARGER THAN BOLTS.
- * RODS SHALL BE 3/4 INCHES IN DIAMETER FOR PIPES 4, 6 AND 8 INCHES IN DIAMETER; 7/8 INCHES FOR PIPE 10 INCHES AND 1 INCH IN DIAMETER FOR PIPE 12 INCHES.
- * BOLTS SHALL BE 5/8 INCHES IN DIAMETER FOR PIPE 4, 6 AND 8 INCHES IN DIAMETER; 3/4 INCHES FOR PIPE 10 INCHES AND 7/8 INCHES IN DIAMETER FOR PIPE 12 INCHES
- * WASHERS MAY BE CAST IRON OR STEEL, ROUND OR SQUARE, DIMENSIONS FOR CAST IRON WASHERS ARE 5/8 BY 3 INCHES FOR PIPE 4, 6, 8 AND 10 INCHES IN DIAMETER AND 3/4 BY 3-1/2 INCHES FOR PIPE 12 INCHES. DIMENSIONS FOR STEEL WASHERS ARE 1/2 BY 3 INCHES FOR PIPE 4, 6, 8 AND 10 INCHES IN DIAMETER AND 1/2 BY 3-1/2 INCHES FOR PIPE 12 INCHES IN DIAMETER. HOLES SHALL BE 1/8 INCH LARGER THAN THE RODS.

FOR PIPE LARGER THAN 12 INCHES IN DIAMETER, RESTRAINT DETAILS SHALL BE SUBMITTED FOR APPROVAL PRIOR TO INSTALLATION.

1. ALL TIE RODS, ROD COUPLINGS, TURNBUCKLES, BOLTS AND NUTS FOR THESE JOINTS SHALL BE OF CARBON STEEL EQUIVALENT TO A.S.T.M. A-307, GRADE B, WITH CADMIUM PLATING IN ACCORDANCE WITH A.S.T.M. A-165. EXCEPT THAT THE MIN. THICKNESS OF THE PLATING SHALL BE .0002 OF AN INCH. CADMIUM PLATED BOLTS SHALL HAVE CLASS 2A THREADS AND THE NUTS, ROD COUPLINGS AND TURNBUCKLES SHALL HAVE 2B THREADS.
2. HIGH STRENGTH, HEAT TREATED CAST IRON TEE-HEAD BOLTS WITH HEXAGON NUTS, ALL IN ACCORDANCE WITH THE STRENGTH REQUIREMENTS OF A.W.W.A. C-111, MAY BE USED IN LIEU OF THE CADMIUM PLATED BOLTS AND NUTS.
3. THE SKETCHES IN THIS SERIES OF FIGURES SHOW ACCEPTABLE METHODS OF PROVIDING ANCHORAGE. THERE IS NO PARTICULAR SIGNIFICANCE TO BE ATTACHED TO WHETHER THE SKETCH SHOWS A BELL AND SPIGOT JOINT OR A STANDARD MECHANICAL JOINT. THE ANCHORING PROCEDURE ILLUSTRATED APPLIES IN MOST CASES TO EITHER TYPE OF JOINT. IN SOME CASES, DIMENSIONS OF THE PARTICULAR PIPE OR HUB AND SPACE AVAILABLE FOR WORKING AROUND THE PARTICULAR JOINT WILL INFLUENCE THE CHOICE OF METHODS USED.
4. IN CERTAIN ASSEMBLIES OF RODS AND CLAMPS SHOWN, RODS RUN FROM A LUG ON THE FITTING (OR A CLAMP BEHIND THE HUB OF A BELL) TO A CLAMP AGAINST A FACE OF A BELL. NOTE THAT THIS ARRANGEMENT ANCHORS ONLY ONE JOINT. THE STABILITY OF THE JOINT WHERE THE CLAMP IS AGAINST THE FACE OF THE BELL DEPENDS ON HAVING SOIL ABOVE A RELATIVELY LONG PIECE OF PIPE ON BOTH SIDES OF THE JOINT. CONSEQUENTLY, IF THE DISTANCE BETWEEN THE FIRST AND SECOND JOINTS IS LESS THAN 12 FEET, THE SECOND JOINT SHOWN SHALL BE ANCHORED BY A CLAMP BEHIND THE HUB OF THE BELL AND RODS TO A CLAMP AT THE FACE OF THE NEXT BELL.
5. COATING TYPE: A.H.D. ASPHALTIC PRIMER 719(A). - ALL EXPOSED METAL.

SHEET 2 OF 2

DETAIL NO.

302-2



STANDARD DETAIL
ENGLISH

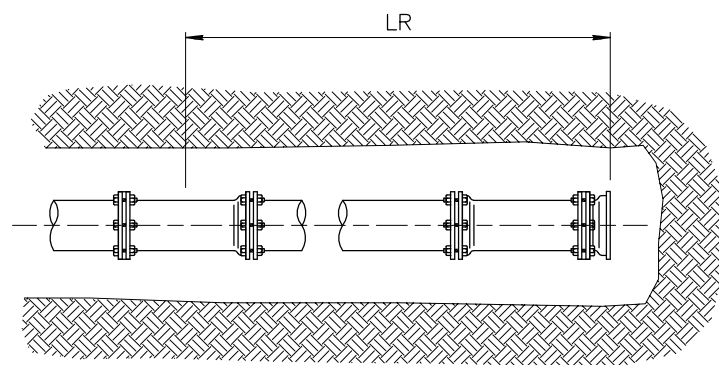
JOINT RESTRAINT WITH TIE RODS

REVISED

01-01-1998

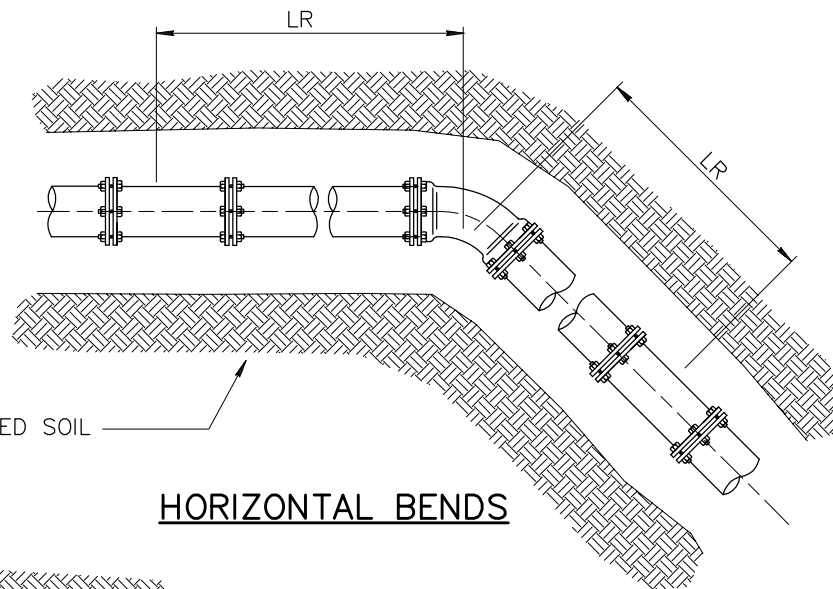
DETAIL NO.

302-2

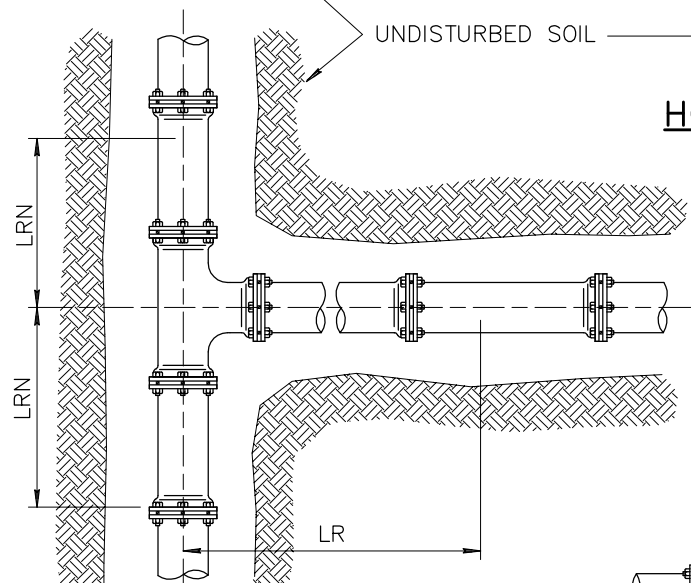


DEAD ENDS

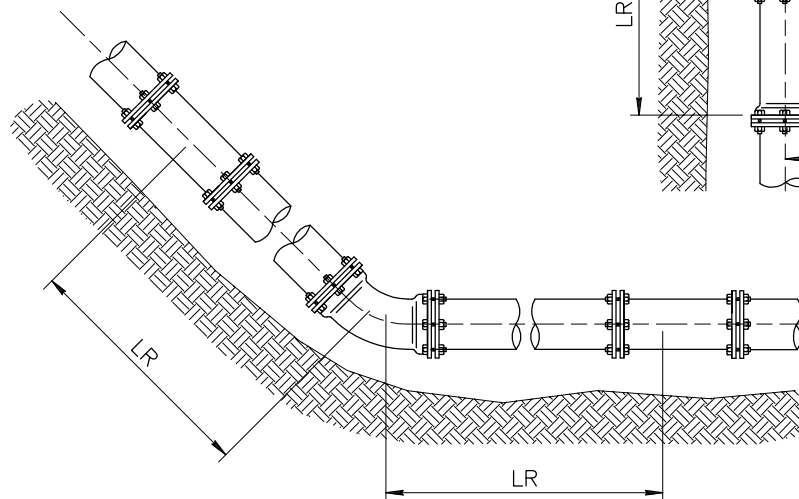
LRN = SHORTEST LENGTH
OF PIPE RESTRAINED TO
THE RUN OF THE TEE
FITTING (BOTH SIDES OF TEE).



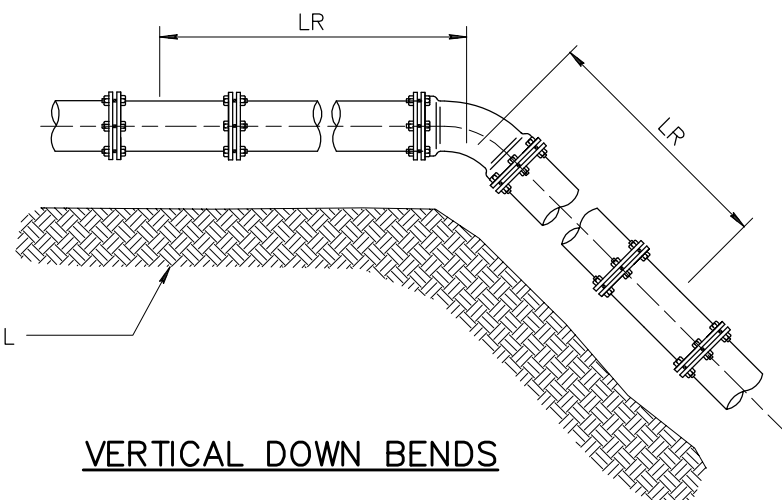
HORIZONTAL BENDS



TEES



VERTICAL UP BEND



VERTICAL DOWN BENDS

UNDISTURBED SOIL

UNDISTURBED SOIL

RESTRAINED LENGTHS, LR, FOR DUCTILE IRON PIPE												
NOMINAL PIPE SIZE INCHES	HORIZONTAL BENDS			TEES		VERTICAL OFFSETS						DEAD ENDS
						90° BEND FITTINGS		45° BEND FITTINGS		22-1/2° BEND FITTINGS		
	90°	45°	22-1/2°	LRN=0'	LRN=10'	DOWN BEND	UP BEND	DOWN BEND	UP BEND	DOWN BEND	UP BEND	
4	18	7	4	30	8	31	18	13	7	6	3	31
6	25	10	5	43	20	44	25	18	10	9	5	44
8	32	13	6	56	34	58	32	24	13	11	6	58
10	38	16	8	68	45	69	38	29	16	14	8	69
12	45	19	9	80	57	81	45	34	19	16	9	81
14	51	21	10	91	68	92	51	38	21	18	10	92
16	57	24	11	103	79	104	57	43	24	21	11	104
18	62	26	12	113	90	115	62	48	26	23	12	115
20	68	28	14	125	100	126	68	52	28	25	14	126
24	79	33	16	145	121	147	79	61	33	29	16	147

RESTRAINED LENGTHS, LR, FOR DUCTILE IRON PIPE WITH POLYETHYLENE WRAP												
NOMINAL PIPE SIZE INCHES	HORIZONTAL BENDS			TEES		VERTICAL OFFSETS						DEAD ENDS
						90° BEND FITTINGS		45° BEND FITTINGS		22-1/2° BEND FITTINGS		
	90°	45°	22-1/2°	LRN=0'	LRN=10'	DOWN BEND	UP BEND	DOWN BEND	UP BEND	DOWN BEND	UP BEND	
4	26	11	5	69	18	72	26	30	11	14	5	72
6	36	15	7	99	47	102	36	42	15	20	7	102
8	47	19	9	130	78	133	47	55	19	26	9	133
10	56	23	11	157	103	159	56	66	23	32	11	159
12	65	27	13	185	131	187	65	77	27	37	13	187
14	74	31	15	211	156	214	74	89	31	42	15	214
16	82	34	16	238	183	241	82	100	34	48	16	241
18	90	37	18	263	207	266	90	110	38	53	18	266
20	98	41	20	289	233	292	98	121	41	58	20	292
24	113	47	22	337	280	340	113	141	47	68	22	340

NOTES:

1. ALL JOINTS WITHIN THE SPECIFIED LENGTH LR MUST BE RESTRAINED.
ALL LENGTHS ARE GIVEN IN FEET.
2. THE MAXIMUM TEST PRESSURE SHALL NOT EXCEED 200 PSI
3. THE MINIMUM DEPTH OF BURY SHALL BE 3' TO TOP OF PIPE.
4. RESTRAINED LENGTHS MAY BE REDUCED WHEN SUPPORTED BY ENGINEERING CALCULATIONS.

DETAIL NO.

303-2



STANDARD DETAIL
ENGLISH

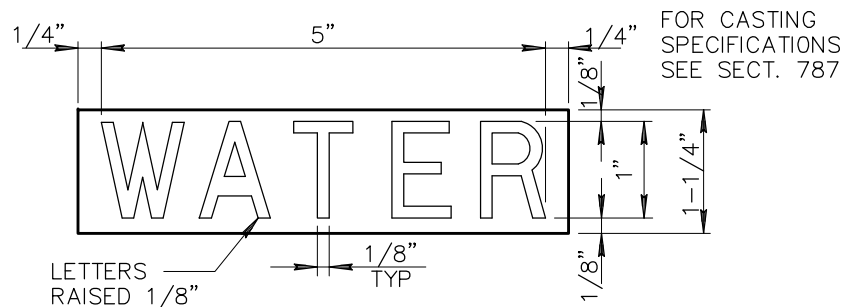
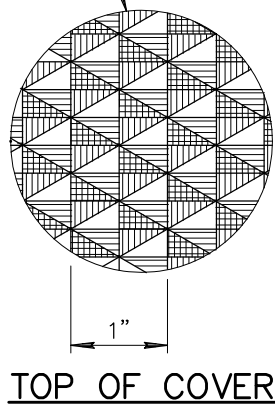
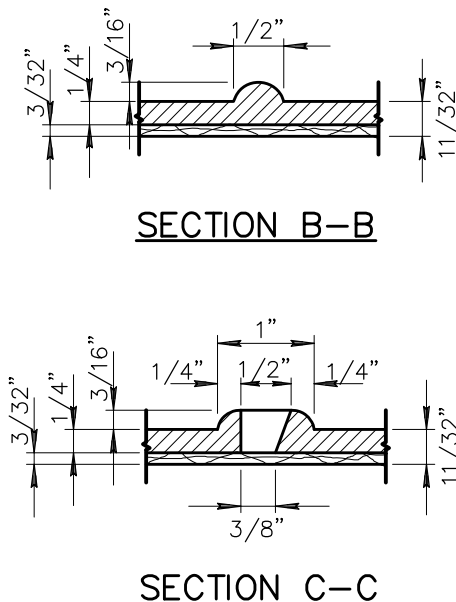
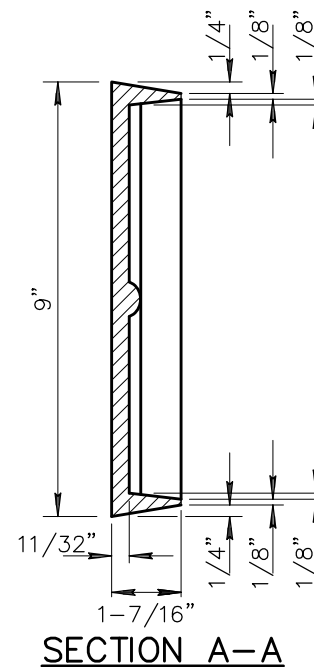
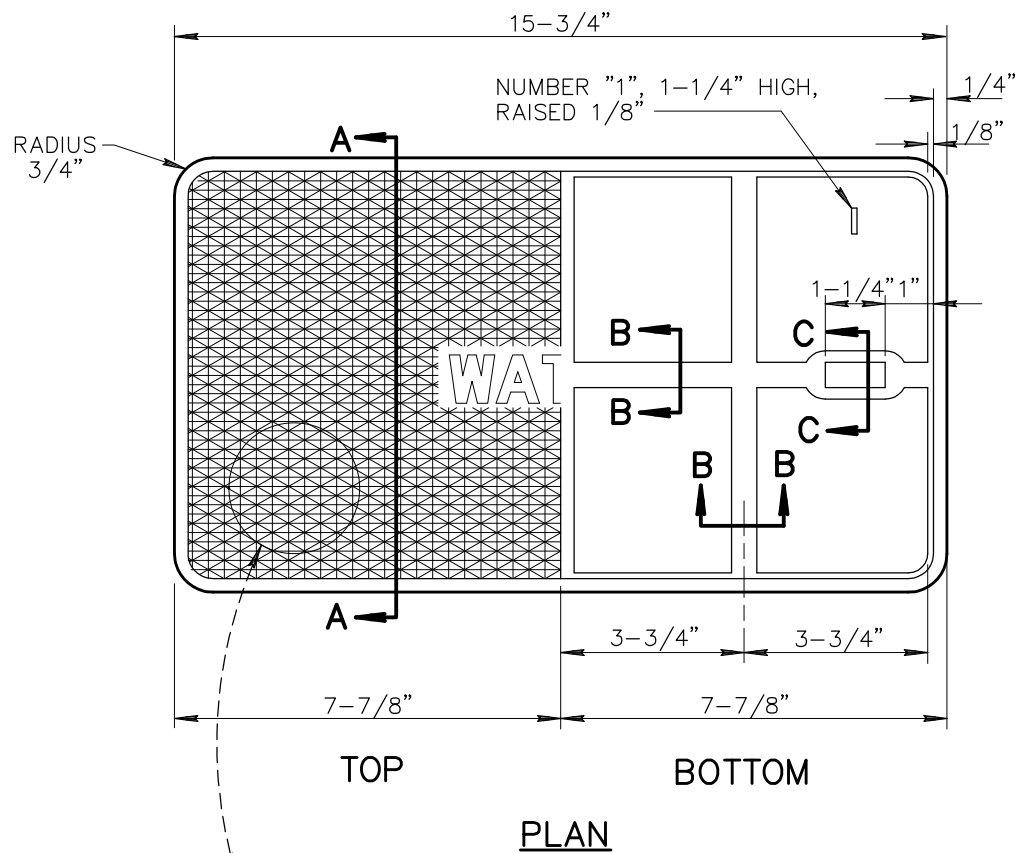
**JOINT RESTRAINT FOR DUCTILE IRON AND
POLYETHYLENE WRAPPED DUCTILE IRON WATER PIPES**

REVISED

01-01-1998

DETAIL NO.

303-2



DETAIL NO.

310



STANDARD DETAIL
ENGLISH

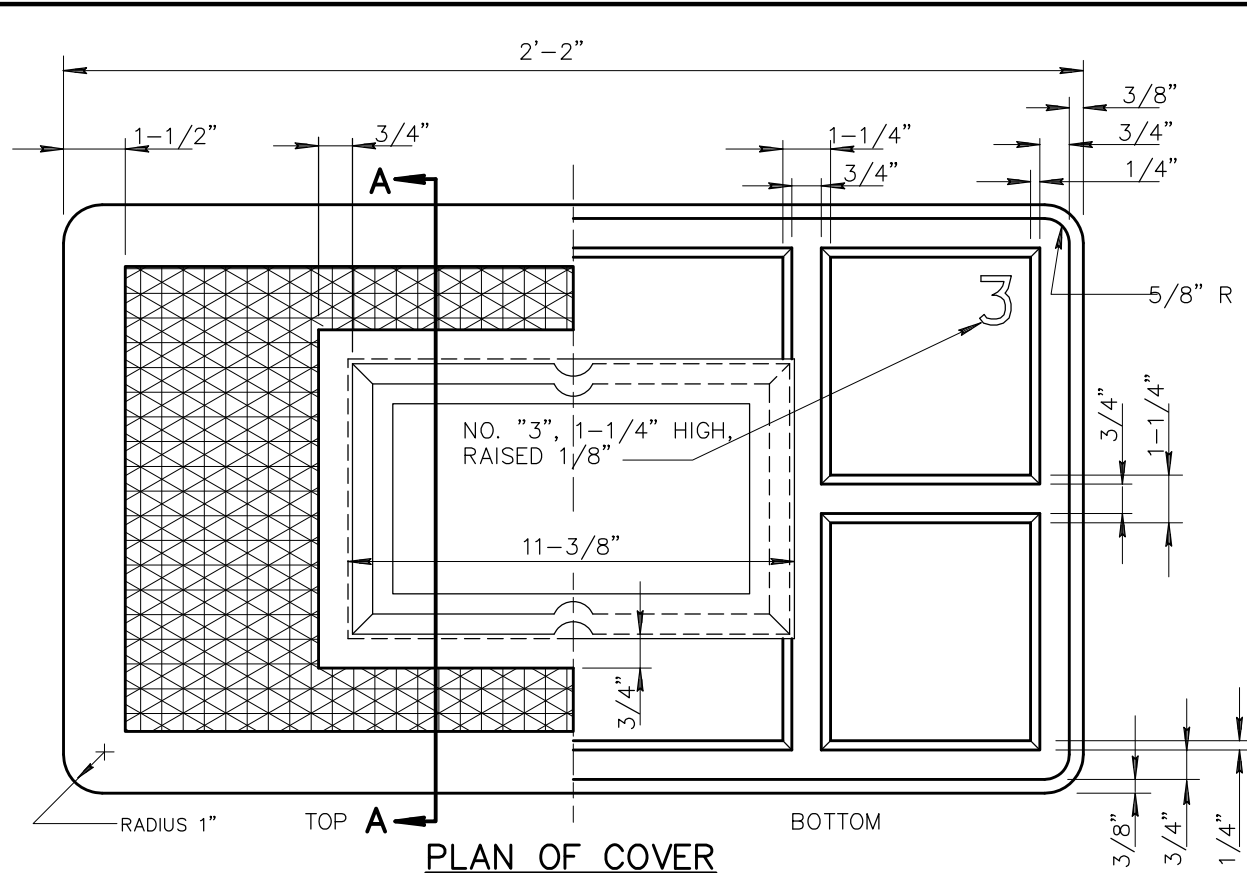
CAST IRON WATER METER BOX
COVER NO. 1

REVISED

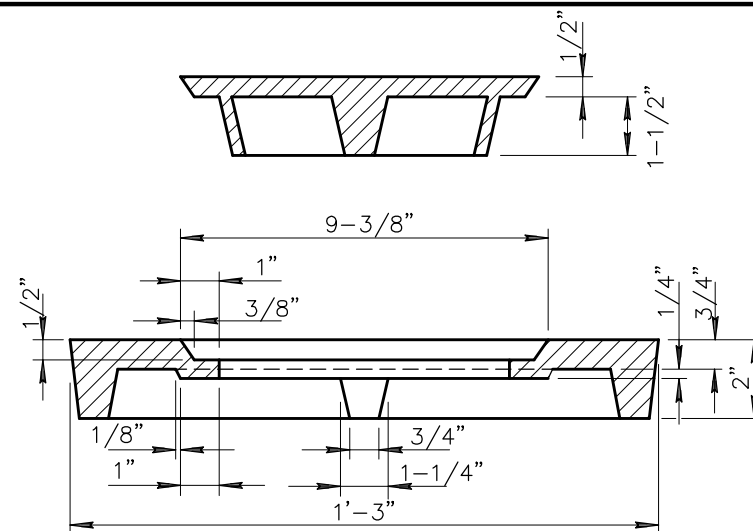
01-01-1998

DETAIL NO.

310



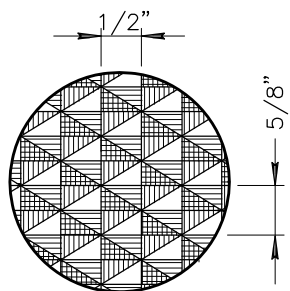
PLAN OF COVER



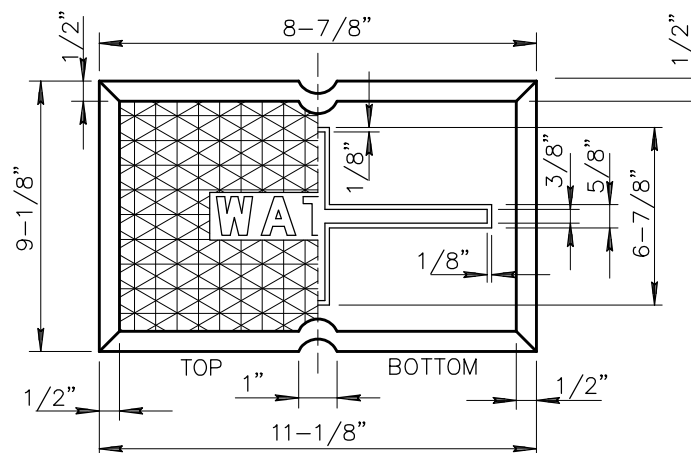
SECTION A-A

NOTES:

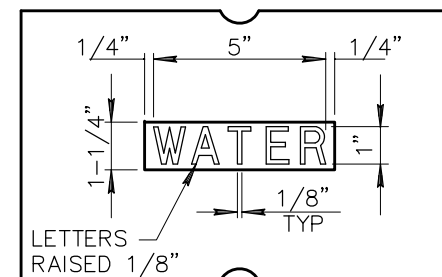
1. INSPECTION PLATE IS SAME AS USED WITH METER BOX COVER NO. 4.
2. FOR CASTING SPECIFICATIONS, SEE SECTION 787.
3. THE BEARING EDGES OF THESE CASTINGS SHALL BE MACHINED TO INSURE A FULL BEARING ON A FLAT SURFACE.



**DETAIL
TOP OF COVER & PLATE**



INSPECTION PLATE



LETTERING DETAIL

DETAIL NO.

312



STANDARD DETAIL
ENGLISH

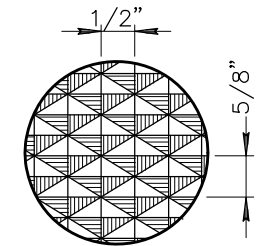
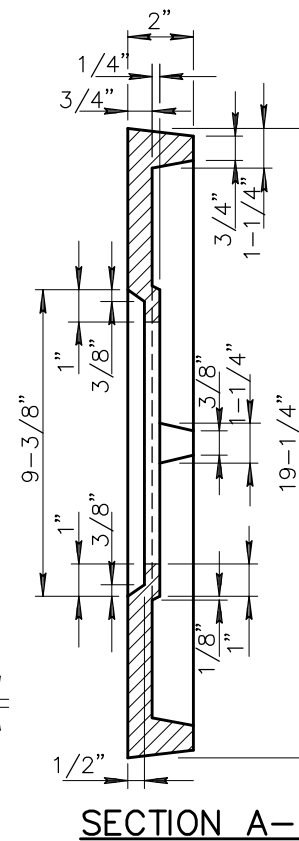
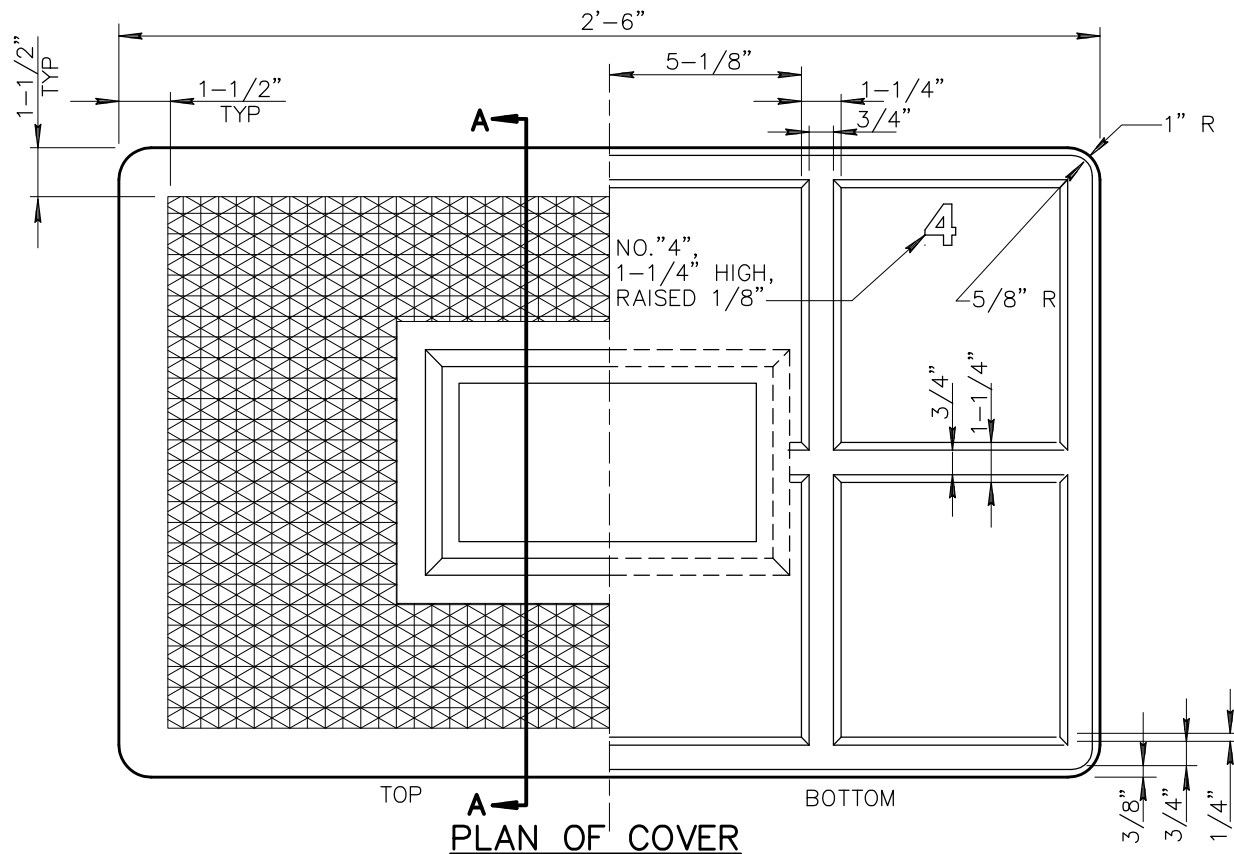
**CAST IRON WATER METER BOX
COVER NO. 3**

REVISED

01-01-1998

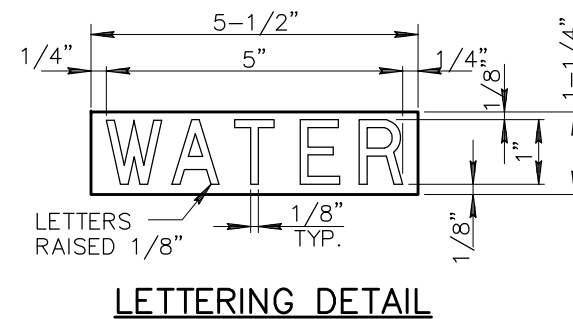
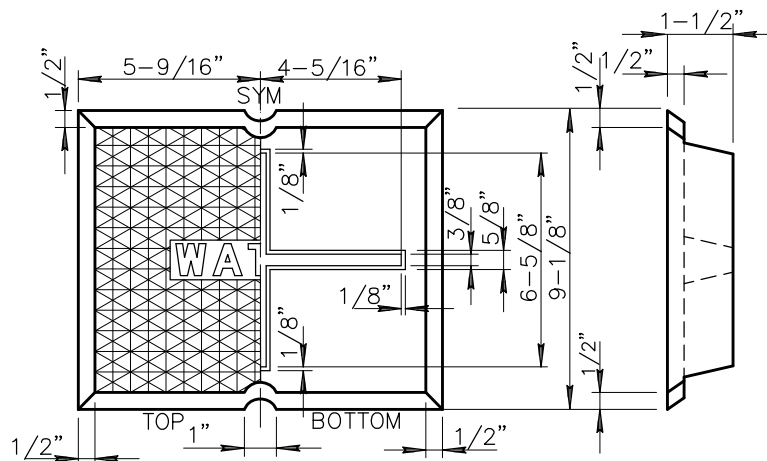
DETAIL NO.

312



NOTES:

1. FOR CASTING SPECIFICATIONS, SEE SECT. 787. THE BEARING
2. THE BEARING EDGES OF THESE CASTINGS SHALL BE MACHINED TO INSURE A FULL BEARING ON A FLAT SURFACE.



DETAIL NO.

313



STANDARD DETAIL
ENGLISH

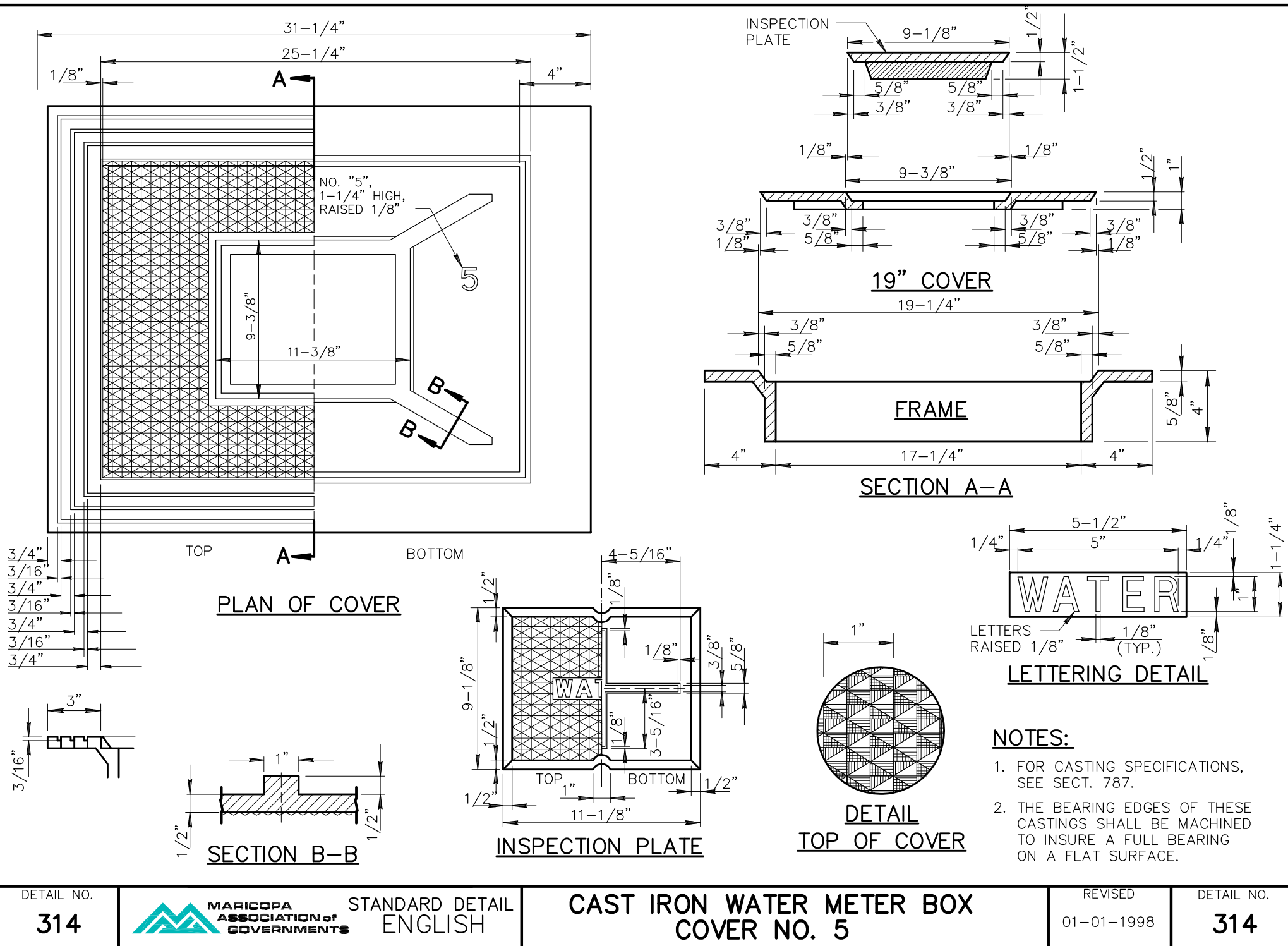
CAST IRON WATER METER BOX
COVER NO. 4

REVISED

01-01-1998

DETAIL NO.

313



DETAIL NO.

314



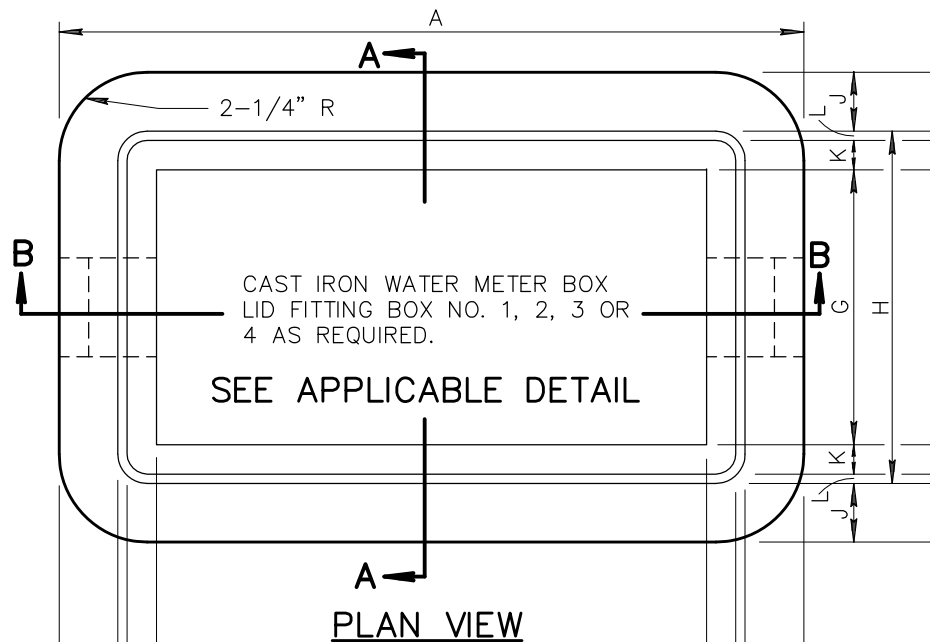
STANDARD DETAIL
ENGLISH

CAST IRON WATER METER BOX
COVER NO. 5

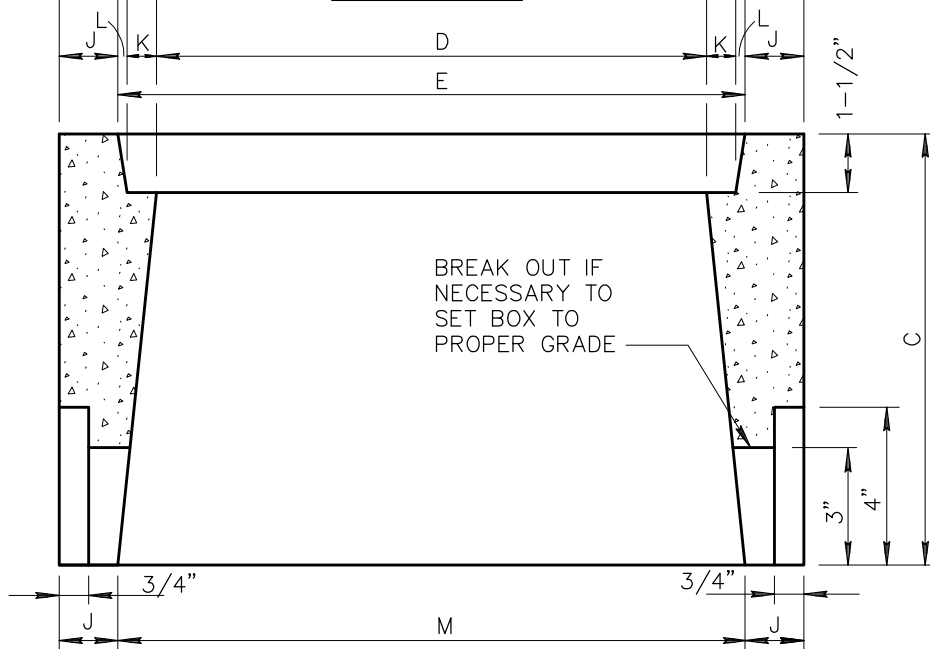
REVISED
01-01-1998

DETAIL NO.

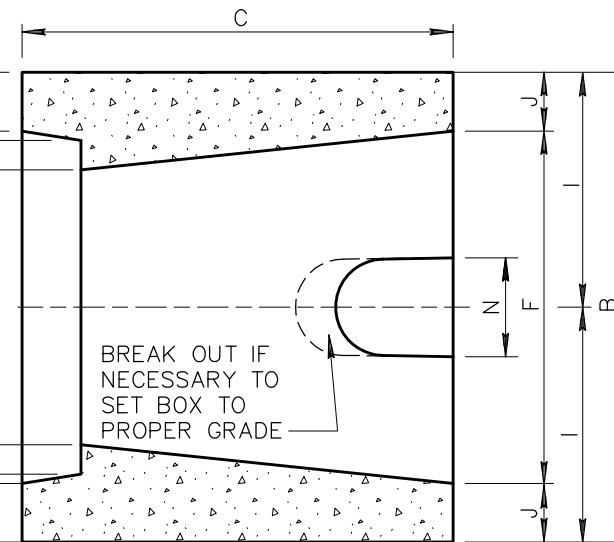
314



PLAN VIEW



SECTION B-B



SECTION A-A

NOTES:

1. THE METER BOXES SHALL CONFORM TO THE DIMENSIONS AS SHOWN AND SHALL BE MADE OF PORTLAND CEMENT CONCRETE POURED AND TAMPED (OR VIBRATED) IN TRUE FORMS.
2. USE CLASS 'AA' CONCRETE PER SECT. 725.

METER BOX DIMENSIONS				
DIMS	BOX NUMBER			
	1	2	3	4
A	19"	24-1/2"	29-1/2"	33-1/2"
B	12"	16-3/4"	18-1/2"	22-3/4"
C	11"	12"	13"	12"
D	14"	19"	23-3/4"	27-3/4"
E	16"	22"	26-1/2"	30-1/2"
F	9"	13-1/4"	15"	19-3/4"
G	7"	11-1/4"	12-3/4"	17"
H	9"	14-1/4"	15-1/2"	19-3/4"
I	6"	8-3/8"	9-1/4"	11-3/8"
J	1-1/2"	1-3/4"	1-3/4"	1-1/2"
K	3/4"	1-1/8"	1"	1"
L	1/4"	3/8"	3/8"	3/8"
M	16"	21"	25-1/2"	30-1/2"
N	2-1/2"	3-1/2"	4"	4"
	5/8" OR 3/4" METER	1" METER	1-1/2" METER	2" METER

DETAIL NO.

320



STANDARD DETAIL
ENGLISH

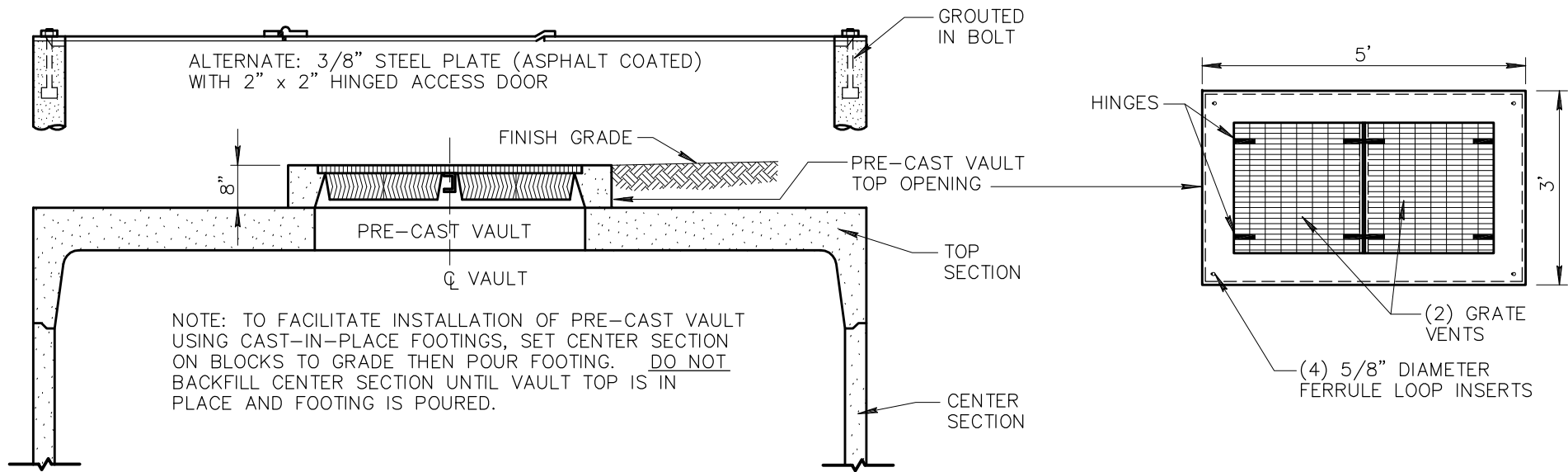
CONCRETE WATER METER BOXES

REVISED

01-01-1998

DETAIL NO.

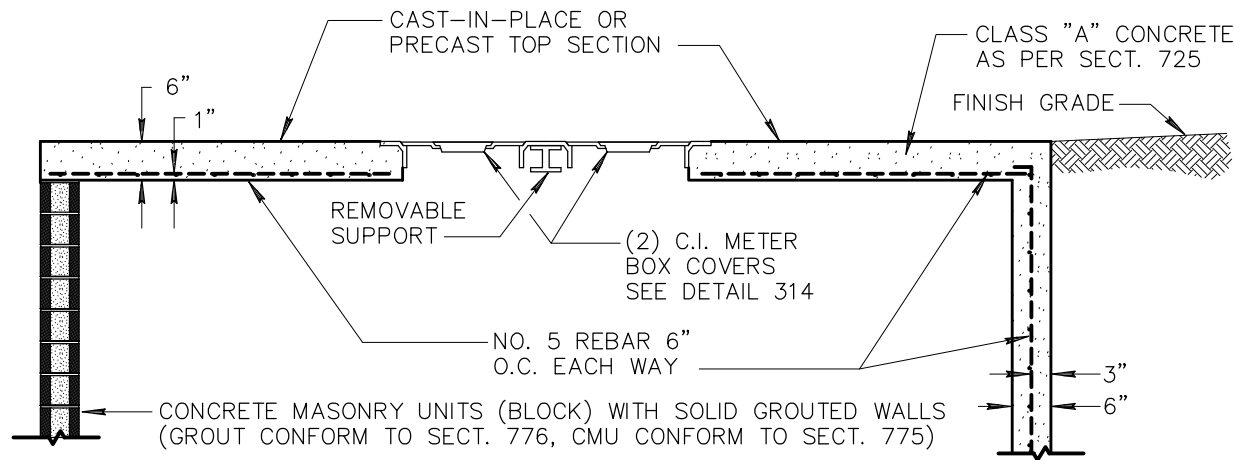
320



NOTE: TO FACILITATE INSTALLATION OF PRE-CAST VAULT USING CAST-IN-PLACE FOOTINGS, SET CENTER SECTION ON BLOCKS TO GRADE THEN POUR FOOTING. DO NOT BACKFILL CENTER SECTION UNTIL VAULT TOP IS IN PLACE AND FOOTING IS POURED.

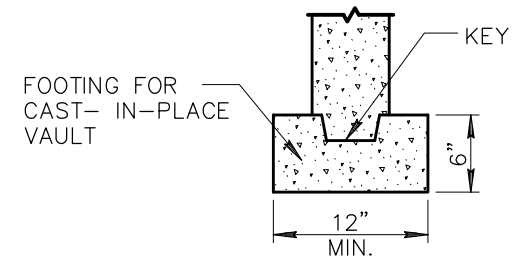
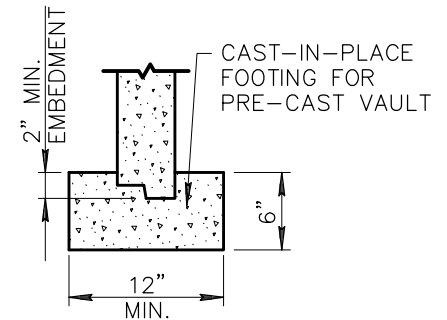
PRE-CAST VAULT SECTION

NOTE: PRECAST REINFORCED VAULT SECTIONS SHALL BE CONSTRUCTED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND DETAILS AS APPROVED BY ENGINEER.



BLOCK MASONRY MAY BE USED IN LIEU OF CAST-IN-PLACE VAULT WALLS, NO. 4 REBAR IN EVERY OTHER CORE.

CAST-IN-PLACE VAULT SECTION



DETAIL NO.

321



STANDARD DETAIL
ENGLISH

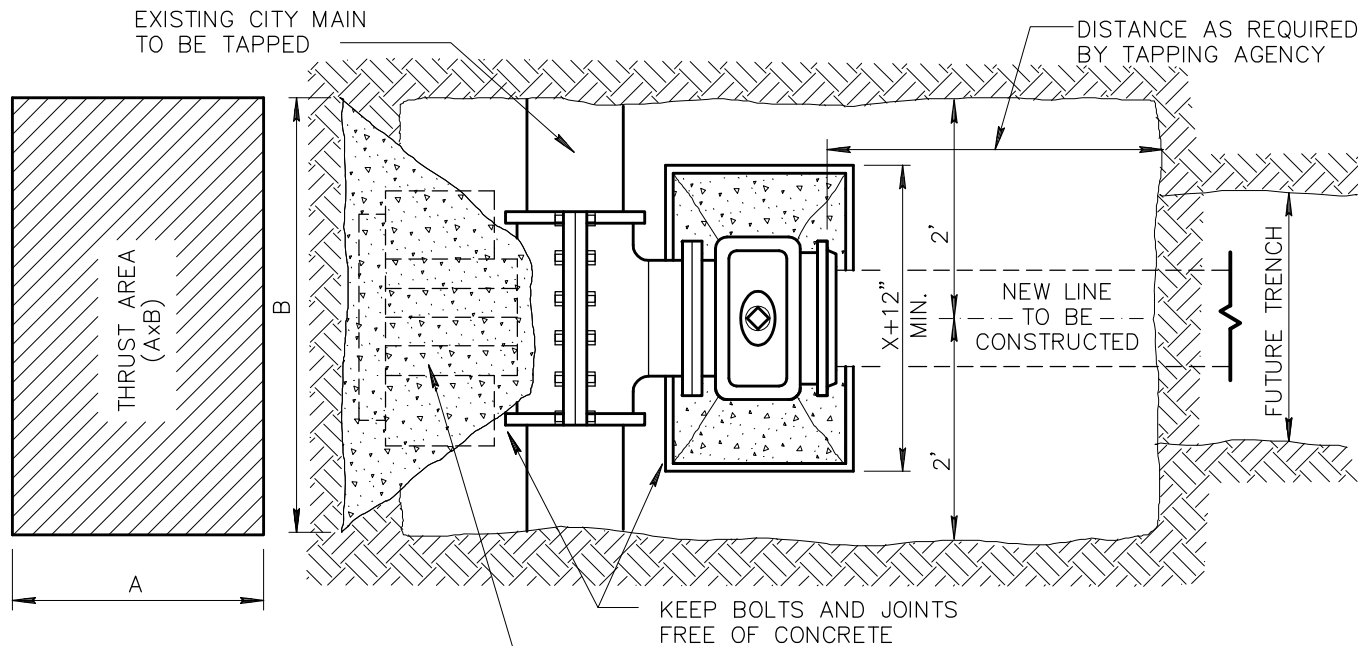
STANDARD WATER METER VAULT

REVISED

01-01-1998

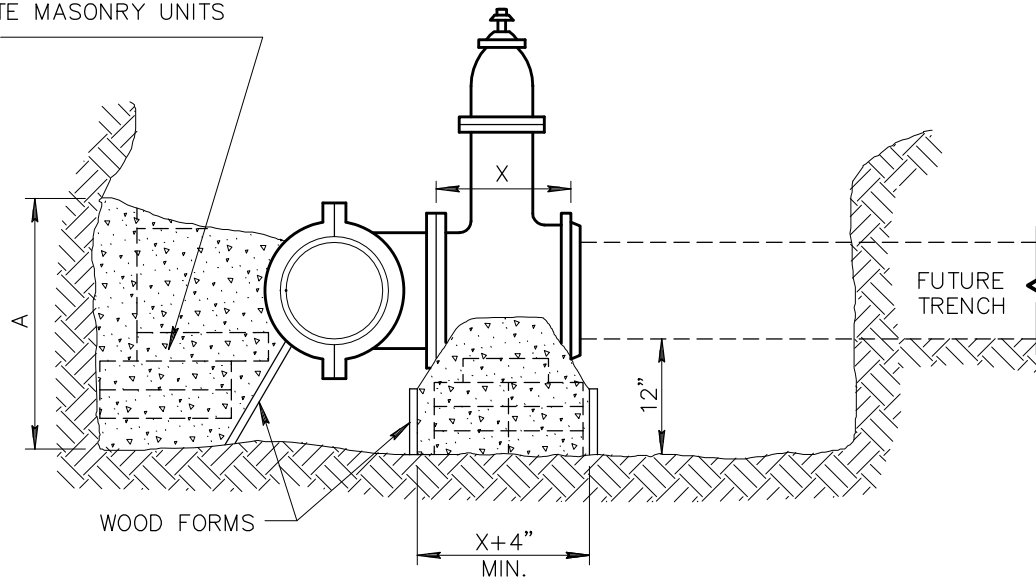
DETAIL NO.

321



PLAN

OPTIONAL BLOCKING – 2" x 8" x 12"
SOLID CONCRETE MASONRY UNITS
AS INDICATED.



ELEVATION

NOTES:

1. TAPPING SLEEVE TO BE PLACED A MINIMUM OF 18" FROM ANY BELL COUPLING, VALVE, FITTING OR OTHER OBSTRUCTION
2. CONTRACTOR SHALL EXCAVATE AS SHOWN AND SHALL SET TAPPING SLEEVE AND VALVE AND TIGHTEN ALL BOLTS PRIOR TO THE PRESSURE TEST.
3. ALL TAPPING SLEEVES AND VALVES MUST BE PRESSURE TESTED PRIOR TO BLOCKING OR TAPPING. THE TEST MUST BE WITNESSED AND APPROVED BY THE INSPECTOR.
4. BLOCKS ARE TO EXTEND TO UNDISTURBED GROUND AND BE INSTALLED BEFORE THE TAP IS MADE. ALL FLANGE BOLTS SHALL BE FREE AND CLEAR OF CONCRETE.
5. CONCRETE THRUST BLOCKS SHALL BE CLASS 'B' PER SECT. 725. NORMALLY, CURE TIME FOR CONCRETE IS 24 HOURS BEFORE BACKFILLING.
6. TAPS SHALL BE MADE BY CITY CREWS AT PREVAILING RATES OR BY APPROVED CONTRACTORS WHEN ALLOWED BY AGENCY.
7. THIS DETAIL COVERS TAPPING SLEEVES 4" THROUGH 16" IN SIZE ON DUCTILE IRON, CAST IRON AND ASBESTOS CEMENT PIPE. ANY OTHER SIZE OR TYPE OF PIPE WILL REQUIRE A SEPARATE SUBMITTAL AND APPROVAL BY THE ENGINEER.

SIZE OF PIPE BEING CONNECTED	MINIMUM THRUST AREA REQUIRED EQUALS (AxB) (SQUARE FEET)
4" AND LESS	3
6"	4
8"	6
10"	9
12"	13
16"	23

DETAIL NO.

340



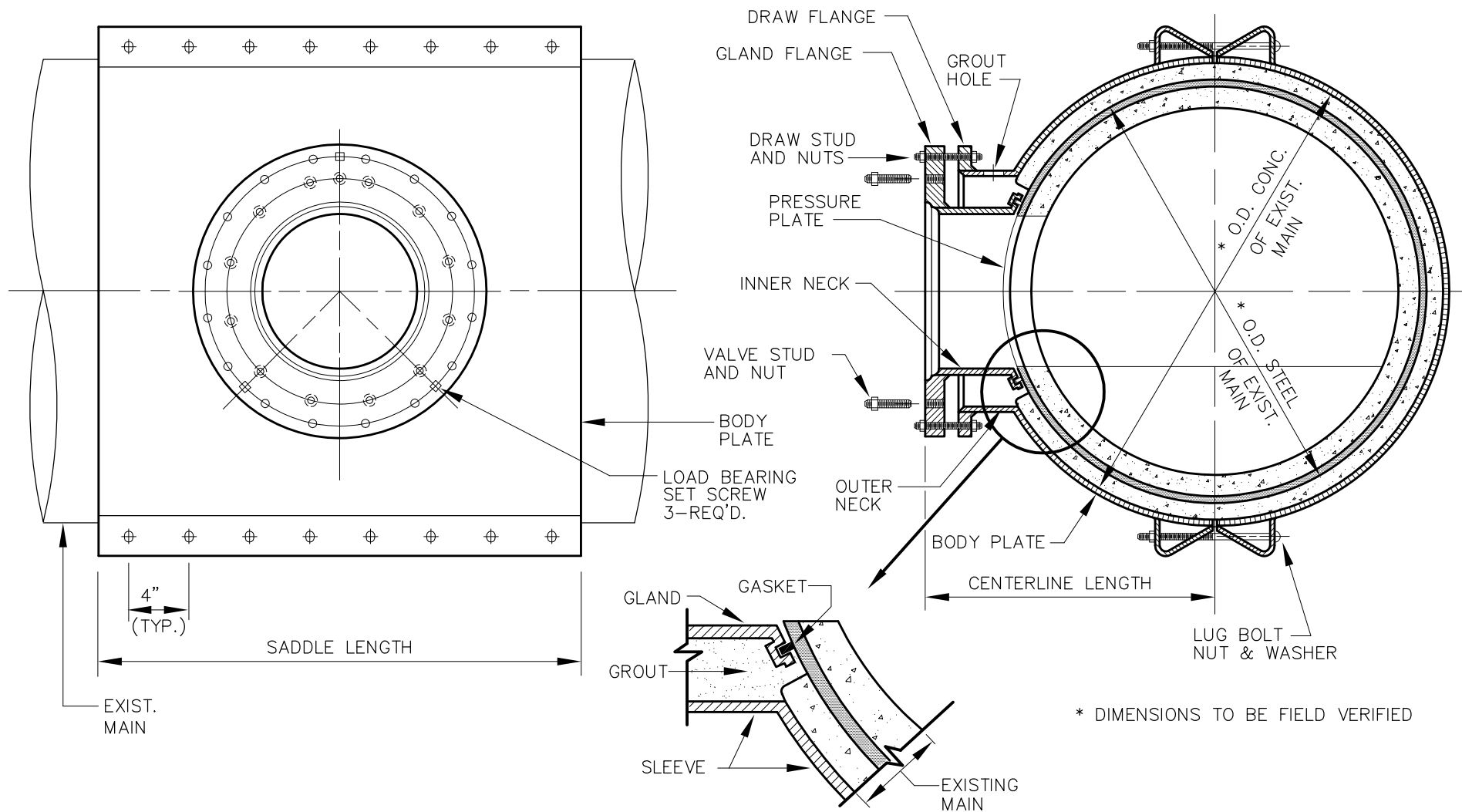
STANDARD DETAIL
ENGLISH

**INSTALLING TAPPING
SLEEVES AND VALVES**

REVISED
01-03-2002

DETAIL NO.

340



DETAIL NO.

342



STANDARD DETAIL
 ENGLISH

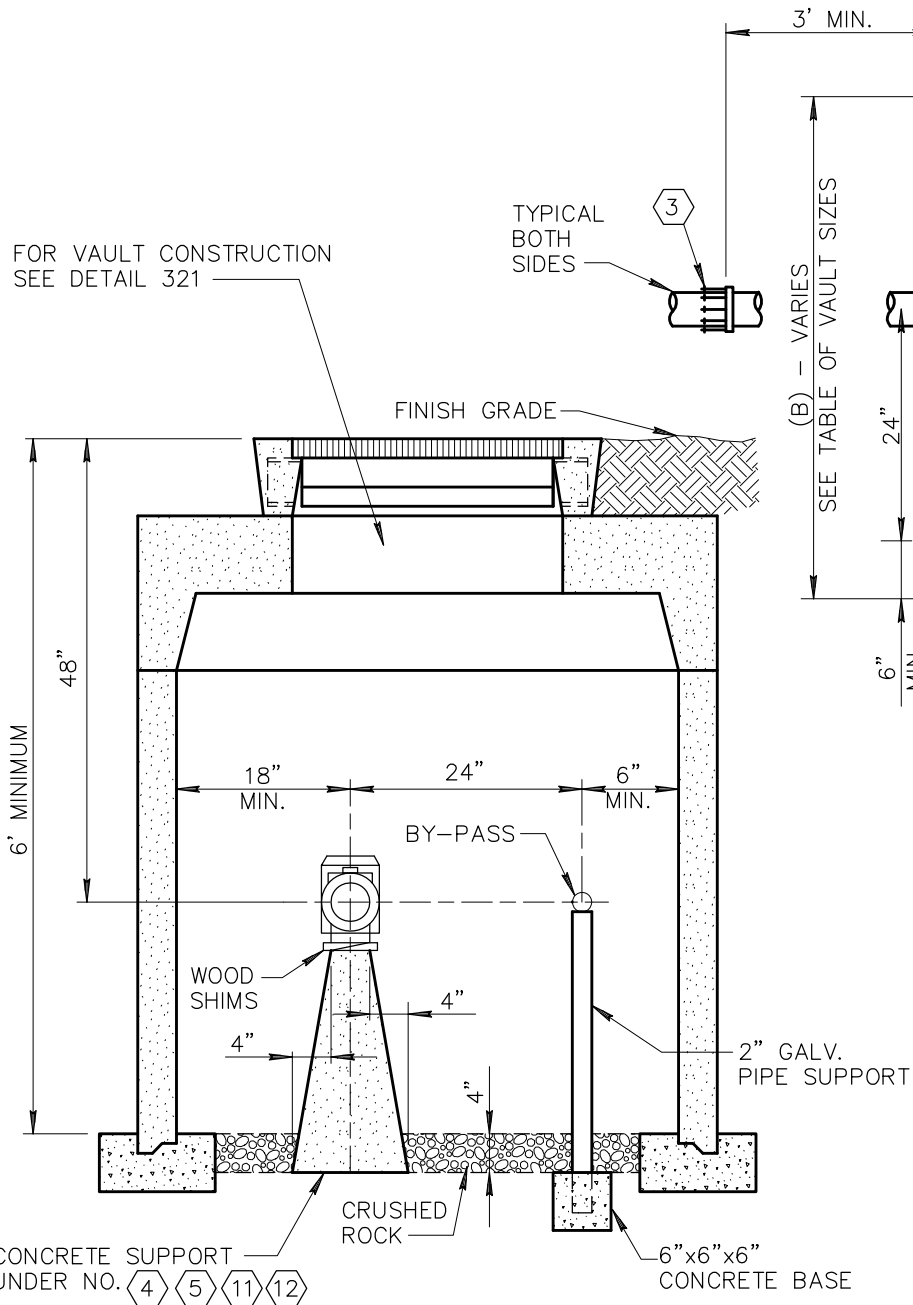
CONCRETE PRESSURE PIPE TAPPING SLEEVE

REVISED

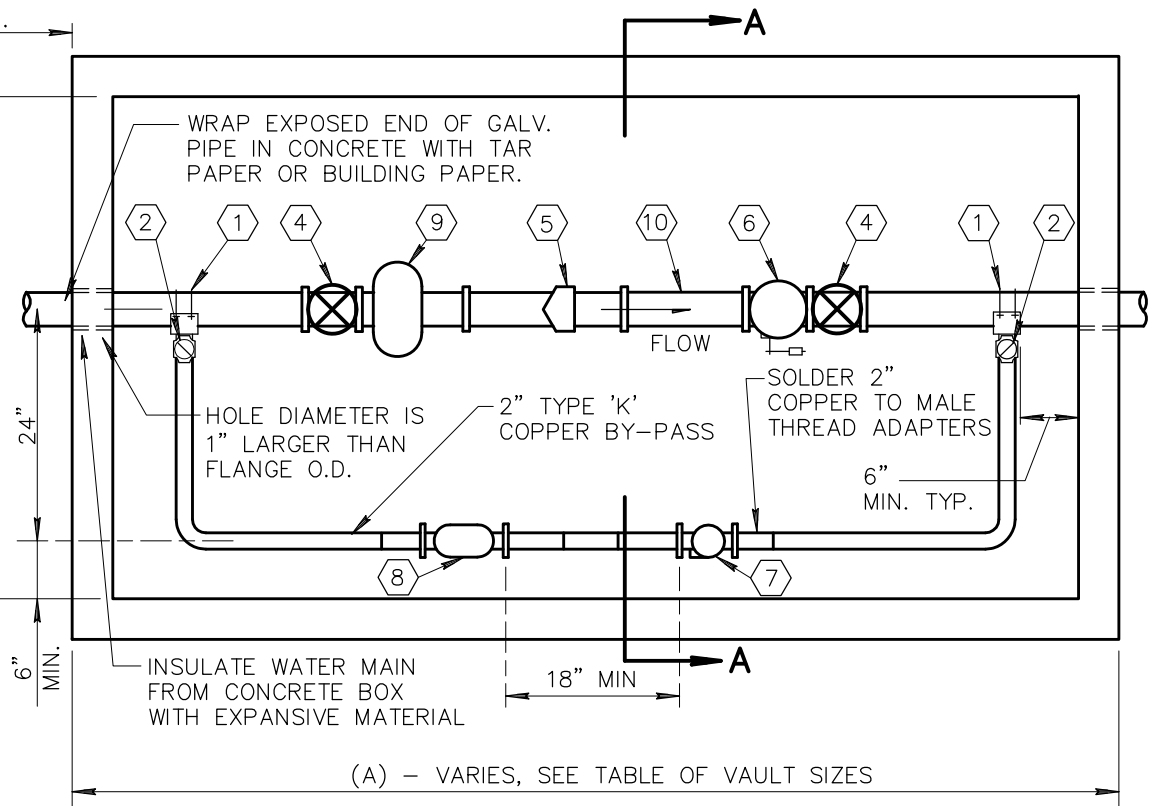
01-01-1998

DETAIL NO.

342



SECTION A-A

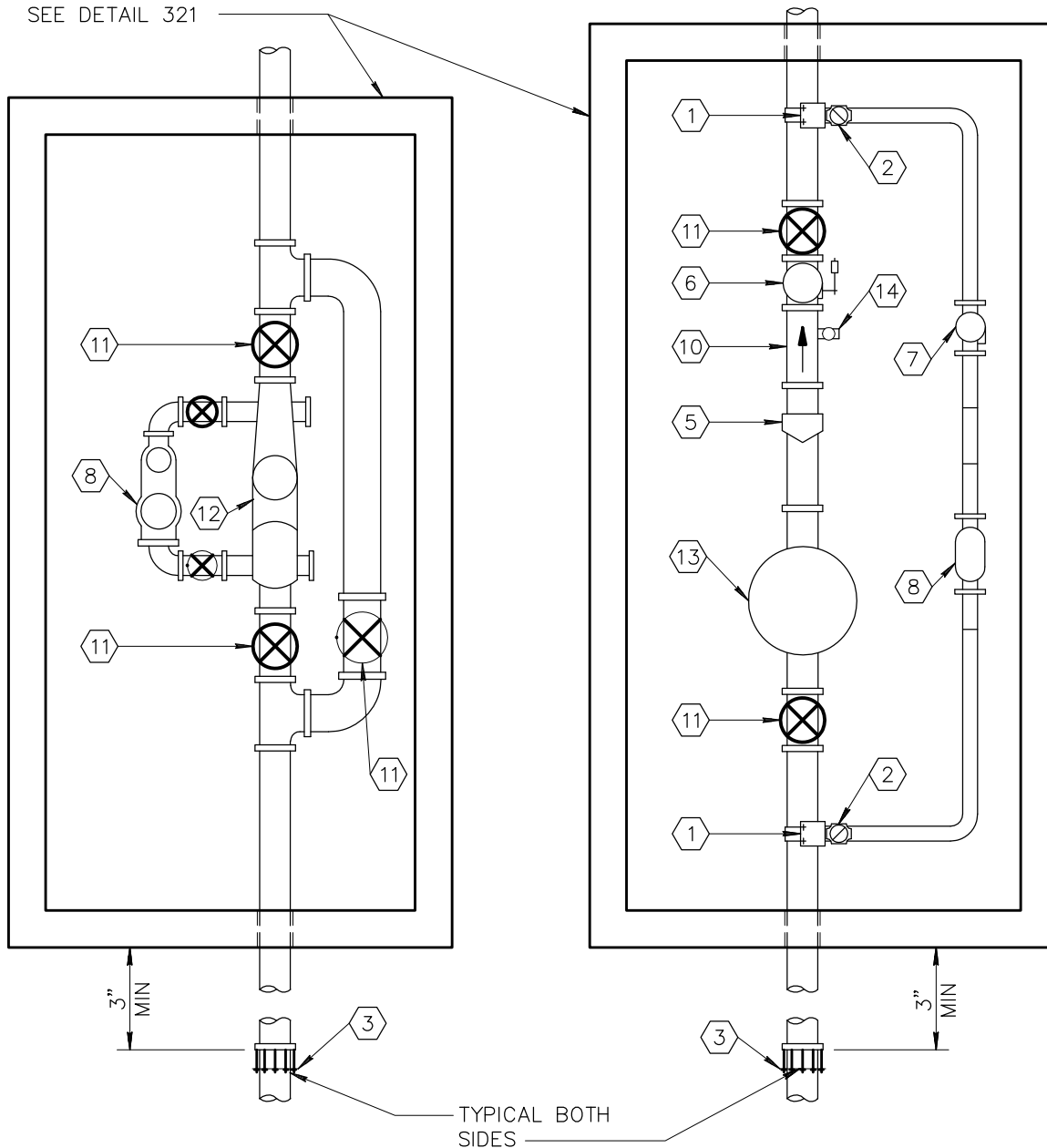


VAULT DIMENSION DETAILS

A.C.P. SIZE	3"	4"	6"
(A)	8'-4"	10'-6"	12'-0"
(B)	4'-4"	5'-0"	5'-0"

NOTE: METER VAULTS MAY BE EITHER CONCRETE MASONRY UNITS OR CAST-IN-PLACE OR PRE-CAST CONCRETE, SEE DETAIL 321 FOR VAULT CONSTRUCTION.

FOR VAULT CONSTRUCTION
SEE DETAIL 321



LEGEND

- ① DOUBLE STRAP ALL BRONZE SERVICE SADDLES.
- ② CORP. STOP, 2" (BALL TYPE).
- ③ ADAPTER, FLANGED, TO MECH. JOINT FOR A.C.P.
- ④ GATE VALVE, FLANGED, WITH HAND WHEEL, OPEN LEFT.
- ⑤ TURBOMETER: ROCKWELL SERIES 'W' OR HERSEY SERIES 'M.H.R.' OR NEPTUNE TRIDENT TURBINE.
- ⑥ FLANGED SWING CHECK VALVE WITH EXTERNAL LEVER AND WEIGHT.
- ⑦ 2" BRONZE CHECK VALVE.
- ⑧ 2" TURBOMETER: ROCKWELL 'W-160' OR HERSEY 'M.H.R.' OR NEPTUNE TRIDENT TURBINE.
- ⑨ STRAINER (3", 4", 6") AVAILABLE FROM METER MANUFACTURER, INSTALL ONLY WHEN 'TURBO' IS USED.
- ⑩ FLANGED SPOOL (3 PIPE DIAMETERS IN LENGTH).
- ⑪ O.S.&Y. GATE VALVE, FLANGED WITH HAND WHEEL OPEN LEFT, AND RISING STEM.
- ⑫ TURBOMETER U.L. APPROVED: ROCKWELL W-5000 DR. OR W-2000 DR. OR HERSEY F.M.-C.T. OR NEPTUNE TURBINE-F.S.-U.L.
- ⑬ 6" OR 10" STRAINER, U.L. APPROVED.
- ⑭ 2" THREADED OUTLET AND GATE VALVE.

NOTES

1. FOR LARGER METERS, SPECIAL VAULT DESIGN IS REQUIRED.
2. USE OF REMOTE READING DEVICE AT OPTION OF UTILTY.
3. CERTAIN AGENCIES AND/OR UTILITIES PREFER TO CONSTRUCT VAULT, CONTACT AGENCY INVOLVED PRIOR TO VAULT CONSTRUCTION.

DETAIL NO.

345-2



STANDARD DETAIL
ENGLISH

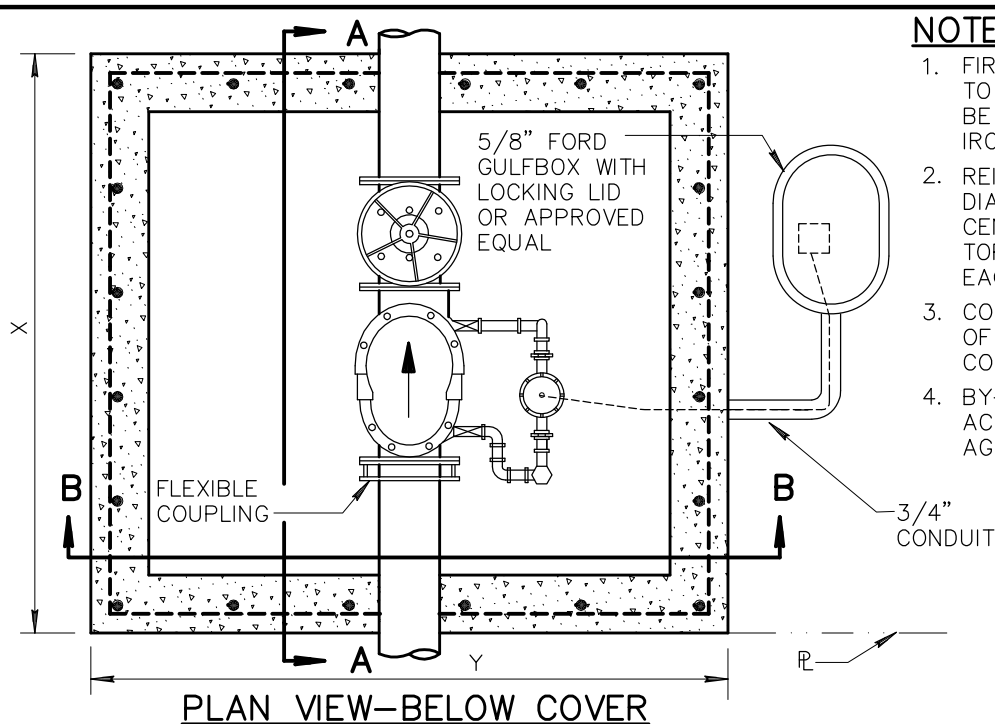
4", 6" WATER METER
WITH ON-SITE FIRE HYDRANTS

REVISED

01-01-1998

DETAIL NO.

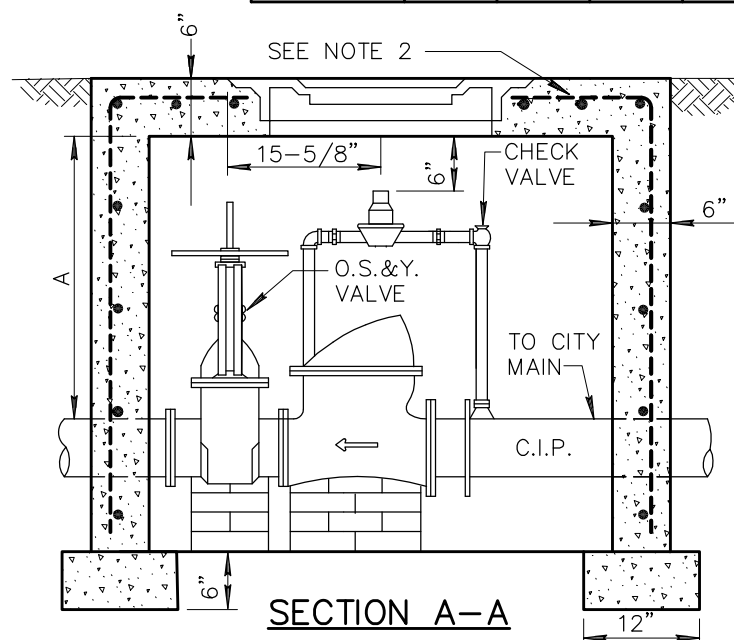
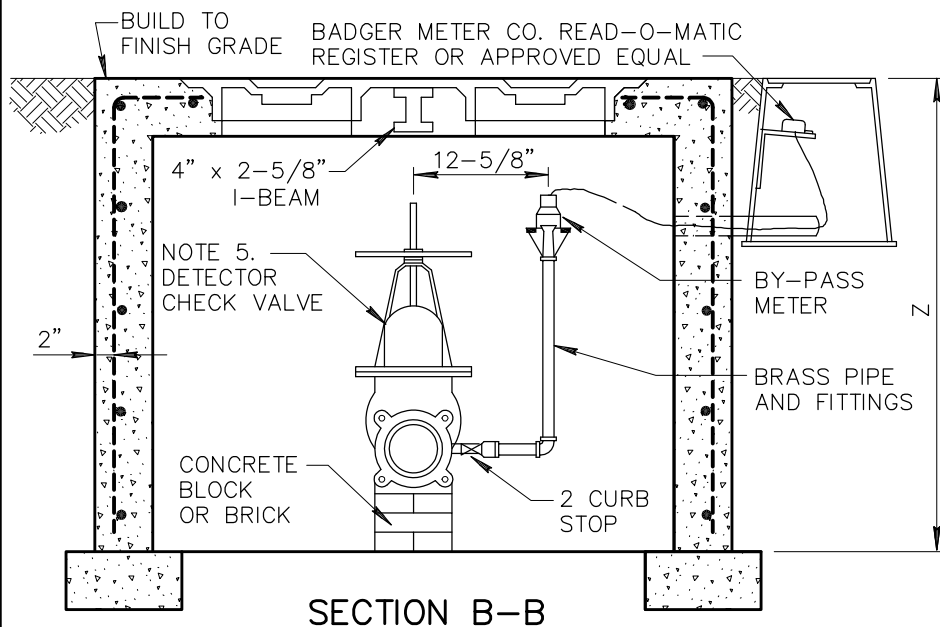
345-2



NOTES:

1. FIRELINE FROM CITY MAIN TO PROPERTY LINE SHALL BE CONSTRUCTED OF CAST IRON PIPE.
2. REINFORCING TO BE 1/2" DIAMETER REBAR ON 6" CENTERS EACH WAY ON TOP AND 12" CENTERS EACH WAY ON THE SIDES.
3. COVERS TO CONSIST OF TWO METER BOX COVERS DET. 314.
4. BY-PASS METER TO BE ACCORDING TO GOVERNING AGENCY.
5. CHECK VALVE TO BE GLOBE MODEL "A" GRINNEL, HERSEY MODEL D.C., VIKING MODEL "A" OR APPROVED EQUAL.
6. VAULT SHALL BE CONSTRUCTED IN OWNERS PROPERTY AGAINST THE FRONT PROPERTY LINE OR ANOTHER APPROVED LOCATION. WALLS AND FENCES SHALL NOT OBSTRUCT ACCESS.
7. CITY CONTROL VALVE TO BE REQUIRED AT MAIN.
8. PARTS OF PIPE TO BE EMBEDDED IN CONC. SHALL BE WRAPPED WITH 30 LB ASPHALT ROOFING FELT.
9. REMOTE READING DEVICE SHALL BE OF SELF GENERATING ELECTRICAL TYPE. HYDRAULIC OR MECHANICAL DRIVE REGISTERS WILL NOT BE ACCEPTABLE.
10. CONCRETE TO BE CLASS 'B' PER SECT. 725.

DIA. OF PIPE	X	Y	Z	BY-PASS METER SIZE	A
4"	60"	66"	49"	5/8" x 3/4"	30"
6"	66"	72"	49"	5/8" x 3/4"	30"
8"	72"	72"	58"	1"	36"
10"	78"	72"	69"	1-1/2"	36"



DETAIL NO.

346



STANDARD DETAIL
ENGLISH

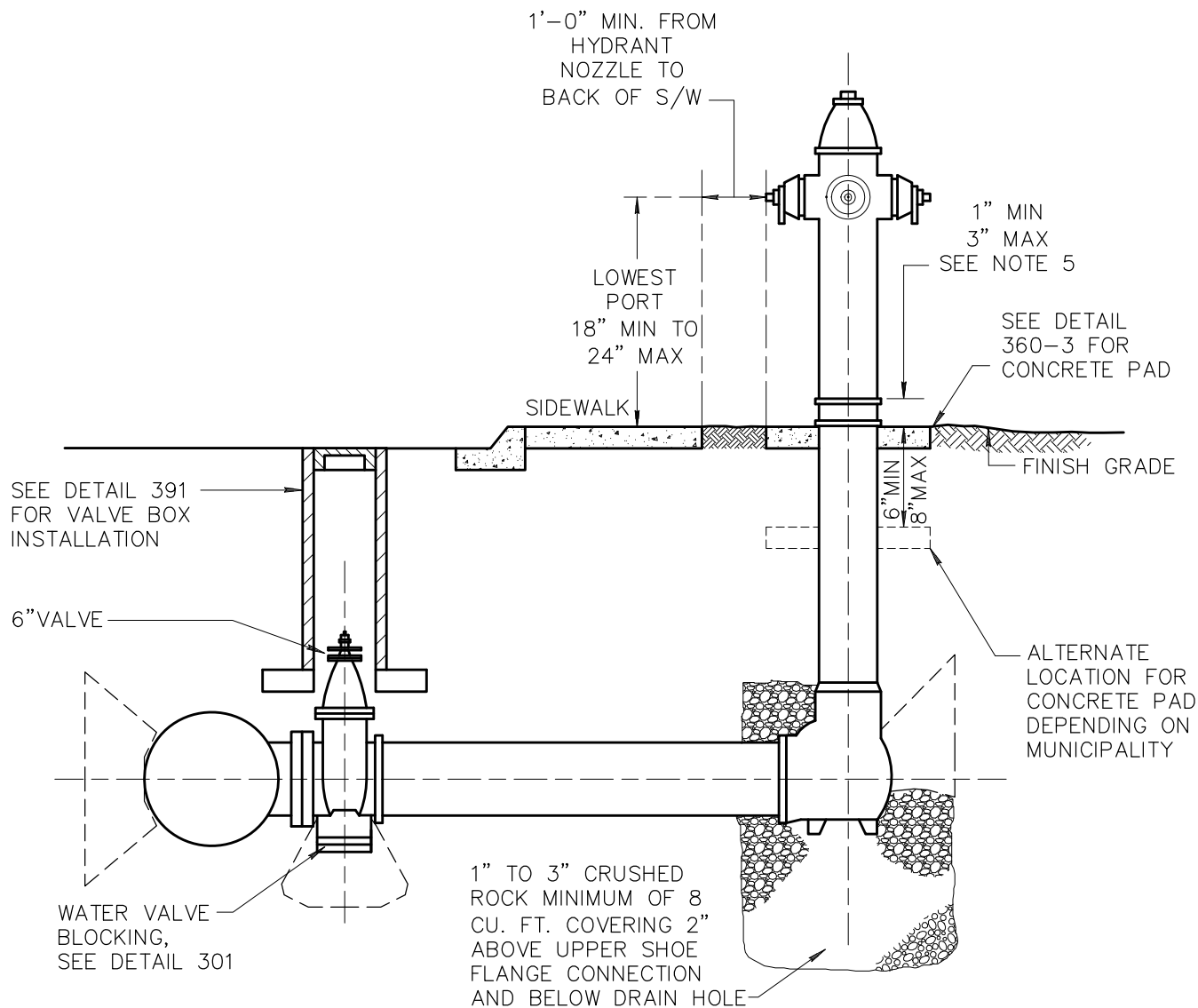
FIRE LINE DETECTOR CHECK VAULT

REVISED

01-01-1998

DETAIL NO.

346



NOTES:

1. JOINTS BETWEEN THE VALVE AND THE MAIN SHALL BE FLANGED TYPE. JOINTS BETWEEN THE VALVE AND HYDRANT SHALL BE RESTRAINT OR MECHANICAL TYPE.
2. RESTRAINTS SHALL BE MECHANICAL RESTRAINT OR THRUST BLOCK PER DETAIL 380.
3. A FLANGE JOINT BY MECHANICAL JOINT VALVE SHALL BE USED AS THE TRANSITION BETWEEN THE JOINT TYPES.
4. PIPING BETWEEN WATER VALVE AND HYDRANT SHALL BE DUCTILE IRON.
5. SEE DETAIL 362 FOR LOCATION OF HYDRANT.
6. PUMPER CONNECTION SHALL FACE THE STREET.
7. NO VALVES ARE TO BE LOCATED IN CURB.
8. NATIONAL STANDARD THREADS REQUIRED ON ALL CONNECTIONS UNLESS OTHERWISE DIRECTED.
9. SEE DETAIL 360-3 FOR CONCRETE PAD.
10. FIRE HYDRANT SHALL BE FRESHLY PAINTED PRIOR TO FINAL ACCEPTANCE.
11. SEE SECTION 756 FOR HYDRANT MATERIAL.

DETAIL NO.

360-1



STANDARD DETAIL
ENGLISH

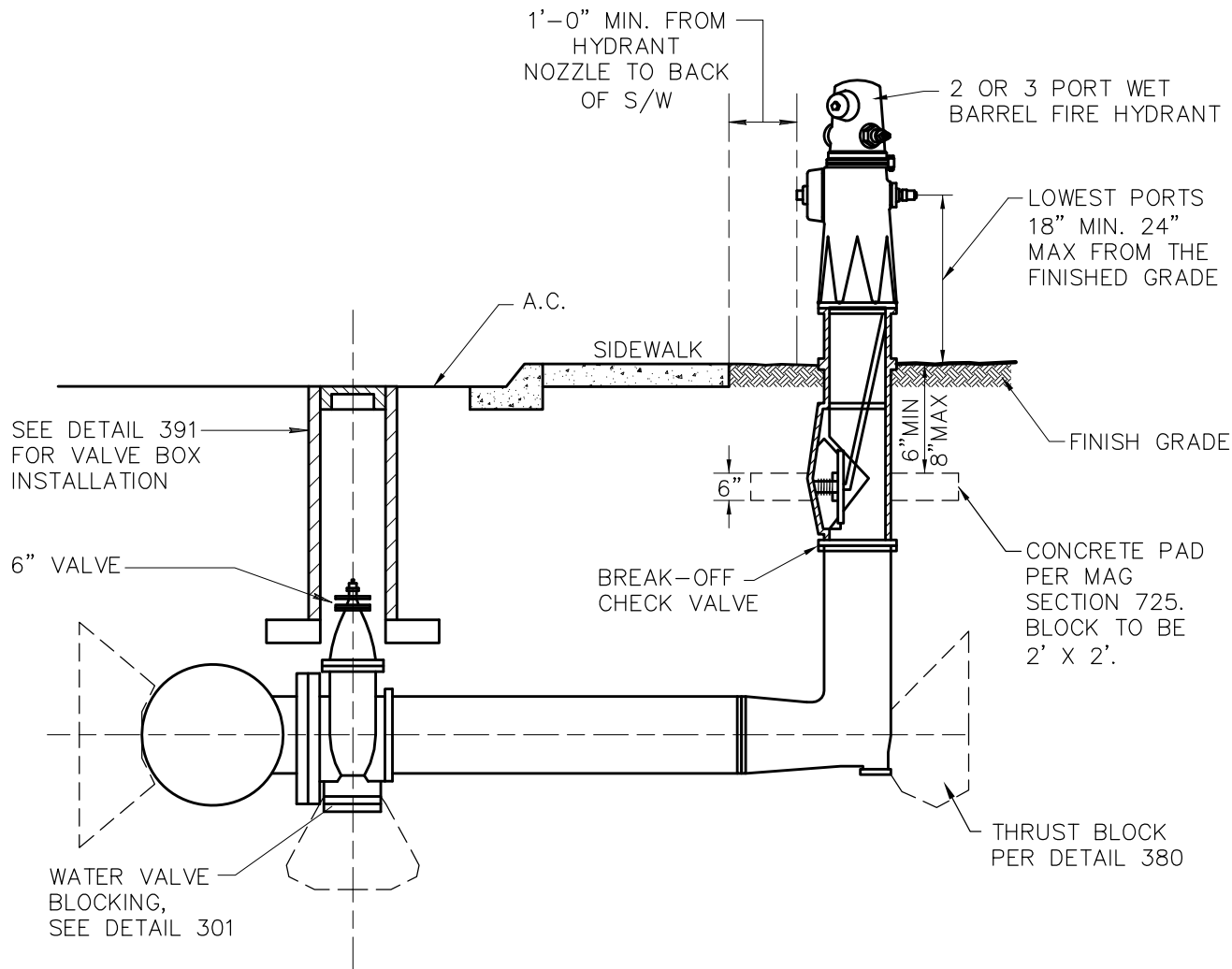
DRY BARREL FIRE HYDRANT INSTALLATION

REVISED

01-01-2013

DETAIL NO.

360-1



NOTES:

1. JOINTS BETWEEN THE VALVE AND THE MAIN SHALL BE FLANGED TYPE. JOINTS BETWEEN THE VALVE AND HYDRANT SHALL BE MECHANICAL RESTRAINT MECHANICAL TYPE.
2. RESTRAINTS SHALL BE MECHANICAL RESTRAINT OR THRUST BLOCK PER DETAIL 380.
3. A FLANGE JOINT BY MECHANICAL JOINT VALVE SHALL BE USED AS THE TRANSITION BETWEEN THE JOINT TYPES.
4. PIPING BETWEEN WATER VALVE AND HYDRANT SHALL BE DUCTILE IRON.
5. SEE DETAIL 362 FOR LOCATION OF HYDRANT.
6. PUMPER CONNECTION SHALL FACE THE STREET.
7. NO VALVES ARE TO BE LOCATED IN CURB.
8. NATIONAL STANDARD THREADS REQUIRED ON ALL CONNECTIONS UNLESS OTHERWISE DIRECTED.
9. SEE DETAIL 360-3 FOR CONCRETE PAD.
10. FIRE HYDRANT SHALL BE FRESHLY PAINTED PRIOR TO FINAL ACCEPTANCE.
11. THE HYDRANT SHALL HAVE 2- 2½" PORT AND 1- 4½" PORT (INDUSTRIAL OR COMMERCIAL).
12. THE HYDRANT SHALL HAVE 1- 2½" PORT AND 1- 4½" PORT (RESIDENTIAL).

DETAIL NO.

360-2



STANDARD DETAIL
ENGLISH

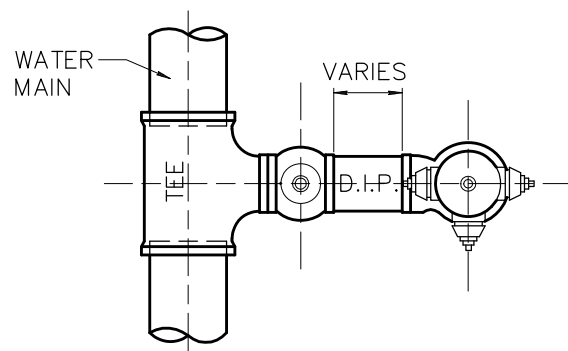
WET BARREL FIRE HYDRANT INSTALLATION

REVISED

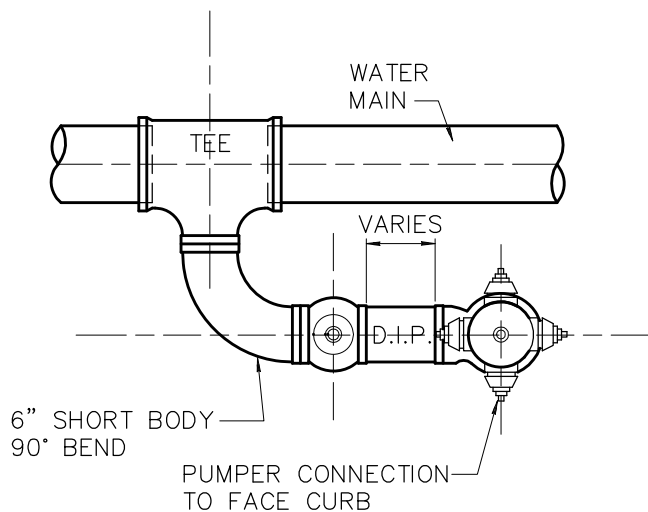
01-01-2013

DETAIL NO.

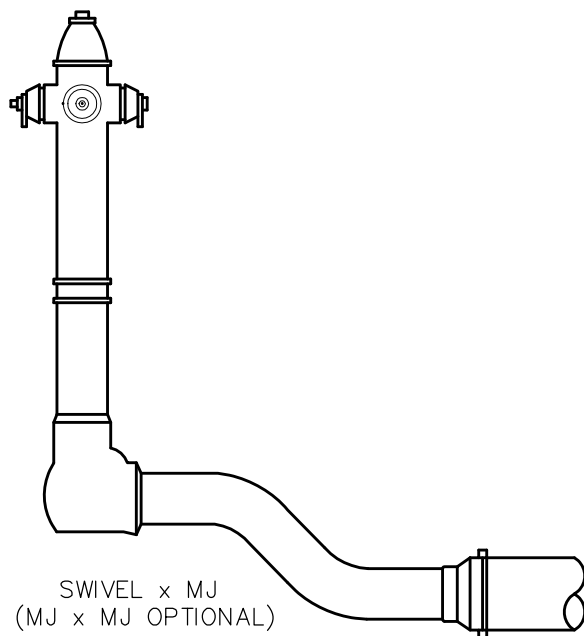
360-2



**TYP MAIN CONNECTION
(PREFERRED)**

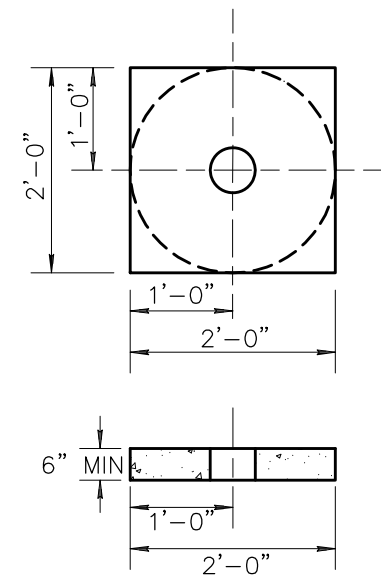


**ALT MAIN
CONNECTION**



OFFSET FITTINGS

SQUARE OR ROUND IS ACCEPTABLE
IF ROUND: 24" DIAMETER MIN. REQUIRED



**CONCRETE PAD
LOCATION DETAIL**

NOTES:

1. CONCRETE FOR PAD SHALL BE CLASS "A".
2. SCORE LINE SHALL BISECT CONCRETE PAD AT MID POINT OF ALL SIDES.
3. CONCRETE COLOR SHALL MATCH ADJACENT CONCRETE. THE FINISHED CONCRETE SURFACE SHALL HAVE A ROUGH BROOM FINISH (SURFACE ONLY).
4. MULTIPLE OFFSET FITTINGS SHALL NOT BE ALLOWED.
5. MINIMUM 36" CLEARANCE PER NFPA-24 AROUND FIRE HYDRANT.
6. 1/2" BITUMINOUS EXPANSION SHALL BE PLACED AROUND THE BARREL OF THE FIRE HYDRANT AT THE CONCRETE PAD.

DETAIL NO.

360-3



STANDARD DETAIL
ENGLISH

FIRE HYDRANT INSTALLATION DETAILS

REVISED

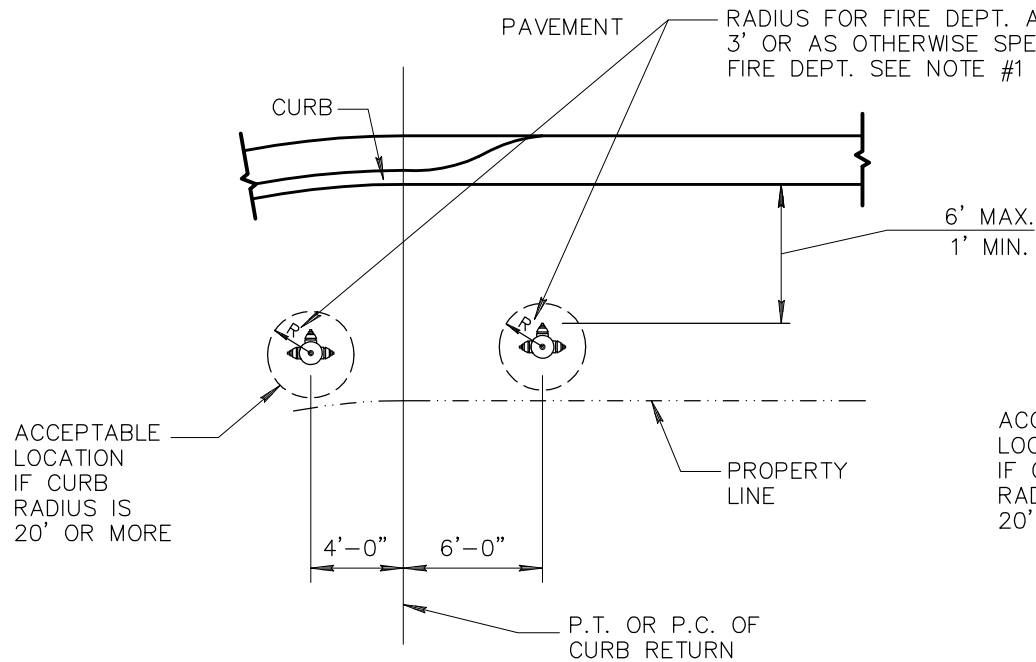
01-01-2013

DETAIL NO.

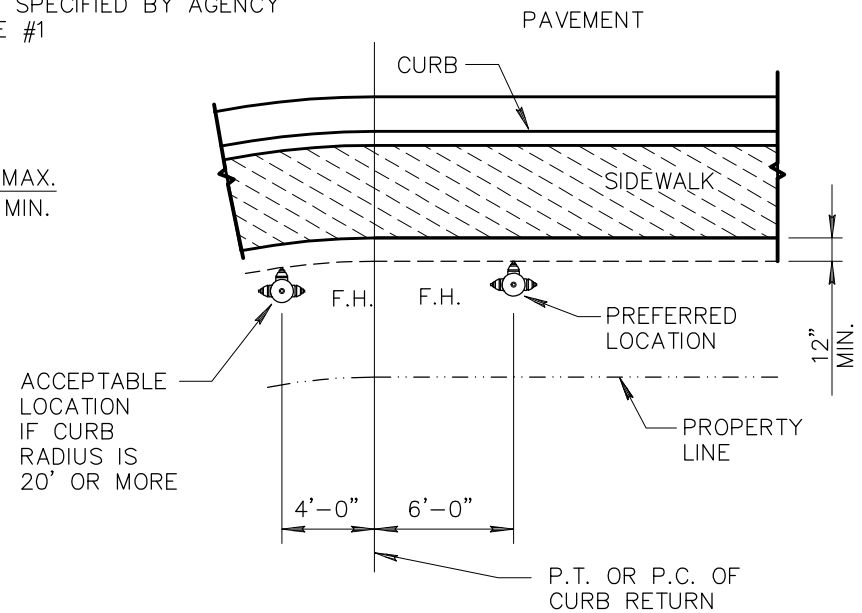
360-3

NOTES:

1. OBSTRUCTIONS SUCH AS UTILITY POLES, STREET SIGNS, IRRIGATION BOXES, FENCES, ETC., MUST NOT BE PLACED BETWEEN CURB AND HYDRANT AND WITHIN THE RADIUS FOR FIRE DEPT. ACCESS.
2. DIMENSIONS SHOWN ON CONSTRUCTION DRAWINGS SUPERSEDE LOCATIONS SHOWN HERE.
3. ON LOCATIONS IN MIDBLOCK, THE FIRE HYDRANT WILL BE ALIGNED WITH A PROPERTY LINE.



PARKWAY AREA OR NO SIDEWALK



AREA WITH SIDEWALK

DETAIL NO.

362



STANDARD DETAIL
ENGLISH

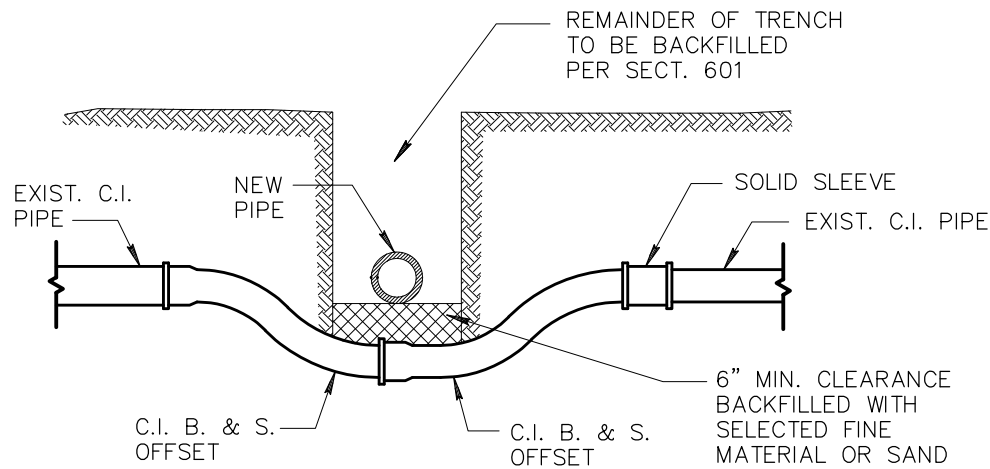
LOCATIONS FOR NEW FIRE HYDRANTS

REVISED

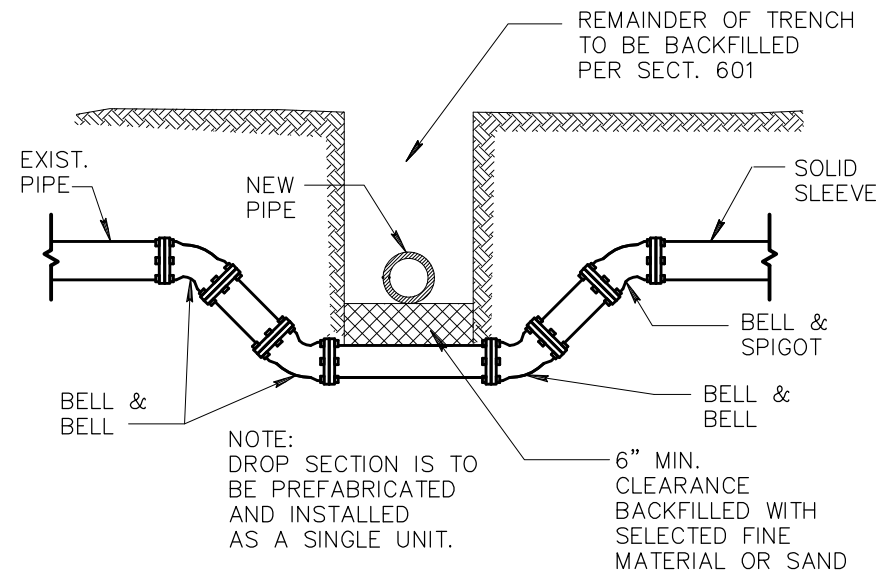
01-01-1999

DETAIL NO.

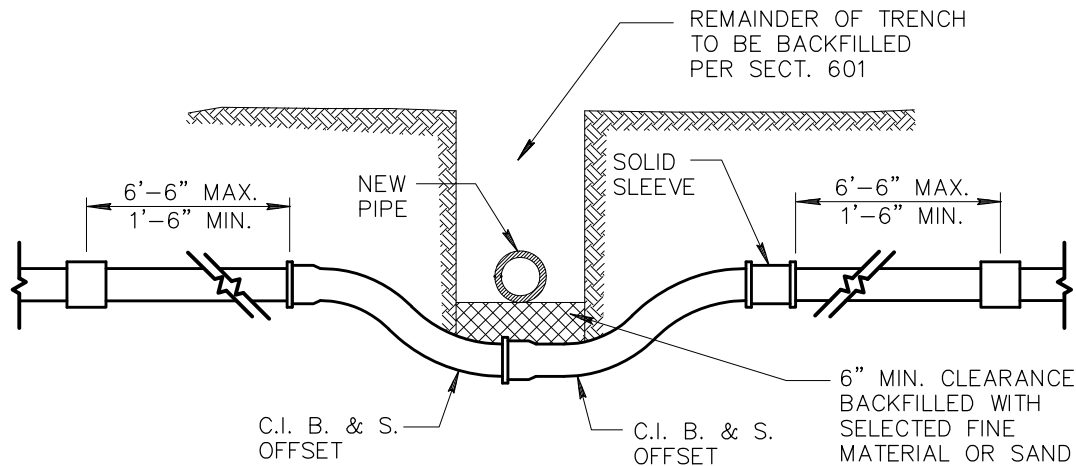
362



CAST IRON



CAST IRON MECHANICAL JOINT



ASBESTOS CEMENT

NOTES:

1. THIS DETAIL COVERS MOVING OF WATER MAINS 2" TO 12" ONLY.
2. THRUST BLOCKING AS PER DET. 380 & 381.
3. IF OFFSET IS TO GO OVER OBSTRUCTION, JOINT RESTRAINTS MUST BE USED.
4. PIPE IS TO BE CAST IRON OR DUCTILE IRON.

DETAIL NO.

370



STANDARD DETAIL
ENGLISH

VERTICAL REALIGNMENT OF WATER MAINS

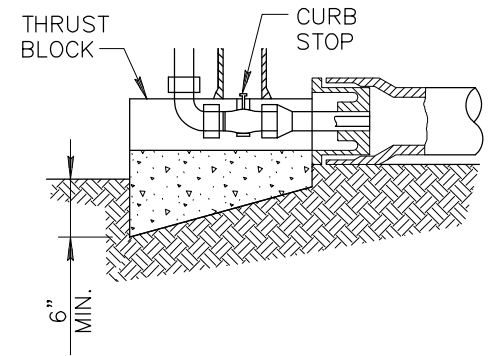
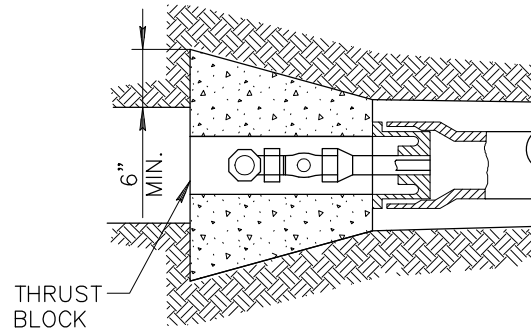
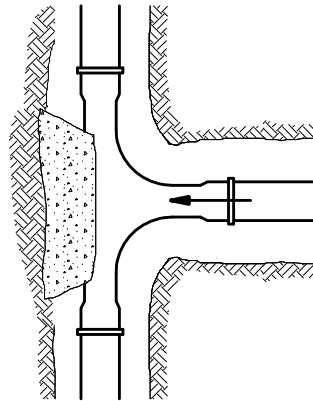
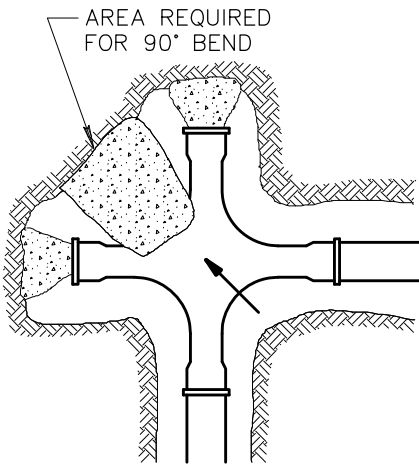
REVISED

01-01-1998

DETAIL NO.

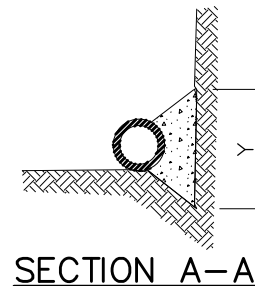
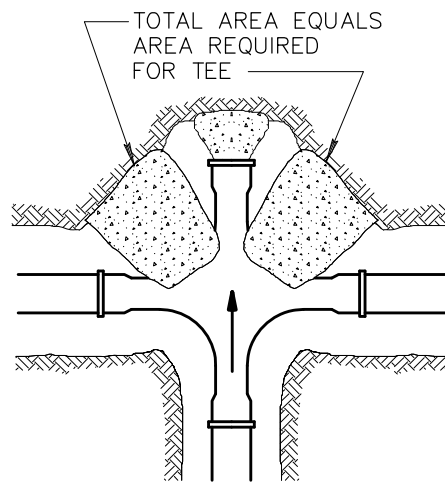
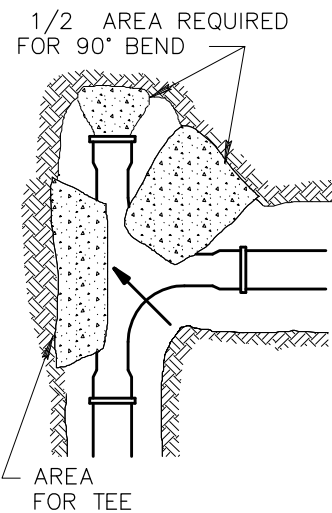
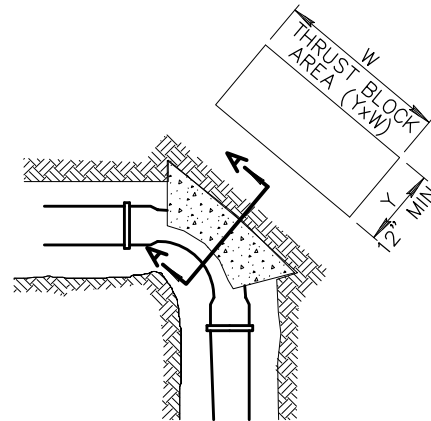
370

TYPICAL LOCATIONS OF THRUST BLOCKS



NOTES:

1. TABLE IS BASED ON 200 P.S.I. TEST PRESSURE AND 3,000 LBS/SQ. FT. SOIL. IF CONDITIONS ARE FOUND TO INDICATE SOIL BEARING IS LESS, THE AREAS SHALL BE INCREASED ACCORDINGLY.
2. AREAS FOR PIPES LARGER THAN 16" SHALL BE CALCULATED FOR EACH PROJECT.
3. FORM ALL NON-BEARING VERTICAL SURFACES.
4. THRUST BLOCKS ARE TO EXTEND TO UNDISTURBED GROUND. CONCRETE TO BE CLASS 'C', SECT. 725.



MINIMUM THRUST BLOCK AREA REQUIRED (YxW) (SQ. FT.)

PIPE SIZE	WATER PIPE	
	TEE, DEAD END, 90° BEND	45° & 22 1/2° BENDS
4" OR LESS	3	3
6"	4	3
8"	6	3
10"	10	5
12"	14	7
16"	24	12

DETAIL NO.

380



STANDARD DETAIL
ENGLISH

THRUST BLOCKS FOR WATER LINES

REVISED

01-01-1998

DETAIL NO.

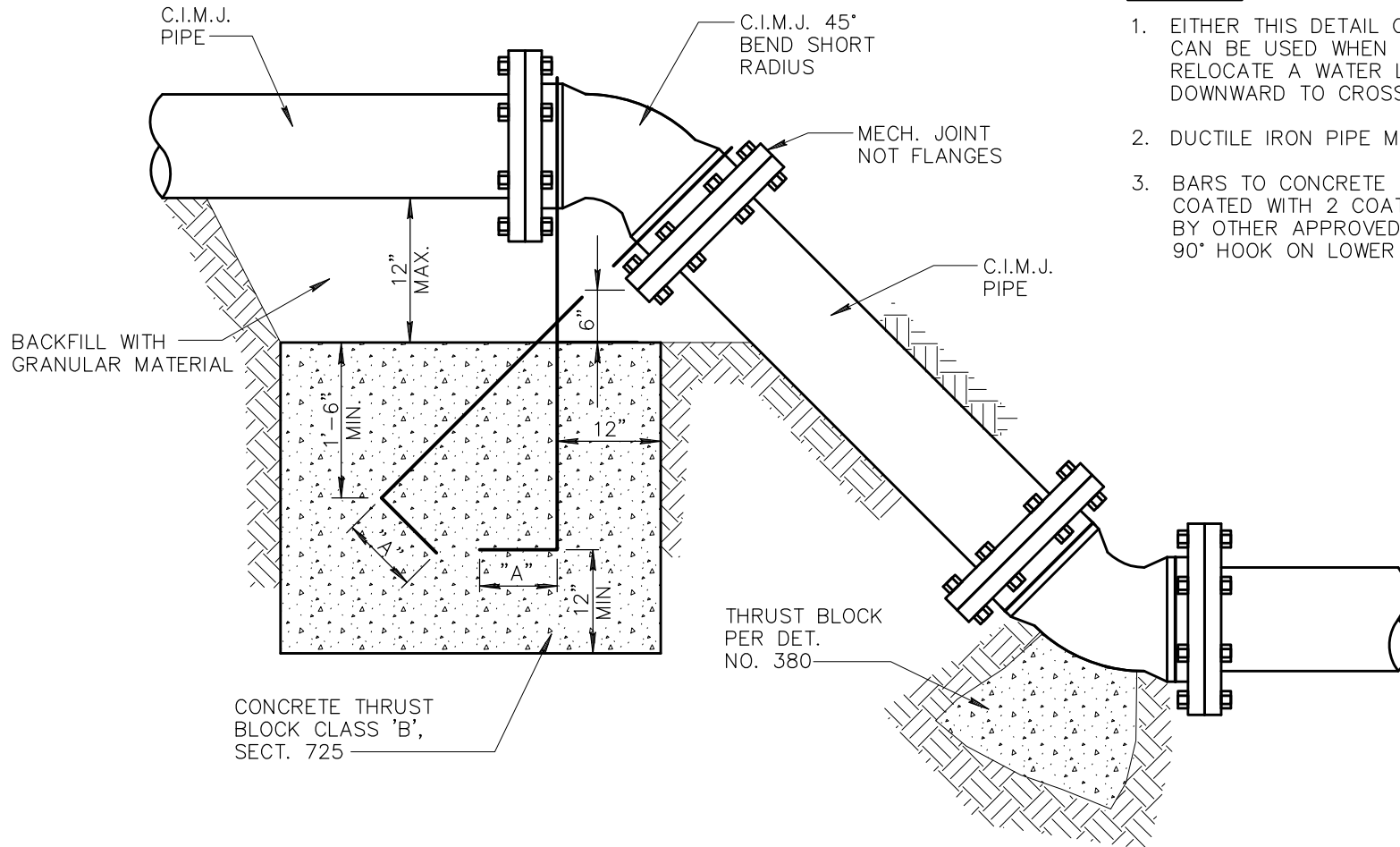
380

PIPE SIZE	MIN BAR SIZE	"A"—DIMENSION HOOK	MIN. * BLOCK DIM.
6"	#6	6"	3' x 3' x 3'
8"	#6	9"	4' x 4' x 2.5'
12"	#8	9"	4' x 4' x 5'

* FOR 125 P.S.I. WORKING PRESSURE.

NOTES:

1. EITHER THIS DETAIL OR RESTRAINT RODS CAN BE USED WHEN IT IS ALLOWED TO RELOCATE A WATER LINE UPWARD OR DOWNWARD TO CROSS A CONFLICT.
2. DUCTILE IRON PIPE MAY BE USED.
3. BARS TO CONCRETE THRUST BLOCK TO BE COATED WITH 2 COATS COAL TAR, EPOXY OR BY OTHER APPROVED METHOD. BARS TO HAVE 90° HOOK ON LOWER END, AS PER TABLE.



DETAIL NO.

381



STANDARD DETAIL
ENGLISH

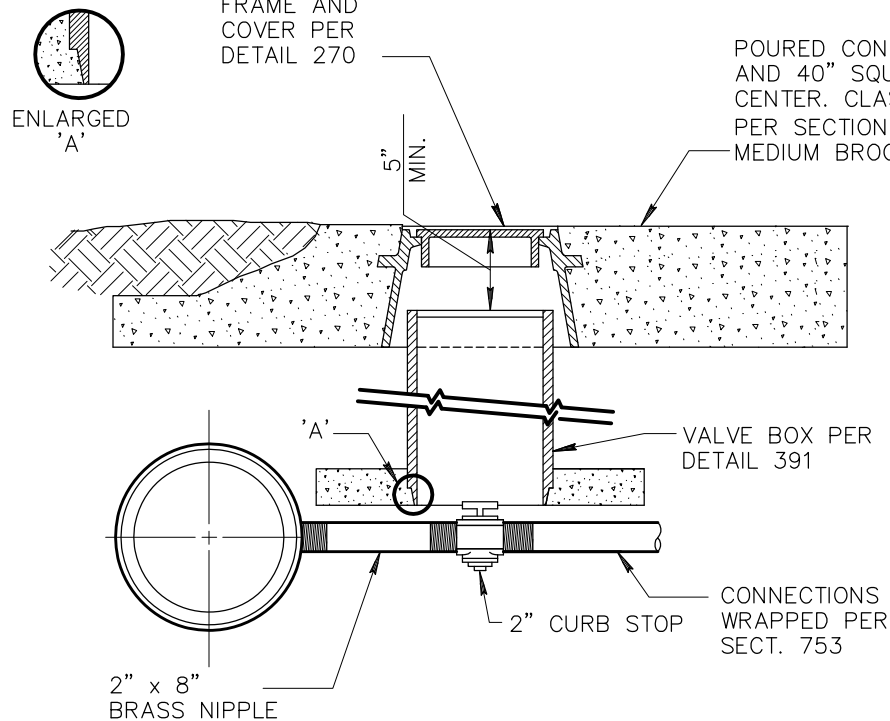
ANCHOR BLOCKS FOR VERTICAL BENDS

REVISED

01-01-1998

DETAIL NO.

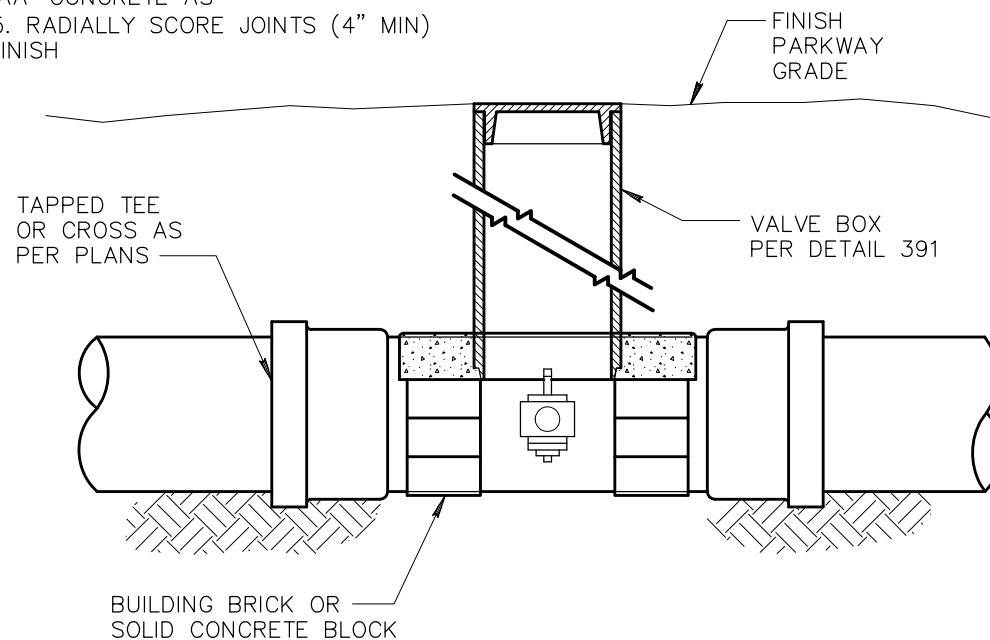
381



TYPE 'A'

NOTES:

1. CURB STOP TO BE MUELLER ORISEAL (H-10283), FORD BALL VALVE B11-777, HAYES BULLETIN 400, J. JONES (J-1900) OR APPROVED EQUAL.
2. REDUCER MAY BE USED WHEN CONNECTING TO SMALLER GALVANIZED PIPE.
3. THIS DETAIL IS TO BE USED WHEN CONNECTING EXISTING GALVANIZED PIPE TO ASBESTOS CEMENT PIPE OR CAST IRON PIPE.



TYPE 'B'

NOTE:

1. VALVE BOX TO BE SUPPORTED ON BRICKS TO PREVENT VERTICAL LOADS FROM BEING TRANSMITTED TO THE SMALL PIPE.

DETAIL NO.

389



STANDARD DETAIL
ENGLISH

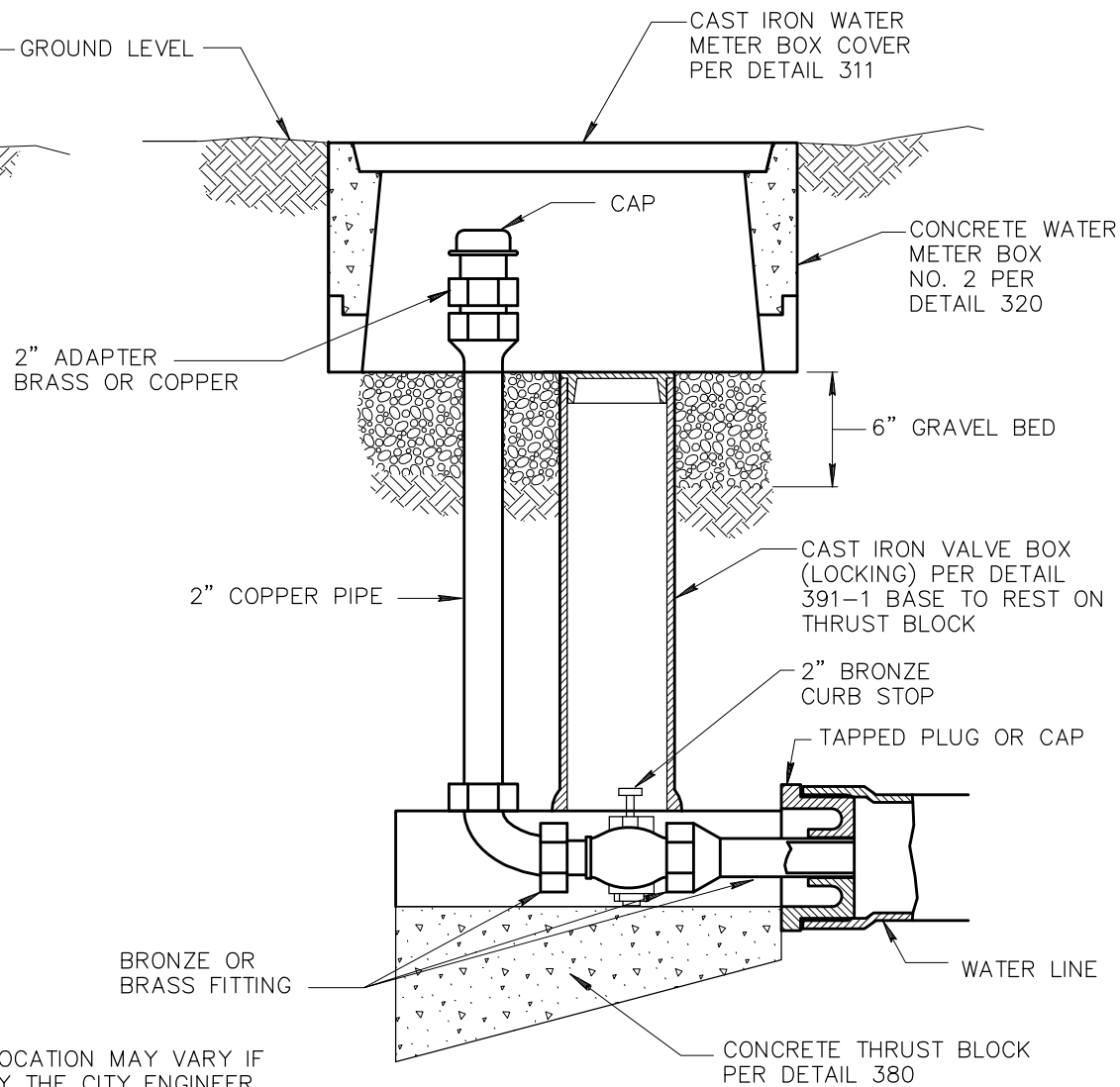
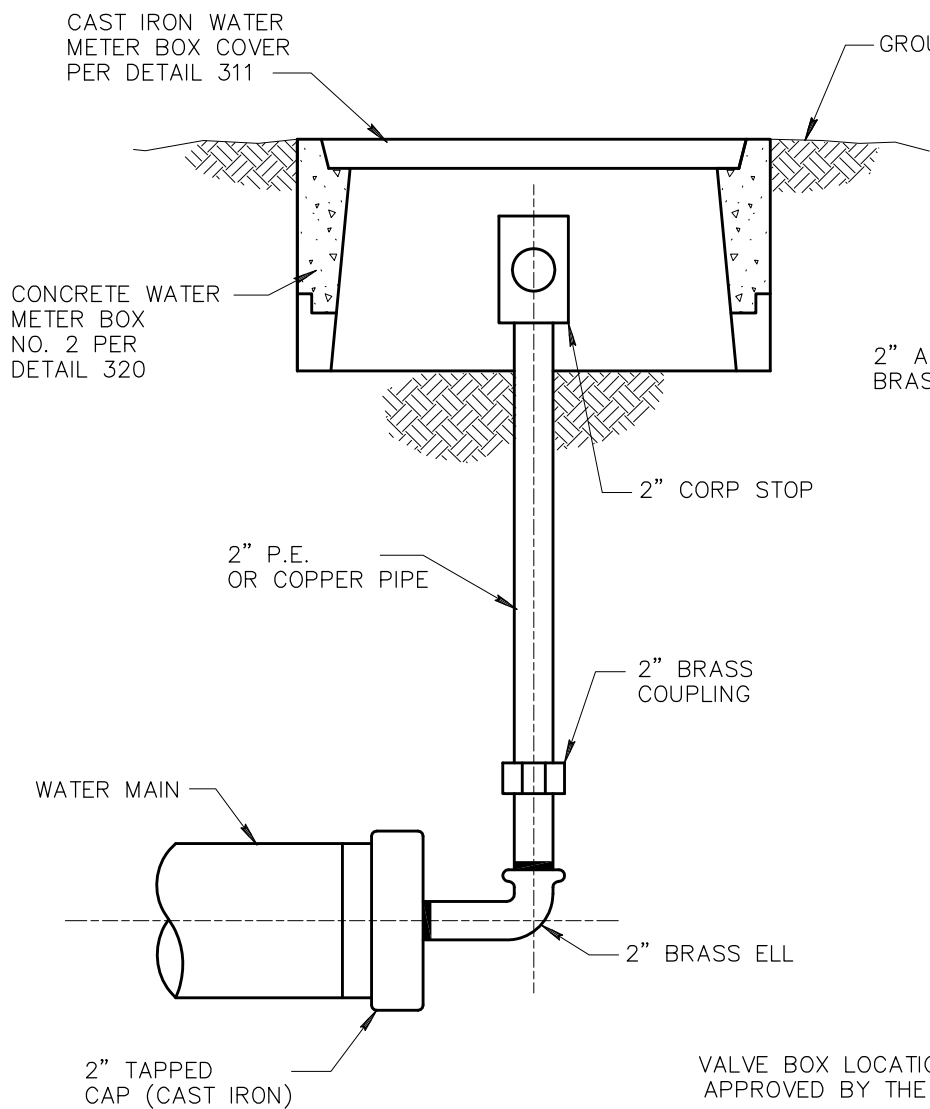
**CURB STOP WITH VALVE BOX
AND COVER**

REVISED

01-01-2001

DETAIL NO.

389



DETAIL NO.

390



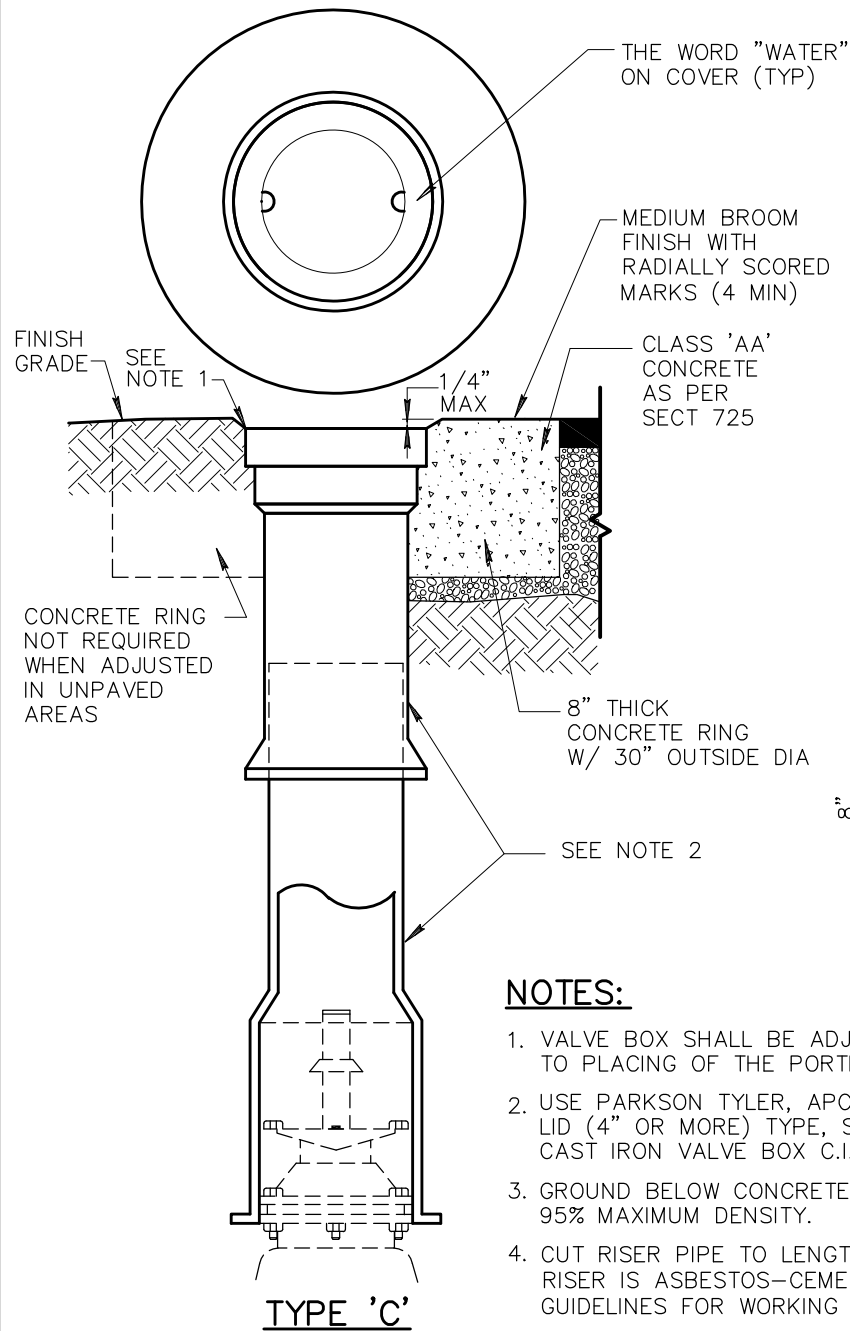
STANDARD DETAIL
ENGLISH

CURB STOP WITH FLUSHING PIPE

REVISED
01-01-1998

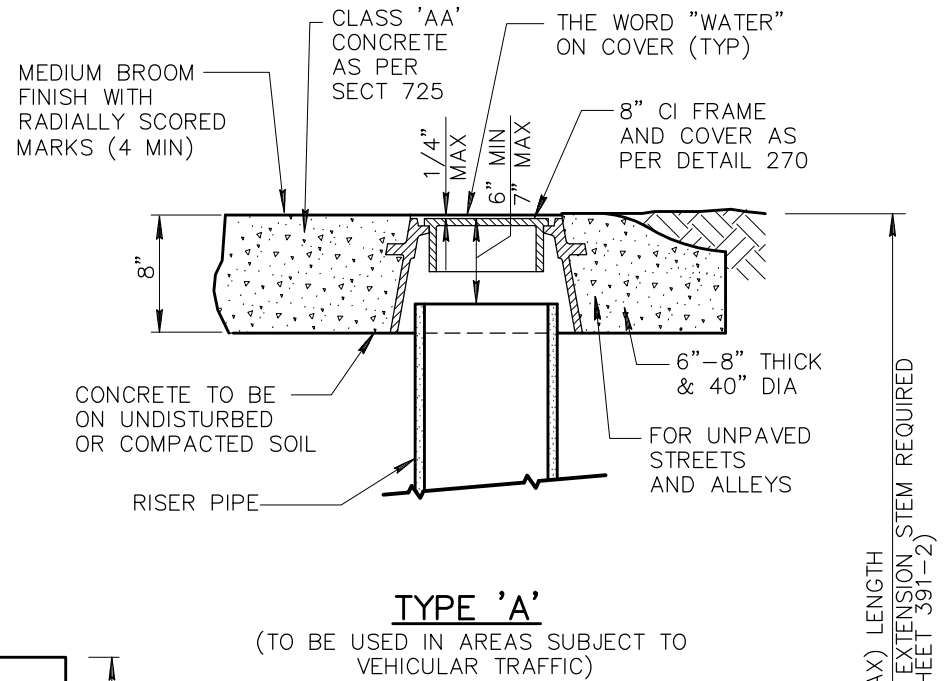
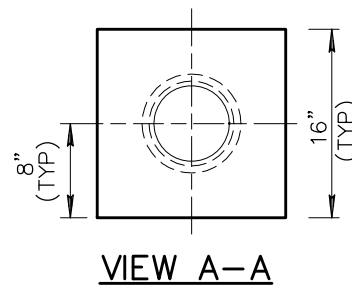
DETAIL NO.

390

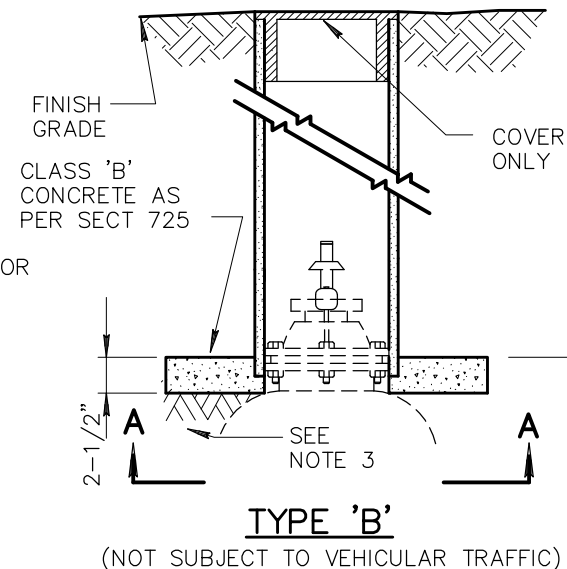


NOTES:

1. VALVE BOX SHALL BE ADJUSTED TO THE FINISHED GRADE PRIOR TO PLACING OF THE PORTLAND CEMENT CONCRETE SURFACE.
2. USE PARKSON TYLER, APCO OR EQUAL DEEP SKIRTED LID (4" OR MORE) TYPE, SLIDING ADJUSTABLE CAST IRON VALVE BOX C.I. MIN. T.S. 30,000 P.S.I.
3. GROUND BELOW CONCRETE PAD TO BE COMPACTED 95% MAXIMUM DENSITY.
4. CUT RISER PIPE TO LENGTH IN FIELD. **CAUTION:** IF EXISTING RISER IS ASBESTOS-CEMENT PIPE (ACP) FOLLOW OSHA GUIDELINES FOR WORKING WITH ACP.



TYPE 'A'
(TO BE USED IN AREAS SUBJECT TO VEHICULAR TRAFFIC)



TYPE 'B'
(NOT SUBJECT TO VEHICULAR TRAFFIC)

DETAIL NO.

391-1



STANDARD DETAIL
ENGLISH

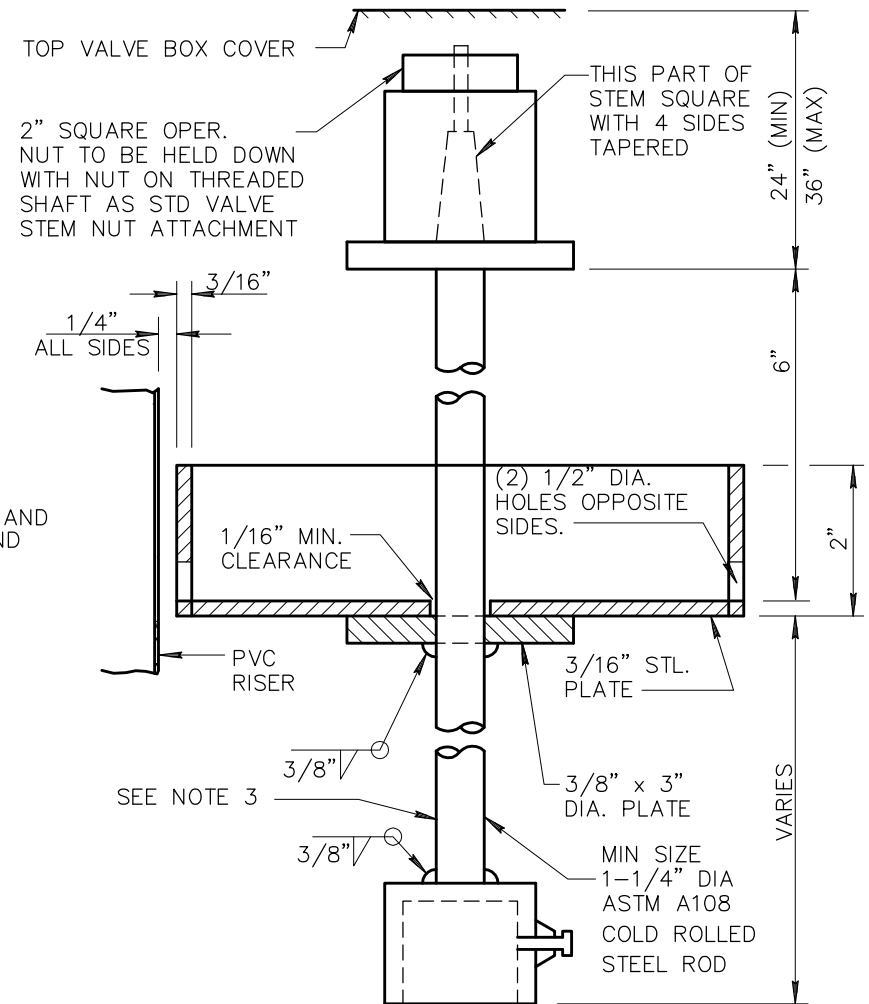
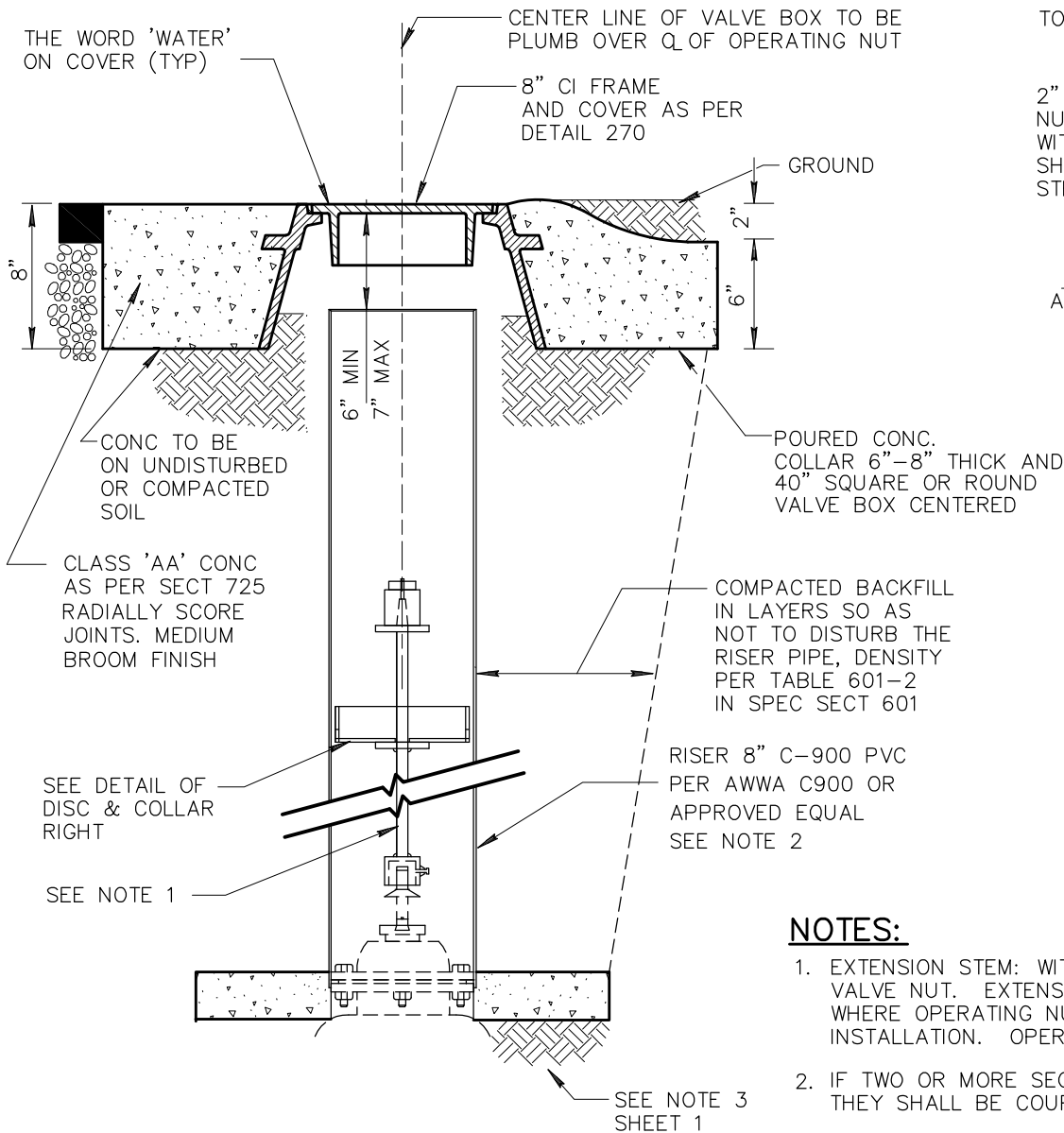
VALVE BOX INSTALLATION AND GRADE ADJUSTMENT

REVISED

01-01-2015

DETAIL NO.

391-1



NOTES:

1. EXTENSION STEM: WITH SQUARE SOCKET ON BOTTOM TO FIT 2" SQUARE VALVE NUT. EXTENSION TO VALVE STEMS REQUIRED ON ALL VALVES INSTALLED WHERE OPERATING NUT IS OVER 5' BELOW SURFACE. LENGTH TO FIT EACH INSTALLATION. OPERATING NUT TO BE HELD ON TOP OF EXTENSION WITH STOP NUT.
2. IF TWO OR MORE SECTIONS OF PIPE ARE USED TO MAKE THE VALVE BOX RISER, THEY SHALL BE COUPLED OR BONDED TO FORM DEBRIS-TIGHT JOINTS.
3. STEM PAINTING: ALL STEEL TO HAVE PRIME COAT OF PAINT NO. 1-D AND ONE HEAVY APPLICATION (FINISH COAT) OF PAINT NO. 9 AS PER SECT. 790.

DETAIL NO.
391-2

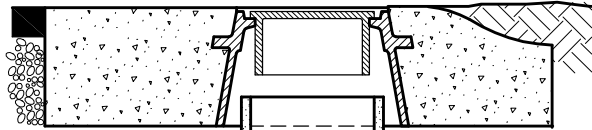


STANDARD DETAIL
ENGLISH

VALVE BOX INSTALLATION AND GRADE ADJUSTMENT

REVISED
01-01-2015

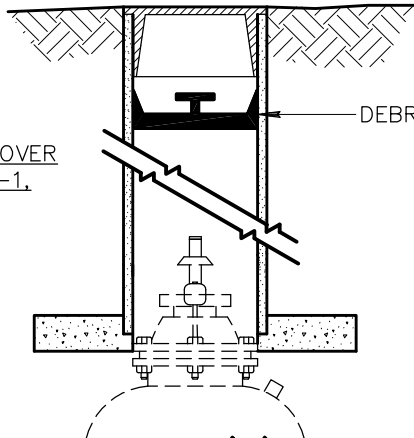
DETAIL NO.
391-2



VALVE BOX AND COVER
FOR DETAIL 391-1,
TYPE A

DEBRIS CAP

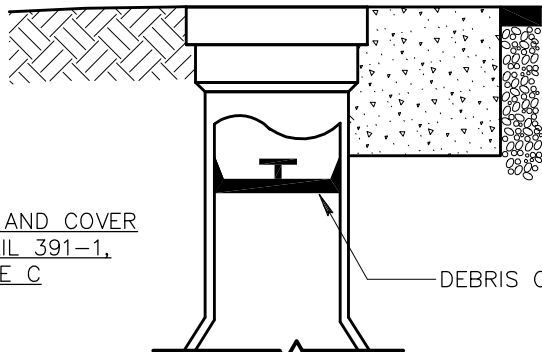
TYPE 'A'



VALVE BOX AND COVER
FOR DETAIL 391-1,
TYPE B

DEBRIS CAP

TYPE 'B'



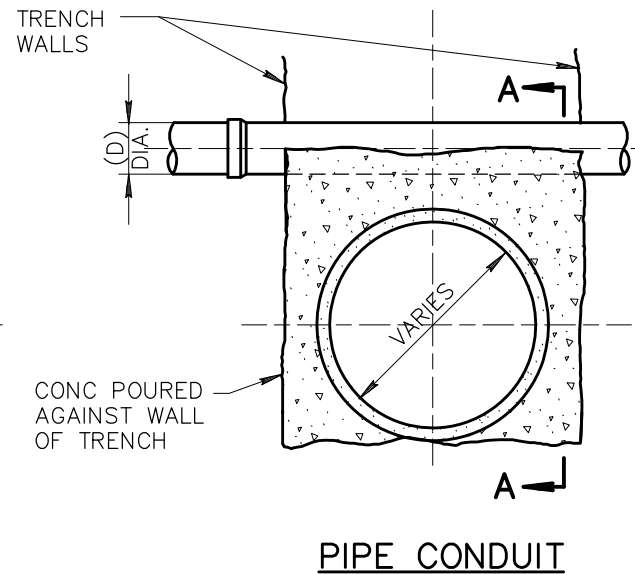
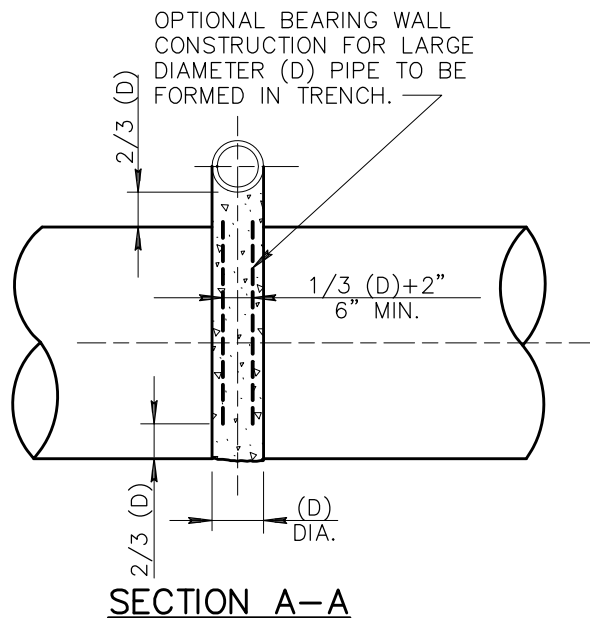
VALVE BOX AND COVER
FOR DETAIL 391-1,
TYPE C

DEBRIS CAP

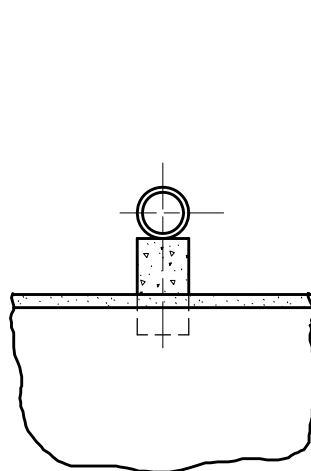
TYPE 'C'

NOTES:

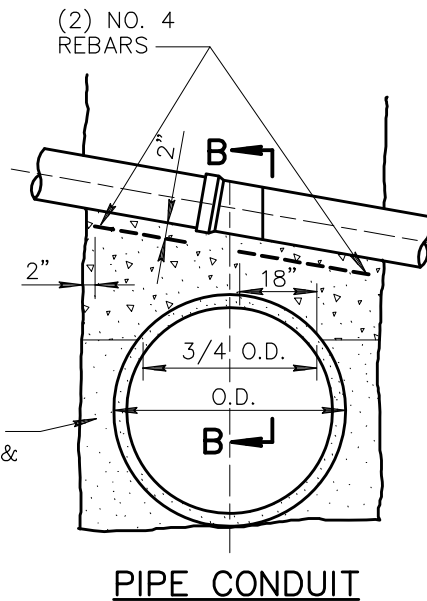
1. THE DEBRIS CAP SHALL BE DESIGNED AND INSTALLED TO PREVENT DEBRIS SUCH AS DIRT, DUST SAND, ETC., FROM PASSING AROUND THE CAP AND DOWN INTO THE VALVE HOUSING. THE CAP SHALL BE HELD IN PLACE BY A MECHANISM WHICH WILL NOT DAMAGE THE VALVE HOUSING.
2. THE CAP SHALL BE MANUFACTURED OF CORROSIVE RESISTANT MATERIALS.
3. DEBRIS CAP SHALL BE INSTALLED AS CLOSE UNDER THE CAST IRON COVER WITHOUT INTERFERING WITH COVER OPERATION.
4. THE CAP SHALL BE CAPABLE OF SECURELY HOLDING A STANDARD LOCATING COIL, "SCOTCH MARK" 4 DISK MARKER BY 3M OR EQUAL.
5. THE CAP SHALL BE CONSTRUCTED TO ALLOW THE DEVICE TO BE SECURED BY A LOCK. THE LOCK (PAD, BARREL, ETC.) SHALL BE SUPPLIED BY THE AGENCY.
6. THE CAP SHALL BE INSTALLED IN ALL VALVE HOUSINGS AS REQUIRED BY THE CONTRACT DOCUMENTS OR BY THE AGENCY'S POLICIES.



TYPE 'A'



SEE SECT. 601
FOR BACKFILL &
COMPACTION



TYPE 'B'

NOTES:

1. TYPE 'A' PIPE SUPPORT MAY BE USED FOR ANY TYPE CROSSING CONDITION.
2. TYPE 'C' PIPE SUPPORT MAY BE USED FOR CROSSING PIPES WITH A BELL DIAMETER OF 18" OR LESS IF SUFFICIENT CLEARANCE OVER STORM SEWER IS AVAILABLE AND TOTAL SPAN IS LESS THAN 34'.
3. INTERMEDIATE PIPE SUPPORT SHALL BE USED IN CONJUNCTION WITH TYPE 'C' PIPE SUPPORT IF TOTAL SPAN EXCEEDS MAX. 'W' IN TABLE.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING ALL SUPPORTS BOTH PERMANENT AND TEMPORARY. TEMPORARY SUPPORTS SHALL NOT BE A SEPARATE PAY ITEM.
5. PERMANENT PIPE SUPPORTS MAY BE DECREASED FROM PLAN QUANTITIES OR EXTENDED TO INCLUDE SOME LISTED BELOW AS TEMPORARY SUPPORTS IF CONDITIONS WARRANT THESE CHANGES AT THE TIME OF CONSTRUCTION. DECISION SHALL BE MADE BY THE ENGINEER.
6. WHEN TYPE 'A' PIPE SUPPORT IS USED AND WHENEVER SO DIRECTED BY THE ENGINEER, THE CONTRACTOR SHALL PIERCE THE WALL WITH SUITABLE OPENINGS TO PREVENT UNEQUAL PRESSURE RESULTING FROM FLOODING OF THE BACKFILL. THE VOLUME OF THE PIERCED OPENING SHALL NOT EXCEED 1/2 THE VOLUME OF THE SUPPORTING WALL.
7. USE TYPE 'B' PIPE SUPPORT INSTEAD OF TYPE 'C' WHEN CLEARANCE IS LESS THAN 'Y' IN TABLE, BETWEEN PIPES.
8. CLASS 'A' CONCRETE AS PER SECT. 725 UNLESS OTHERWISE NOTED.

SCHEDULE OF REQUIRED SUPPORTS

PERMANENT	TEMPORARY
SEWER LINES	CAST IRON PIPE CONC. IRRIG. PIPE BURIED TELCO. GAS PIPES
OTHER UTILITIES AS NOTED ON THE PLANS OR AS REQUIRED BY THE ENGINEER AT TIME OF CONSTRUCTION.	CONC. STORM DRAIN CONC. BOX CULVERT TRAFFIC CONTROL CONDUIT WATER & SEWER LINES

DETAIL NO.

403-1



STANDARD DETAIL
ENGLISH

PIPE SUPPORT ACROSS TRENCHES

REVISED

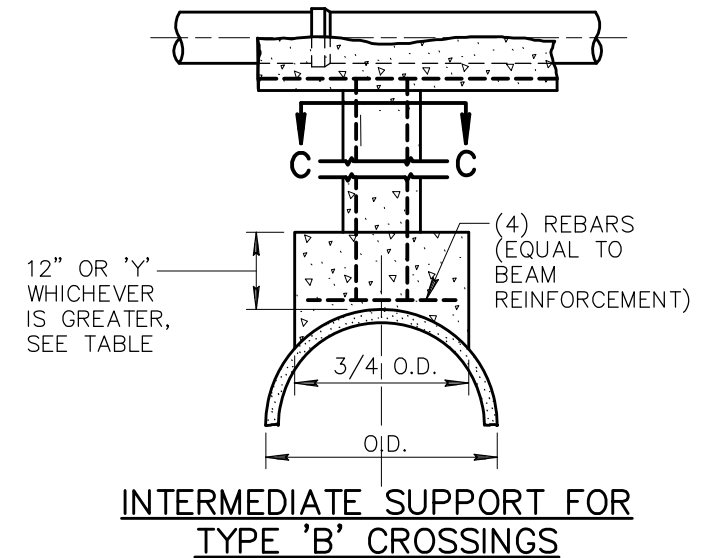
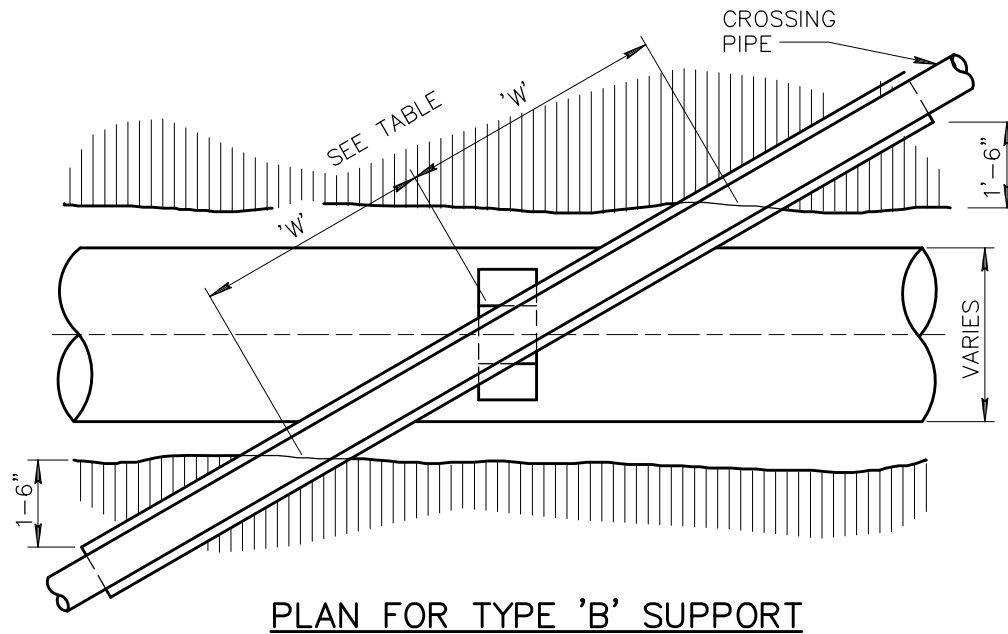
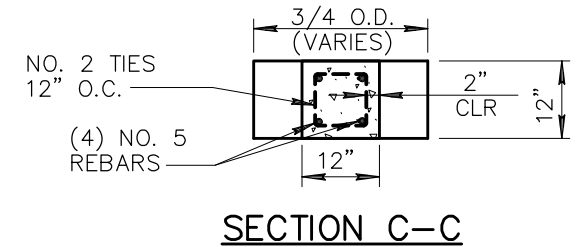
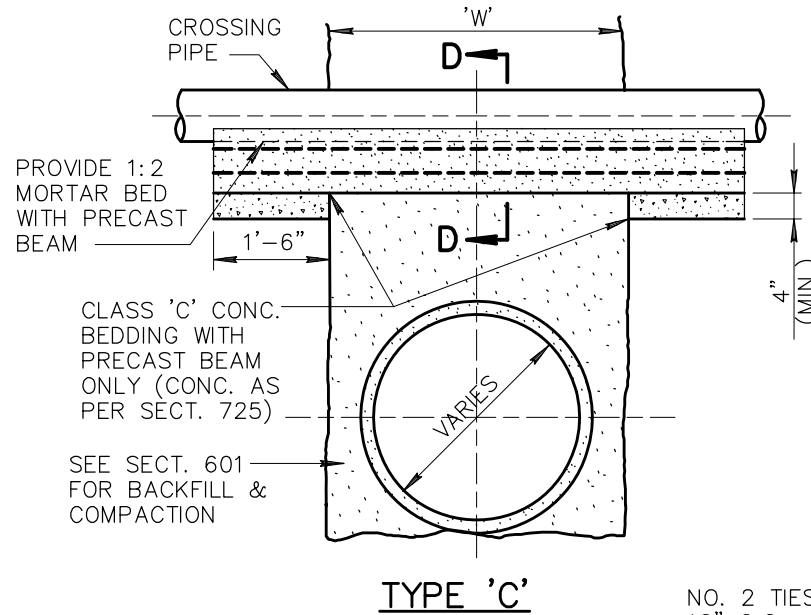
01-01-1998

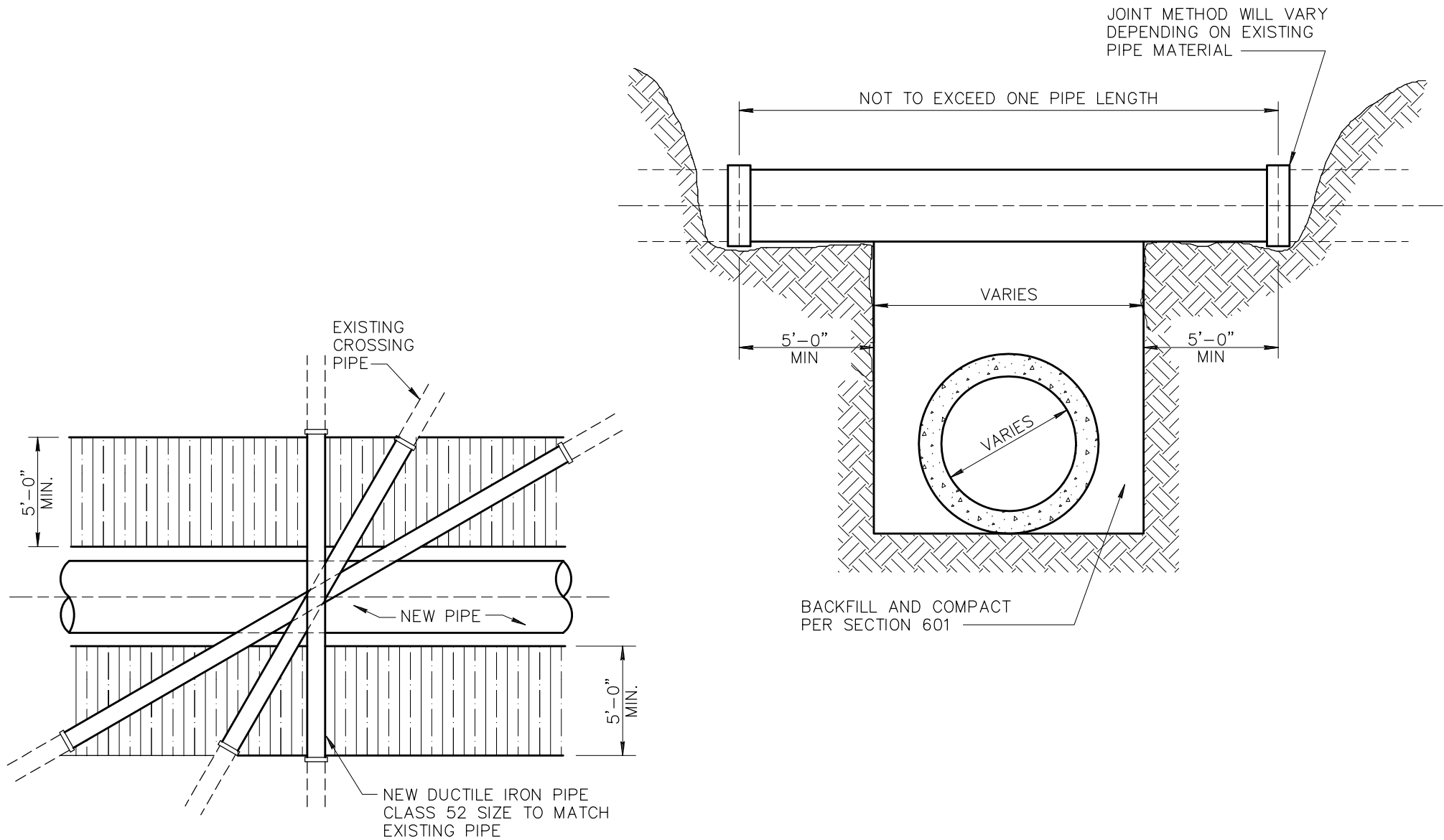
DETAIL NO.

403-1

TABLE

'W'	DEPTH OF COVER ON SUPPORTS			
	0' TO 8'		8' TO 16'	
	BAR NO.	Y	BAR NO.	Y
TO 6'	5	8"	6	11"
7'	5	9"	6	12"
8'	5	10"	6	13"
9'	6	11"	6	14"
10'	6	12"	7	15"
11'	6	13"	7	16"
12'	6	14"	7	17"
13'	7	15"	7	19"
14'	7	16"	8	20"
15'	7	17"	8	21"
16'	7	18"		
17'	8	19"		





DETAIL NO.
403-3



STANDARD DETAIL
ENGLISH

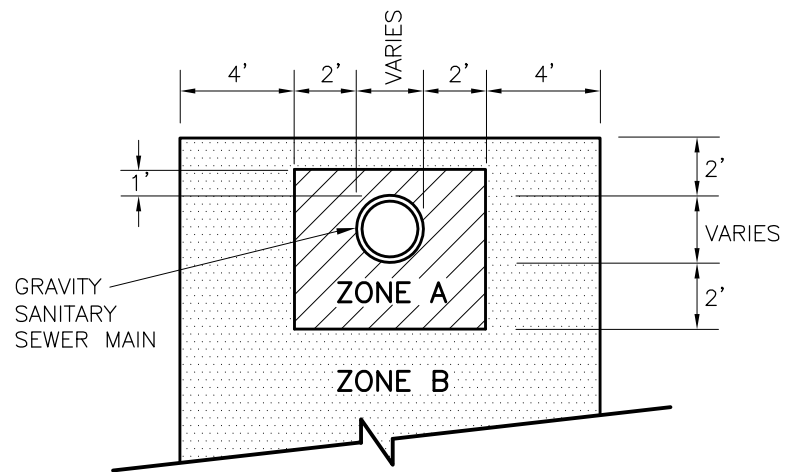
ALTERNATE TO PIPE SUPPORT

REVISED
01-01-1998

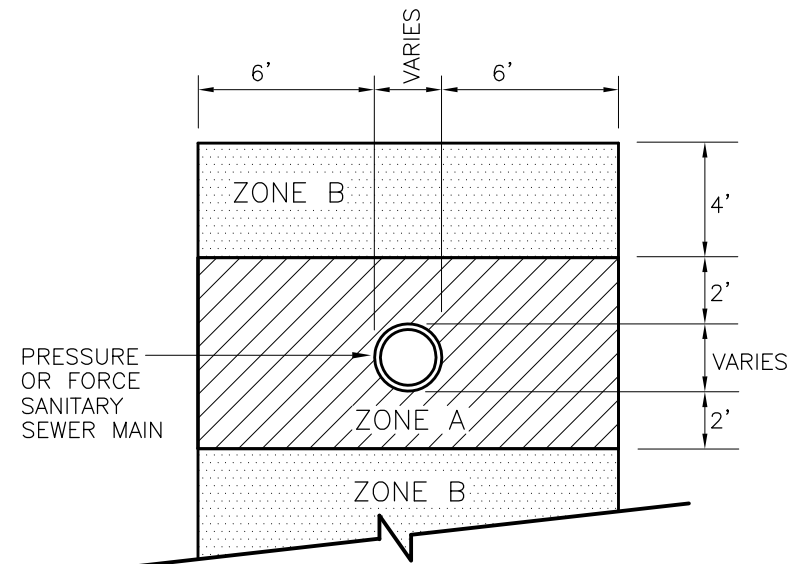
DETAIL NO.
403-3

WATER LINE EXCLUSION AND EXTRA PROTECTION ZONES*

GRAVITY SANITARY SEWER



PRESSURIZED SANITARY SEWER



NOTES:

ZONE A: NO WATER LINES ALLOWED/MINIMUM SEPARATION.

ZONE B: EXTRA PROTECTION REQUIRED FOR WATER LINES.

* REFER TO STANDARD 610, WATER LINE CONSTRUCTION.

DETAIL NO.

404-1



STANDARD DETAIL
ENGLISH

WATER AND SANITARY SEWER
SEPARATION/PROTECTION

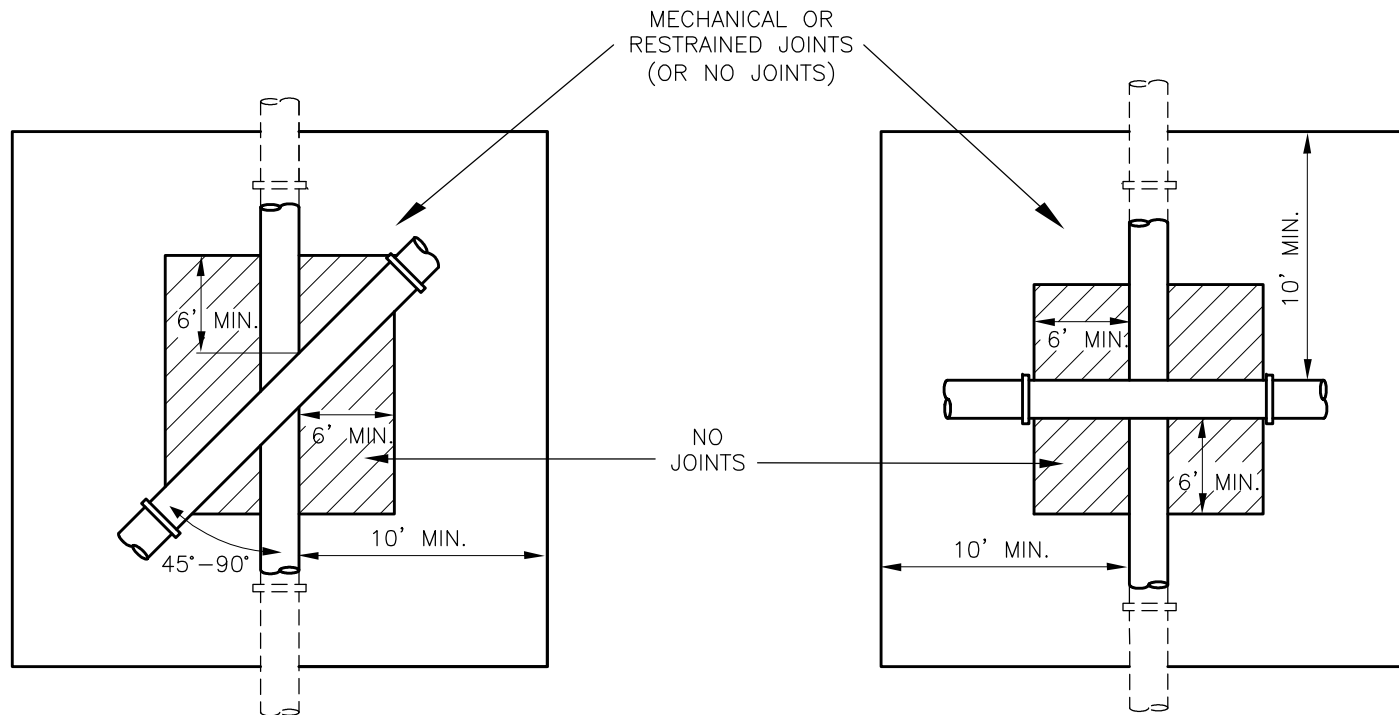
REVISED

01-01-2006

DETAIL NO.

404-1

WATER LINE EXTRA PROTECTION DUCTILE IRON PIPE WITH RESTRAINED OR MECHANICAL JOINTS*



EXTRA PROTECTION DUCTILE IRON PIPE
(GRAVITY OR PRESSURIZED) SEWER LINE

NOTES:

* REFER TO MAG STANDARD SPECIFICATION SECTION 610.

DETAIL NO.
404-2



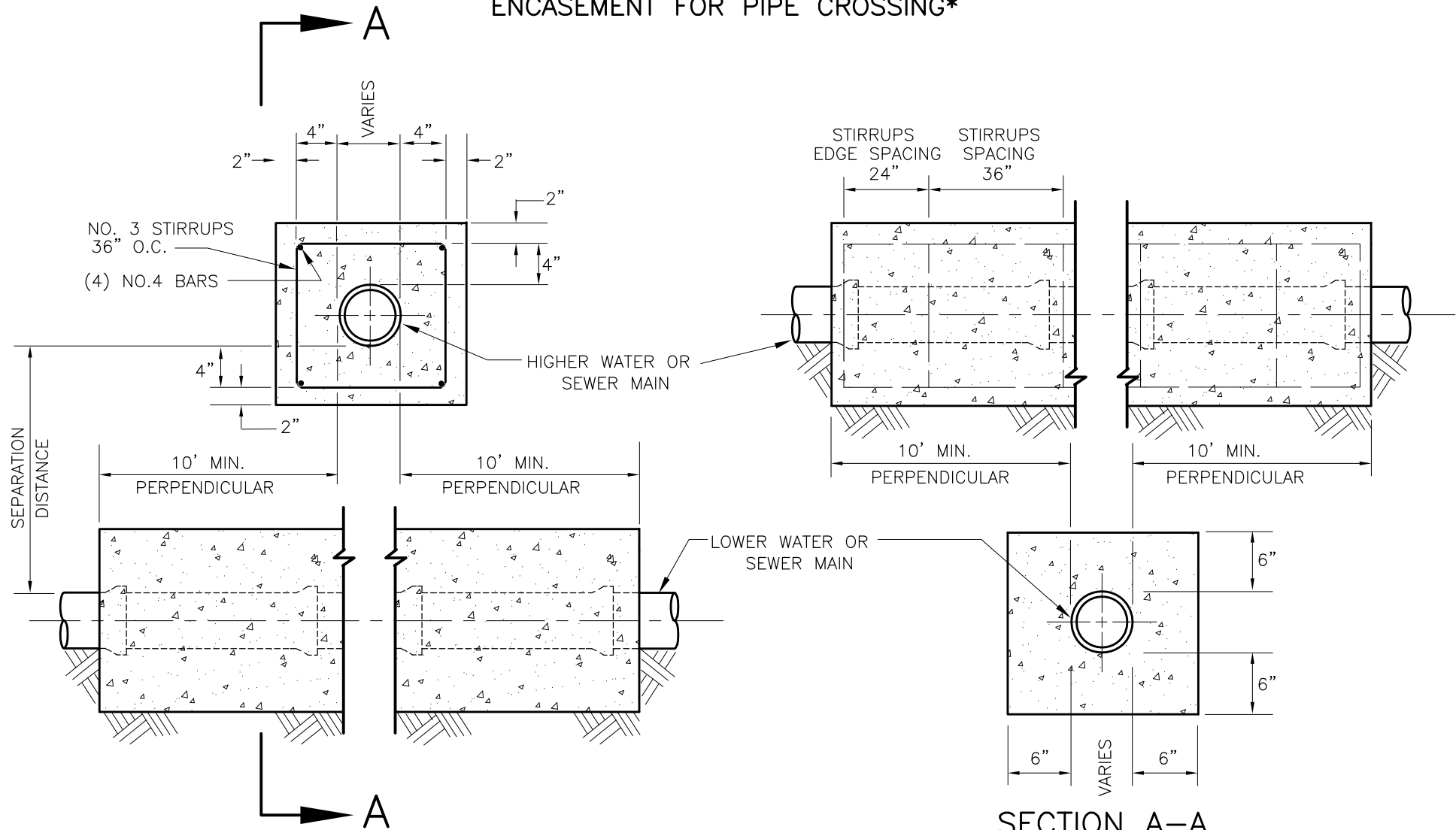
STANDARD DETAIL
ENGLISH

**WATER AND SANITARY SEWER
SEPARATION/PROTECTION**

REVISED
01-01-2006

DETAIL NO.
404-2

ENCASEMENT FOR PIPE CROSSING*



SECTION A-A

NOTES:

1. CLASS 'C' CONCRETE AS PER SECTION 725.
- *REFER TO MAG STANDARD SPECIFICATION SECTION 610.

DETAIL NO.
404-3

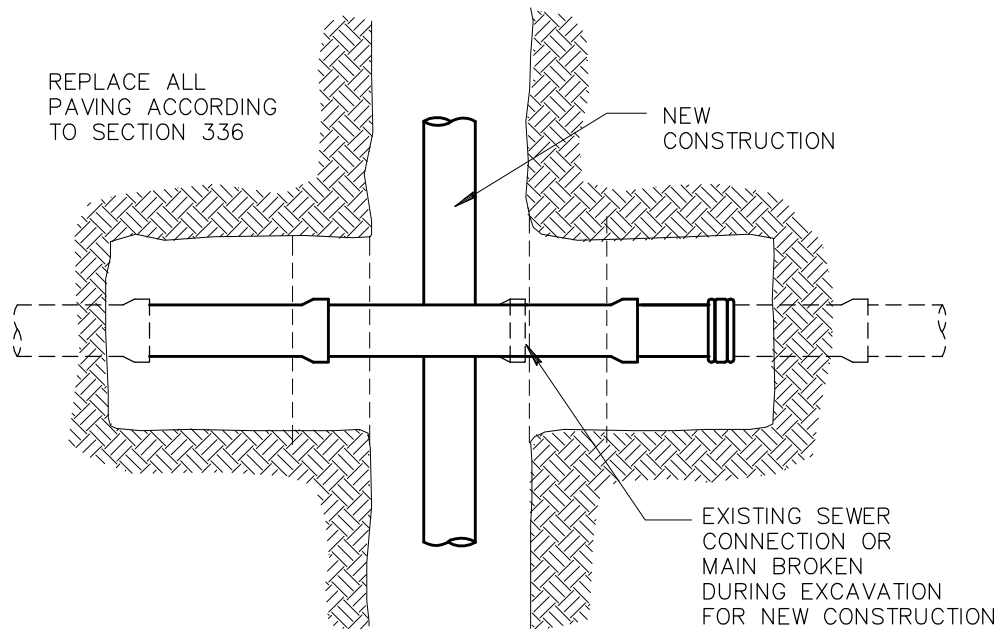


STANDARD DETAIL
ENGLISH

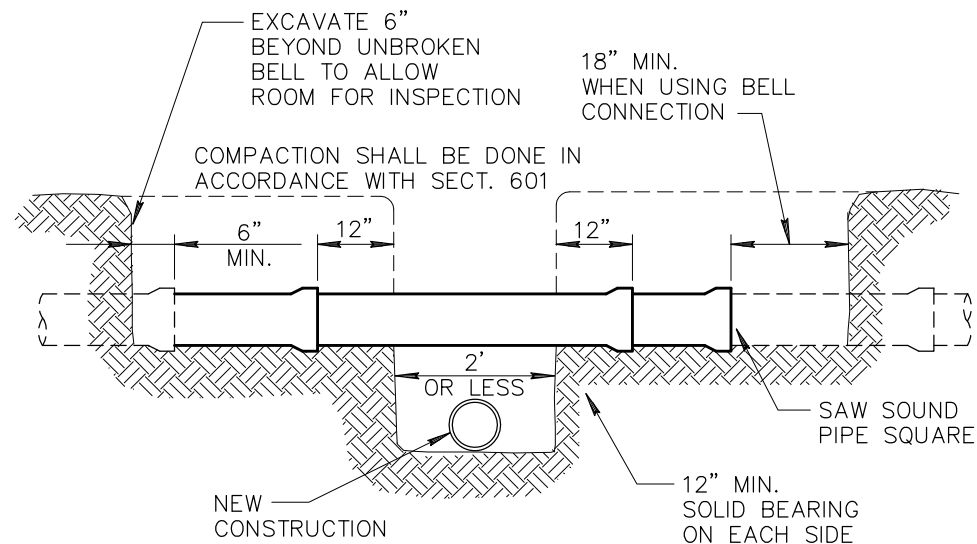
**WATER AND SANITARY SEWER
SEPARATION/PROTECTION**

REVISED
01-01-2006

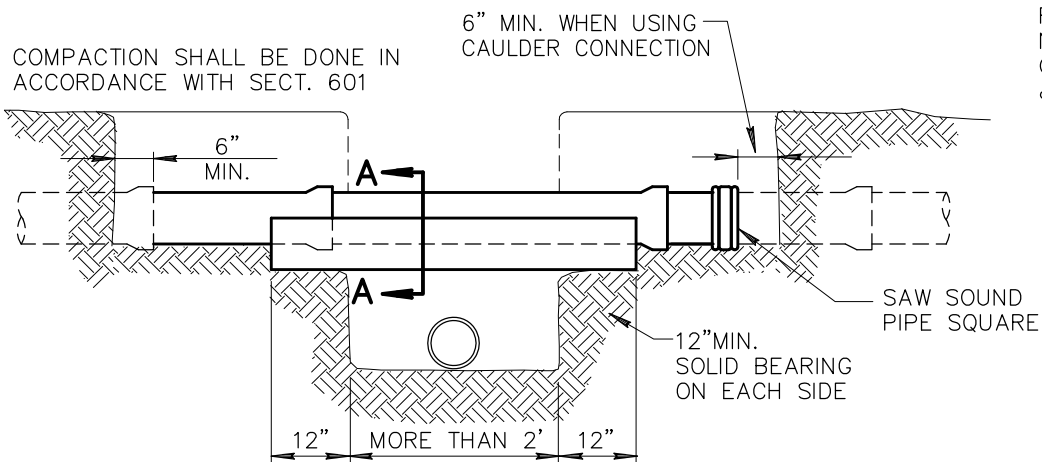
DETAIL NO.
404-3



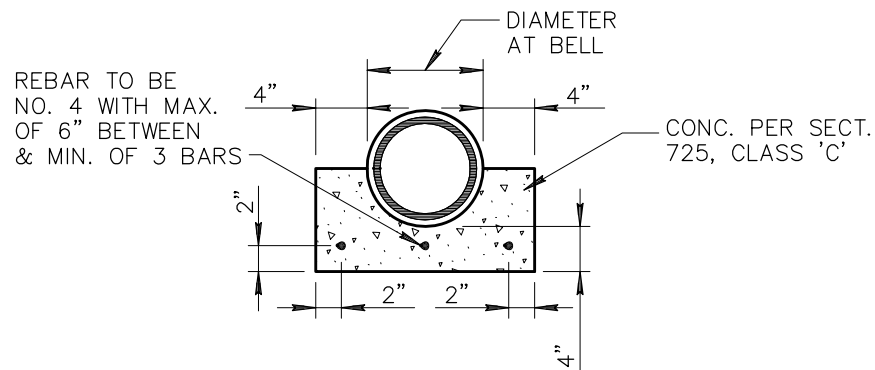
PLAN VIEW OF REPLACEMENT



REPLACEMENT WHEN NEW TRENCH 2' WIDE OR LESS



REPLACEMENT WHEN NEW TRENCH MORE THAN 2' WIDE



SECTION 'A-A'

NOTES:

1. BROKEN PIPE SHALL BE REPLACED WITH A MINIMUM OF ONE FULL JOINT AND TWO SHORT LENGTHS WITH UNBROKEN BELLS. CONSTRUCTION AND JOINTS TO BE MADE AS PER SECTION 615.

DETAIL NO.

405



STANDARD DETAIL
ENGLISH

BROKEN SEWER LINE REPLACEMENT

REVISED

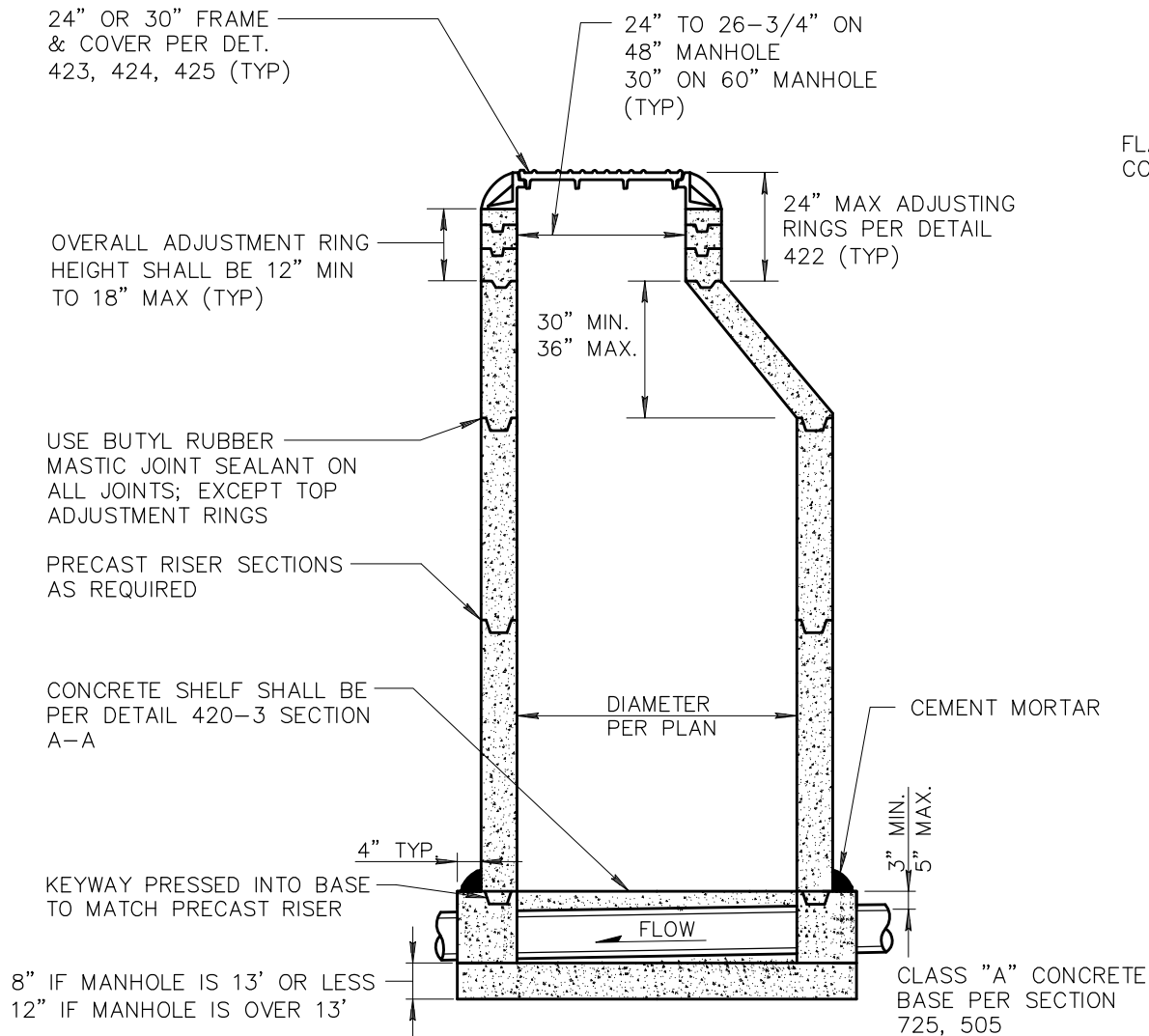
01-01-1998

DETAIL NO.

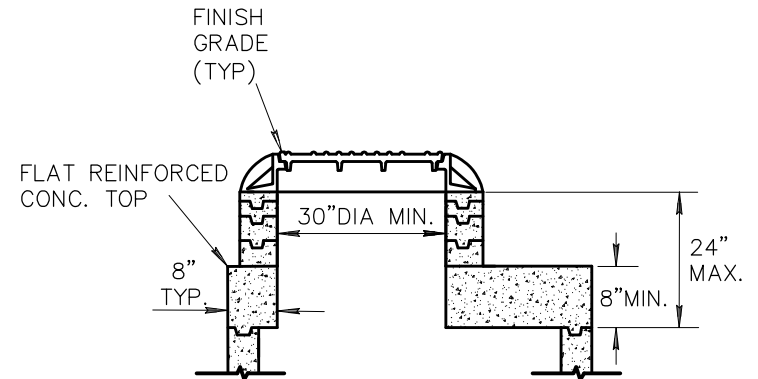
405

TYPE 'A' TOP

(PRECAST ECCENTRIC CONICAL TOP MANHOLE)



(PRECAST FLAT TOP M.H.)



NOTES:

1. PRECAST STEEL REINFORCED MANHOLE SECTIONS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C 478 EXCEPT AS MODIFIED HEREIN.
2. CAST-IN-PLACE MANHOLE BASE TO BE CONSTRUCTED IN ONE PLACEMENT.
3. CAST-IN-PLACE MANHOLE BASE SHELF AND CHANNEL TO RECEIVE SMOOTH TROWEL FINISH.
4. MANHOLE COATINGS PER AGENCY.
5. SEE MAG DETAIL 422 FOR FINAL ADJUSTMENT TO GRADE.
6. ANY MANHOLE OVER 20' SHALL REQUIRE ENGINEER (STRUCTURAL) CALCS.
7. THE MANHOLE ACCESS POINT SHALL BE ORIENTED IN SUCH A WAY THAT THE OPENING IS DIRECTLY ABOVE THE LOWEST INVERT, OR AS OTHERWISE DIRECTED BY THE PLANS OR ENG.
8. FOR PRECAST BASE SEE DETAIL 420-2.
9. FLAT TOPS SHALL ONLY BE USED WITH APPROVAL FROM THE ENGINEER.

DETAIL NO.

420-1



STANDARD DETAIL
ENGLISH

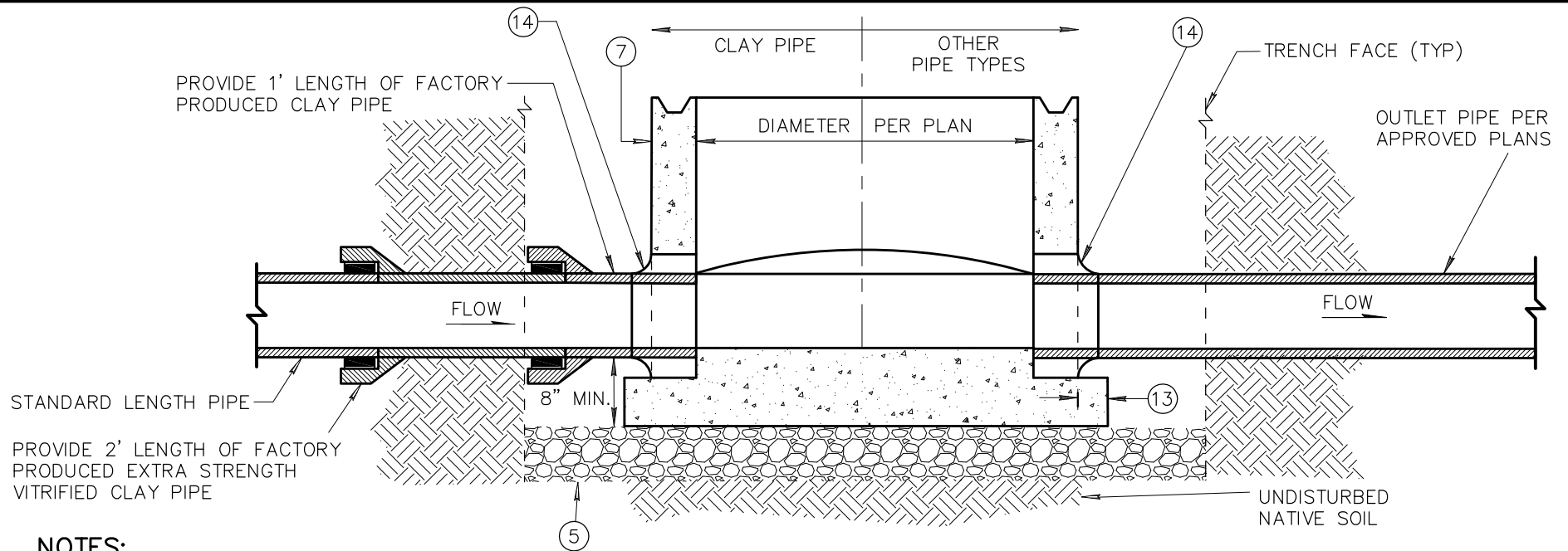
CONCRETE SANITARY SEWER MANHOLE

REVISED

01-01-2015

DETAIL NO.

420-1



NOTES:

- ① PRECAST, MANUFACTURER SHALL BE AN NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA) CERTIFIED PLANT. ENTIRE PRECAST BASE SHALL BE MANUFACTURED AT THE PLANT PER ASTM C478.
- ② MAG "AA" 4000 PSI CONCRETE SHALL BE USED FOR PRECAST MANHOLE BASES.
- ③ SPRING LINE OF CAST-IN-PLACE BELL SHALL STOP AT INSIDE FACE OF MANHOLE.
- ④ JOINTS FOR BARREL SECTION SHALL BE TONGUE AND GROOVE TYPE. ALL LIFTING HOLES SHALL BE SEALED WITH GROUT.
- ⑤ ALL PRECAST MANHOLE BASES SHALL BE PLACED ON 8" MINIMUM OF ABC PER SECTION 702 COMPACTED TO 100% MAXIMUM DENSITY.
- ⑥ ALL MODIFICATIONS SHALL BE APPROVED BY THE ENGINEER.
- ⑦ MINIMUM WALL THICKNESS SHALL BE PER ASTM C478 (MIN 5").
- ⑧ REINFORCEMENT SHALL BE DESIGNED BY AN ARIZONA REGISTERED PROFESSIONAL ENGINEER.
- ⑨ CHANNEL TRANSITION SHALL BE CONSTANT FROM INLET TO OUTLET OF MANHOLE TO FACILITATE SMOOTH TRANSITIONS AND ACCOMMODATE CORRESPONDING MANDREL.
- ⑩ THERE SHALL BE NO HARD CONNECTIONS (GROUTED) INTO THE MANHOLE BASE UNLESS APPROVED BY THE ENGINEER.
- ⑪ ALL SEWER SERVICE CONNECTIONS SHALL HAVE THE SAME CONNECTION TYPES IN THE PRECAST MANHOLE BASE.
- ⑫ ALL CORE HOLES INTO THIS STRUCTURAL PRECAST BASE SHALL BE COATED WITH AN APPROVED COATING MATERIAL.
- ⑬ THE MANHOLE BOTTOM SHALL EXTEND OUTSIDE THE MANHOLE WALL A MINIMUM 6" WIDE ON 48" BASES, 7" WIDE ON 60" BASES, AND 8" WIDE ON 72" BASES. EXTENDED BOTTOM SHALL BE A MINIMUM OF 5" THICK.
- ⑭ ALL PIPE CONNECTIONS SHALL BE IN COMPLIANCE WITH ASTM F477 OR ASTM C425. AN EXTRA STRENGTH VCP BELL WITH A POLYURETHANE JOINT THAT MEETS ASTM C425 MAY BE USED WITH VCP.

DETAIL NO.
420-2

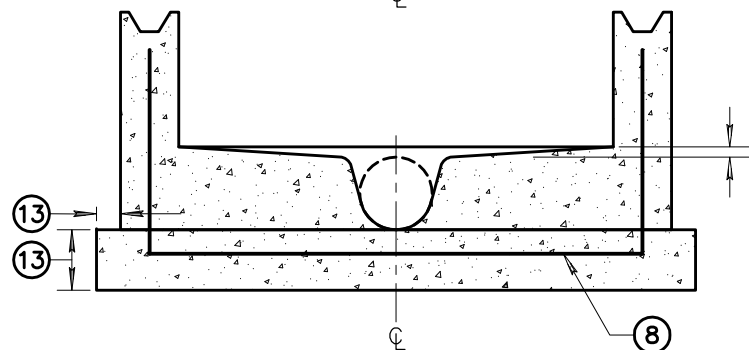
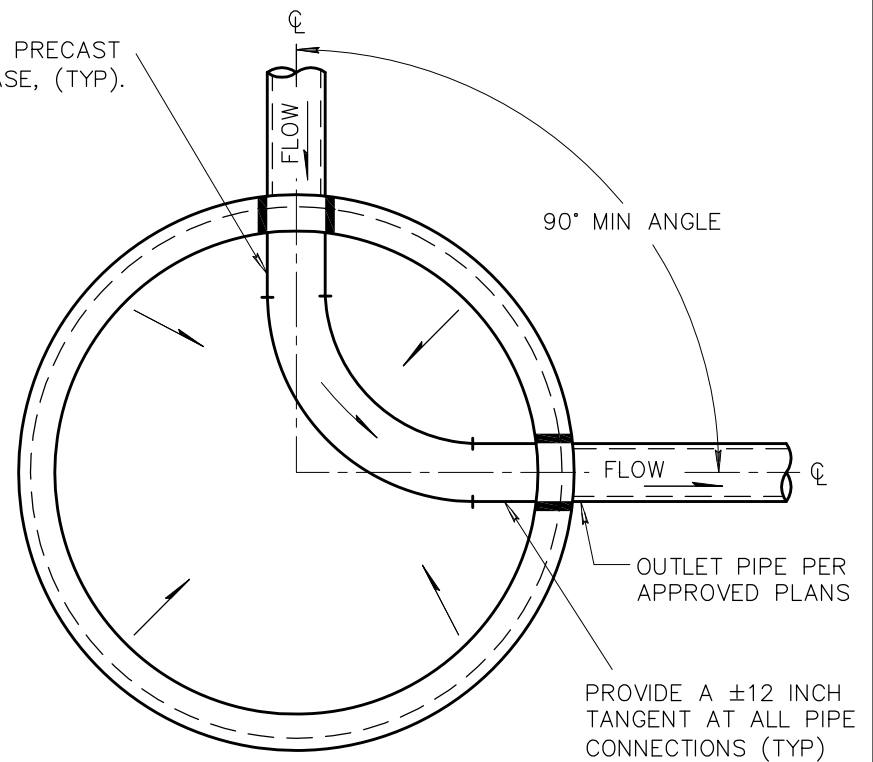
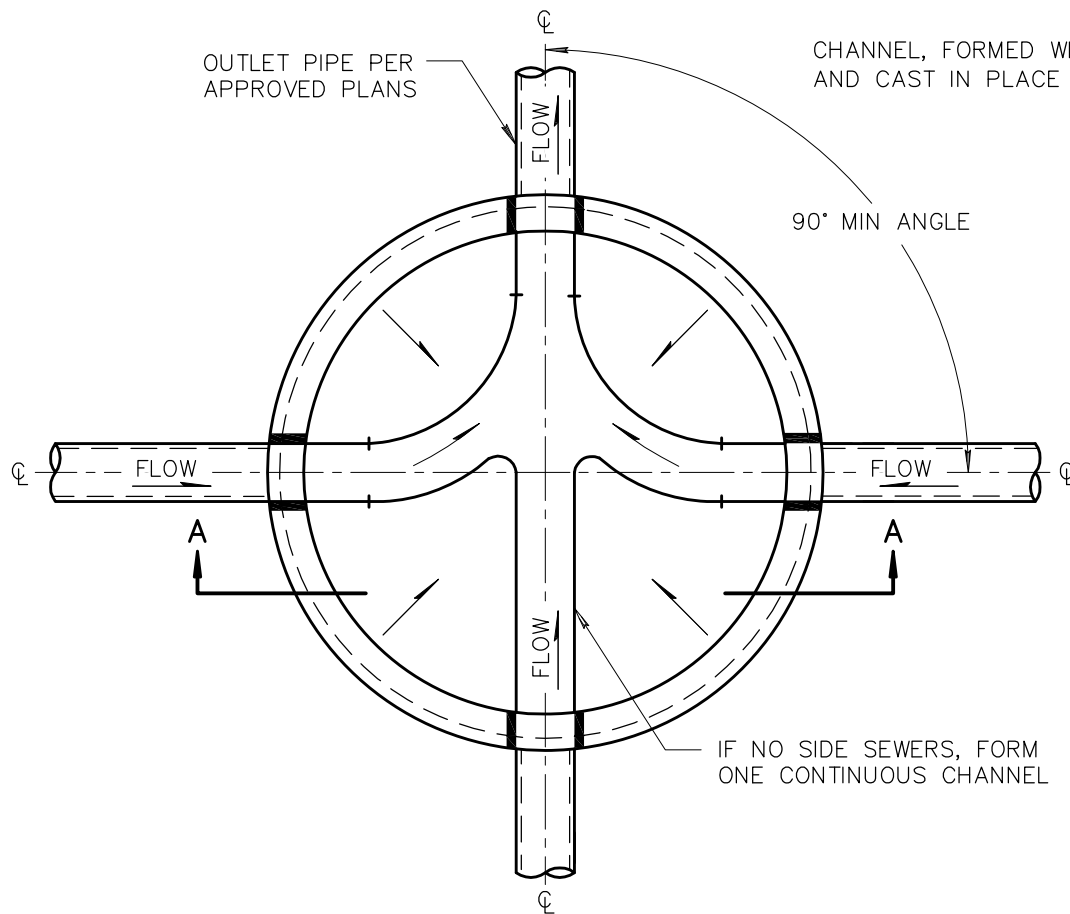


STANDARD DETAIL
ENGLISH

PRECAST CONCRETE MANHOLE BASE

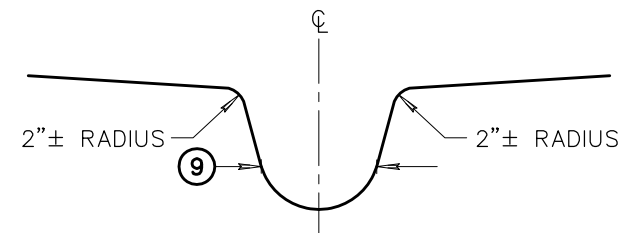
REVISED
01-01-2015

DETAIL NO.
420-2



SECTION A-A

TOP OF SHELF TO
TOP OF PIPE
(MIN 2% SLOPE)
NOT
TO EXCEED 3"



CHANNEL TRANSITION SHALL BE CONSISTENT
FROM INLET TO OUTLET OF MANHOLE TO
FACILITATE SMOOTH TRANSITIONS AND
ACCOMMODATE CORRESPONDING MANDREL.

TYPICAL CHANNEL

SEE DETAIL 420-2 FOR NOTES

DETAIL NO.
420-3



STANDARD DETAIL
ENGLISH

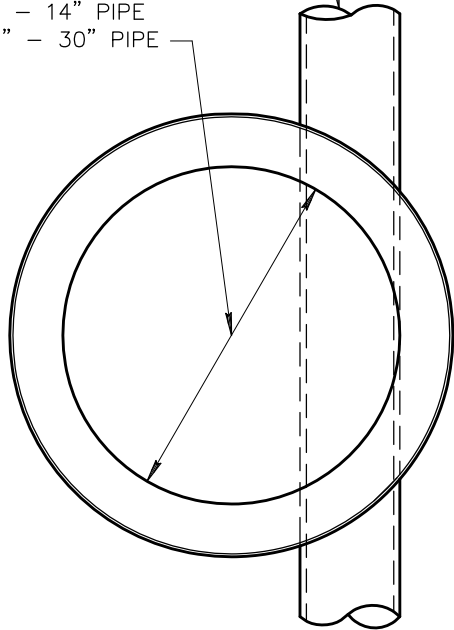
CONCRETE MANHOLE BASE

REVISED
01-01-2015

DETAIL NO.
420-3

PIPE SIZE & ELEVATION
AS SHOWN ON PLANS

48" I.D. FOR 8" - 14" PIPE
60" I.D. FOR 15" - 30" PIPE



MANHOLE ADJUSTMENT
PER DETAIL 422

COMBINED CURB
AND GUTTER

SEE DETAIL
420-1 FOR
ADJUSTMENT
REQUIREMENTS

MANHOLE TO BE
PRECAST PER
SECT. 625

PRECAST RISER PER
ASTM C-478

4"
TYP

2% MIN NOT TO
EXCEED 3"

CEMENT
MORTAR
(TYP)

30" MIN.
36" MAX.

CLASS A CONCRETE
PER SECT. 725, 505

TROWEL
FINISH
SMOOTH

8" IF MANHOLE
IS 13' OR LESS
12" IF MANHOLE
IS OVER 13'

DETAIL NO.

421



STANDARD DETAIL
ENGLISH

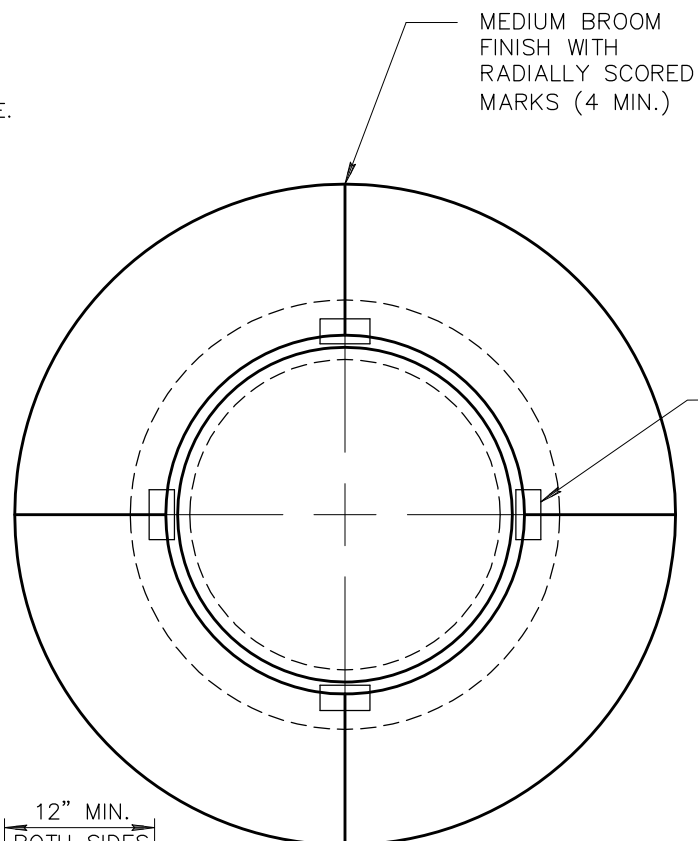
OFFSET MANHOLE 8" TO 30" PIPE

REVISED

01-01-2015

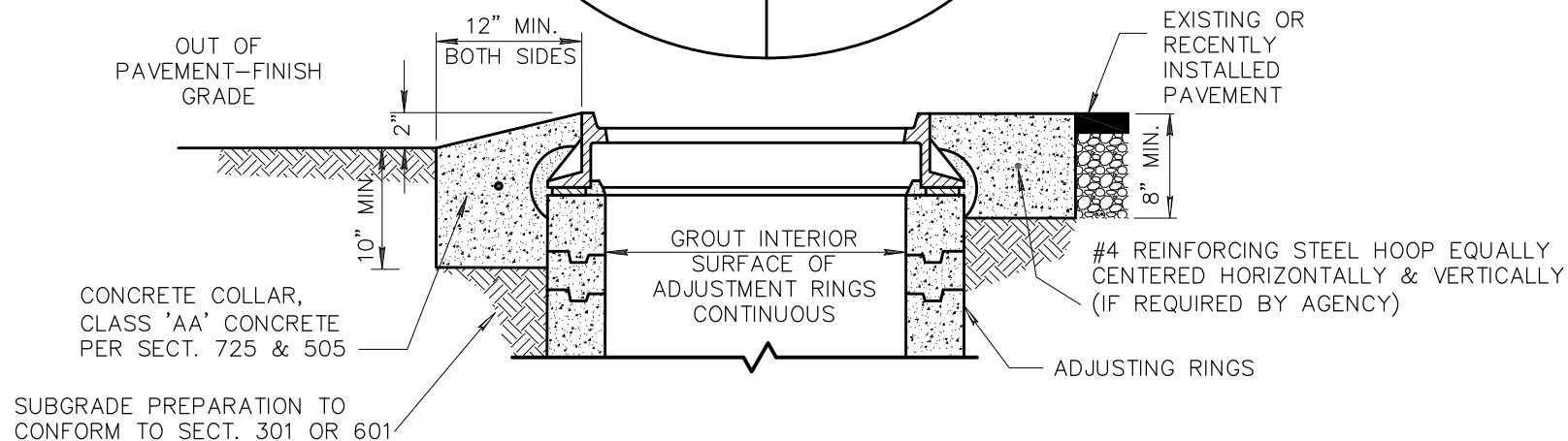
DETAIL NO.

421

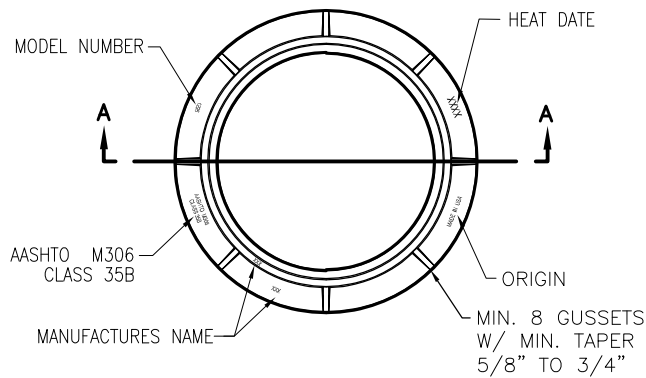


1. CONTRACTORS SHALL ADJUST ALL MANHOLE RINGS AND COVERS, INCLUDING MANHOLES OUTSIDE OF THE PAVEMENT.
2. ADJUSTMENT SHALL BE CONSTRUCTED PER MAG SECTION 345.
3. MANHOLE COATINGS PER AGENCY
4. GROUT SHALL BE USED BETWEEN FRAME AND ADJUSTING RING TO ACHIEVE WATER TIGHTNESS.

SPACER TYPE	REQUIRED THICKNESS
BRICK	GREATER THAN 2"
4"x2" STEEL SPACER	½" TO 2"
GROUT	LESS THAN ½"

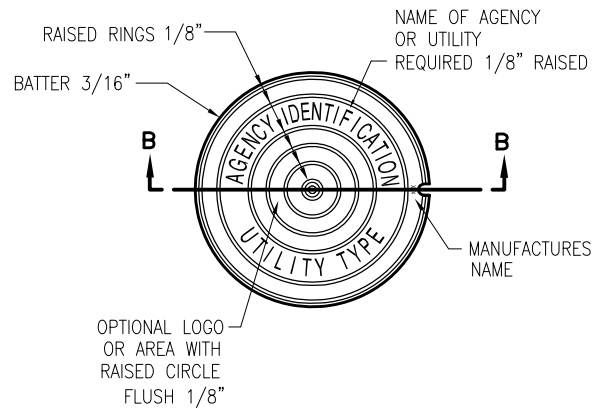


FRAME TOP VIEW

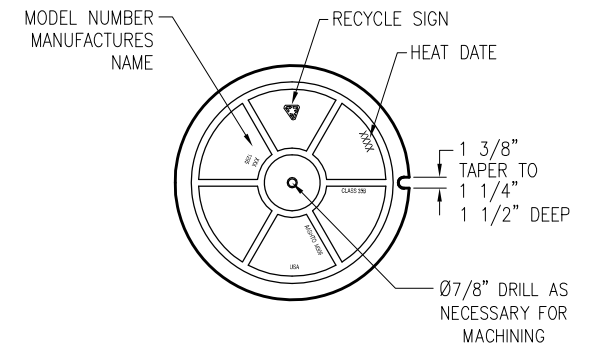


FRAME WT. (CL. 35) – 180 LBS

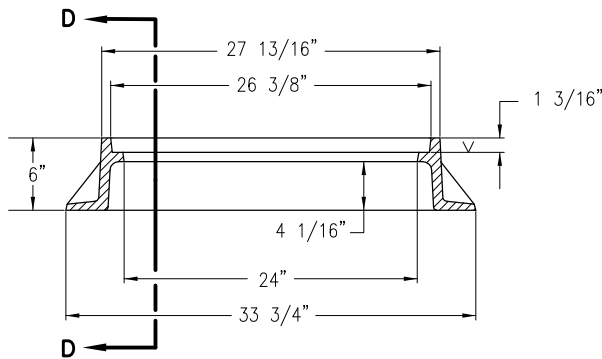
COVER TOP VIEW



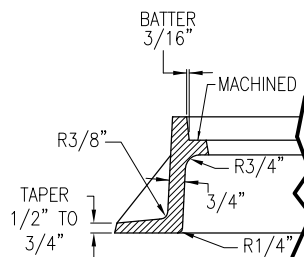
COVER BOTTOM VIEW



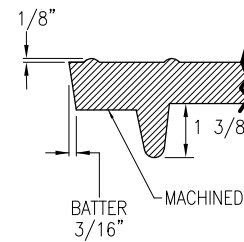
COVER WT. (CL. 35) – 188 LBS



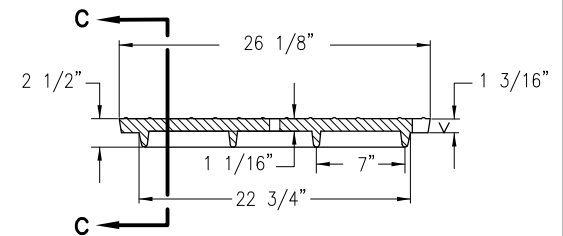
SECTION A



SECTION D



SECTION C



SECTION B

NOTE:

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF RINGS. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.
423-1



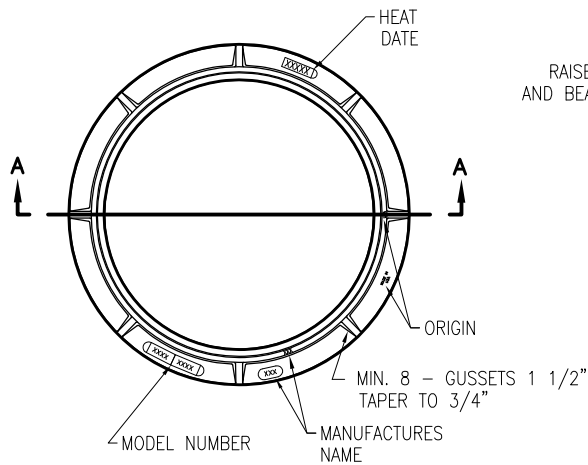
STANDARD DETAIL
ENGLISH

**24" CAST IRON
MANHOLE FRAME AND COVER**

REVISED
01-01-2012

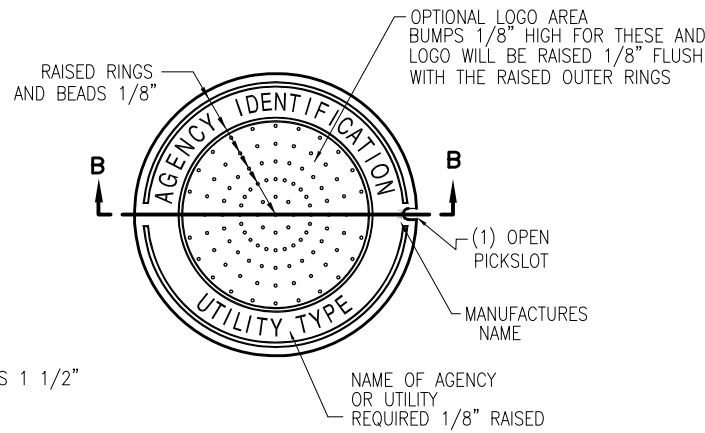
DETAIL NO.
423-1

FRAME TOP VIEW

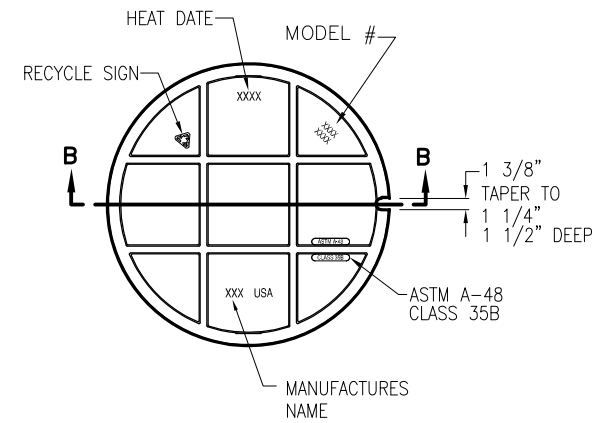


FRAME WT. (CL. 35) - 227 LBS

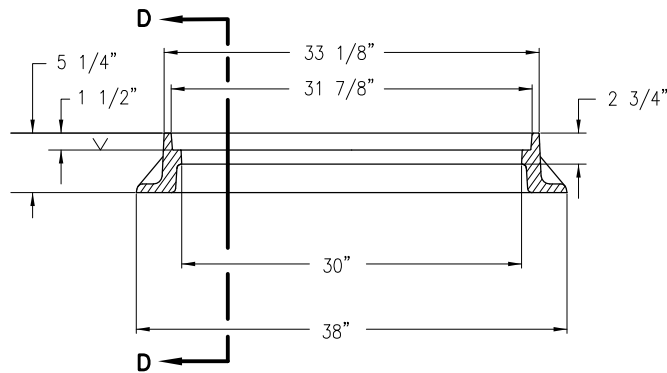
COVER TOP VIEW



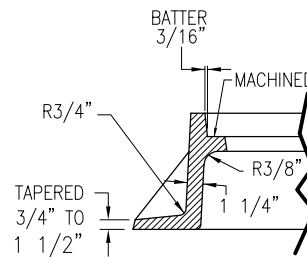
COVER BOTTOM VIEW



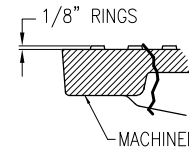
COVER WT. (CL. 35) - 210 LBS



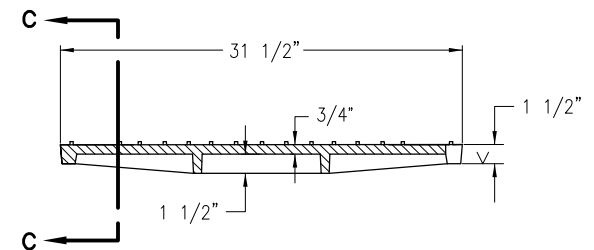
SECTION A



SECTION D



SECTION C



SECTION B

NOTE:

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.

423-2



STANDARD DETAIL
ENGLISH

30" CAST IRON
MANHOLE FRAME AND COVER

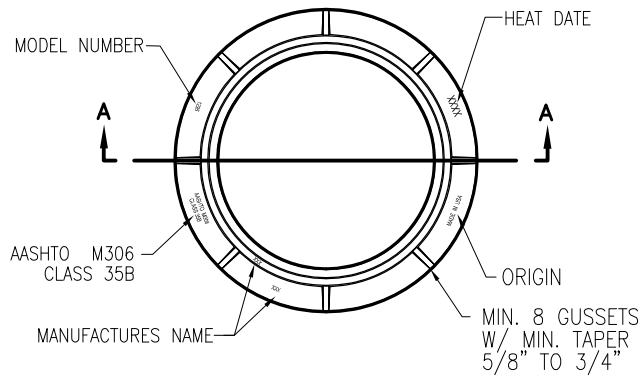
REVISED

01-01-2012

DETAIL NO.

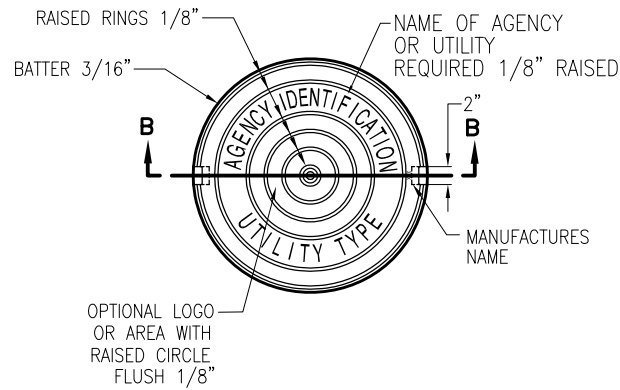
423-2

FRAME TOP VIEW

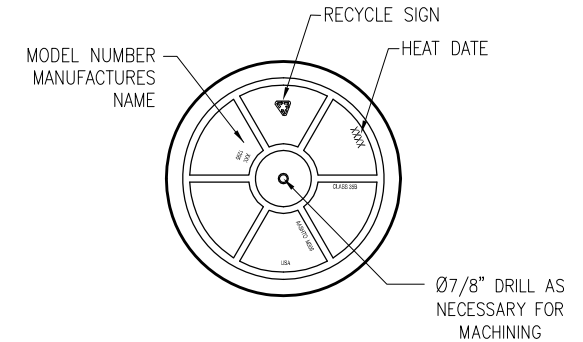


FRAME WT. (CL. 35) – 180 LBS

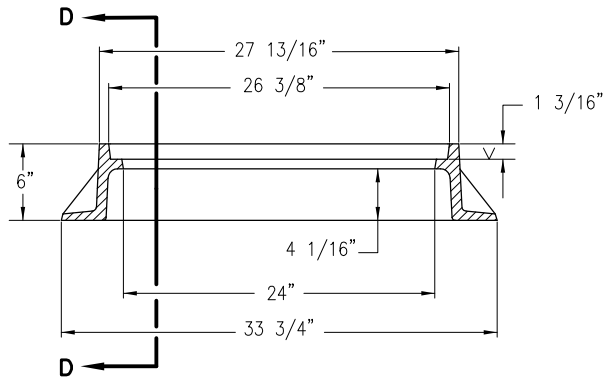
COVER TOP VIEW



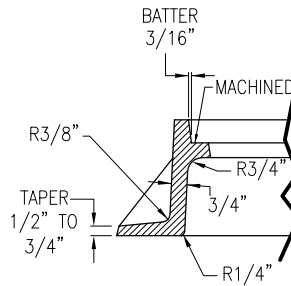
COVER BOTTOM VIEW



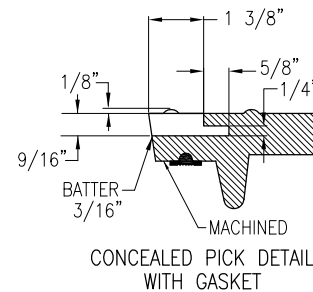
COVER WT. (CL. 35) – 188 LBS



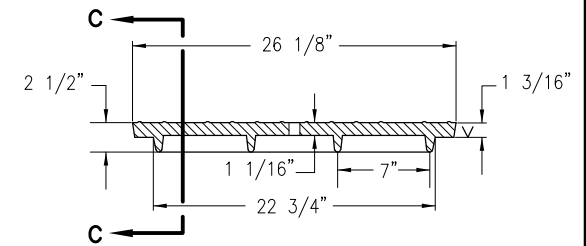
SECTION A



SECTION D



SECTION C



SECTION B

NOTE:

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.
424-1



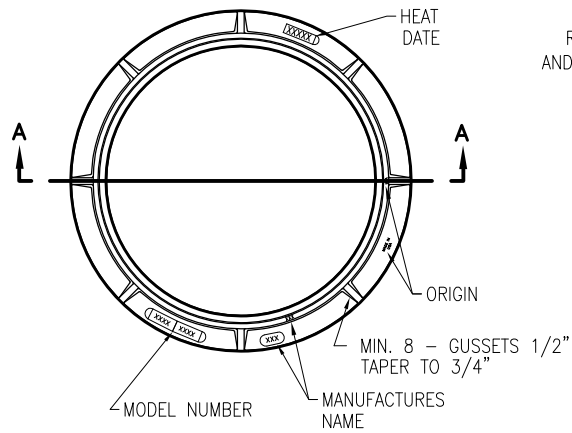
STANDARD DETAIL
ENGLISH

**24" CAST IRON WATERTIGHT
MANHOLE FRAME AND COVER**

REVISED
01-01-2012

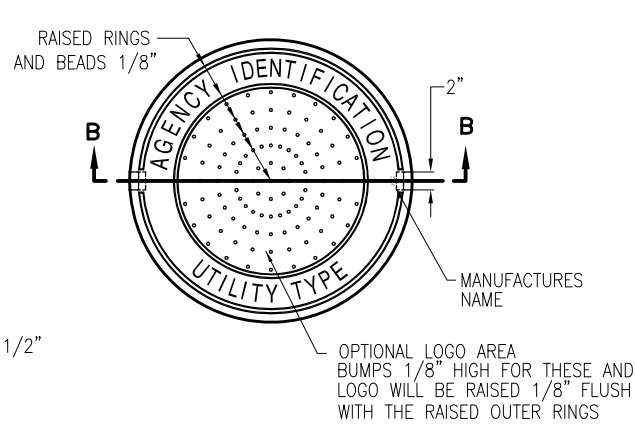
DETAIL NO.
424-1

FRAME TOP VIEW

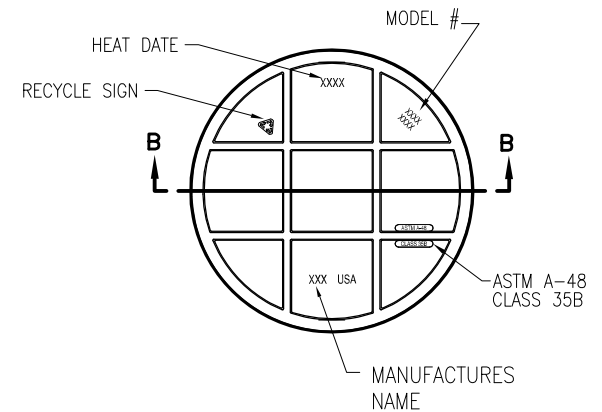


FRAME WT. (CL. 35) - 227 LBS

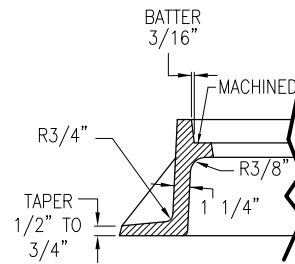
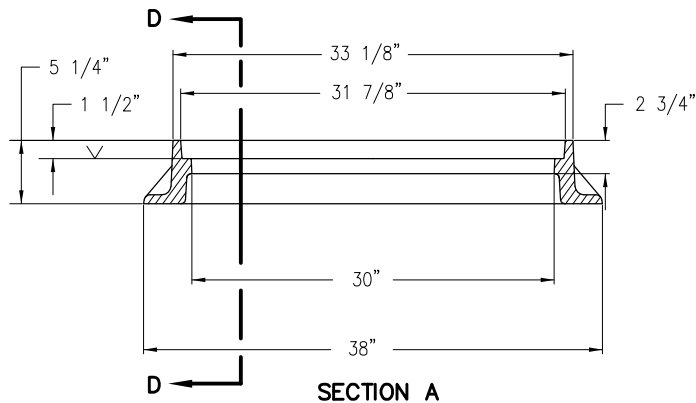
COVER TOP VIEW



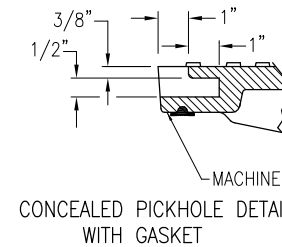
COVER BOTTOM VIEW



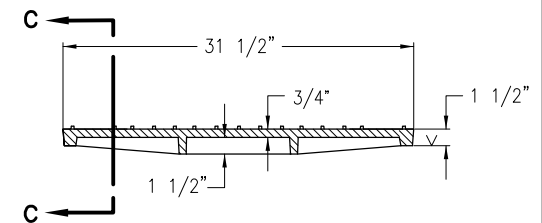
COVER WT. (CL. 35) - 210 LBS



SECTION D



SECTION C



SECTION B

NOTE:

LETTERING ON MANHOLE COVER TO CONTAIN NAME OF AGENCY AND UTILITY FOR WHICH MANHOLE IS NEEDED, (I.E. "PHOENIX SANITARY SEWER"), OR AS DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS TO BE SUCH THAT LETTERS AND WORDS ARE EQUALLY SPACED AND BALANCED TO FORM A COMPLETE CIRCLE WITH SPACERS BEFORE AND AFTER THE WORD IDENTIFYING THE AGENCY INVOLVED. LETTERS TO BE 2" IN HEIGHT AND RAISED FLUSH W/ TOP OF COVER. TYPE OF LETTERS TO BE SUBMITTED FOR APPROVAL. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2% MORE OR LESS THAN THE APPROXIMATE WEIGHT SPECIFIED. CASTINGS SHALL CONFORM TO ASTM A-48, CLASS 35 AND AASHTO M306. THE BEARING SURFACES OF THE FRAMES AND COVERS SHALL BE MACHINED AND THE COVERS SHALL SEAT FIRMLY WITHOUT ROCKING. ALL DIMENSIONS SHALL HAVE A 1/16" TOLERANCE.

DETAIL NO.

424-2



STANDARD DETAIL
ENGLISH

30" CAST IRON WATERTIGHT
MANHOLE FRAME AND COVER

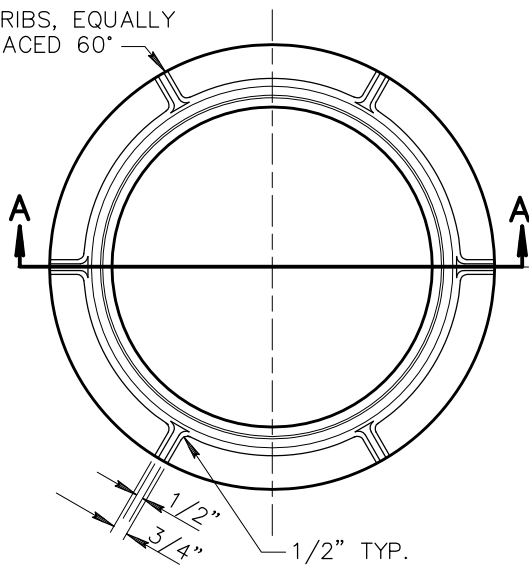
REVISED

01-01-2012

DETAIL NO.

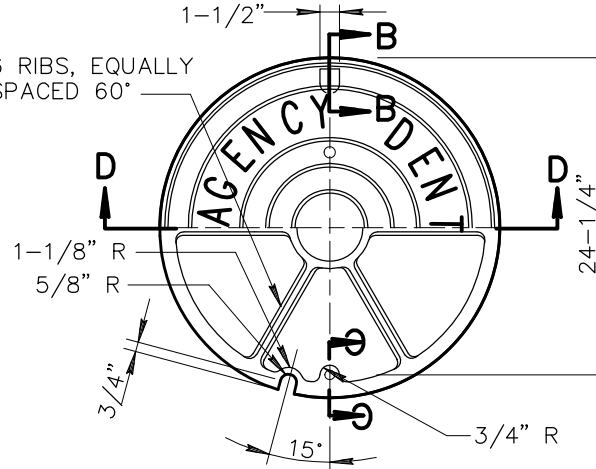
424-2

6 RIBS, EQUALLY
SPACED 60°

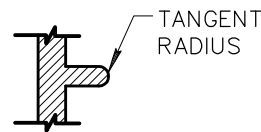


TOP VIEW

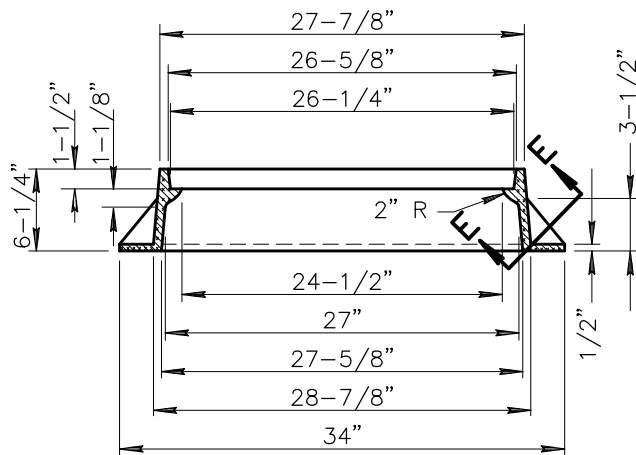
6 RIBS, EQUALLY
SPACED 60°



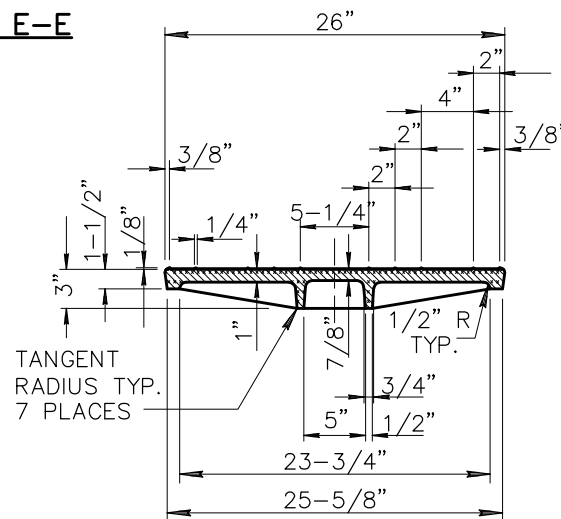
BOTTOM VIEW



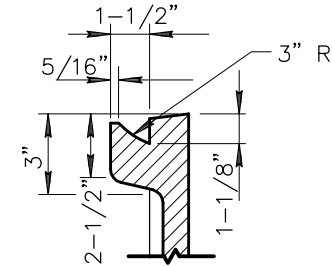
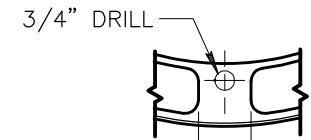
SECTION E-E



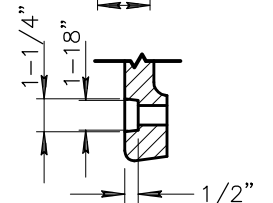
SECTION 'A-A'



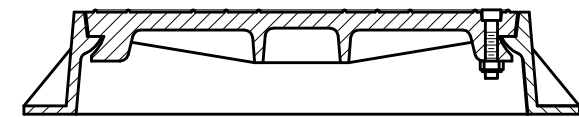
SECTION 'D-D'



SECTION 'B-B'



SECTION 'C-C'



**SECTION VIEW OF FRAME AND COVER
WITH CAM LOCKING DEVICE**

NOTES:

1. MATERIAL SHALL CONFORM TO A.S.T.M. STANDARDS
B 179-65 ALLOY SN122A
B 179-65 ALLOY CN42A
B 108-65 ALLOY SC103A
(ALL 3 ACCEPTABLE)
2. LETTERING ON MANHOLE COVER TO CONTAIN NAME
OF AGENCY AND UTILITY FOR WHICH MANHOLE IS
NEEDED. (I.E. "PHOENIX SANITARY SEWER"), OR AS
DIRECTED. THE TOTAL WIDTH OF INDIVIDUAL LETTERS
TO BE SUCH THAT LETTERS AND WORDS ARE
EQUALLY SPACED AND BALANCED TO FORM A
COMPLETE CIRCLE WITH SPACERS BEFORE AND
AFTER THE WORD IDENTIFYING THE AGENCY
INVOLVED. LETTERS TO BE 2" RAISED 1/8"
ABOVE LEVEL OF COVER. TYPE OF LETTERS TO BE
SUBMITTED FOR APPROVAL.
3. WEIGHT OF CASTINGS SHALL BE NO MORE THAN 2%
LESS THAN THE APPROXIMATE WEIGHT SPECIFIED.
4. CASTINGS SHALL CONFORM TO SECT. 787.
5. SHALL CONFORM TO SECT. 625.3.1 - (FRAME
AND COVER).

DETAIL NO.

425



STANDARD DETAIL
ENGLISH

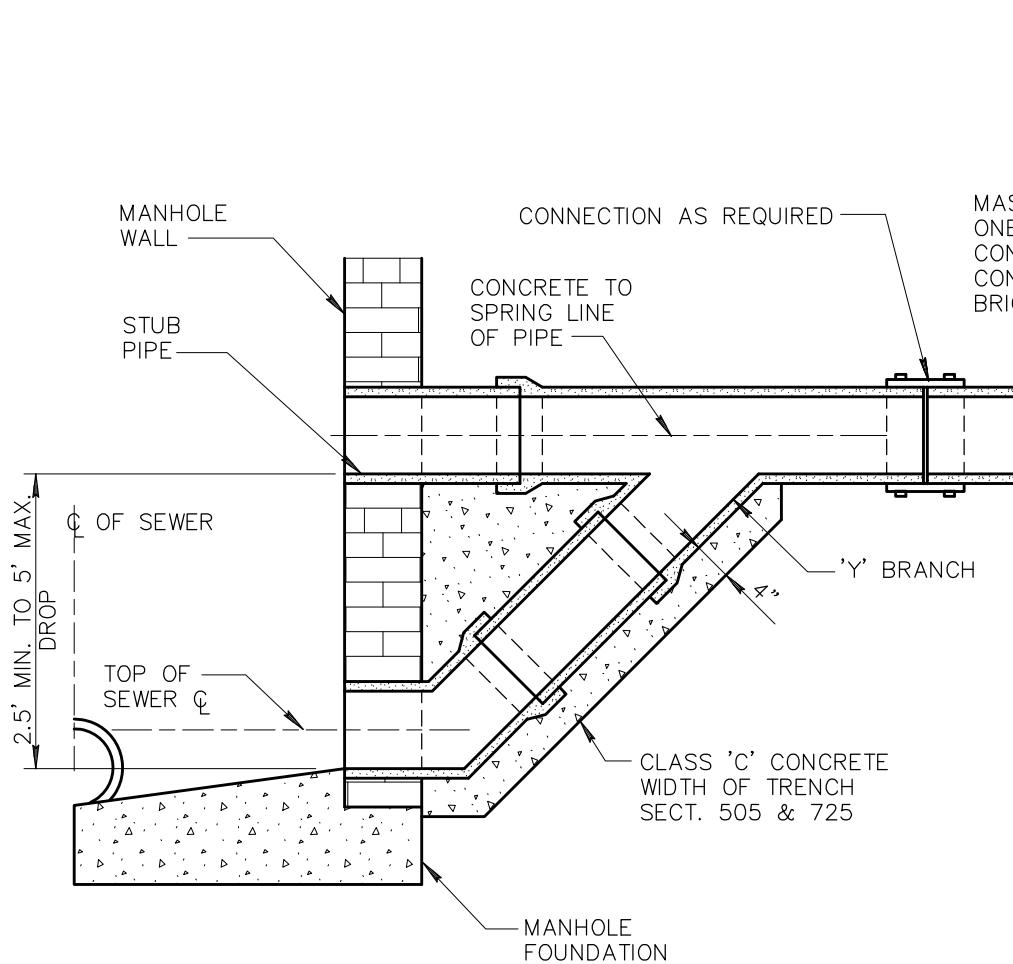
**24" ALUMINUM
MANHOLE FRAME AND COVER**

REVISED

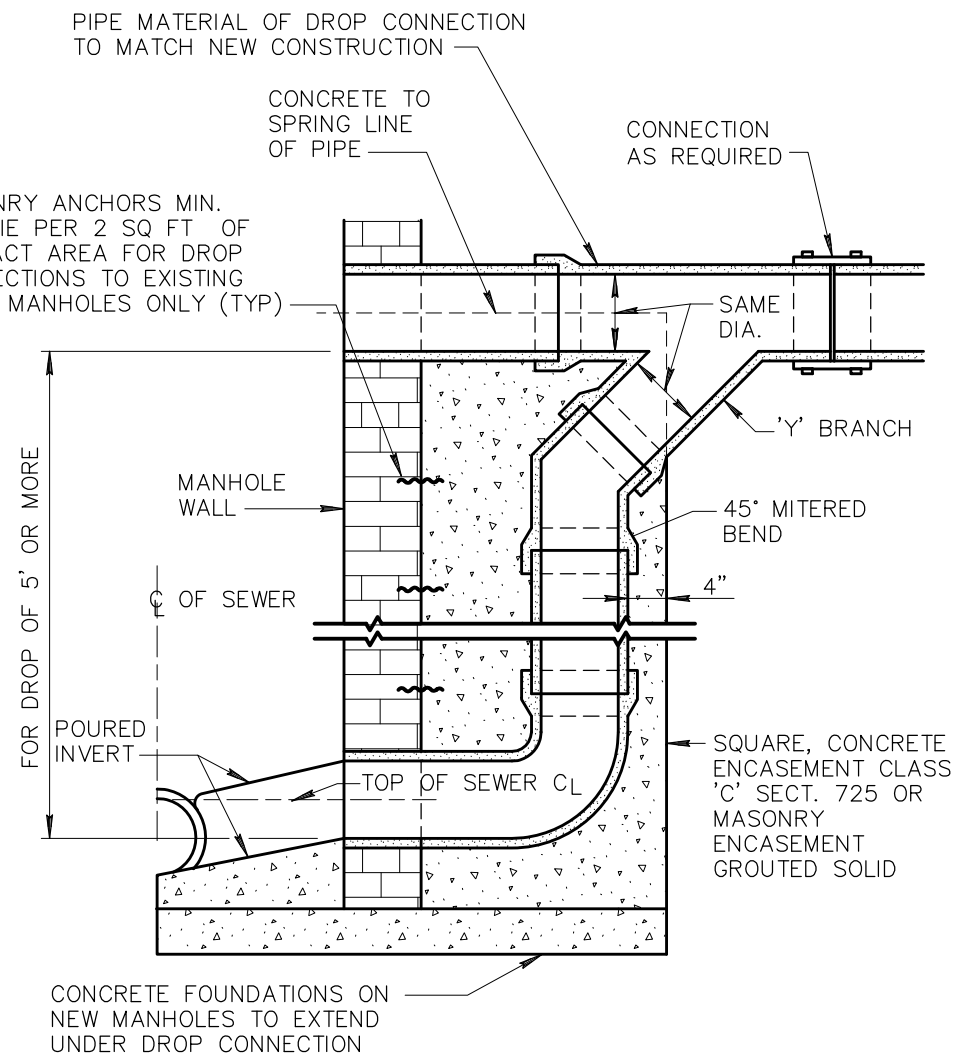
01-01-1998

DETAIL NO.

425



TYPE A
2.5' TO 5' DROP



TYPE B
5' OR MORE

DETAIL NO.

426



STANDARD DETAIL
ENGLISH

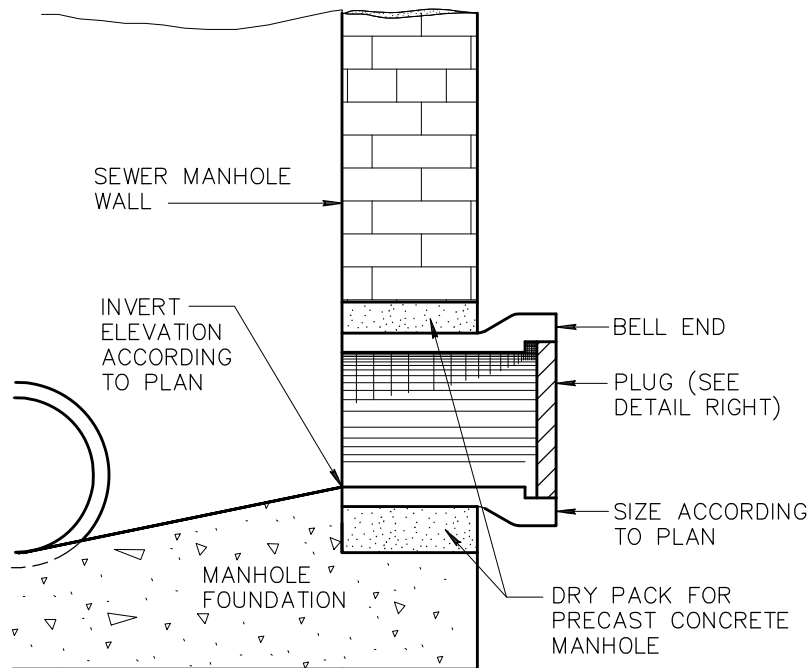
DROP SEWER CONNECTIONS

REVISED

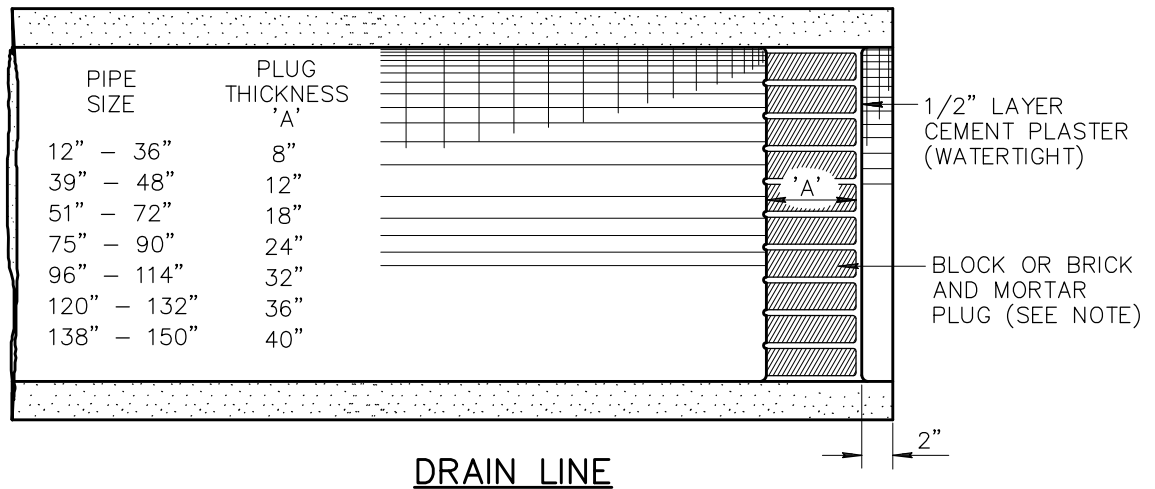
01-01-2007

DETAIL NO.

426

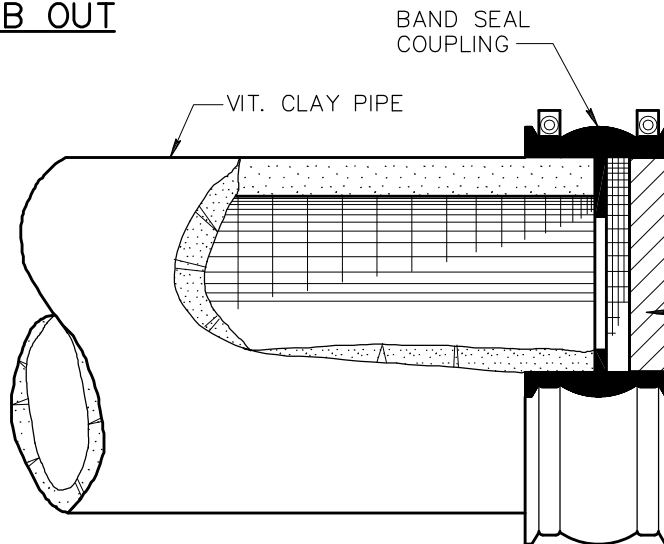


TYPICAL STUB OUT

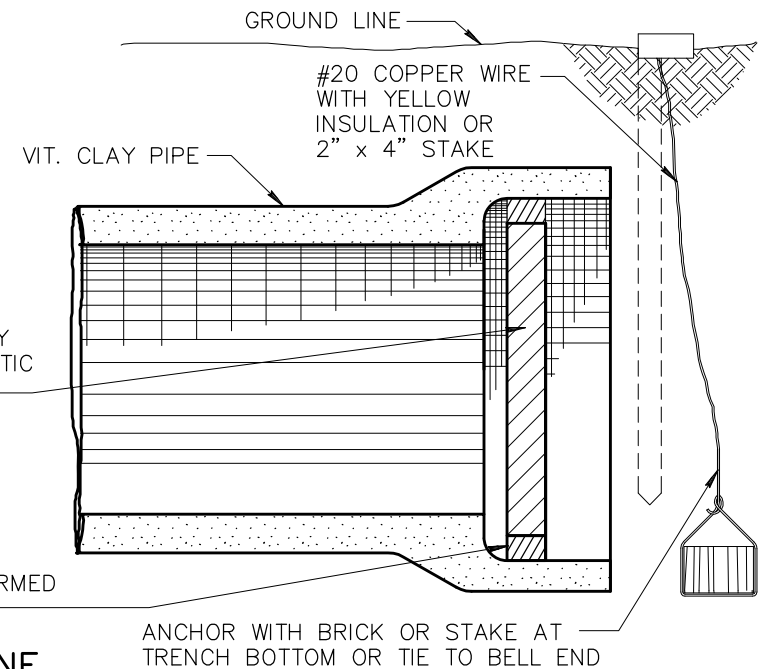


NOTES:

1. NOTE: COMPACT SOIL AT END OF PIPE TO 95% OF MAXIMUM DENSITY.
2. IF DEPTH OF COVER IS LESS THAN 5' OR GREATER THAN 10' INCREASE PLUG THICKNESS A MIN. OF 4".



SEWER LINE



DETAIL NO.

427



STANDARD DETAIL
ENGLISH

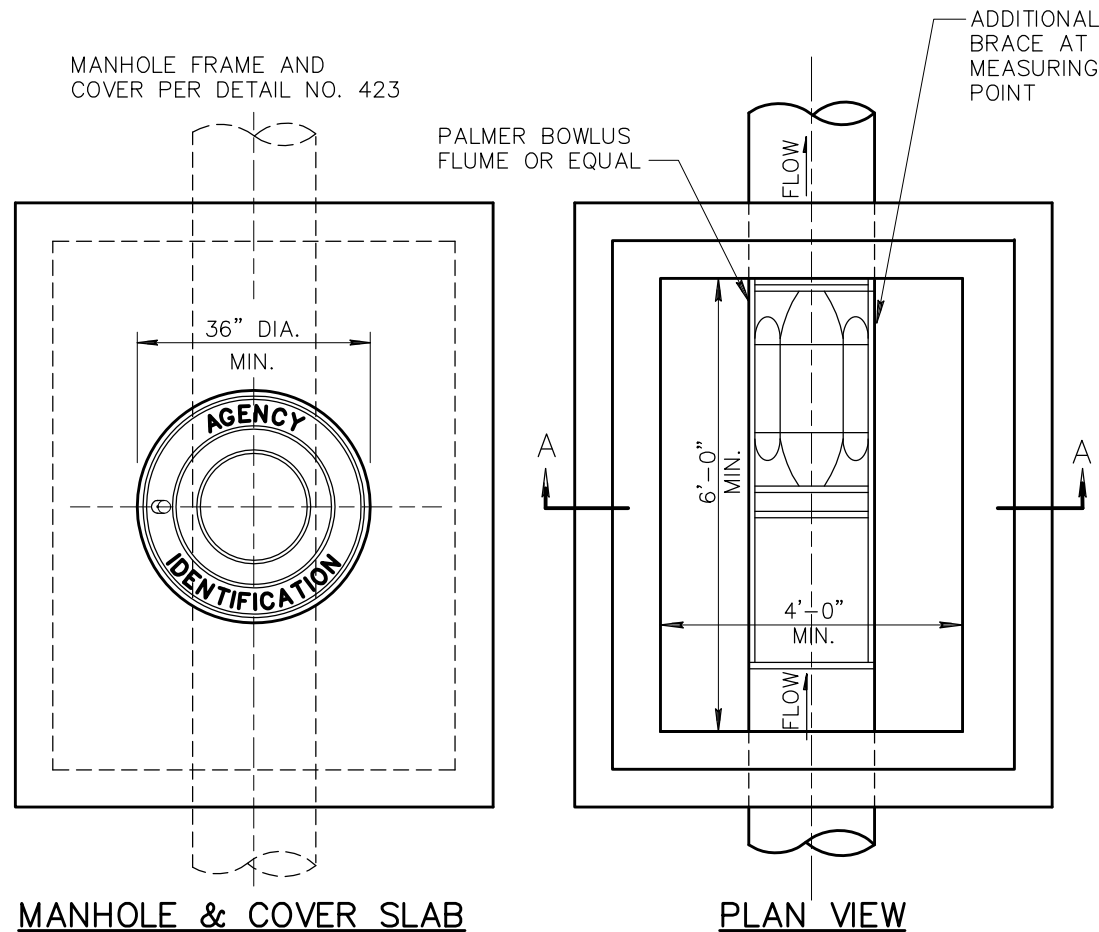
STUB OUT AND PLUGS

REVISED

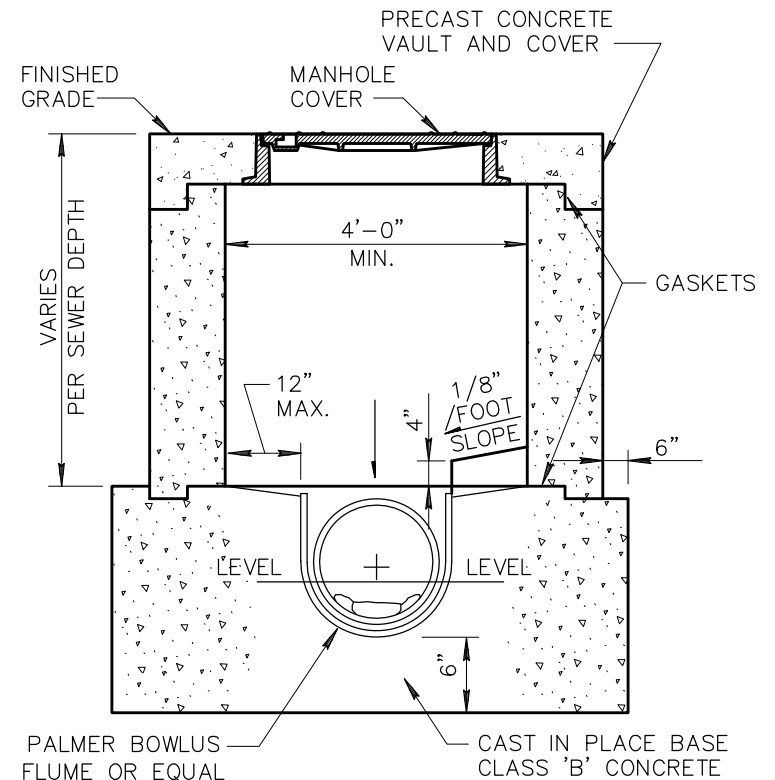
01-01-1998

DETAIL NO.

427



NOTE: WITH COVER REMOVED.



NOTE: LADDER NOT SHOWN IN SECTION VIEW.
SECTION SHOWN WITH COVER IN PLACE.

NOTES:

1. THIS CONTROL VAULT WITH MANHOLE AND COVER SHALL BE USED ON 6" AND 8" DIAMETER SEWER WITH FLOWS IN THE RANGE OF 40 TO 340 GPM.
2. VAULT TO BE CONSTRUCTED ON STRAIGHT RUN OF BUILDING SEWER. ACCESSIBLE AND SAFELY LOCATED ON THE OWNERS PROPERTY ADJACENT TO A PUBLIC RIGHT-OF-WAY.
3. THE PALMER BOWLUS FLUME SHALL BE INSTALLED PER THE MANUFACTURERS RECOMMENDATIONS.
4. THE PRE-CAST CONCRETE VAULT SHALL BE RECTANGULAR WITH MINIMUM INSIDE DIMENSIONS OF 4' WIDE AND 6' LONG AND AT A DEPTH OF THE DESIGN OF THE BUILDING SEWER.
5. A SHOP DRAWING SHALL BE SUBMITTED TO THE CONTRACTING AGENCY FOR APPROVAL BEFORE INSTALLATION OF THE VAULT AND THE PALMER BOWLUS FLUME WILL BE ALLOWED.

DETAIL NO.

429



STANDARD DETAIL
ENGLISH

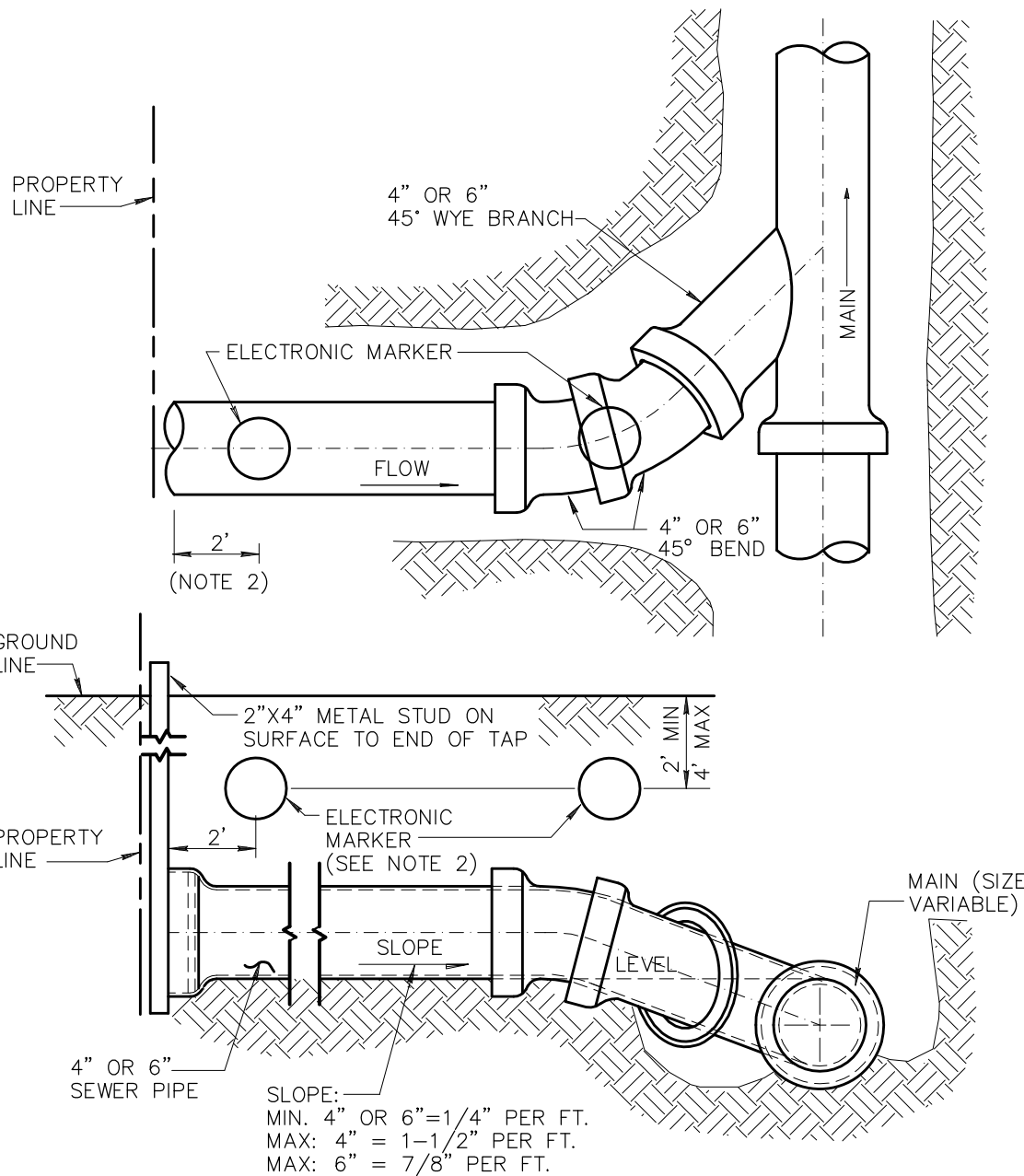
INDUSTRIAL WASTE CONTROL VAULT WITH MANHOLE

REVISED

01-01-2015

DETAIL NO.

429



ELECTRONIC MARKER PLACEMENT

NOTES:

1. ELECTRONIC MARKER SHALL BE A 3M MODEL 1424-XR/iD [4" DIAMETER SELF LEVELING MARKER BALL GREEN IN COLOR] OR APPROVED EQUAL OR AS REQUIRED BY THE LOCAL AGENCY.
2. MARKER SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S DIRECTIONS, 2' BACK FROM THE END OF THE SEWER SERVICE STUB AND CINCH TIED TO PIPE OR ABOVE PIPE AS REQUIRED BY LOCAL AGENCY. AN ADDITIONAL MARKER SHALL BE INSTALLED AT EACH SERVICE STUB BEND.
3. ELECTRONIC MARKER SHALL BE RESTORED BY CONTRACTOR IF DISTURBED WHEN PRIVATE SERVICE LINE CONNECTION IS INSTALLED.
4. MARKER SHALL BE USED IN ADDITION TO A 2"x4" METAL STUD.
5. CONSTRUCTION DETAIL APPLIES WHERE CONTRACTOR BUILDS HOUSE CONNECTION. TAP EXTENDS TO PROPERTY LINE IN ALLEYS OR STREETS OR TO EASEMENT LINE.
6. SIZE OF TAP SHALL BE DESIGNATED ON PLANS.
7. CONSTRUCT TAP AT MINIMUM SLOPE IF COVER WILL BE LESS THAN 5' AT PROPERTY LINE.
8. ALL FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321. THE CONTRACTOR MAY VARY FROM THE DRAWING TO USE THE APPROPRIATE WYES, TEE-WYES AND BENDS TO ENSURE NO MISALIGNMENT OF THE PIPE AND FITTINGS. BLOCK OR BRACE FITTINGS JOINTS TO ENSURE ZERO DEGREES ANGULAR JOINT DEFLECTION.
9. END OF TAP TO BE SEALED AND MARKED AS NOTED.

DETAIL NO.
440-1

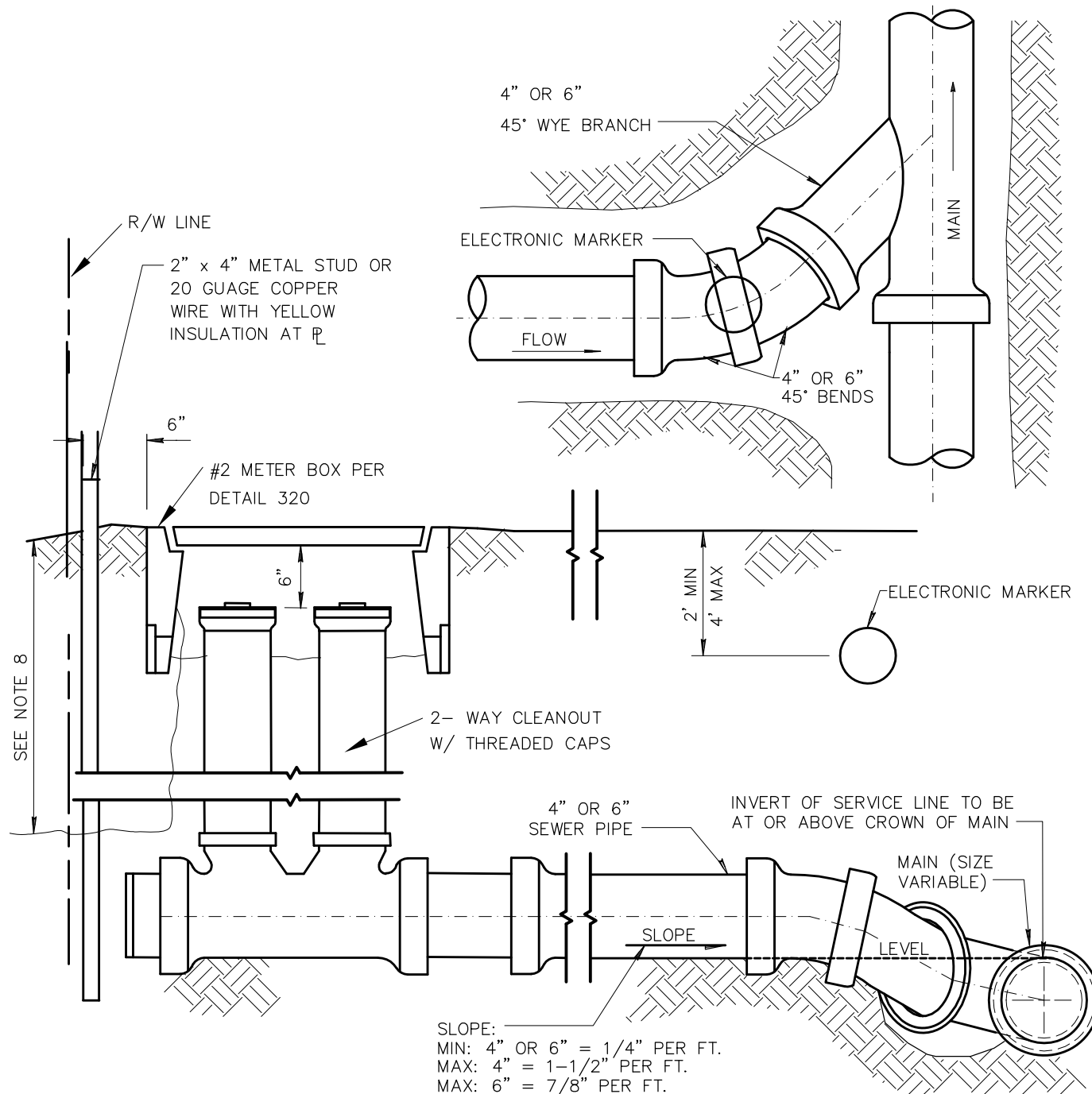


STANDARD DETAIL
ENGLISH

**TYPE 'A' - SEWER BUILDING CONNECTION
ELECTRONIC BALL MARKERS (STANDARD)**

REVISED
01-01-2007

DETAIL NO.
440-1



NOTES:

1. CONSTRUCTION DETAIL APPLIES WHERE CONTRACTOR BUILDS HOUSE CONNECTION. TAP EXTENDS TO PROPERTY LINE IN ALLEYS OR STREETS OR TO EASEMENT LINE.
2. SIZE OF TAP SHALL BE DESIGNATED ON PLANS.
3. CONSTRUCT TAP AT MINIMUM SLOPE IF COVER WILL BE LESS THAN 5' AT PROPERTY LINE.
4. IF DEPTH REQUIRES, MINIMUM SLOPE CAN BE REDUCED TO 1/8" PER FOOT PROVIDED STUB IS STAKED TO GRADE.
5. ALL FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321. THE CONTRACTOR MAY VARY FROM THE DRAWING TO USE THE APPROPRIATE WYES, TEE-WYES AND BENDS TO ENSURE NO MISALIGNMENT OF THE PIPE AND FITTINGS. BLOCK OR BRACE FITTING JOINTS TO ENSURE ZERO DEGREES ANGULAR JOINT DEFLECTION.
6. END OF TAP TO BE SEALED AND MARKED AS NOTED.
7. ELECTRONIC MARKER SHALL BE A 3M MODEL 1424-XR/iD [4" DIAMETER SELF LEVELING MARKER BALL GREEN IN COLOR] OR APPROVED EQUAL OR AS REQUIRED BY THE LOCAL AGENCY.
8. # 14 BARE COPPER LOCATOR WIRE ACCESSIBLE AT R/W AND AT PROPERTY OWNER CLEANOUT BOX NO GREATER THAN 4' DEEP.
9. STAMP OR WELD THE LETTER "S" ON LID OF METER BOX.

DETAIL NO.

440-2



STANDARD DETAIL
ENGLISH

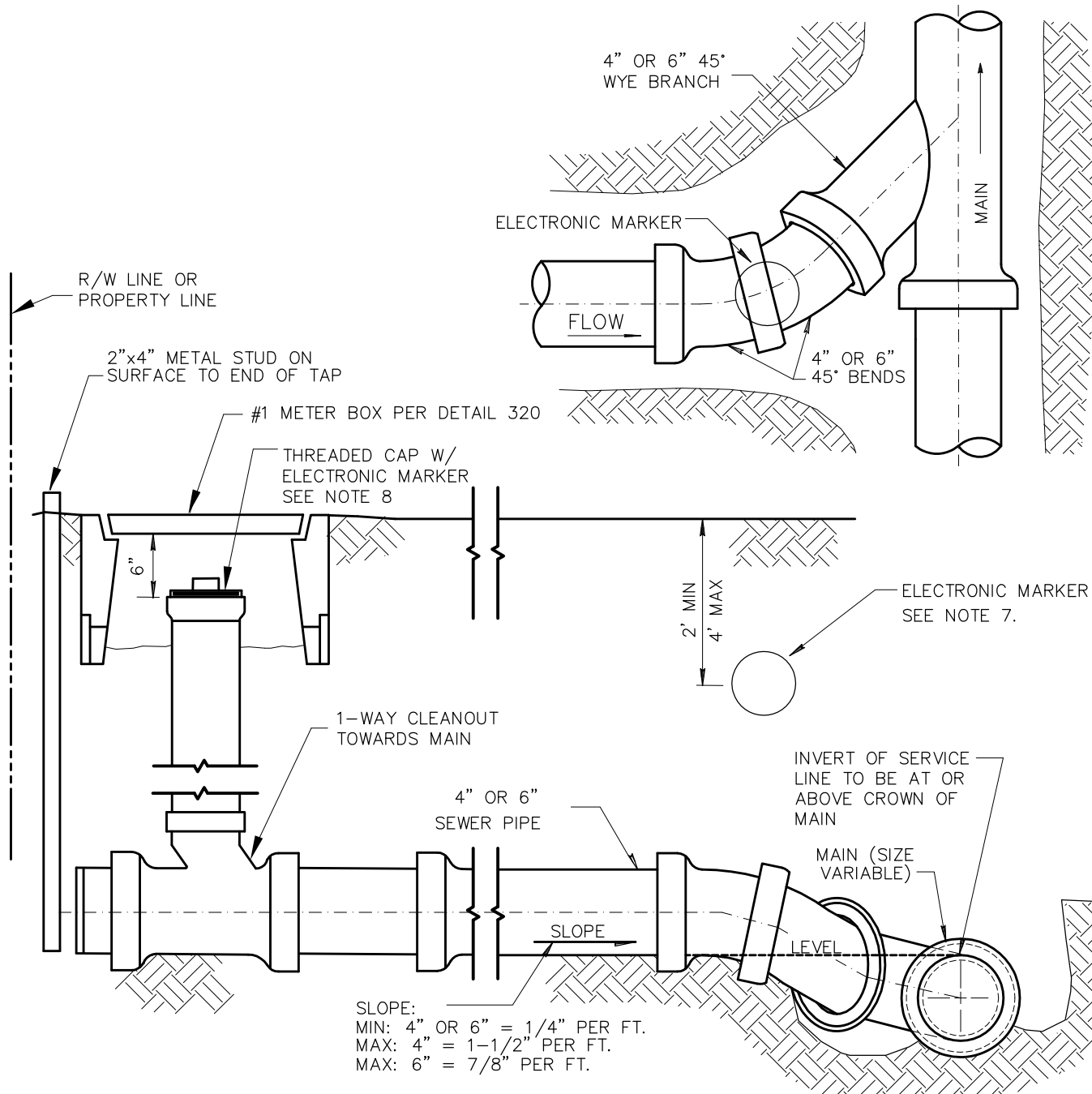
TYPE 'B' – SEWER BUILDING CONNECTION
TWO-WAY CLEANOUT AND METER BOX AT R/W
(WHEN SPECIFIED BY LOCAL AGENCY)

REVISED

01-01-2007

DETAIL NO.

440-2



NOTES:

1. CONSTRUCTION DETAIL APPLIES WHERE CONTRACTOR BUILDS HOUSE CONNECTION. TAP EXTENDS TO PROPERTY LINE IN ALLEYS OR STREETS OR TO EASEMENT LINE.
2. SIZE OF TAP SHALL BE DESIGNATED ON PLANS.
3. CONSTRUCT TAP AT MIN. SLOPE IF COVER WILL BE LESS THAN 5' AT PROPERTY LINE.
4. IF DEPTH REQUIRES, MINIMUM SLOPE CAN BE REDUCED TO 1/8" PER FOOT PROVIDED STUB IS STAKED TO GRADE.
5. ALL FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321. THE CONTRACTOR MAY VARY FROM THE DRAWING TO USE THE APPROPRIATE WYES, TEE-WYES AND BENDS TO ENSURE NO MISALIGNMENT OF THE PIPE AND FITTINGS. BLOCK OR BRACE FITTING JOINTS TO ENSURE ZERO DEGREES ANGULAR JOINT DEFLECTION.
6. END OF TAP TO BE SEALED AND MARKED.
7. ELECTRONIC MARKER SHALL BE A 3M MODEL 1424-XR/iD [4" DIAMETER SELF LEVELING MARKER BALL GREEN IN COLOR] OR APPROVED EQUAL OR AS REQUIRED BY THE LOCAL AGENCY.
8. INSTALL RAISED 4" THREADED PLUG IN CLEANOUT INCORPORATING 3M MODEL 1414 ELECTRONIC DISC MARKER. GREEN IN COLOR. LOCATOR PLUG TO BE GPK PRODUCTS MODEL #228-0004 DM OR APPROVED EQUAL.
9. STAMP OR WELD THE LETTER "S" ON LID OF METER BOX.

DETAIL NO.

440-3



STANDARD DETAIL
ENGLISH

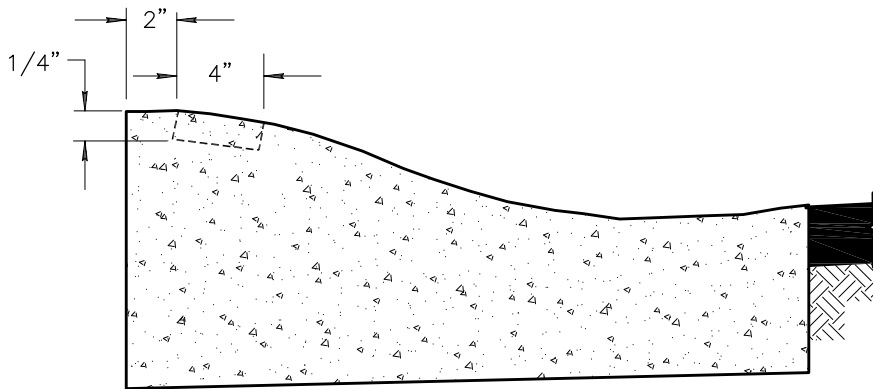
TYPE 'C' – SEWER BUILDING CONNECTION
ONE-WAY CLEANOUT AND METER BOX
(WHEN SPECIFIED BY LOCAL AGENCY)

REVISED

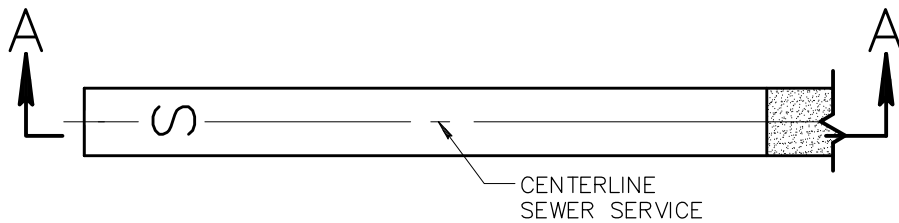
01-01-2007

DETAIL NO.

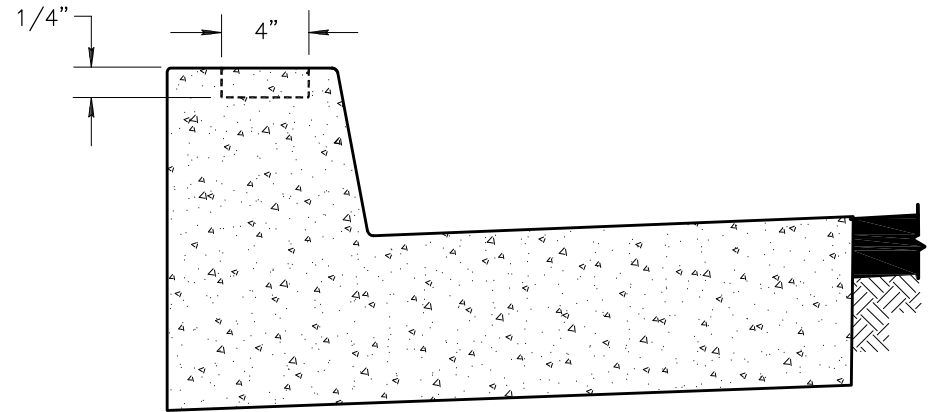
440-3



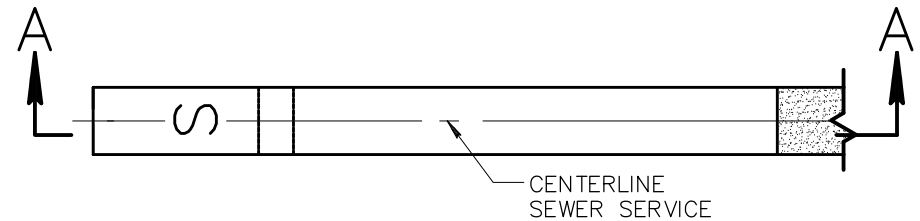
SECTION A-A



CURB STAMP ROLLED CURB



SECTION A-A



CURB STAMP VERTICAL CURB

NOTES:

1. STAMP TOP OF CURB WITH 4" TALL BY 1/4" DEEP "S" TO DESIGNATE SEWER SERVICE LINE CROSSING.

DETAIL NO.

440-4



STANDARD DETAIL
ENGLISH

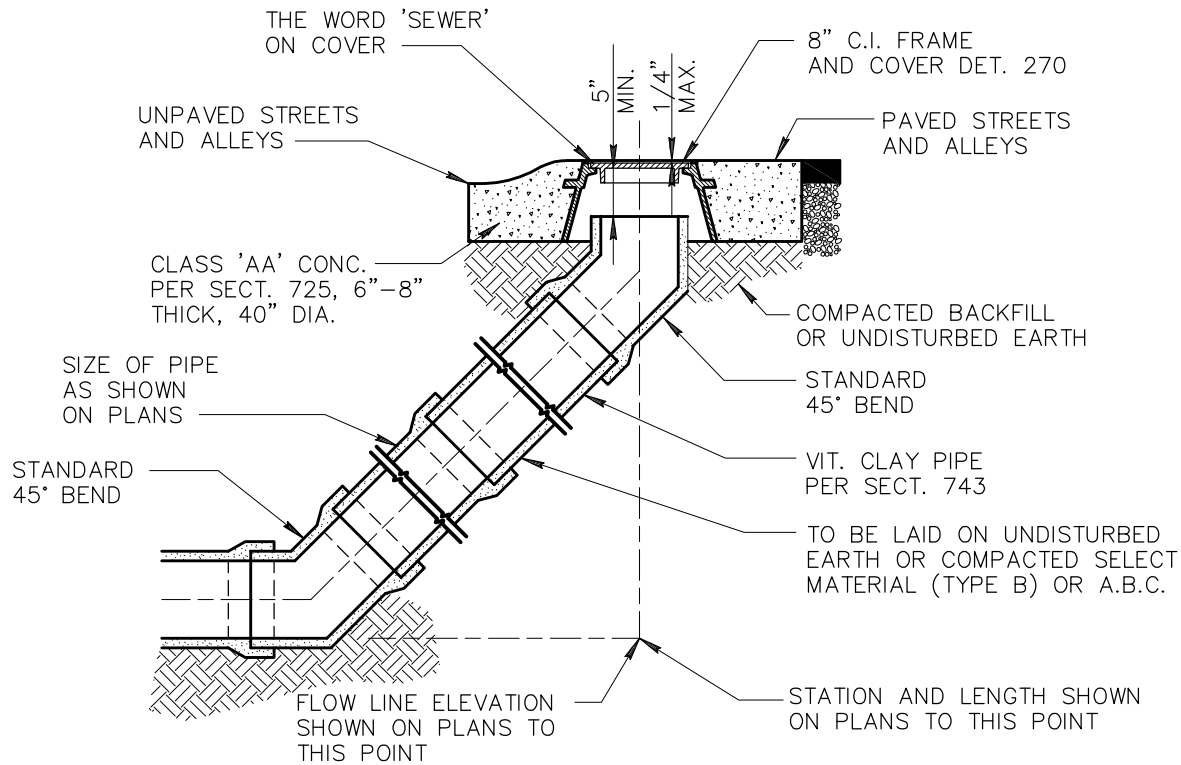
**SEWER SERVICE CURB CROSSING
STAMP DETAIL**

REVISED

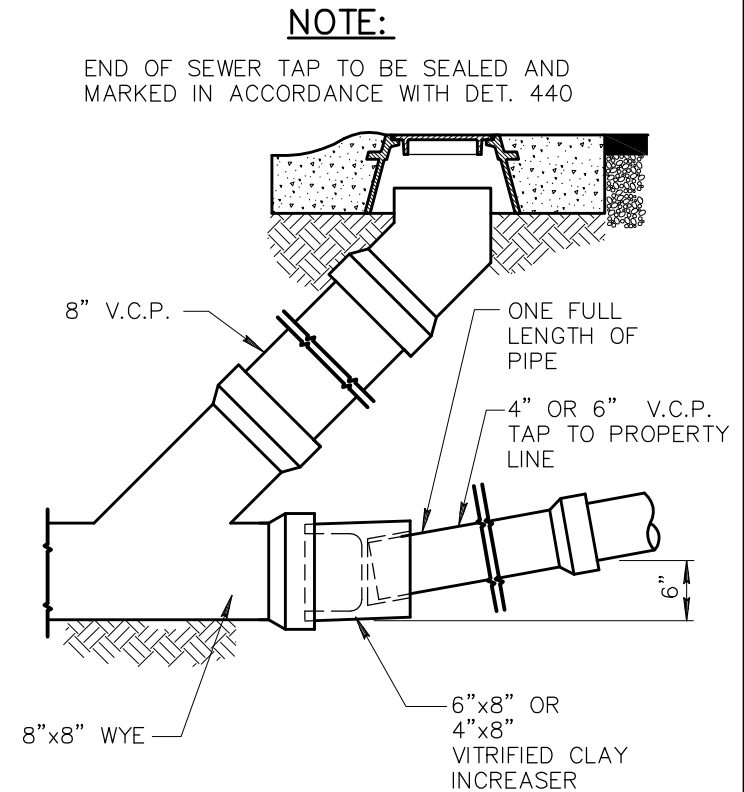
01-01-2006

DETAIL NO.

440-4



CLEANOUT INSTALLATION



SEWER TAP AT CLEANOUT

DETAIL NO.

441



STANDARD DETAIL
ENGLISH

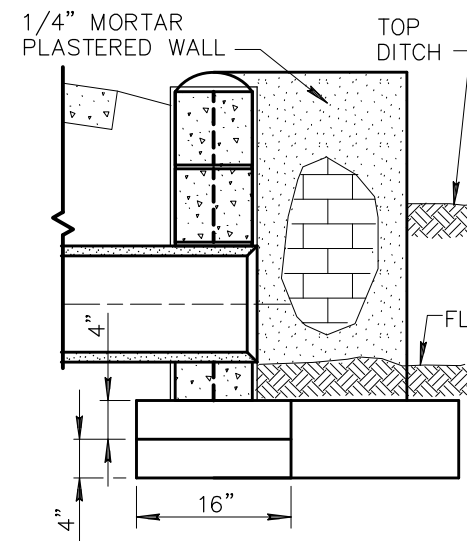
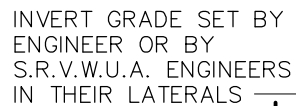
SEWER CLEANOUT

REVISED

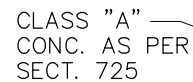
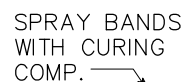
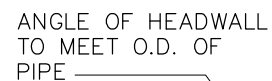
01-01-2001

DETAIL NO.

441

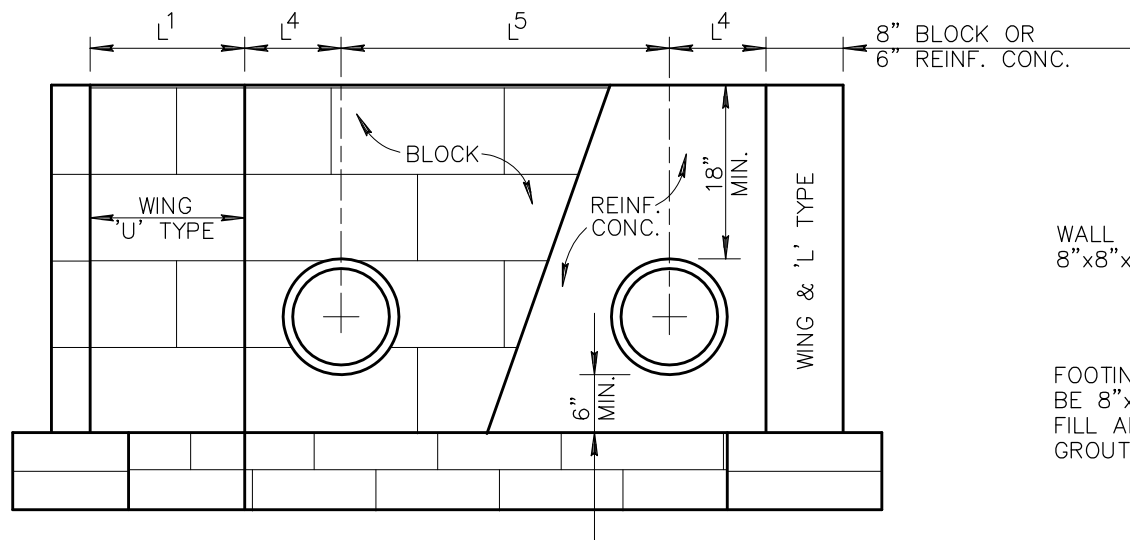


CLASS "A"
CONC.
AS PER
SECT. 725



NO.4 REINF. BAR FULL -
LENGTH IN EACH CORE.
CORES TO BE FILLED
WITH GROUT MIX 1:3

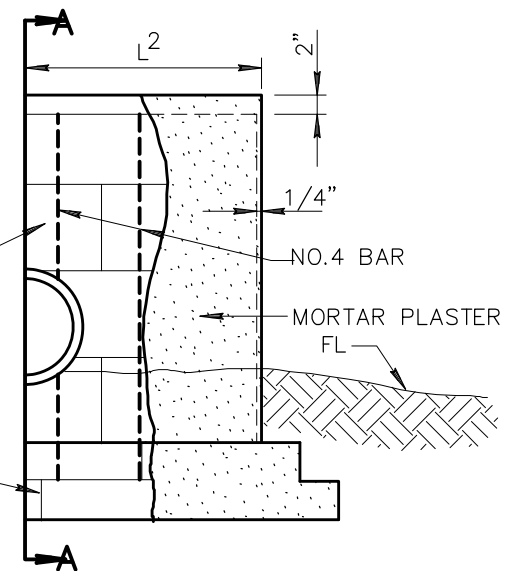
'U' TYPE



DOUBLE PIPE HEADWALL

WALL BLOCKS TO BE
8"x8"x16"

FOOTING BLOCKS TO BE
8"x8"x16".
FILL ALL CORES WITH
GROUT MIX 1:3.



ELEVATION

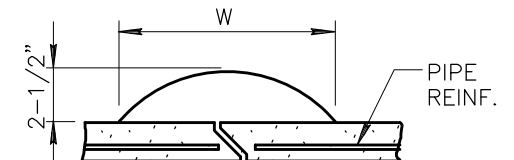
CONCRETE MASONRY UNITS (BLOCK)
HEADWALLS JOINED WITH CEMENT
MORTAR PLASTERED BOTH SIDES
OF WALL FULL HEIGHT AND SHALL
BE CURED PER SECT. 726.

NOTES:

1. ALL CONCRETE SHALL BE CLASS 'A' PER SECT. 505 & 725.
2. CONCRETE MASONRY UNITS (BLOCK) PER SECT. 510, 775 & 776.
3. CONCRETE REINF. SHALL BE NO.4 BAR 12" O.C. BOTH WAYS.

HEADWALL DIMENSIONS					
*NOMINAL PIPE SIZE	L ¹	L ²	L ³	L ⁴	L ⁵
12"	1'-4"	2'-0"	3'-8"	0'-10"	2'-10"
15"	2'-0"	2'-8"	4'-0"	1'-0"	3'-0"
18"	2'-0"	3'-8"	4'-8"	1'-2"	3'-4"
21"	2'-8"	4'-0"	5'-4"	1'-3"	3'-8"
24"	2'-8"	4'-0"	5'-4"	1'-6"	3'-11"
30"	2'-8"	5'-4"	6'-8"	1'-10"	4'-7"
36"	3'-4"	6'-8"	8'-0"	1'-10"	5'-2"
42"	4'-0"	8'-0"	9'-4"	2'-2"	5'-9"

* NOMINAL PIPE SIZE GIVEN FOR REINFORCED CONC. PIPE.



PIPE SIZE	W
12" - 21" INCL.	11"
24" - 42" INCL.	13"

DETAIL "A"

DETAIL NO.

501-2



STANDARD DETAIL
ENGLISH

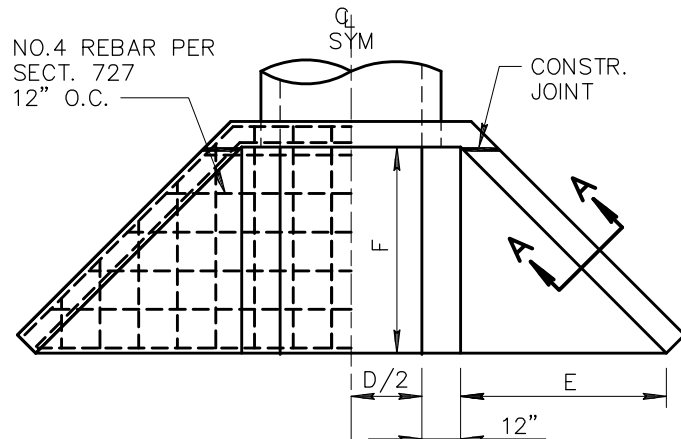
HEADWALL

REVISED

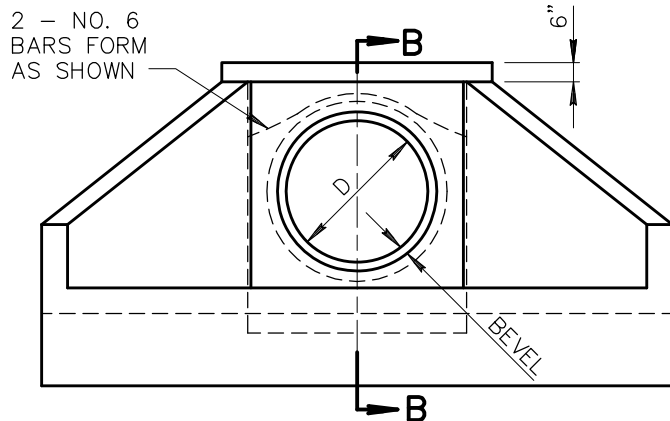
01-01-2012

DETAIL NO.

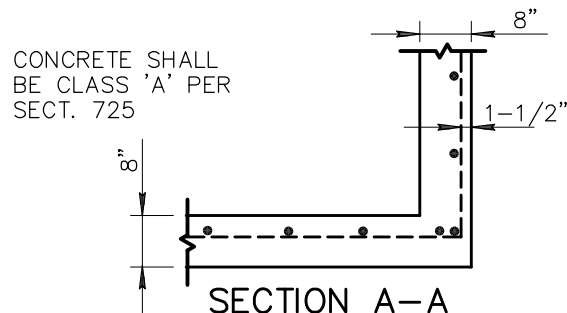
501-2



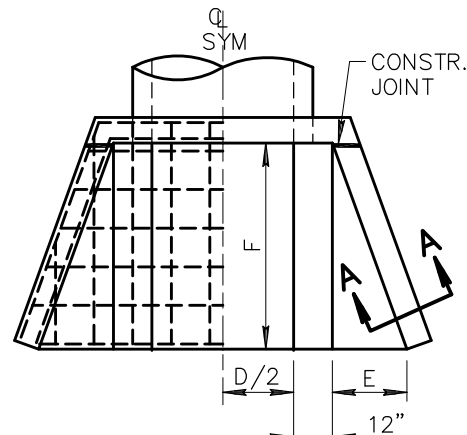
INLET HEADWALL



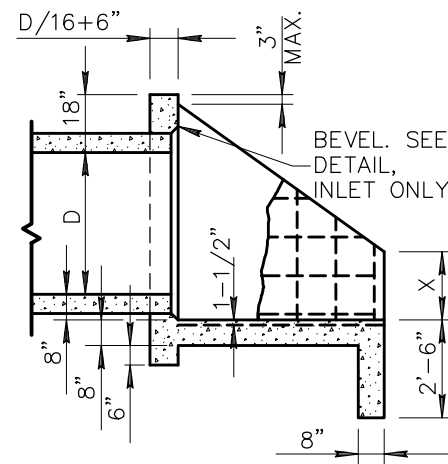
**INLET HEADWALL FACE ELEVATION
OUTLET SIMILAR**



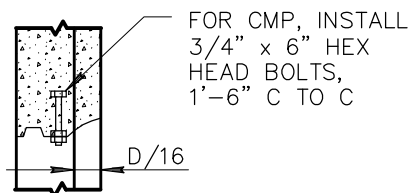
SECTION A-A



OUTLET HEADWALL



SECTION B-B



CMP BEVEL DETAIL

1:1 1/2 EMBANKMENT SLOPE

D	TYPE *	DIMENSIONS		
		F	E	X
42"	1 (IN)	5'-2"	5'-2"	1'-9"
	2 (OUT)	5'-2"	1'-11"	1'-9"
48"	3 (IN)	5'-8"	5'-8"	1'-11"
	4 (OUT)	5'-8"	2'-1"	1'-11"
54"	5 (IN)	6'-2"	6'-2"	2'-1"
	6 (OUT)	6'-2"	2'-3"	2'-1"
60"	7 (IN)	6'-8"	6'-8"	2'-3"
	8 (OUT)	6'-8"	2'-5"	2'-3"
66"	9 (IN)	7'-2"	7'-2"	2'-5"
	10 (OUT)	7'-2"	2'-7"	2'-5"
72"	11 (IN)	7'-8"	7'-8"	2'-7"
	12 (OUT)	7'-8"	2'-9"	2'-7"
78"	13 (IN)	8'-2"	8'-2"	2'-9"
	14 (OUT)	8'-2"	3'-0"	2'-9"
84"	15 (IN)	8'-8"	8'-8"	2'-11"
	16 (OUT)	8'-8"	3'-2"	2'-11"

1:4 EMBANKMENT SLOPE

D	TYPE *	DIMENSIONS		
		F	E	X
42"	17 (IN)	8'-8"	8'-8"	3'-0"
	18 (OUT)	8'-8"	3'-2"	3'-0"
48"	19 (IN)	8'-8"	8'-8"	3'-6"
	20 (OUT)	8'-8"	3'-2"	3'-6"
54"	21 (IN)	8'-8"	8'-8"	4'-0"
	22 (OUT)	8'-8"	3'-2"	4'-0"
60"	23 (IN)	9'-4"	9'-4"	4'-4"
	24 (OUT)	9'-4"	3'-5"	4'-4"
66"	25 (IN)	9'-8"	9'-8"	4'-9"
	26 (OUT)	9'-8"	3'-6"	4'-9"
72"	27 (IN)	9'-8"	9'-8"	5'-3"
	28 (OUT)	9'-8"	3'-6"	5'-3"
78"	29 (IN)	10'-0"	10'-0"	5'-8"
	30 (OUT)	10'-0"	3'-8"	5'-8"
84"	31 (IN)	10'-8"	10'-8"	6'-0"
	32 (OUT)	10'-8"	3'-11"	6'-0"

* (IN) REFERS TO INLET
(OUT) REFERS TO OUTLET

DETAIL NO.

501-3



STANDARD DETAIL
ENGLISH

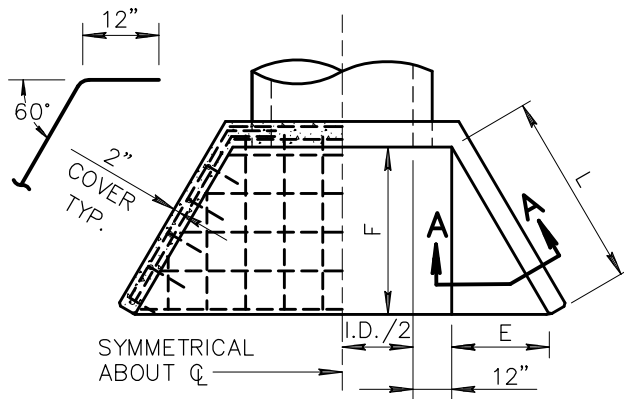
HEADWALL 42" TO 84" PIPE

REVISED

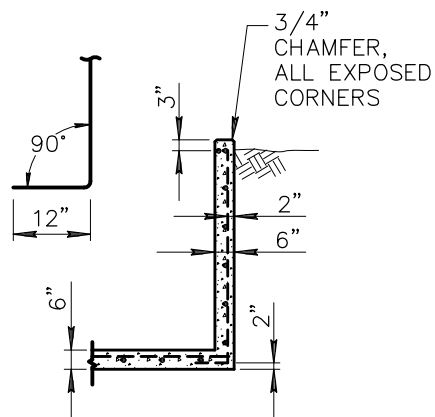
01-01-1998

DETAIL NO.

501-3

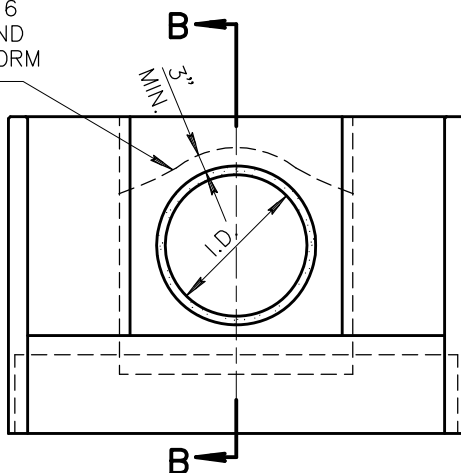


PLAN

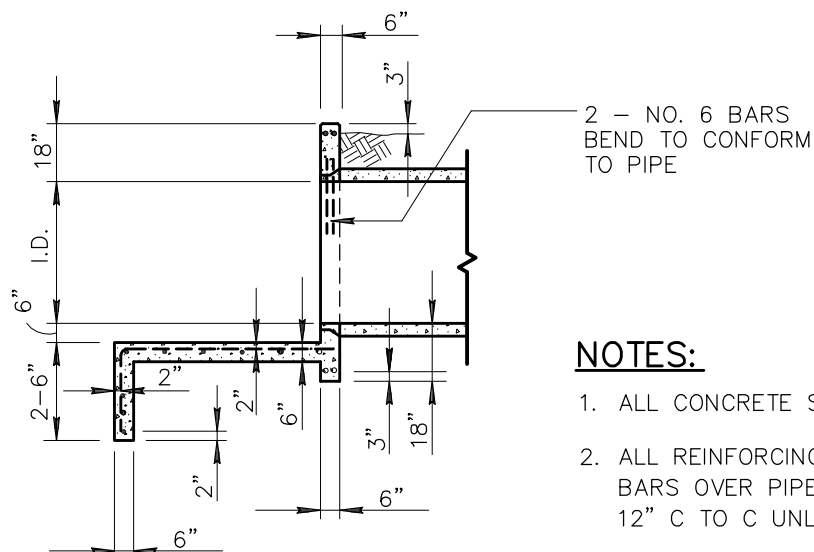


SECTION A-A

2 - NO. 6
BARS BEND
TO CONFORM
TO PIPE



ELEVATION



SECTION B-B

PIPE I.D.	DIMENSIONS		
	L	E	F (APPROX)
18"	2'-0"	1'-0"	1'-9"
24"	2'-0"	1'-0"	1'-9"
30"	3'-0"	1'-6"	2'-7"
36"	4'-0"	2'-0"	3'-6"
42"	5'-0"	2'-6"	4'-4"
48"	6'-0"	3'-0"	5'-2"
54"	7'-0"	3'-6"	6'-1"
60"	8'-0"	4'-0"	6'-11"

NOTES:

1. ALL CONCRETE SHALL BE CLASS 'A' PER SECT. 725.
2. ALL REINFORCING BARS SHALL BE NO. 4 EXCEPT NO. 6 BARS OVER PIPE. BAR SPACING APPROXIMATELY 12" C TO C UNLESS OTHERWISE NOTED.
3. 30° WING WALL FLARE SHOWN; 45° NORMALLY DESIRABLE.

DETAIL NO.

501-4



STANDARD DETAIL
ENGLISH

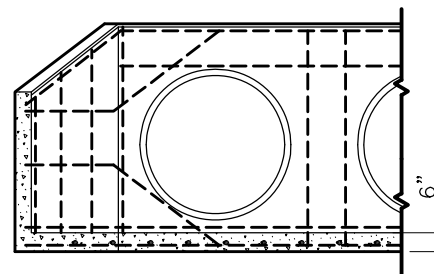
**HEADWALL IRRIGATION
18" TO 60" PIPE**

REVISED

01-01-1998

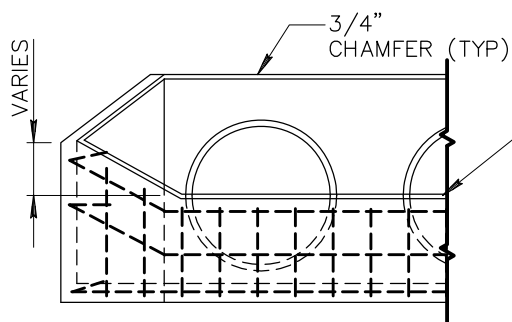
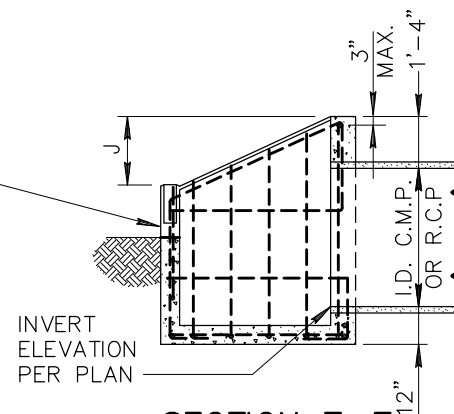
DETAIL NO.

501-4



SECTION Y-Y

PLAN

ELEVATION

SECTION Z-Z

NOTES:

1. HIGH POINT OF HEADWALL SHALL NOT PROJECT MORE THAN 3" ABOVE SLOPE.
2. ALL CONCRETE SHALL BE CLASS 'A' PER SECT. 725.
3. ALL REINFORCING BARS SHALL BE NO. 4, 12" C TO C AND 3" CLEAR TO INSIDE OF FLOOR AND WALLS.

PIPE	DIMENSIONS							
I.D.	W		A	B	E	F	J	K
	SINGLE	DOUBLE						
18"	2'-6"	5'-2"	2'-8"	1'-3"	0'-9"	1'-3.5/8"	9"	1'-6"
24"	3'-0"	6'-6"	3'-6"	1'-7.1/2"	1'-1.1/2"	1'-11.3/8"	11"	2'-3"
30"	3'-6"	7'-10"	4'-4"	2'-0"	1'-6"	2'-7.1/4"	1'-1"	3'-0"
36"	4'-0"	9'-2"	5'-2"	2'-4.1/2"	1'-10.1/2"	3'-3"	1'-4"	3'-9"
42"	4'-6"	10'-6"	6'-0"	2'-9"	2'-3"	3'-10.3/4"	1'-6"	4'-6"

DETAIL NO.

501-5



STANDARD DETAIL
ENGLISH

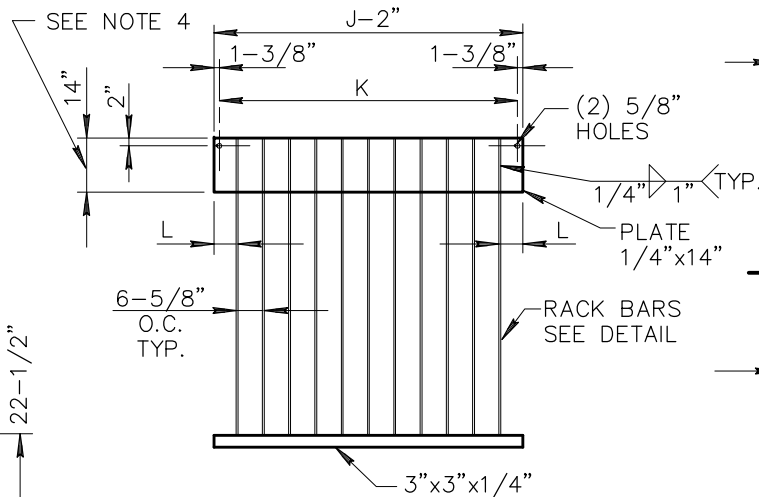
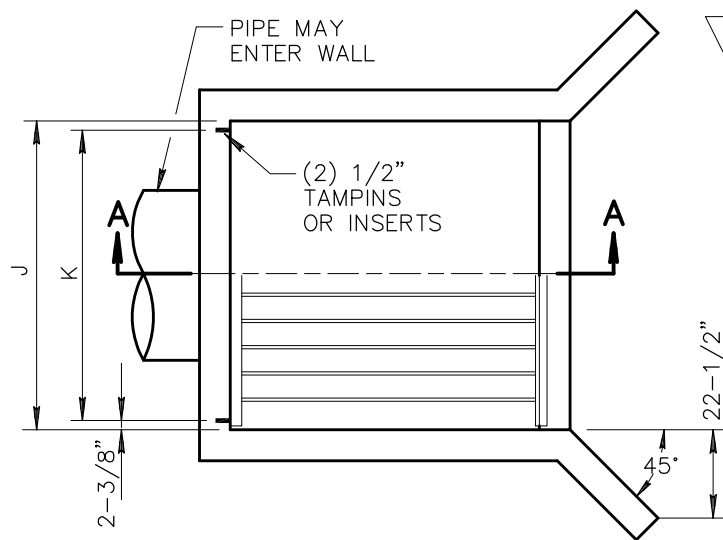
HEADWALL DROP INLET

REVISÉD

01-01-2014

DETAIL NO.

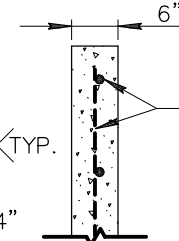
501-5



TRASH RACK

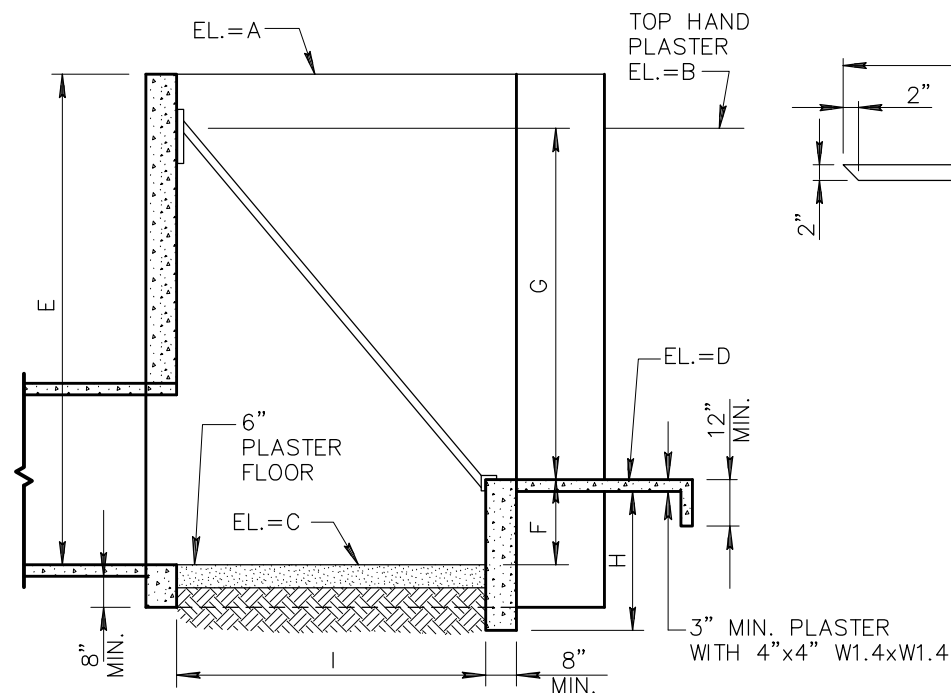
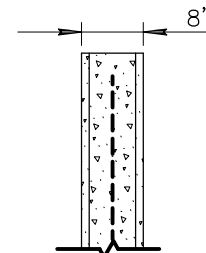
POURED WALLS

NO. 4 REINFORCED BARS 12" O.C. BOTH WAYS, CLASS 'A' CONC PER SECT. 505, 725 & 727.

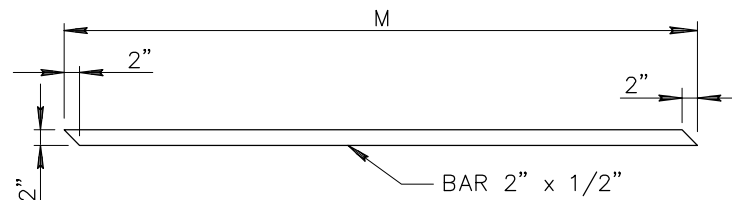


BLOCK WALLS

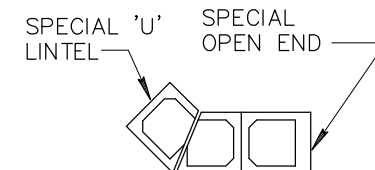
BLOCK HEADWALL TO HAVE ONE NO.4 REINF. BAR CENTERED IN EACH CORE FOR FULL HEIGHT AND CORES FILLED WITH CONCRETE OR CEMENT GROUT (3:1 RATIO). ALL BLOCKS TO BE JOINED WITH MORTAR. PLASTERED ON EXPOSED SURFACES THEN SPRAY WITH WHITE PIGMENTED CURING COMPOUND. SECT. 510, 727 & 776.



SECTION A-A



RACK BARS



45° BLOCK CORNER

NOTES:

1. REMOVE ALL SCALE FROM RACK BARS. METAL SPRAY OR PAINT WITH ONE COAT ZINC CHROMATE OR RED LEAD PRIMER (INDUSTRIAL QUALITY). OVERCOAT WITH GREY INDUSTRIAL ENAMEL SECT. 790.
2. SHAPE, COMPACT AND PLASTER NEW DITCH FROM HEADWALL TO UNDISTURBED EXISTING DITCH. PLASTER TO EXTEND TO MINIMUM ELEVATION NOTED 3 FEET BEYOND CONNECTION TO UNDISTURBED EXISTING DITCH.
3. ELEVATIONS A, B, C & D AND DIMENSIONS E, F, G, H, I, J, K, L & M WILL BE SHOWN ON PLANS. DIMENSIONS SHOULD PROVIDE STANDARD SIZE BLOCK.
4. 14" PLATE SHALL NOT EXTEND BELOW TOP OF PIPE.

CONCRETE MANSIONRY
UNITS (BLOCK)

REINF. CONC.
CLASS 'A' PER
SECT. 725

STRAIGHT
TYPE

'U' TYPE

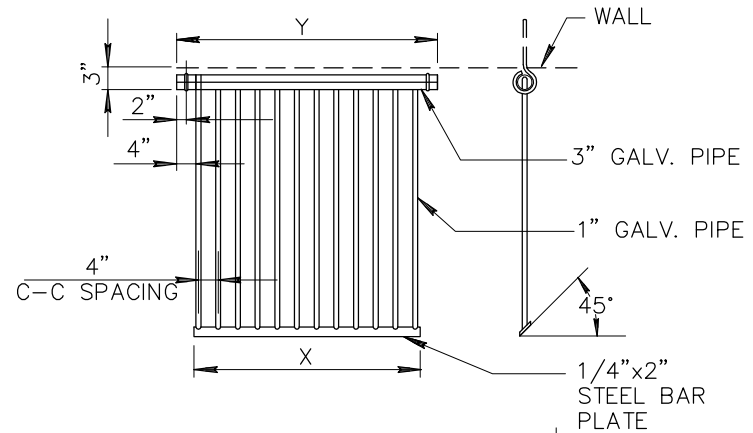
CONC. LINING
THICKNESS 1-1/2"
MIN., 2" MAX.

A

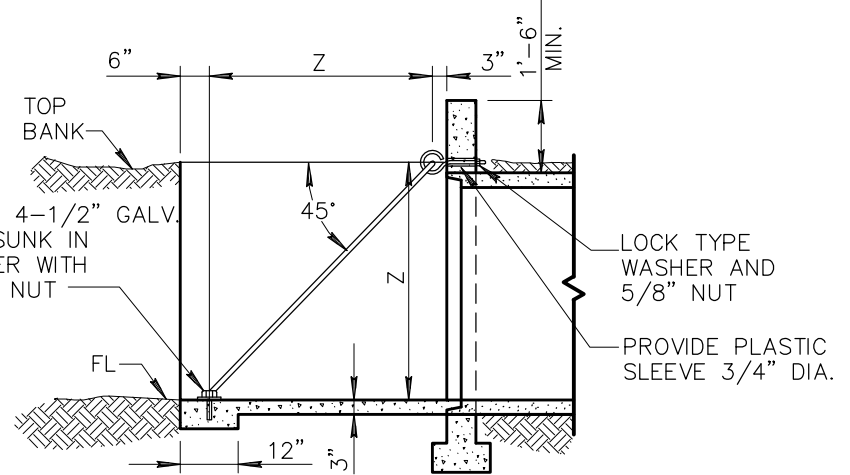
12" TYP.

SLOPE
1:1 MIN.
1:1.5 MAX.

A



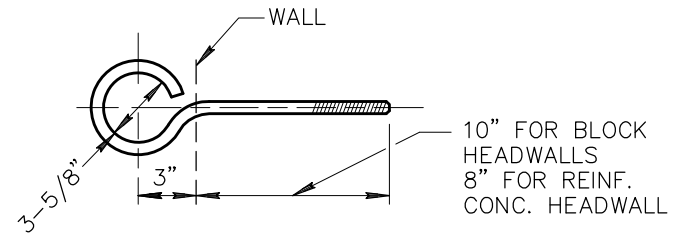
1/2" x 4-1/2" GALV.
BOLT SUNK IN
PLASTER WITH
BRASS NUT



SECTION A-A

TYPE BASED ON PIPE SIZE

TYPE	PIPE SIZE	NO. OF BARS	LENGTH OF BARS	DIMENSIONS		
				X	Y	Z
A	18"	6	3'-7"	1'-9"	2'-5"	2'-5"
	24"	8	3'-7"	2'-5"	3'-1"	2'-5"
B	30"	10	4'-4 1/4"	3'-1"	3'-9"	2'-11 1/2"
C	36"	10	5'-1 1/2"	3'-1"	3'-9"	3'-6"
D	42"	12	5'-10 5/8"	3'-9"	4'-5"	4'-0 1/2"
E	48"	14	6'-7 3/4"	4'-5"	5'-1"	4'-7"



EYE BOLT

DETAIL NO.

502-2



STANDARD DETAIL
ENGLISH

TRASH RACK

REVISED

01-01-2004

DETAIL NO.

502-2

NOTE:
PAINT COVER BOTH SIDES
ONE PRIME COAT, TWO
FINISH COATS, SECT.
790, PAINT NO. 9

10 GAUGE SHEET
STEEL COVER

HANDLE EXTENDS
6" BELOW
TOP WHEN GATE
IS OPEN

STANDARD
CONCRETE
PIPE

CONCRETE AS
REQUIRED TO
SECURE GATE

FINISH
GRADE

VARIABLE

(2) 5/16"
HOLES
4" O.C.

1/4" ROD
HANDLE

2-1/2"

UNLESS OTHERWISE
SPECIFIED

GROUT JOINTS
WATER
TIGHT

GATE TYPE,
SIZE AND NO.
REQUIRED AS
GIVEN ON PLANS

SIZE OF PIPE
AS SHOWN
ON PLANS

TYPE 'A'

NOTES:

1. BRACE TO BE INSTALLED EVERY 2'
FROM TOP OF HEADGATE FRAME. BOTTOM
BRACE TO BE HIGH ENOUGH TO ENABLE
FULL OPENING OF HEADGATE.
2. INSTALL 1/2" BOLTS INTO LEAD
PLUG DRILLED TO WITHIN 1" OF
OUT SIDE OF STANDPIPE. SPACERS
TO BE INSTALLED AT EACH BOLT
BETWEEN HEADGATE FRAME AND INSIDE
OF STAND PIPE.
3. LOCATION OF 2" HOLE FOR GATE
STEM TO BE DETERMINED AFTER
INSTALLATION OF GATE.
4. CONCRETE SHALL BE
CLASS A PER SECT. 725.

PAINT ARROW ON OUTSIDE OF
STANDPIPE INDICATING DIRECTION
"TO OPEN" HEADGATE.

SEE NOTE 3

(4) 3/8" BOLTS TO BE
GROUTED INTO STANDPIPE
EQUI-DISTANT WITH
1-1/2"x3" RECTANGULAR
WASHERS AND NUTS

GALVANIZED EXPANDED
METAL LID (9 GAUGE)

SEE NOTE 2

REINF. CONC.
PIPE

VARIES
48" MIN.
52" MAX.

SEE NOTE 1

GROUT JOINTS
WATER TIGHT

FINISH
GRADE

18"
MIN.

1" C.R.S.
LIFT ROD

HEADGATE TO BE SWANSON
800 SERIES
OR APPROVED
EQUAL

SIZE OF
PIPE AS
SHOWN
ON PLANS

FORM CONC. AROUND
END OF PIPE BEHIND
HEADGATE FRAME

TYPE 'B'

DETAIL NO.

503



STANDARD DETAIL
ENGLISH

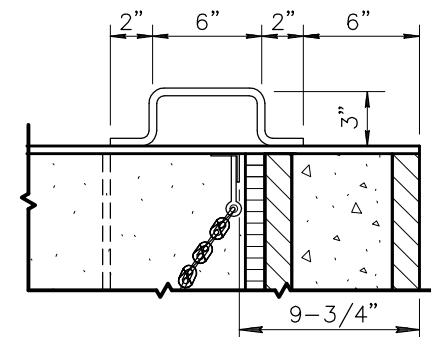
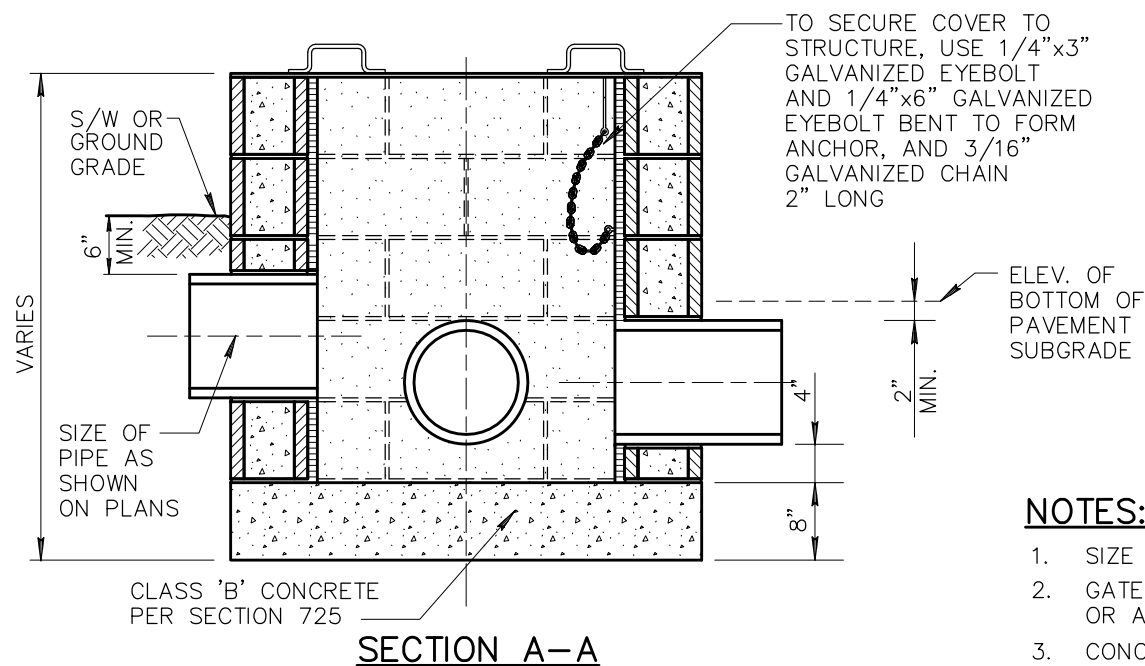
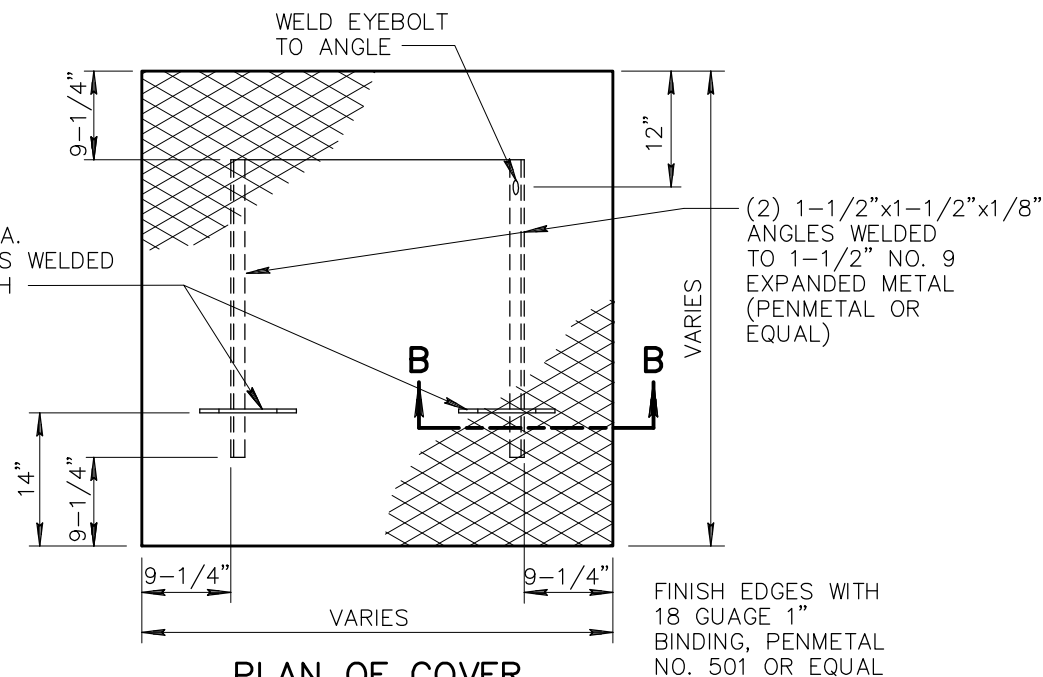
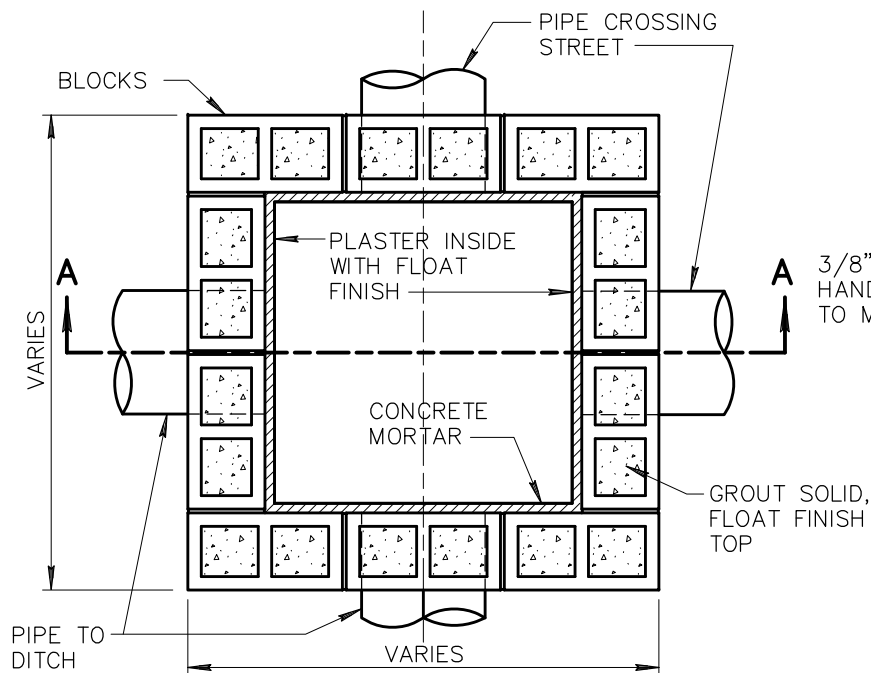
IRRIGATION STANDPIPE

REVISED

01-01-1998

DETAIL NO.

503



NOTES:

1. SIZE OF JUNCTION BOX TO BE DETERMINED BY THE ENGINEER.
2. GATE TYPE, SIZE AND NUMBER REQUIRED AS SHOWN ON PLANS OR AS SPECIFIED.
3. CONCRETE MASONRY UNITS (BLOCK) PER SECT. 510, 775 & 776

SECTION B-B

DETAIL NO.

504



STANDARD DETAIL
ENGLISH

CONCRETE BLOCK JUNCTION BOX

REVISED
01-01-1998

DETAIL NO.

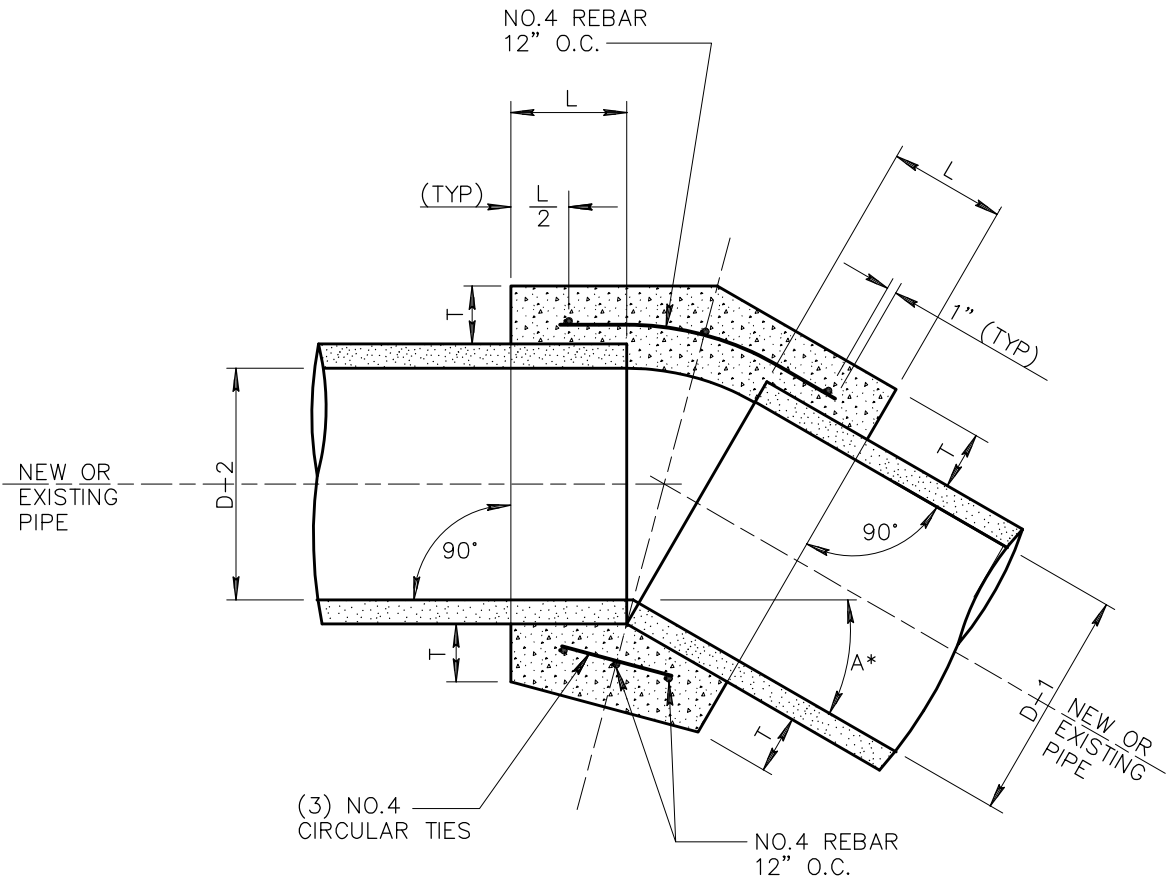
504

NOTES:

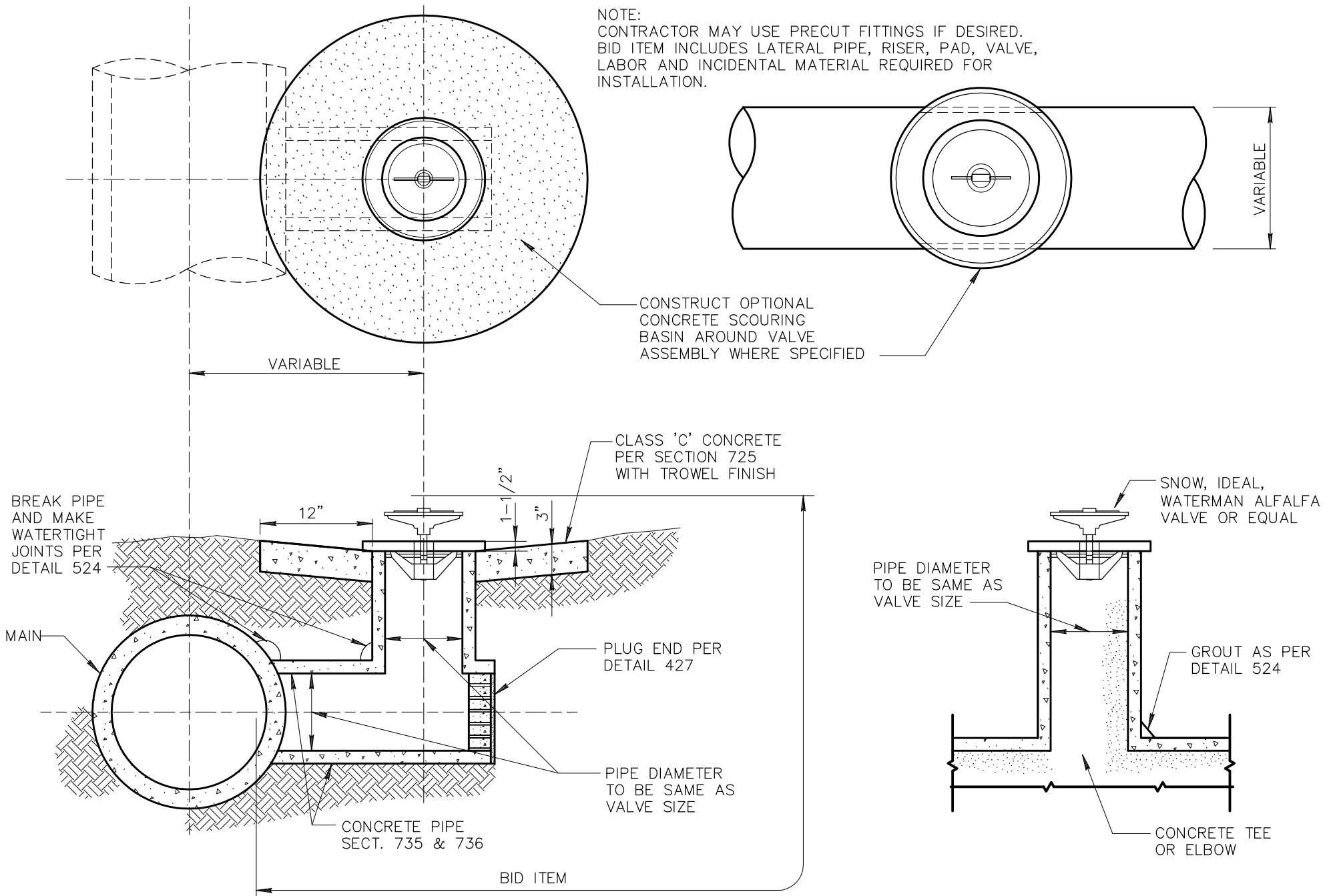
1. A CONCRETE COLLAR IS REQUIRED WHERE PIPES OF DIFFERENT DIAMETERS OR MATERIALS ARE JOINED, OR WHERE THE CHANGE IN ALIGNMENT OR GRADE EXCEEDS THAT ALLOWED FOR ON ORDINARY JOINTS.
2. WHERE PIPES OF DIFFERENT DIAMETERS ARE JOINED WITH A CONCRETE COLLAR, L AND T SHOULD BE THOSE OF THE LARGER PIPE. $D=D-1$, OR $D-2$ WHICHEVER IS GREATER.
3. FOR PIPE SIZES NOT LISTED AND LESS THAN 66" USE NEXT SIZE LARGER.
4. OMIT REINFORCING ON PIPE 24" OR LESS IN DIAMETER.
5. WHERE REINFORCING IS REQUIRED, THE DIAMETER OF THE CIRCULAR TIES SHALL BE....
OUTSIDE DIAMETER OF PIPE+T.
6. FIELD CLOSURES OF PIPE OF THE SAME DIAMETER AND WITHOUT CHANGE IN GRADE OR ALIGNMENT SHALL BE MADE WITH A CONCRETE COLLAR.
7. CONCRETE SHALL BE CLASS B PER SECT. 725.

A*=ANGLE OF DEFLECTION

TABLE		
D	L	T
12"	1.0'	4"
18"	1.0'	5"
24"	1.0'	6"
36"	1.5'	8"
48"	1.5'	10"
57"	1.5'	10"
60"	1.75'	11"
66"	1.75'	11"



NOTE:
CONTRACTOR MAY USE PRECUT FITTINGS IF DESIRED.
BID ITEM INCLUDES LATERAL PIPE, RISER, PAD, VALVE,
LABOR AND INCIDENTAL MATERIAL REQUIRED FOR
INSTALLATION.



DETAIL NO.

506



STANDARD DETAIL
ENGLISH

IRRIGATION VALVE INSTALLATION

REVISED

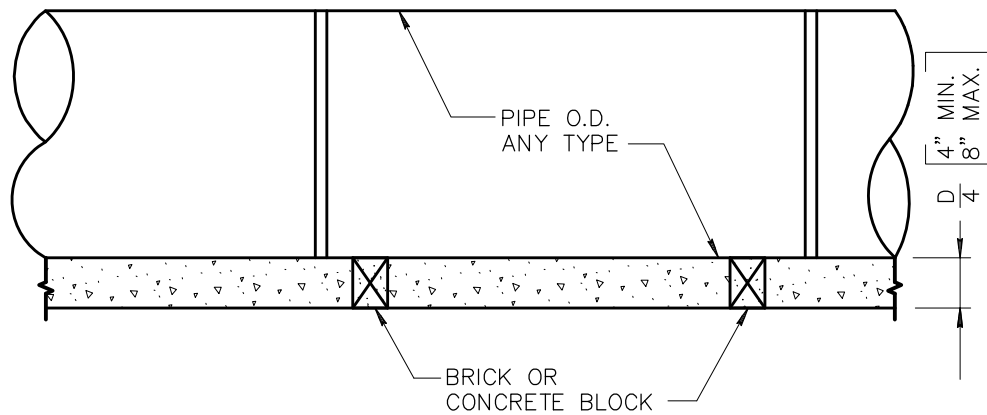
01-01-1998

DETAIL NO.

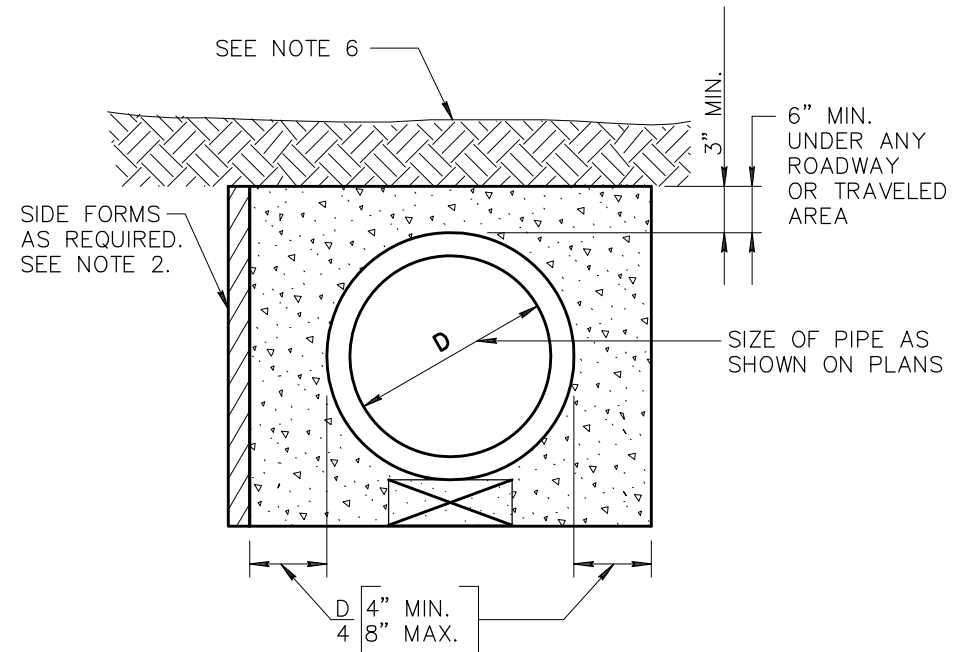
506

NOTES:

1. THIS DETAIL SHALL BE REQUIRED WHEN NEW OR EXISTING PIPE INSTALLATIONS WILL BE SUBJECT TO DAMAGE ANYTIME IN THE FUTURE DUE TO LACK OF PROPER COVER, AS DETERMINED BY THE ENGINEER.
2. FOR PIPE OVER 18" I.D. WOOD, METAL OR GYPSUM BOARD FORMS MUST BE USED TO FORM THE SIDES OF THE ENCASEMENT. GYPSUM BOARD FORMS MAY BE LEFT IN THE GROUND BELOW THE TOP OF THE ENCASEMENT. THIS SHALL BE OPTIONAL WITH POURING AGAINST TRENCH WALLS FOR ENCASEMENT OF 18" AND SMALLER PIPE.
3. FOR ALL SITUATIONS WHERE SIDE FORMS ARE USED, TRENCH WALLS SHALL BE OVER-EXCAVATED TO ALLOW SUFFICIENT ROOM TO OPERATE PROPER MECHANICAL COMPACTION EQUIPMENT.
4. CONCRETE WHICH SPILLS BEYOND 12" FROM THE SIDES OF THE PIPE FOR ANY REASON SHALL BE REMOVED BACK TO THE PROPER LINE PRIOR TO BACKFILLING.
5. SEE SECTION 601 FOR TRENCH PREPARATION.
6. CONCRETE TO BE CLASS 'A' PER SECT. 725.
7. COVER TO BE APPROVED BY ENGINEER.



LONGITUDINAL SECTION



END SECTION

DETAIL NO.

507



STANDARD DETAIL
ENGLISH

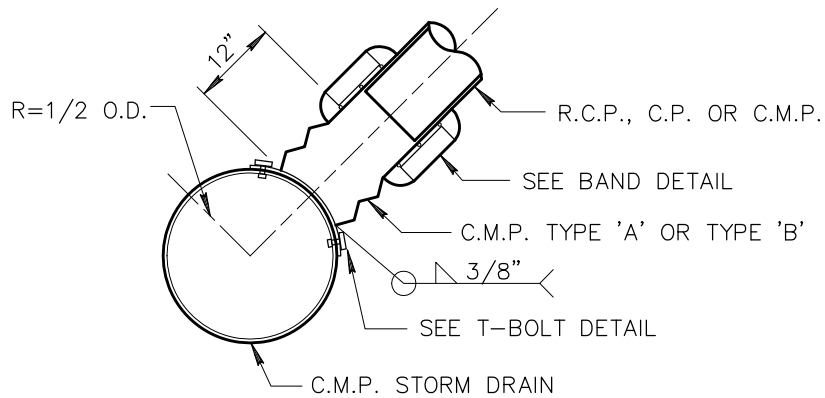
**ENCASED CONCRETE PIPE
(FOR SHALLOW INSTALLATION)**

REVISED

01-01-1998

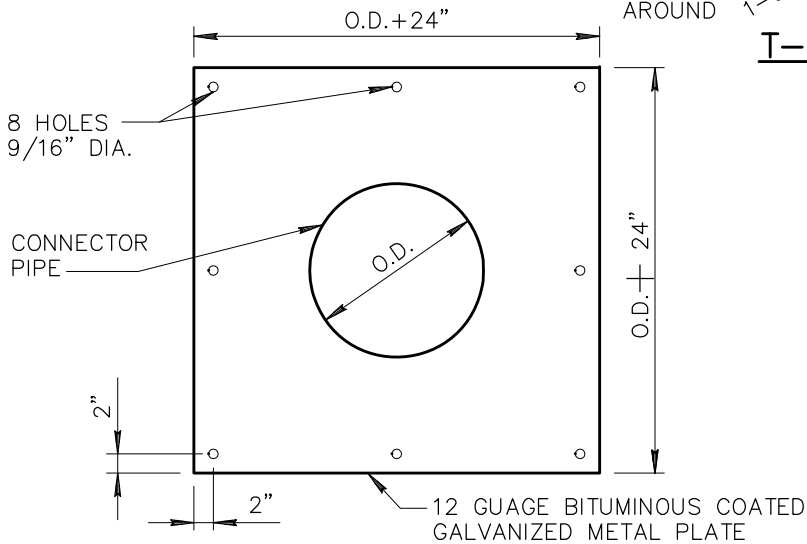
DETAIL NO.

507

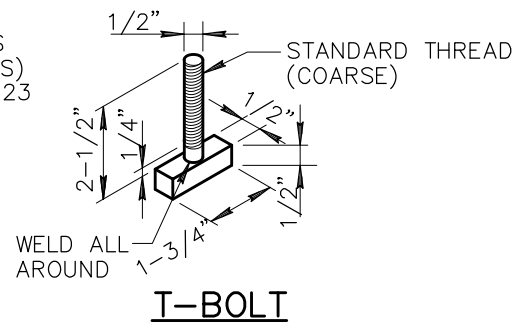


CONNECTOR CROSS SECTION

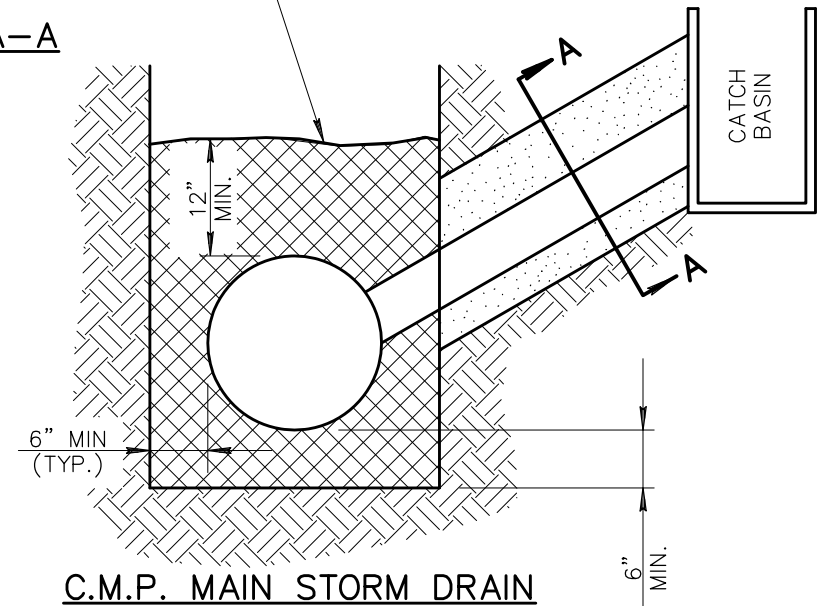
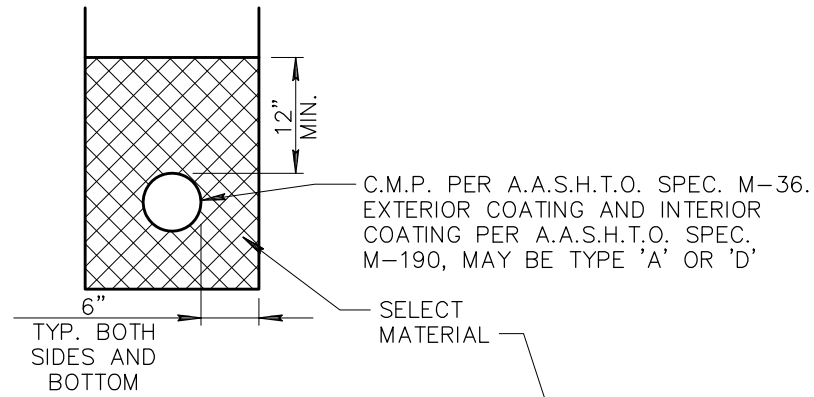
NOTE:
USE 5/8" WASHER AND NUT, ALL PIECES
(NUTS, WASHERS, AND FABRICATED BOLTS)
TO BE GALVANIZED AS PER A.S.T.M. A-123
LATEST REVISION.



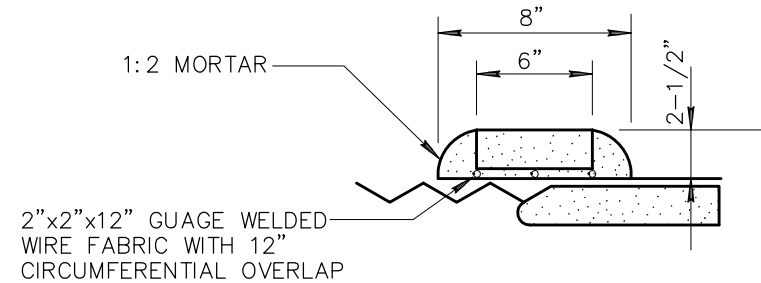
C.M.P. CONNECTION TO MAIN STORM DRAIN 24" PIPE AND SMALLER



SECTION A-A



C.M.P. MAIN STORM DRAIN



BAND DETAIL

DETAIL NO.

510



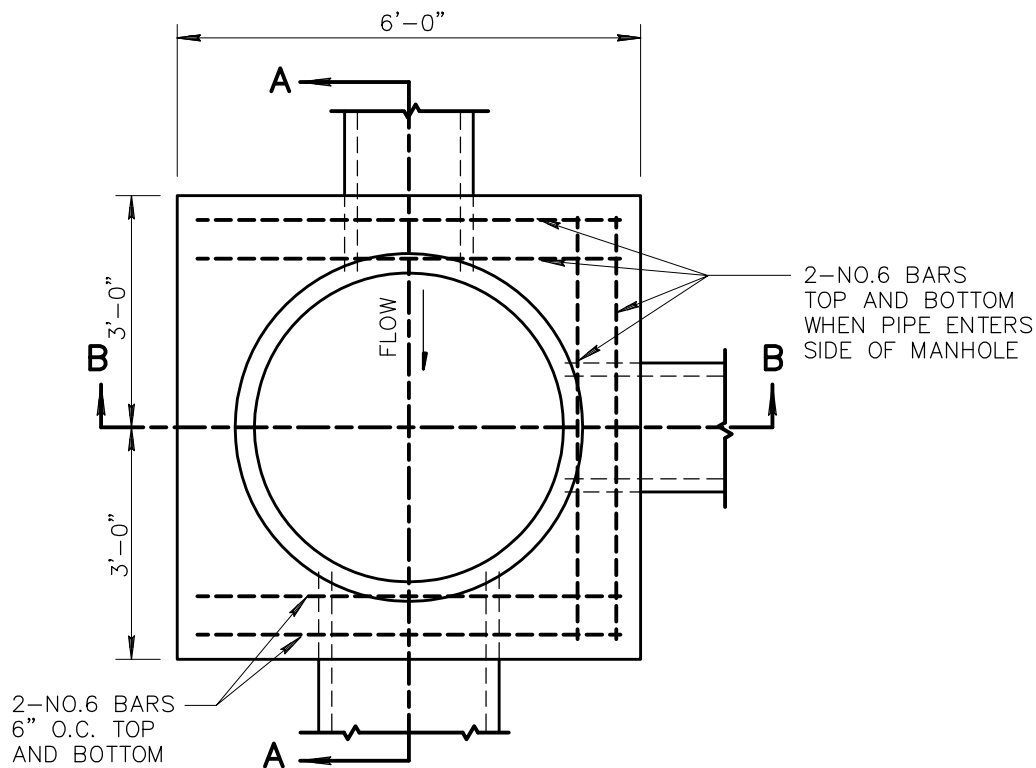
STANDARD DETAIL
ENGLISH

CORRUGATED METAL PIPE
AND INSTALLATION

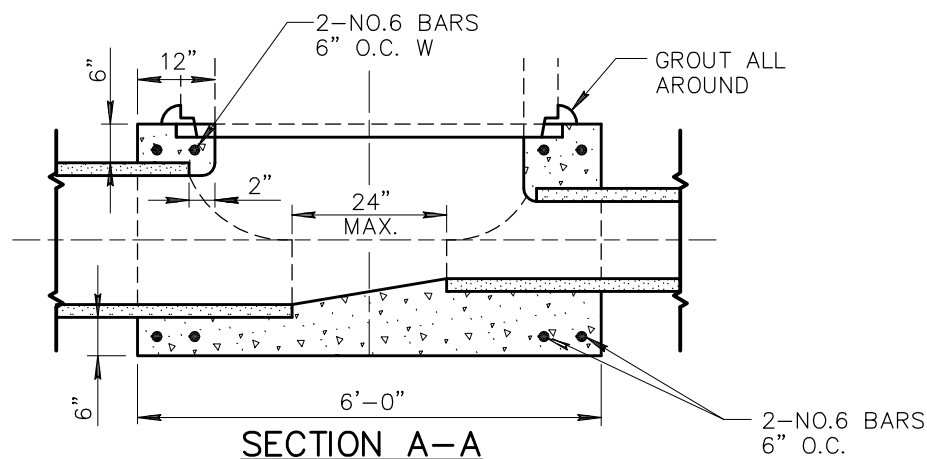
REVISED
01-01-1998

DETAIL NO.

510



PLAN

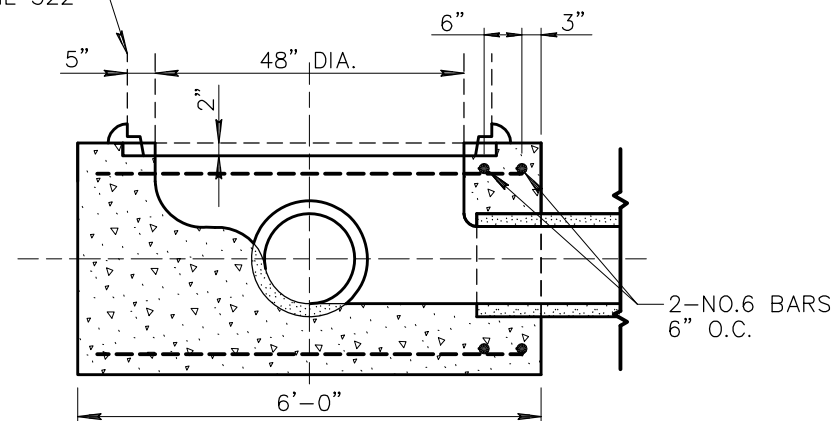


SECTION A-A

NOTES

1. ALL CONCRETE TO BE CLASS 'A' PER SECT. 725, 505.
2. MATCH SPRING LINES OF PIPE ENTERING MANHOLE UNLESS OTHERWISE NOTED.
3. CUT PIPES TO ALLOW SETTING OF 4' DIA. CYLINDRICAL FORM FROM 6" ABOVE MAIN LINE PIPE TO SPRING LINE. CUT PIPE 2" LARGER THAN FORM TO ALLOW 2" CONCRETE OVER ENDS OF ALL CUT PIPE.
4. INVERT AND BASE OF MANHOLE TO BE POURED AND INVERT TO BE SHAPED BY HAND TO MAKE SMOOTH TRANSITION. FINISH WITH RUBBER FLOAT.
5. CENTER MANHOLE ON PIPE JOINT WHERE PIPE CHANGES SIZES, LEAVING A GAP OF 12" MINIMUM, 24" MAXIMUM.

MANHOLE SHAFT
PER DETAIL 522



SECTION B-B

DETAIL NO.

520



STANDARD DETAIL
ENGLISH

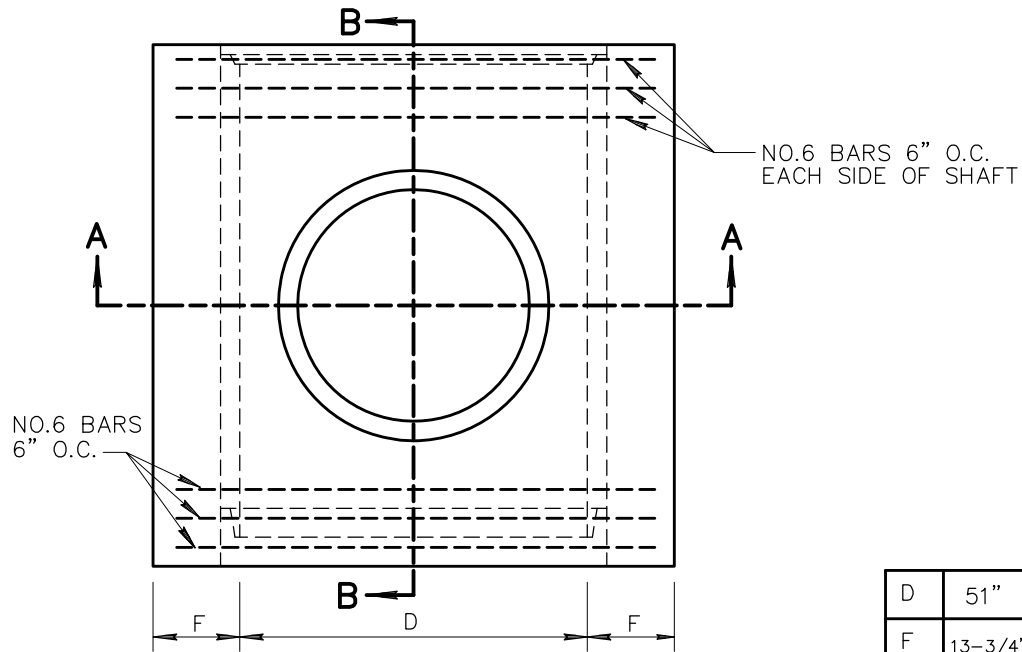
STORM DRAIN MANHOLE BASE (48" AND SMALLER)

REVISED

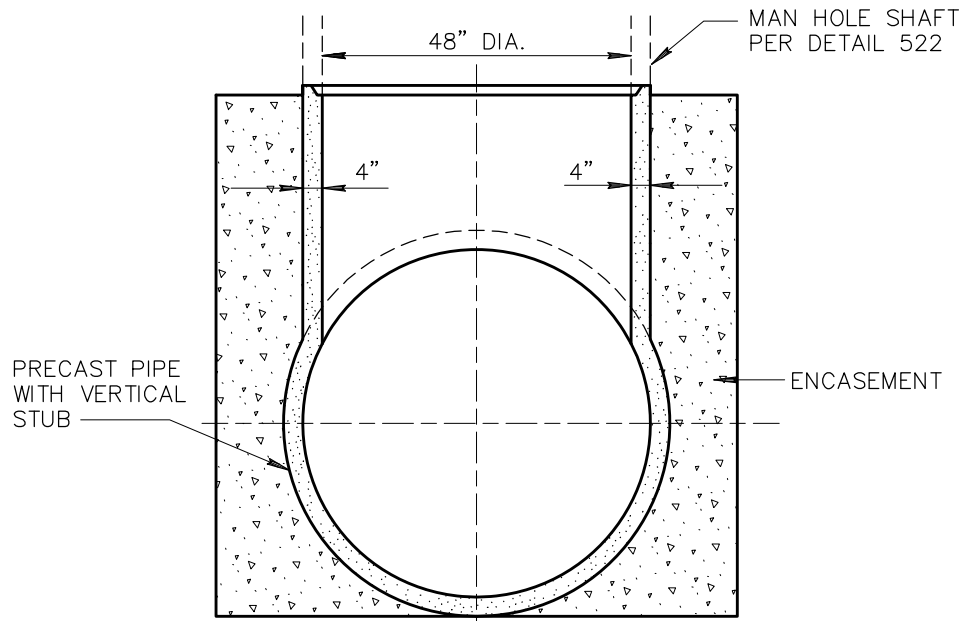
01-01-1998

DETAIL NO.

520



PLAN



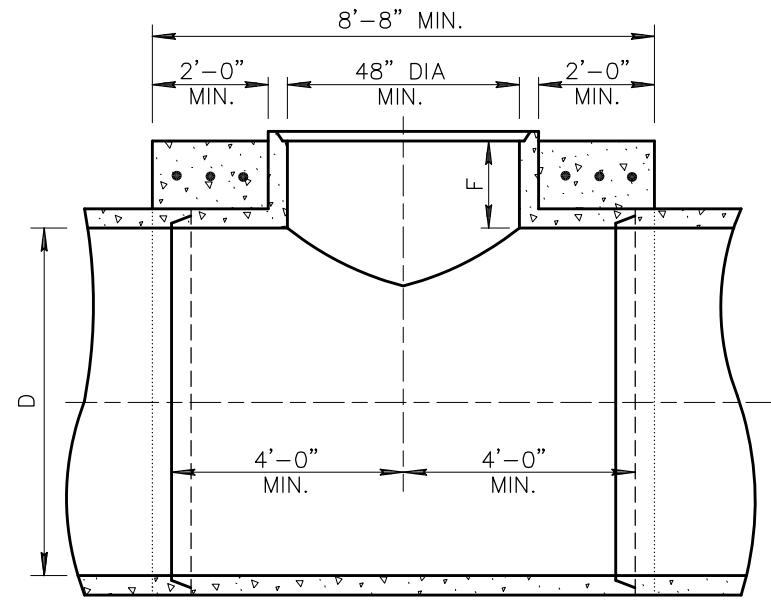
SECTION A-A

NOTES:

1. LINE PIPE AND STUB MAY BE CAST MONOLITHICALLY OR STUB MAY BE CAST ON TO LINE PIPE SECTION PRIOR TO COMPLETE CURING.
2. ALL LINE PIPE REINFORCEMENT SHALL BE TURNED UP INTO STUB.
3. THE VERTICAL STUB TO BE A.S.T.M. C-76 CLASS II WALL 'A' AND THE HORIZONTAL PIPE TO BE EQUAL TO STRENGTH OF PIPE ENTERING MANHOLE.
4. ALL REINFORCING STEEL SHALL CLEAR FACE OF CONCRETE BY 1-1/2" UNLESS SHOWN OTHERWISE.
5. CONCRETE ENCASEMENT SHALL BE CLASS 'A' PER SECT. 725 AND 505.

TABLE OF VALUES FOR 'F' & 'D'

D	51"	54"	57"	60"	63"	66"	69"	72"	78"	84"	90"	96"
F	13-3/4"	14-1/2"	15"	15-1/2"	16-1/4"	16-3/4"	17-1/2"	18"	19-1/4"	20-1/2"	21-3/4"	23"



SECTION B-B

DETAIL NO.

521



STANDARD DETAIL
ENGLISH

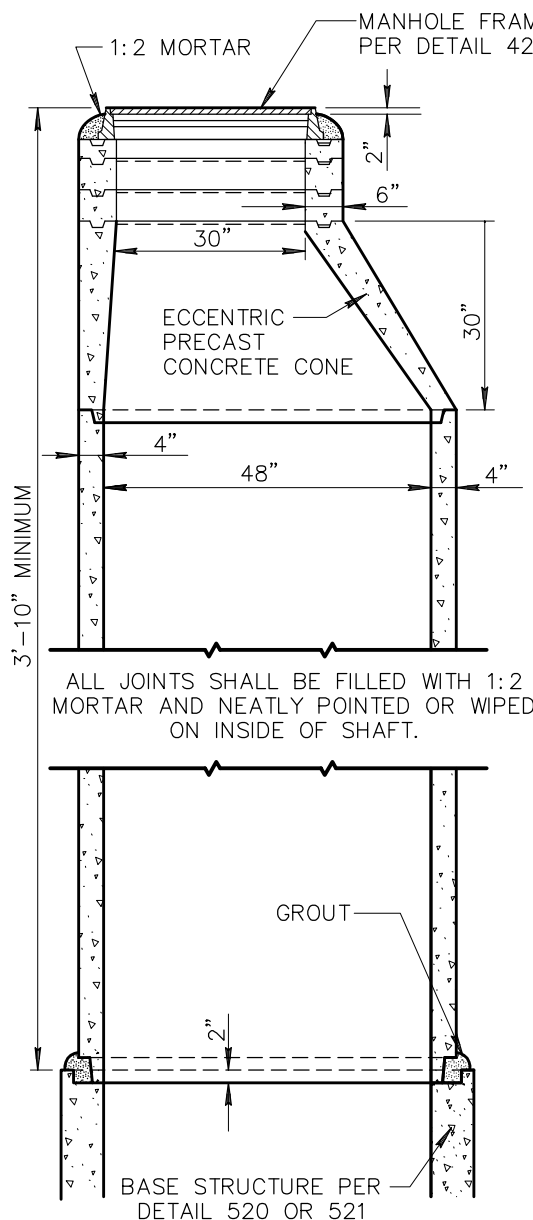
STORM DRAIN MANHOLE BASE (51" OR LARGER)

REVISED

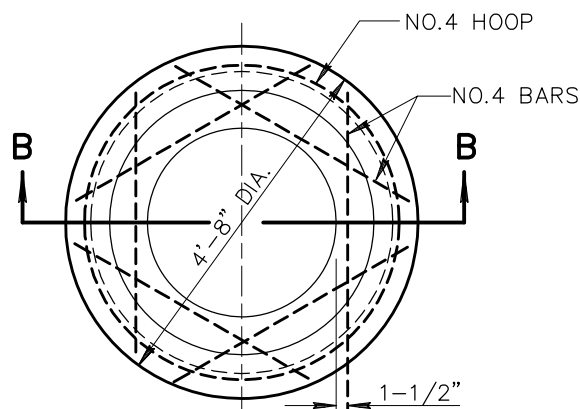
01-01-1998

DETAIL NO.

521

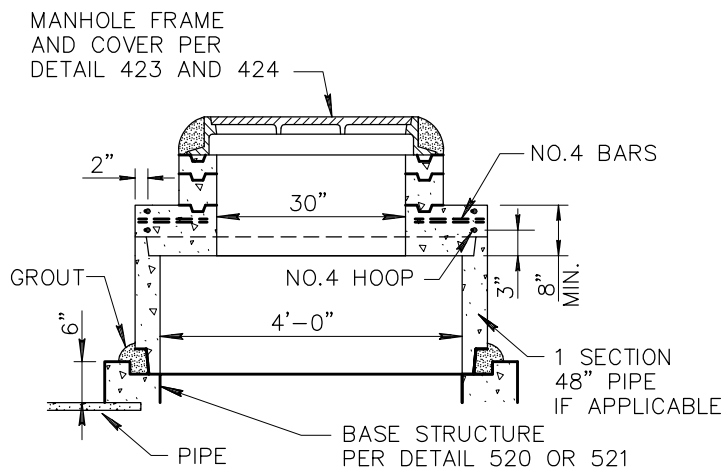


**VERTICAL SECTION OF
ECCENTRIC MANHOLE SHAFT**



PLAN

USE WHERE THERE IS 3'-10"
OR LESS COVER OVER PIPE

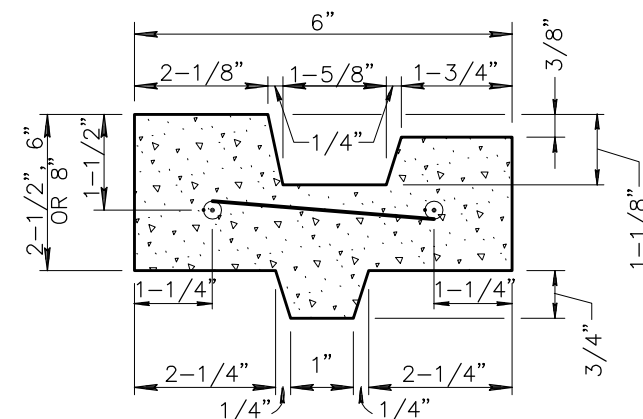


SECTION B-B

SHALLOW MANHOLE

NOTES:

1. PRECAST CONCRETE CONES AND SECTIONS TO BE A.S.T.M. C-478.
2. BRICK MAY BE USED IN LIEU OF OR IN COMBINATION WITH CONCRETE ADJUSTING RINGS.
3. PRECAST CONCRETE SECTIONS 48" DIA PIPE MAY BE FURNISHED IN STANDARD LENGTHS.
4. UNLESS OTHERWISE SHOWN ON PLANS, USE (2) 2-1/2" PRECAST CONCRETE ADJUSTING RINGS ON IMPROVED STREETS AND (4) 2-1/2" RINGS ON UNIMPROVED STREETS.
5. CONCRETE SHALL BE CLASS A PER SECTION 725 AND 505.



2-1/2" RINGS SHALL BE REINFORCED WITH TWO 1/4" ROUND STEEL HOOPS; 6" AND 8" RINGS SHALL BE REINFORCED WITH FOUR 1/4" HOOPS, TIED WITH NO. 14 A.S. & W. GAUGE WIRE 8" O.C.

**REINFORCED CONCRETE
ADJUSTING RING**

DETAIL NO.

522



STANDARD DETAIL
ENGLISH

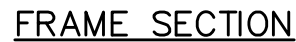
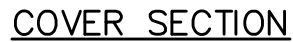
STORM DRAIN MANHOLE SHAFT

REVISED

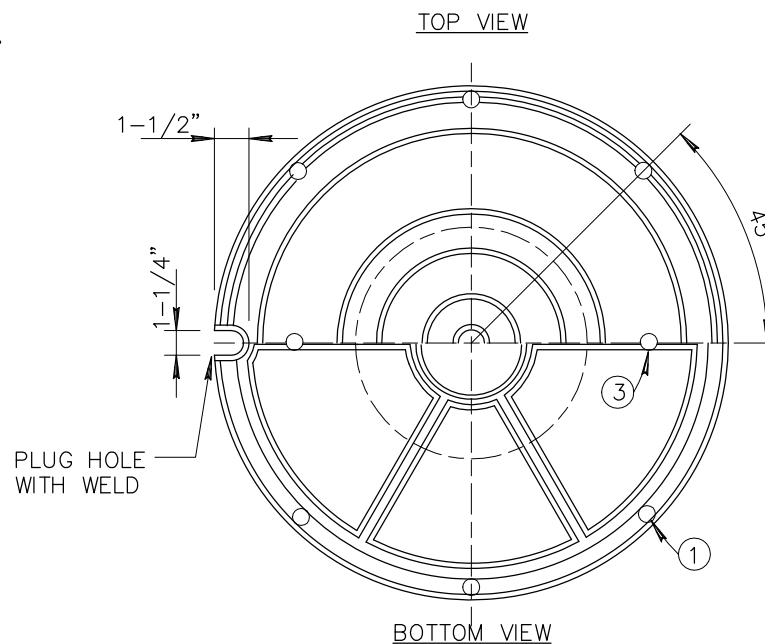
01-01-2015

DETAIL NO.

522



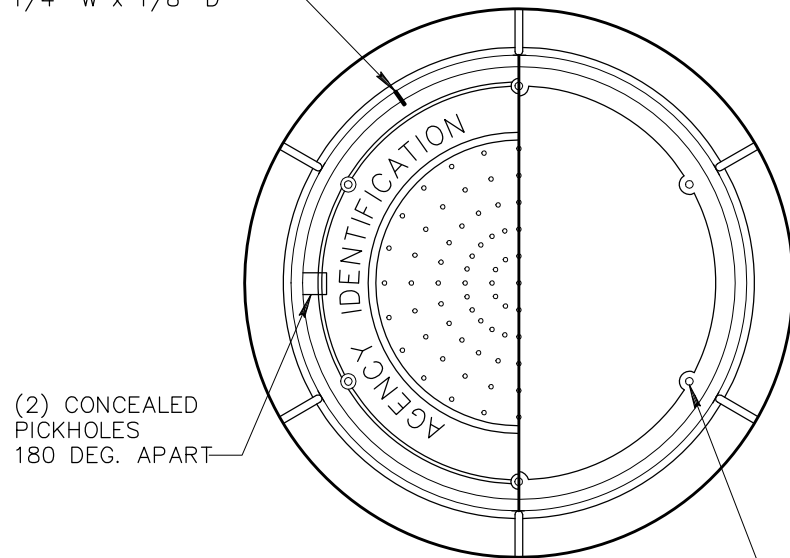
FOR A 24" M.H. OPENING, MODIFY THE STD. 24"
M.H. FRAME & COVER, FOLLOWING THE NOTED PROCEDURES,
ONE THRU FIVE.



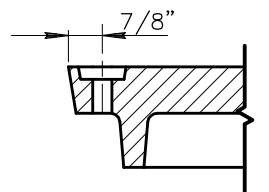
STANDARD 24" M.H.
FRAME AND COVER

- ① DRILL (8) HOLES 17/32" IN COVER FOR 1/2" CAPSCREWS, COUNTERBORE 1/2" DEEP BY 1-1/8" DIA. TO ACCOMMODATE CAPSCREW AND SOCKET WRENCH. SPACE EQUALLY.
 - ② DRILL (8) HOLES AND TAP FOR 1/2" - 13 THREAD NATIONAL COARSE BOLT.
 - ③ DRILL, TAP AND COUNTERBORE (2) HOLES FOR 1/2" CAPSCREWS TO BE USED FOR LIFTING COVER. PLUG WITH CAPSCREWS.
 - ④ COVER AND FRAME MUST BE MATCHED, DRILLED AND TAPPED IN SETS.
 - ⑤ CASTING DIMENSIONS GIVEN ABOVE ARE FROM DET. 424, 24" MANHOLE FRAME AND COVER.
- BOTH 24" AND 30" FRAMES TO BE ANCHORED AS FOLLOWS:
- ⑥ DRILL 1/2" HOLE IN FILLET. DO NOT USE ADJACENT FILLETS.
 - ⑦ 1/4" STAINLESS STEEL CABLE. SECURED WITH CABLE CLAMPS.
 - ⑧ 1/2"x9" HOOK AND EYE TURNBUCKLE.
 - ⑨ 1/2" EYE BOLT WITH 1" DIA. EYE.
 - ⑩ INSTALL THREE CABLES PER 24" COVER (FOUR CABLES FOR 30" COVERS). EYEBOLTS TO BE SET DIRECTLY BELOW FILLETS USED.
 - ⑪ TRIPLE WRAP TURNBUCKLES AND CABLE CLAMPS WITH 1" WIDE TAPE, SAFE-T-CLAD, F.O.S. 655, OR APPROVED EQUAL.

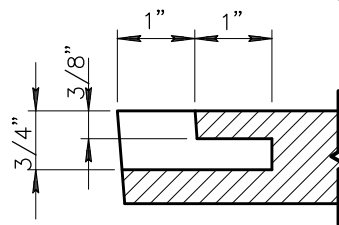
GROUND MATCH MARK
1/4" W x 1/8" D



(2) CONCEALED
PICKHOLES
180 DEG. APART



BOLT HOLE DETAIL



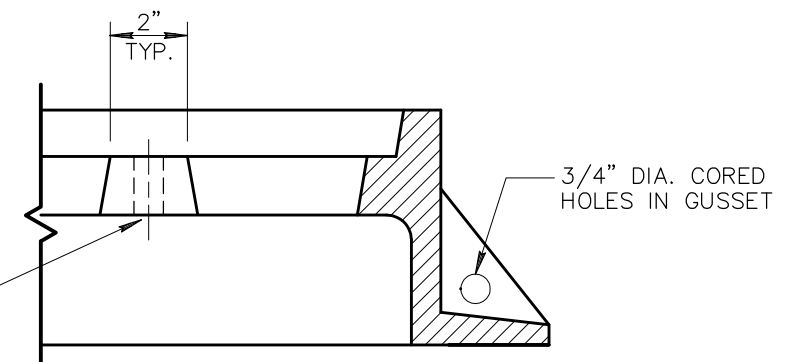
PICKHOLE DETAIL

COVER SECTION

NOTES:

1. DRILL (6) HOLES IN 30" COVER (4 HOLES IN 24" COVER) 17/32" CORED RECESS FOR 1/2" CAPSCREWS. SPACE EQUALLY (304 S.S.)
2. DRILL (6) HOLES IN 30" FRAME (4 HOLES IN 24" FRAME) AND TAP FOR 1/2" - NATIONAL COARSE BOLT (HEX HEAD).
3. COVER AND FRAME MUST BE MATCH MARKED, DRILLED AND TAPPED IN SETS.
4. DIMENSIONS, LETTERING, WEIGHTS AND MATERIALS SHALL CONFORM TO DET. 424.
5. REFER TO DETAIL 523-1 FOR INSTALLATION PROCEDURES.

TYP. BOLT PAD



FRAME SECTION

DETAIL NO.

523-2



STANDARD DETAIL
ENGLISH

PRESSURE MANHOLE

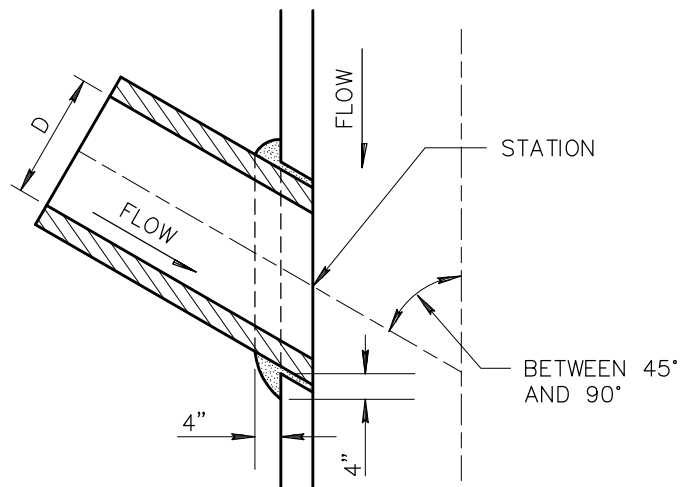
REVISED

01-01-1998

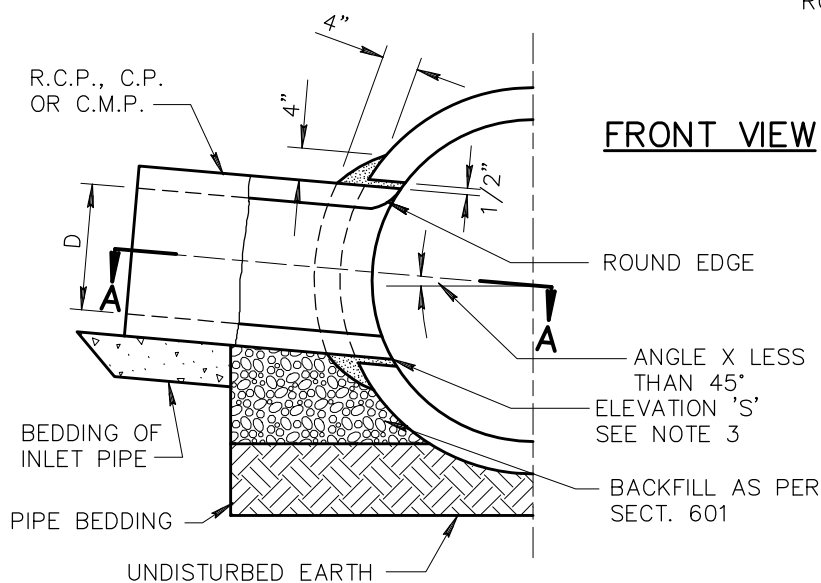
DETAIL NO.

523-2

TOP VIEW

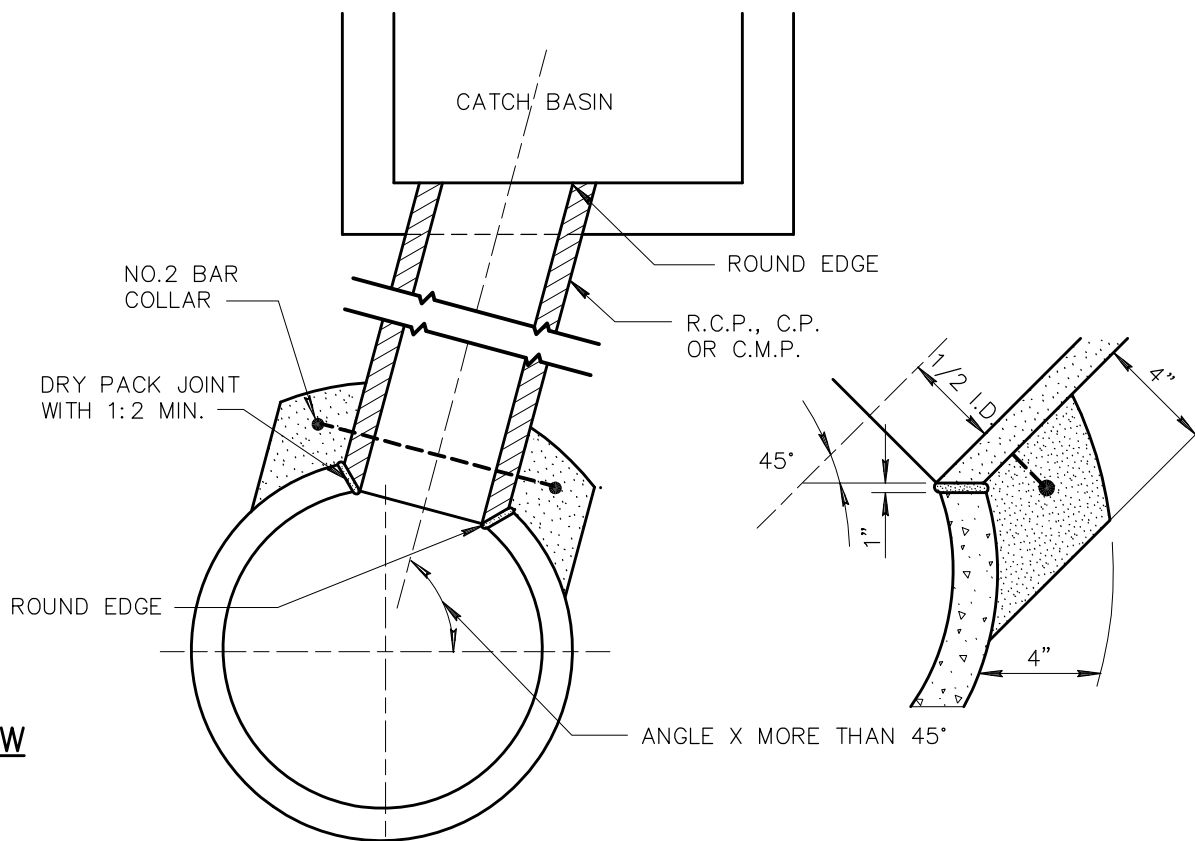


SECTION A-A



SIDE INLET
TYPE 1

FRONT VIEW



CATCH BASIN ABOVE STORM DRAIN
TYPE 2

NOTES:

1. D SHALL BE 24" OR LESS. FOR LARGER VALUE OF D USE MANHOLE OR JUNCTION STRUCTURE.
2. IN NO CASE SHALL THE OUTSIDE DIAMETER OF THE INLET EXCEED ONE HALF THE INSIDE DIAMETER OF THE MAIN STORM DRAIN.
3. CENTERLINE OF INLET SHALL BE ON RADIUS OF MAIN STORM DRAIN EXCEPT WHEN ELEVATION S IS SHOWN ON PLANS.
4. THE MINIMUM OPENING INTO THE STORM DRAIN SHALL BE THE OUTSIDE DIAMETER OF THE CONNECTING PIPE PLUS 1".
5. IF ANGLE X FROM HORIZONTAL IS 45° OR LESS USE TYPE 1.
IF ANGLE X IS 45° OR OVER USE TYPE 2.

DETAIL NO.

524



STANDARD DETAIL
ENGLISH

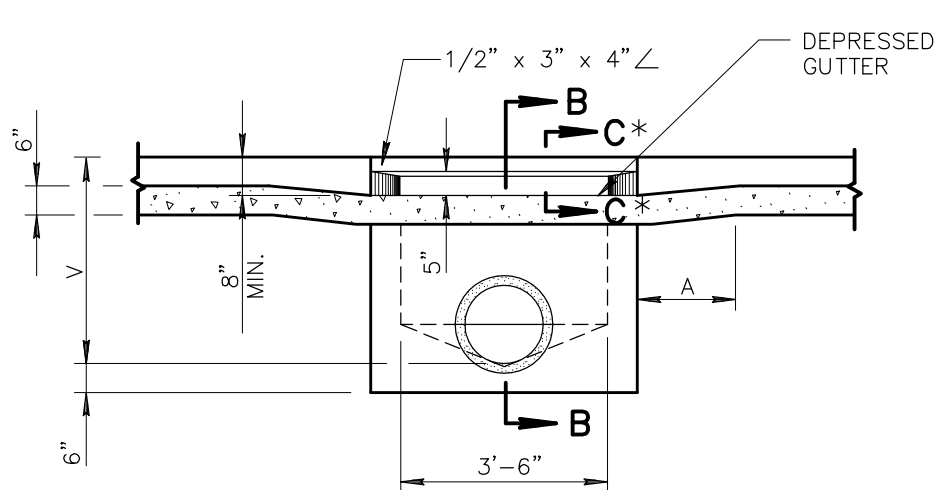
STORM DRAIN LATERAL
PIPE CONNECTIONS

REVISED

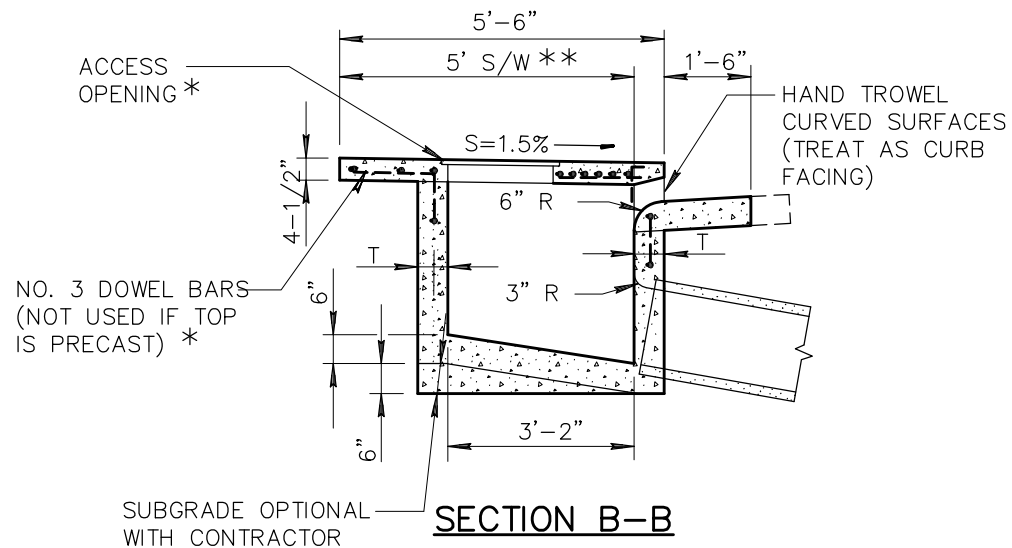
01-01-1998

DETAIL NO.

524

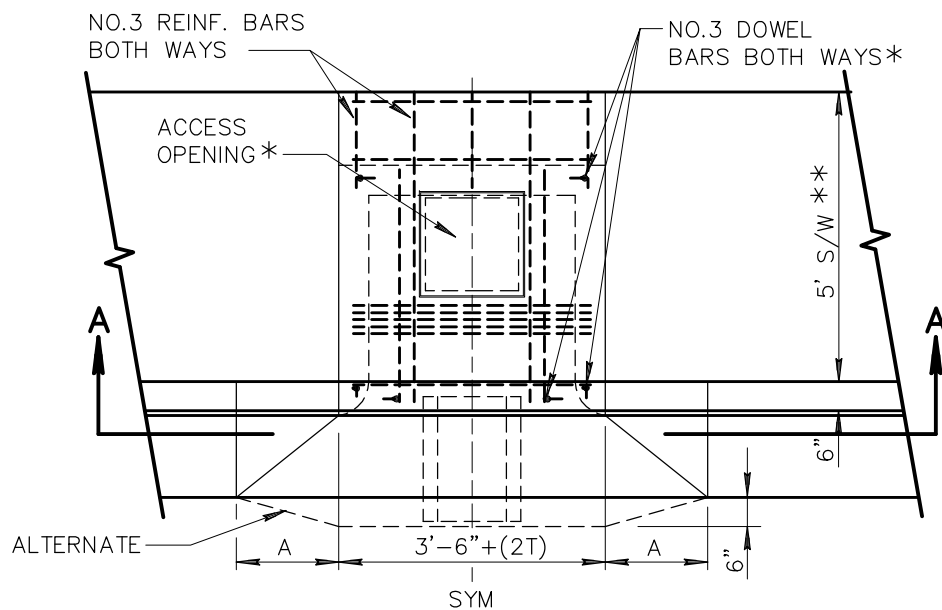


SECTION A-A



NOTES:

1. THE ENTIRE CATCH BASIN COVER MAY BE POURED IN PLACE OR PRECAST.
2. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
3. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO. 1 D PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. CONCRETE SHALL BE CLASS A PER SECTION 725.



PLAN VIEW

CURB	A
4"	3'-3"
6"	1'-9"
7"	1'-0"

DIMENSIONS

T=6" IF V=4' OR LESS
T=8" IF V IS BETWEEN 4' AND 8'
T=10" IF V IS 8' OR MORE (IF V EXCEEDS 10' SPECIAL DESIGN IS REQUIRED)
V=3'-6" UNLESS OTHERWISE SPECIFIED.

- * SEE DETAILS 536-1 AND 536-2 FOR DETAILS AND SECTIONS COMMON TO ALL CURB OPENING CATCH BASINS.
** 4' LOCATIONS WHERE 4' S/W IS REQUIRED.

DETAIL NO.

530



STANDARD DETAIL
ENGLISH

**3'-6" CURB OPENING
CATCH BASIN - TYPE 'A'**

REVISED

01-01-1998

DETAIL NO.

530



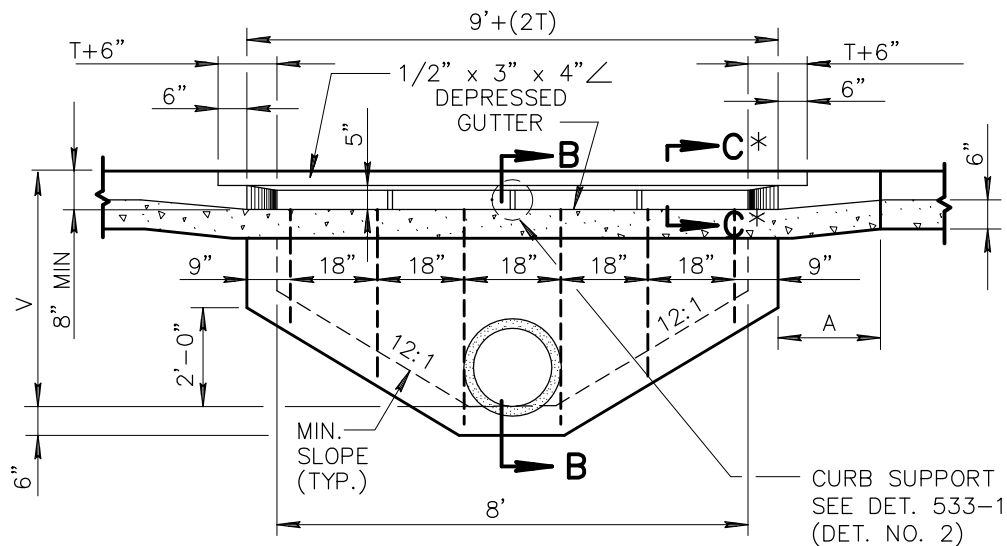
1. THE ENTIRE CATCH BASIN COVER MAY BE POURED IN PLACE OR PRECAST.
2. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
3. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO. 1 D PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. CONCRETE SHALL BE CLASS A PER SECTION 725.



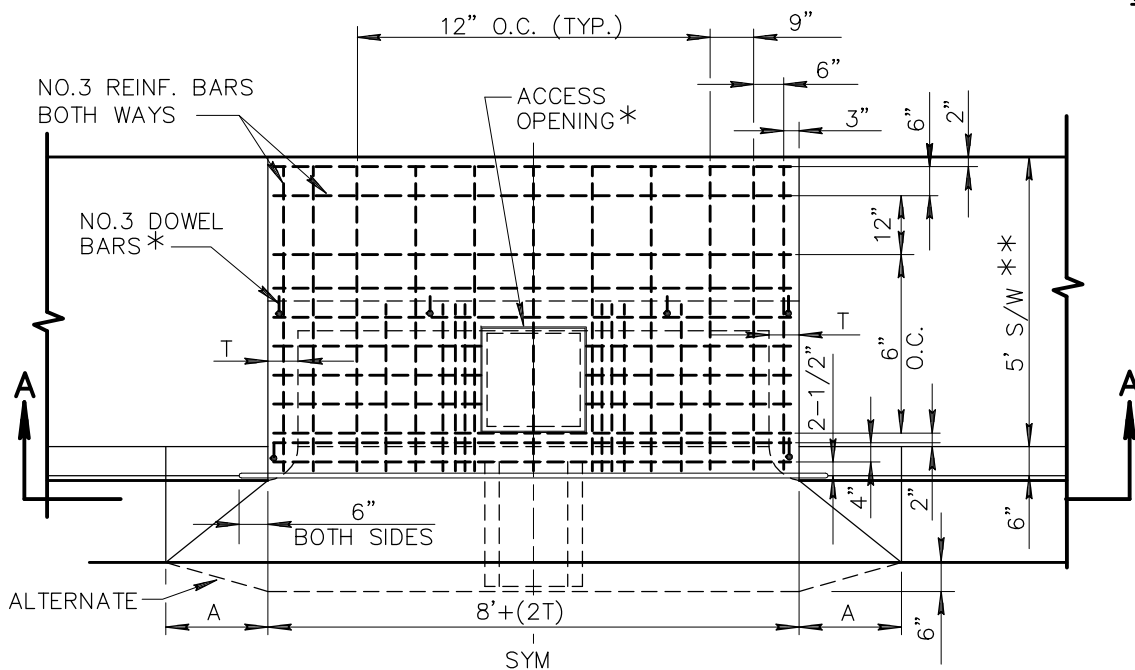
CURB	A
4"	3'-3'
6"	1'-9'
7"	1'-0'

T=6" IF V=4' OR LESS
T=8" IF V IS BETWEEN 4' AND 8'
T=10" IF V IS 8' OR MORE (IF V EXCEEDS
10' SPECIAL DESIGN IS REQUIRED)
V=3'-6" UNLESS OTHERWISE SPECIFIED.

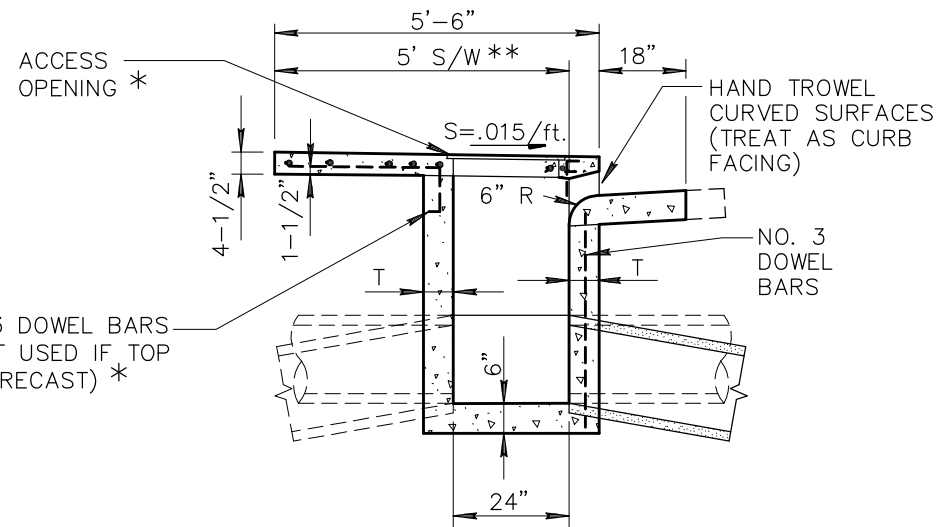
* SEE DETAILS 536-1 AND 536-2 FOR DETAILS AND SECTIONS
COMMON TO ALL CURB OPENING CATCH BASINS.
** 4' LOCATIONS WHERE 4' S/W IS REQUIRED.



SECTION A-A



PLAN VIEW



SECTION B-B

NOTES:

1. THE ENTIRE CATCH BASIN COVER MAY BE POURED IN PLACE OR PRECAST.
2. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
3. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
4. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO.1 D PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. CONCRETE SHALL BE CLASS A PER SECTION 725.

CURB	A
4"	3'-3"
6"	1'-9"
7"	1'-0"

DIMENSIONS

T=6" IF V=4' OR LESS
T=8" IF V IS BETWEEN 4' AND 8'
T=10" IF V IS 8' OR MORE (IF V EXCEEDS 10' SPECIAL DESIGN IS REQUIRED)
V=4' UNLESS OTHERWISE SPECIFIED.

* SEE DETAILS 536-1 AND 536-2 FOR DETAILS AND SECTIONS COMMON TO ALL CURB OPENING CATCH BASINS.
** 4' LOCATIONS WHERE 4' S/W IS REQUIRED.

DETAIL NO.

532



STANDARD DETAIL
ENGLISH

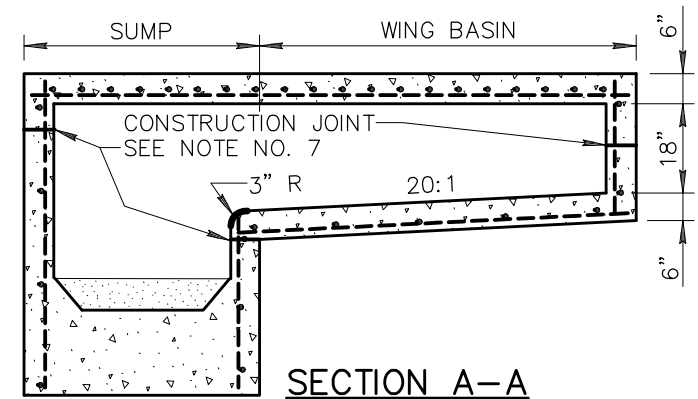
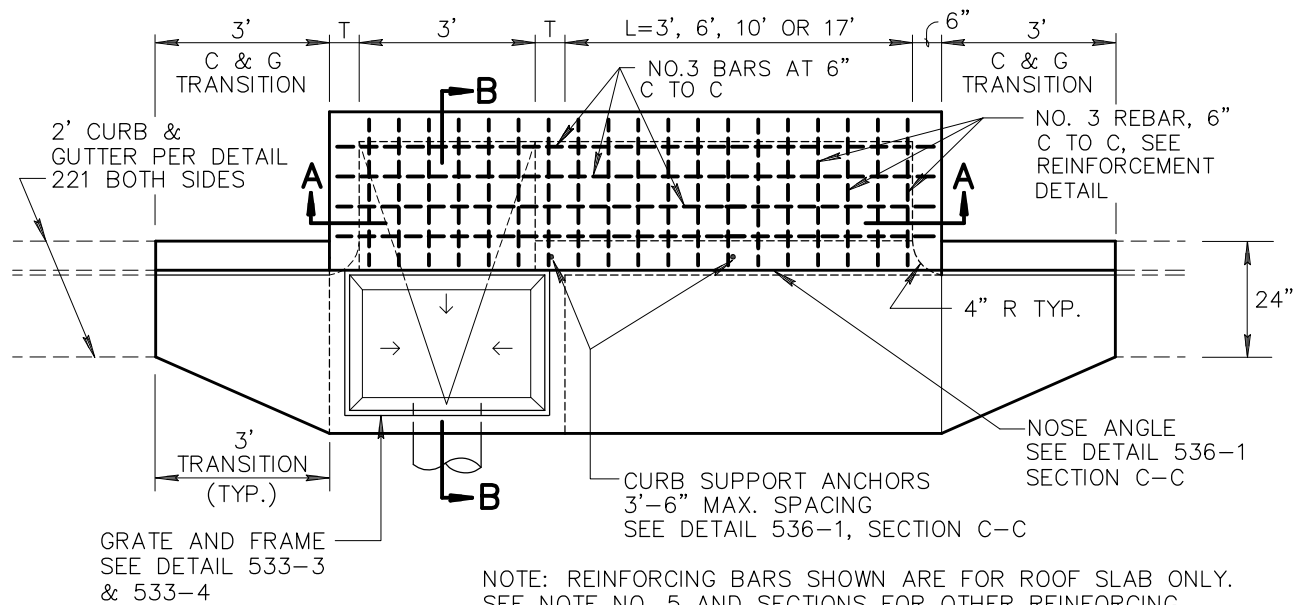
**8'-0" CURB OPENING
CATCH BASIN - TYPE 'C'**

REVISED

01-01-1998

DETAIL NO.

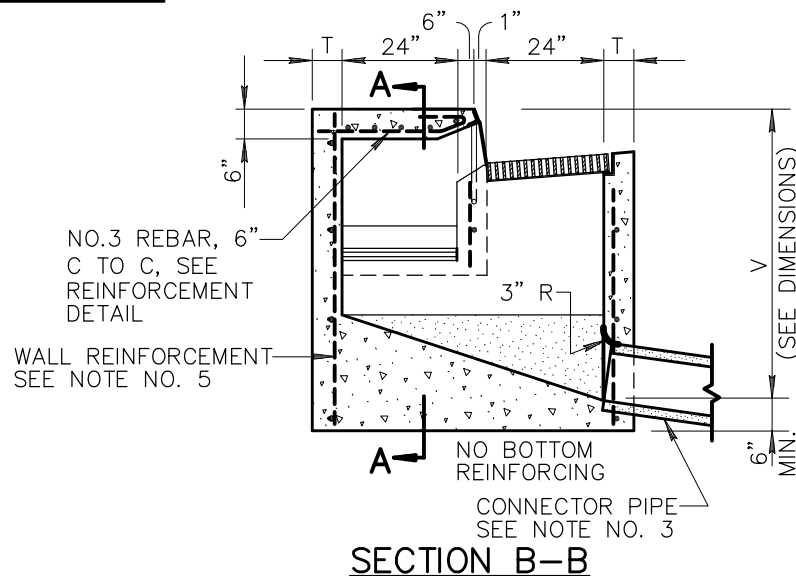
532



NOTES:

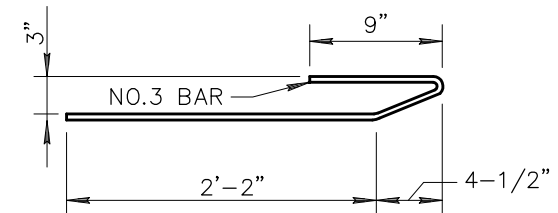
1. SINGLE C.B. (ILLUSTRATED), SUMP WITH WING BASIN UPSTREAM.
2. DOUBLE C.B. SUMP WITH SYMMETRICAL WING BASINS EACH SIDE.
3. PIPES CAN BE PLACED IN ANY WALL EXCEPT WALL ADJACENT TO A WING BASIN. PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS PLACED.
4. SUMP FLOOR SHALL HAVE A WOOD TROWEL FINISH AND A MIN. SLOPE OF 4:1 IN ALL DIRECTIONS TOWARD OUTLET PIPE.
5. ALL REFORCING BARS SHALL BE NO.4 18" C TO C BOTH WAYS AND 1-1/2" CLEAR TO INSIDE OF WALLS AND OUTSIDE WING BASIN FLOOR EXCEPT AS SHOWN. SEE SECT. 727.
6. ALL CONCRETE SHALL BE CLASS 'A', PER SECT. 725.
7. CONSTRUCTION JOINTS SHALL BE PLACED TO MEET FIELD CONDITIONS.
8. ALL EXPOSED STEEL SHALL BE GALVANIZED OR PAINTED WITH ONE SHOP COAT OF #1 PAINT AND TWO FIELD COATS OF #10 PAINT.

PLAN VIEW



DIMENSIONS

- V = 3'-3" MIN. WHEN L = 3'
- V = 3'-5" MIN. WHEN L = 6'
- V = 3'-7" MIN. WHEN L = 10'
- V = 4'-0" MIN. WHEN L = 17'
- T = 6" WHEN V IS LESS THAN 8'
- T = 8" WHEN V IS EQUAL TO OR GREATER THAN 8'
- H = CURB HEIGHT PRIOR TO THE TRANSITION



DETAIL NO.

533-1



STANDARD DETAIL
ENGLISH

CATCH BASIN TYPE 'D'

REVISED

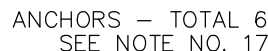
01-01-1998

DETAIL NO.

533-1

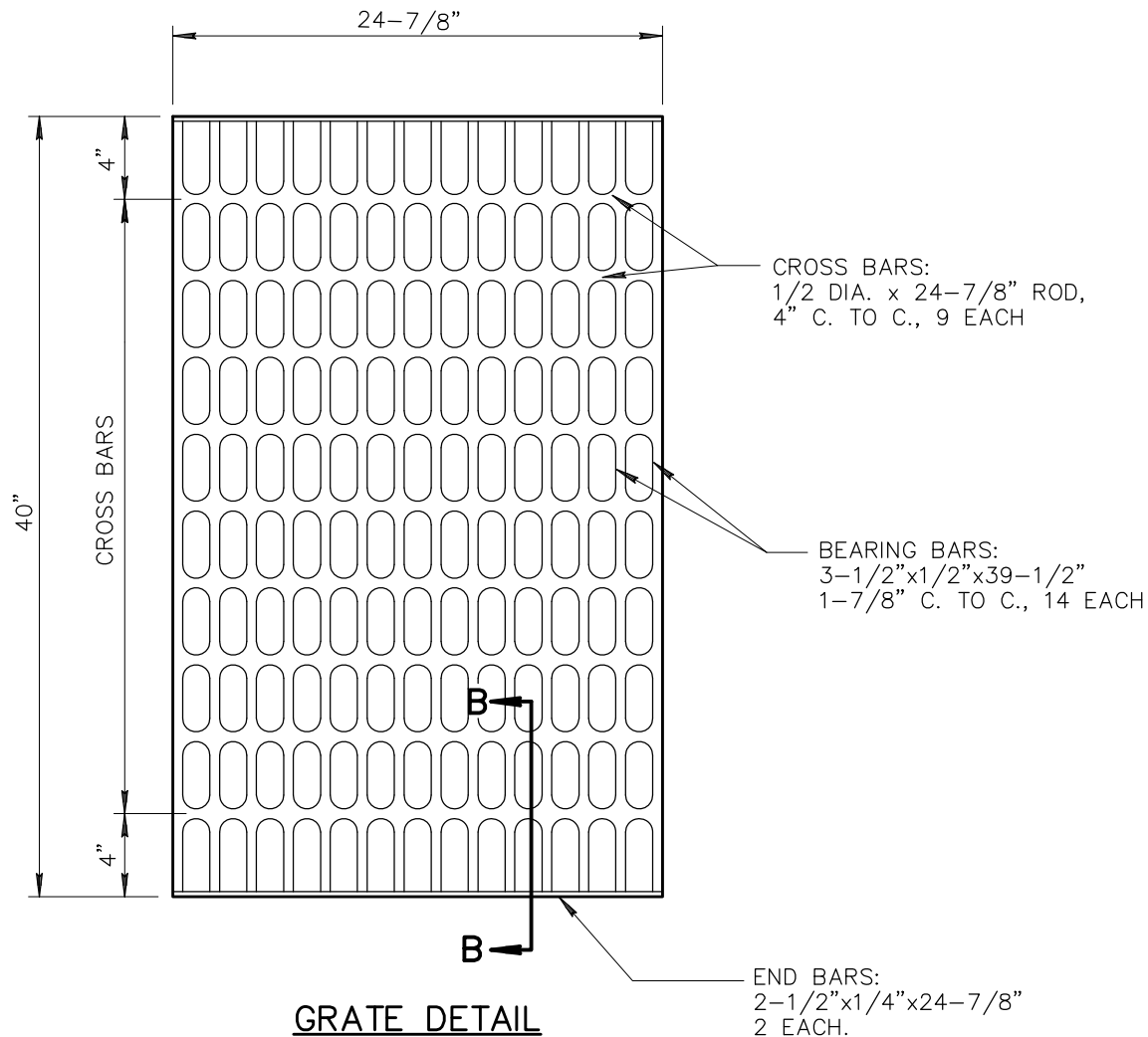


9. APRON IS CONSTRUCTED ONLY WHEN SPECIFIED ON PLANS.
10. CONCRETE IN APRON SHALL BE NOT LESS THAN 8" THICK.
11. CURB FACES AT CATCH BASIN OPENING AND POINT G SHALL BE THAT OF THE EXISTING CURB FACE PLUS 2' OR AS OTHERWISE SHOWN.
12. ELEVATION AT THE OUTER CORNERS OF THE LOCAL DEPRESSION SHOWN ON THE PLANS ARE FOR THE FINISHED SURFACE.
13. SEE DETAIL 533-1 FOR ADDITIONAL DIMENSIONS, REBAR PLACEMENT AND OTHER INFORMATION TO CONSTRUCT CATCH BASIN.

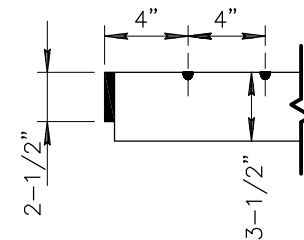


- ## FRAME AND GRATE NOTES





GRATE DETAIL
GRATE OPENING: 4.344 SQ. FT.



SECTION B-B

DETAIL NO.

533-4



STANDARD DETAIL
ENGLISH

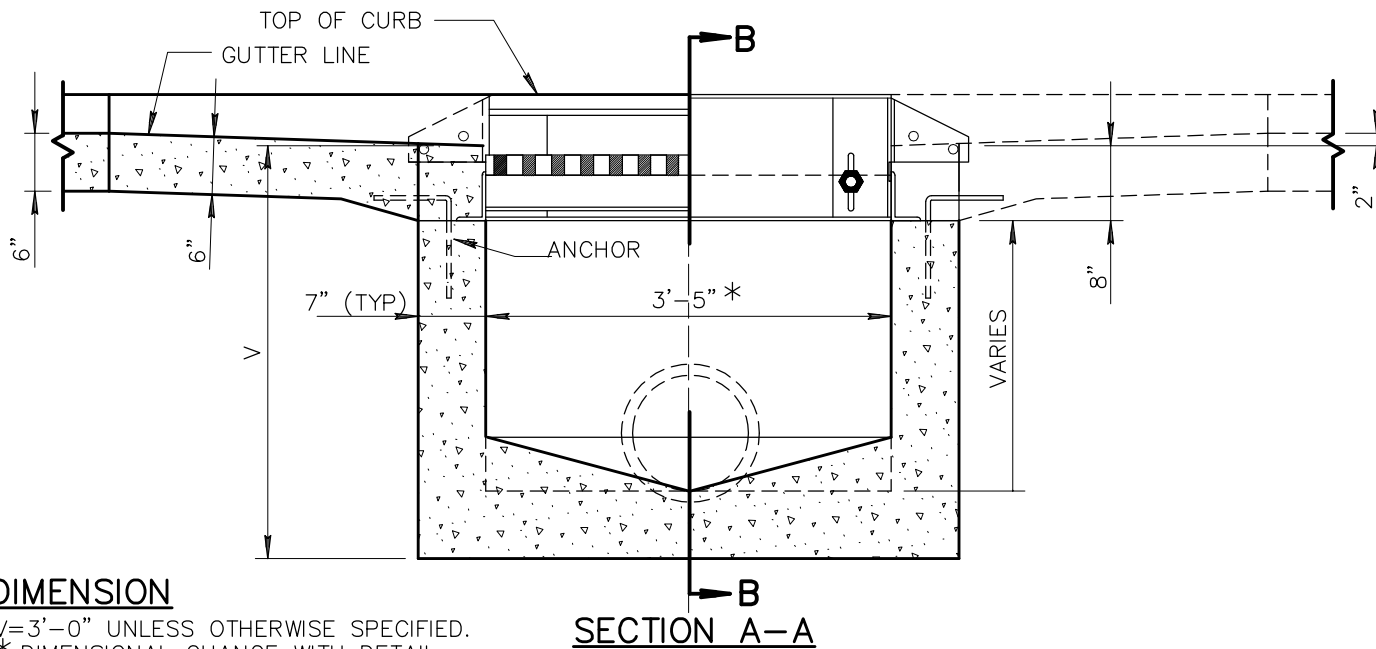
**7'-0" CURB OPENING CATCH BASIN
TYPE 'D' - GRATE DETAILS**

REVISED

01-01-2007

DETAIL NO.

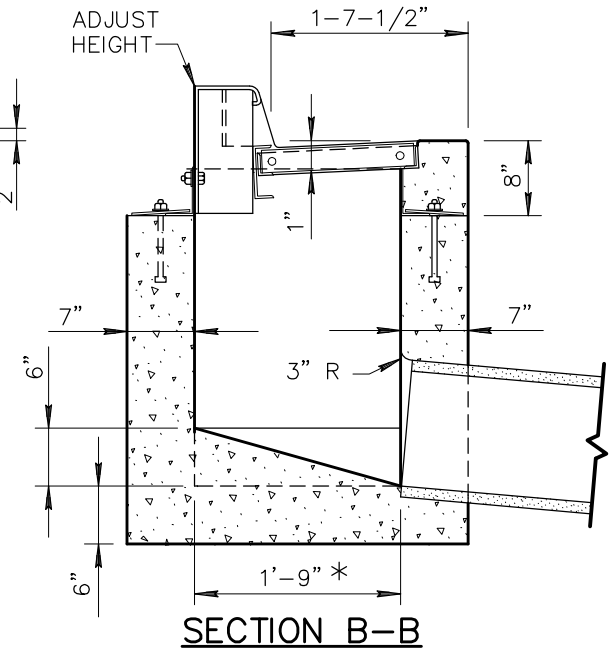
533-4



DIMENSION

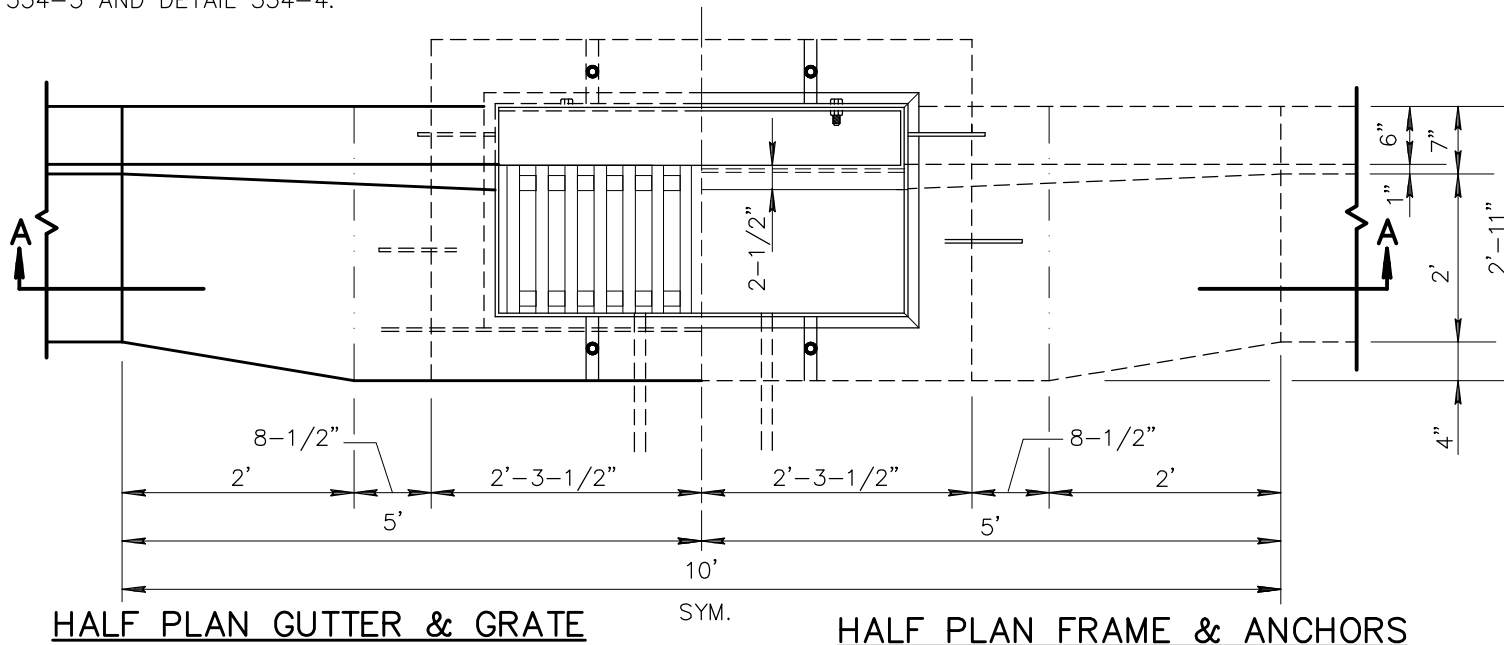
V=3'-0" UNLESS OTHERWISE SPECIFIED.

* DIMENSIONAL CHANGE WITH DETAIL 534-3 AND DETAIL 534-4.



NOTES:

1. ADJUSTABLE CURB, FRAME AND GRATING UNITS SHALL BE STRUCTURAL STEEL OR CAST IRON
2. PIPES MAY ENTER OR LEAVE ANY WALL. BOTTOM OF BOX TO BE SLOPED TO OUTLET PIPE FROM ALL DIRECTIONS AND TROWELLED TO A HARD SMOOTH SURFACE.
3. CONNECTION PIPES MAY BE PLACED IN ANY POSITION AROUND THE WALLS PROVIDED THE POSITION IS CONSISTENT WITH THE PLAN.
4. OUTLET PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
5. ALL STRUCTURAL STEEL TO BE PAINTED ONE SHOP COAT OF NO. 1 PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECT. 790.
6. ALL CONCRETE, CLASS 'A' AS PER SECTION 725.



DETAIL NO.

534-1



STANDARD DETAIL
ENGLISH

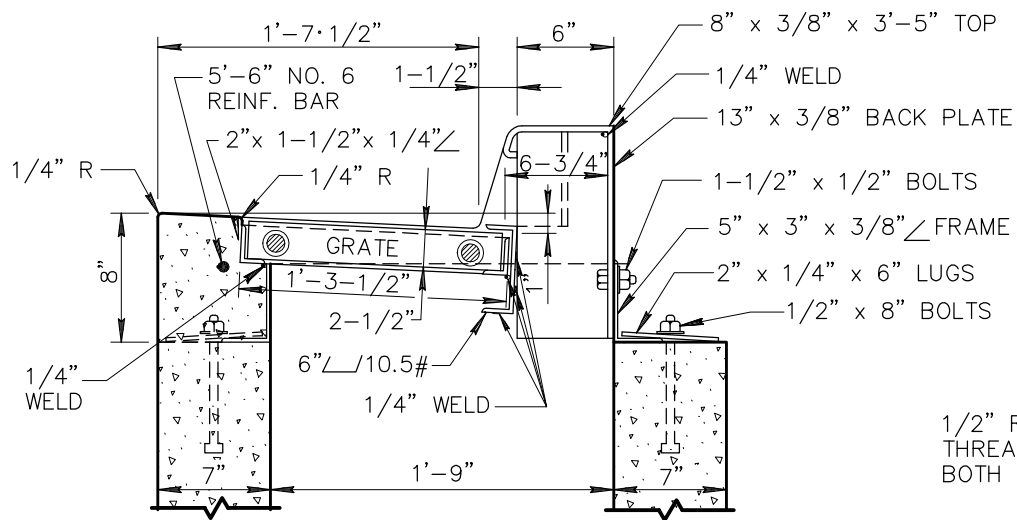
CATCH BASIN TYPE 'E'

REVISED

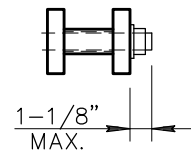
01-01-1998

DETAIL NO.

534-1

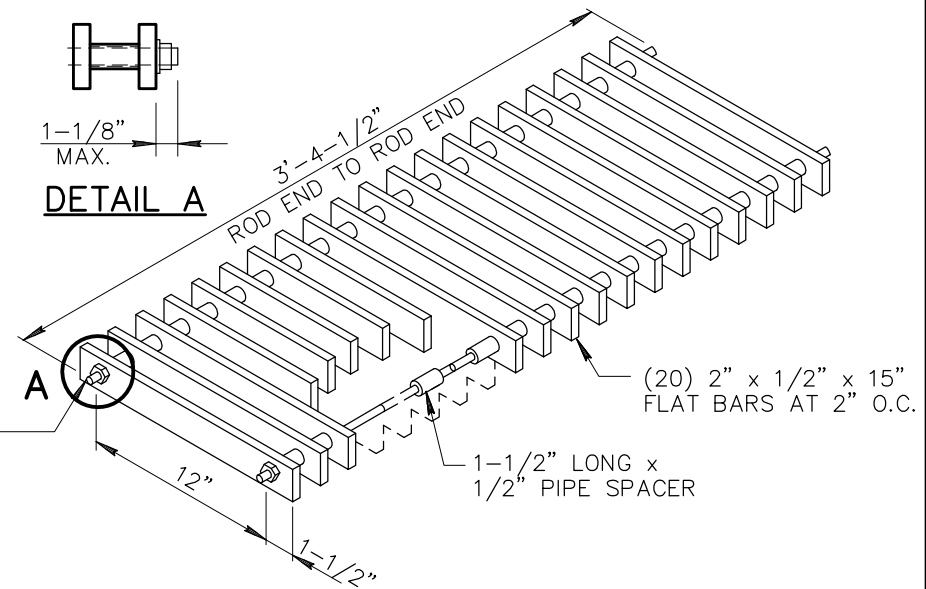


CROSS SECTION

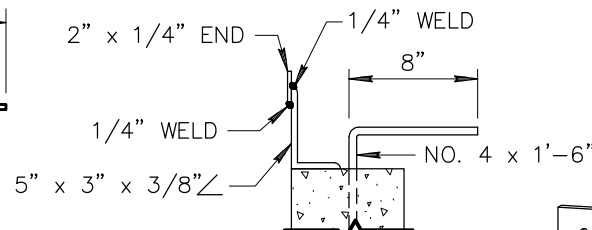
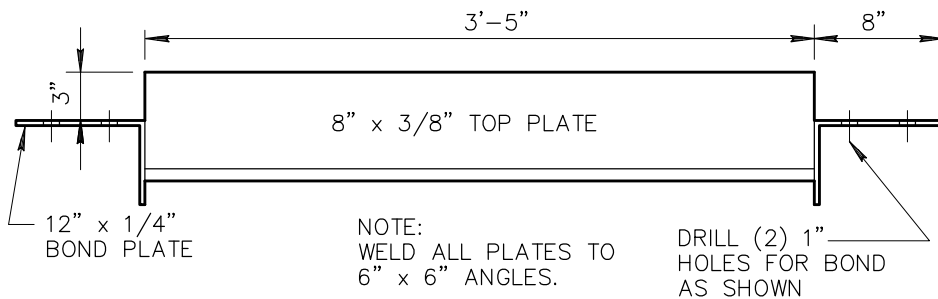


DETAIL A

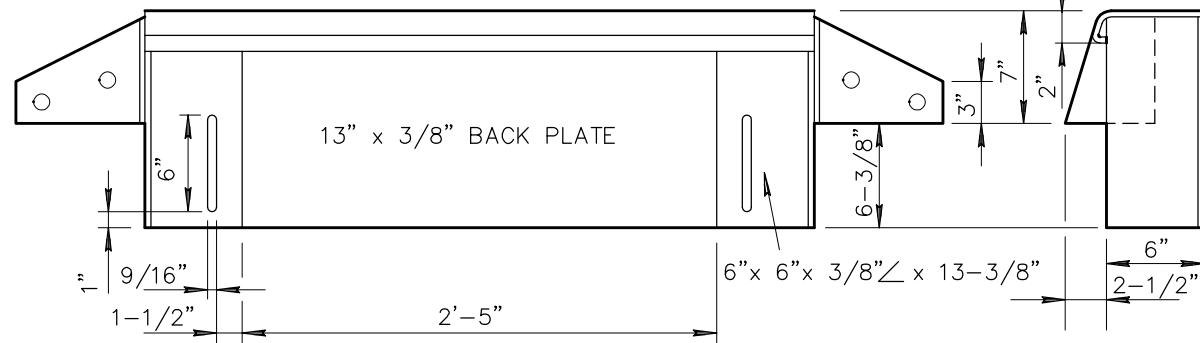
1/2" RODS
THREADED
BOTH ENDS



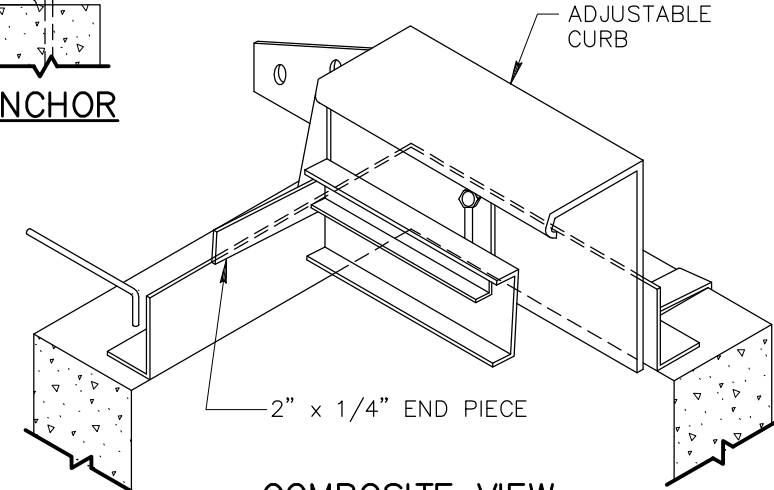
GRATE



ANCHOR



ADJUSTABLE CURB



COMPOSITE VIEW

DETAIL NO.

534-2



STANDARD DETAIL
ENGLISH

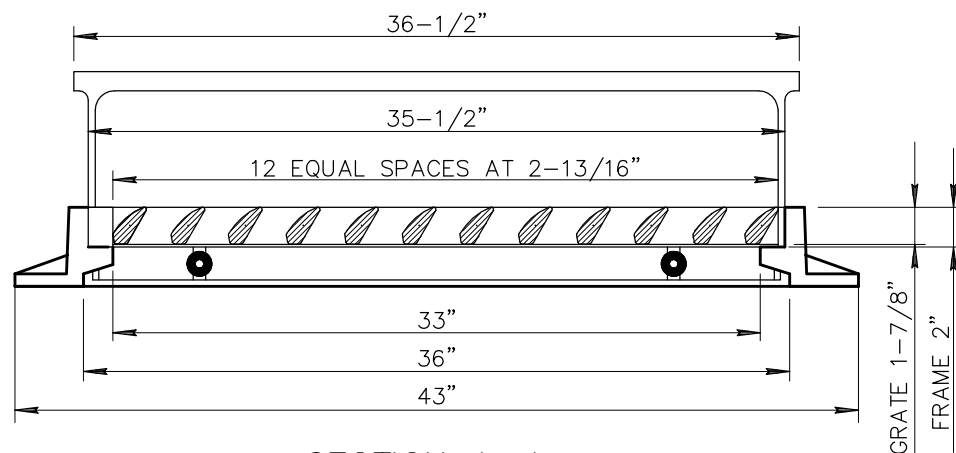
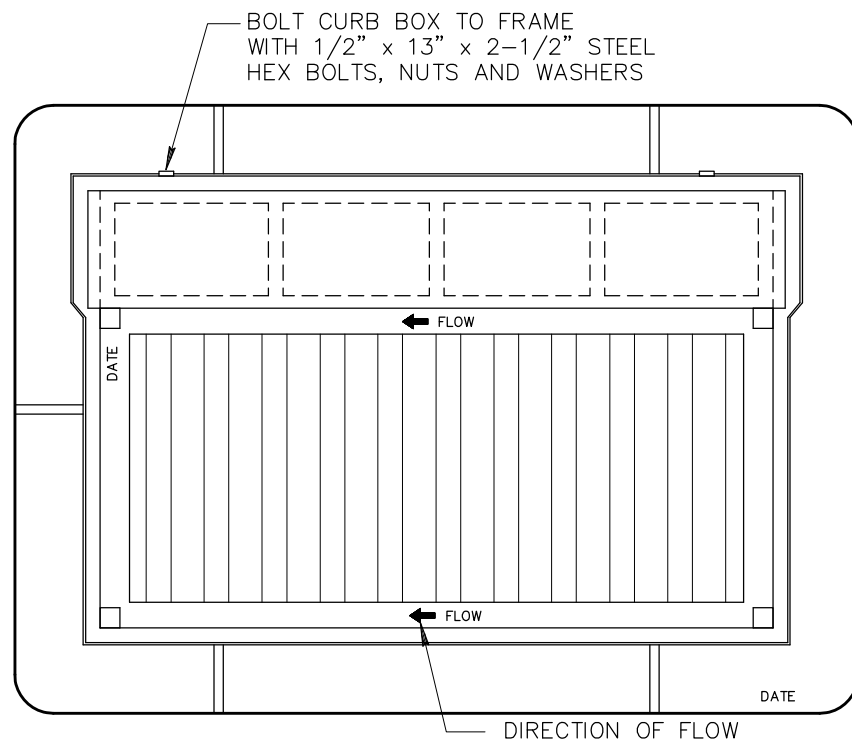
CATCH BASIN TYPE 'E' (DETAILS)

REVISED

01-01-1998

DETAIL NO.

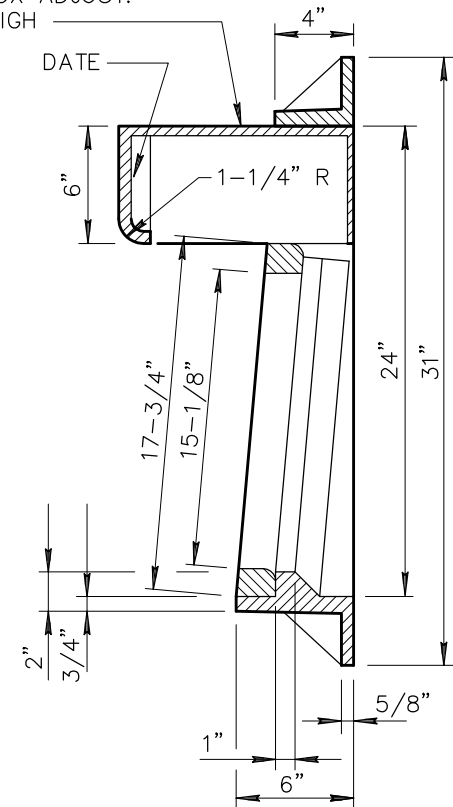
534-2



SECTION A-A

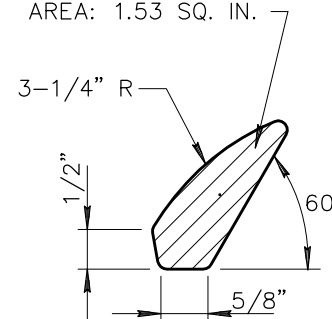
CAST IRON FRAME — GRATE — CURB BOX

CURB BOX ADJUST.
TO 9" HIGH



SECTION B-B

CROSS-SECTIONAL
AREA: 1.53 SQ. IN.



VANE DETAIL

NOTE:

DIMENSIONAL CHANGE REQUIRED FROM 3'-5"
WIDTH TO 3'-0" AND 1'-9" DEPTH TO 2'-0"
MATERIAL CAST GRAY IRON ASTM A-48-83 CLASS 35B.
FRAME WEIGHT 209 LBS; GRATE 140 LBS; CURB BOX 92 LBS.

DETAIL NO.
534-3

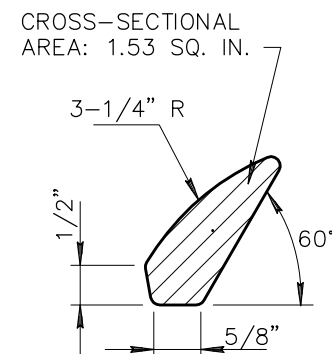
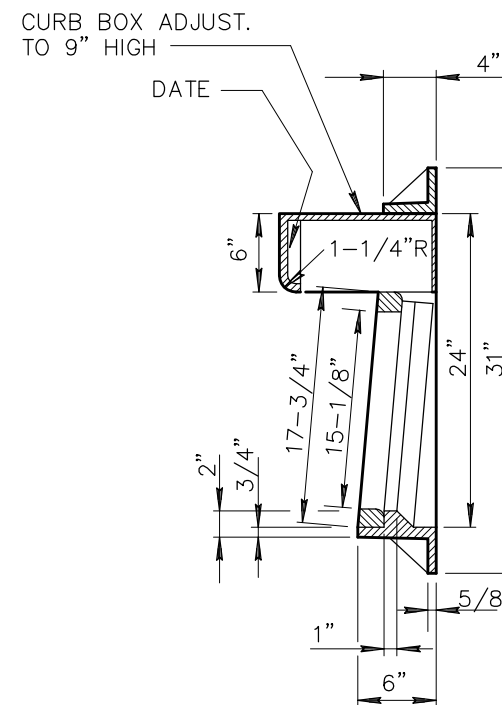
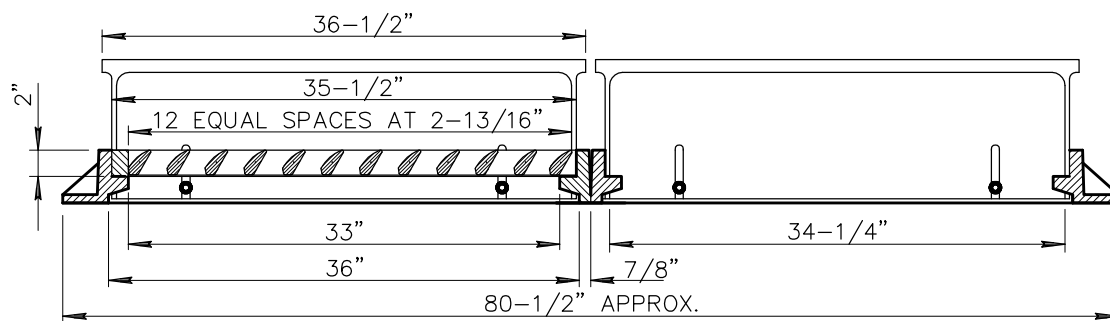
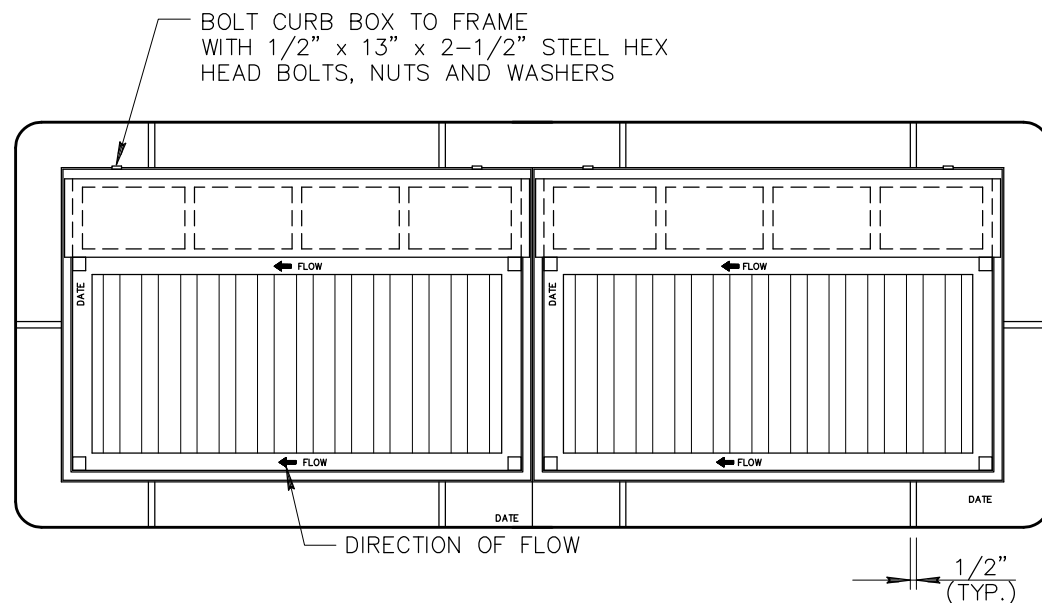


STANDARD DETAIL
ENGLISH

CATCH BASIN TYPE 'E' (DETAILS)

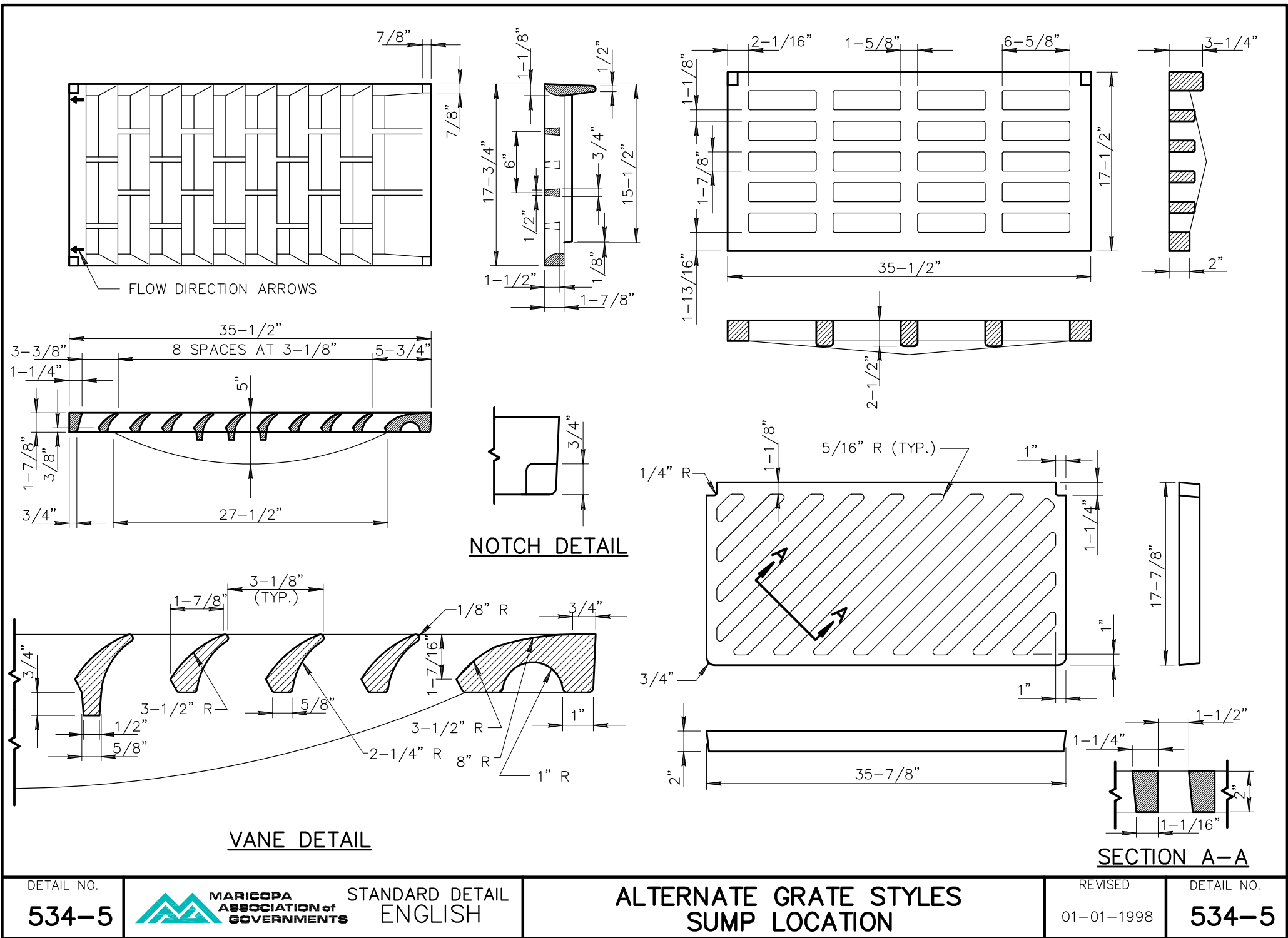
REVISED
01-01-1998

DETAIL NO.
534-3



NOTE:

DIMENSIONAL CHANGE REQUIRED FROM 3'-5"
WIDTH TO 6'-2", AND 1'-9" DEPTH TO 2'-0"
REQUIRES ONE CENTER STEEL I-BEAM 4" x 7.7 LBS.
MATERIAL CAST GRAY IRON ASTM A-48-83 CLASS 35B.
FRAME WEIGHT 197 LBS.; GRATE 140 LBS.; CURB BOX 92 LBS.



DETAIL NO.

534-5



STANDARD DETAIL
ENGLISH

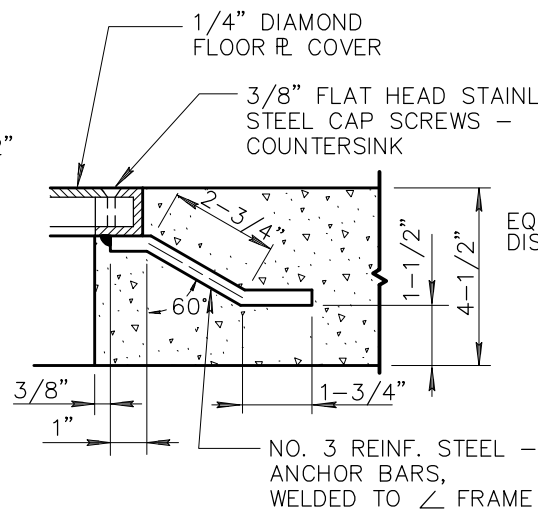
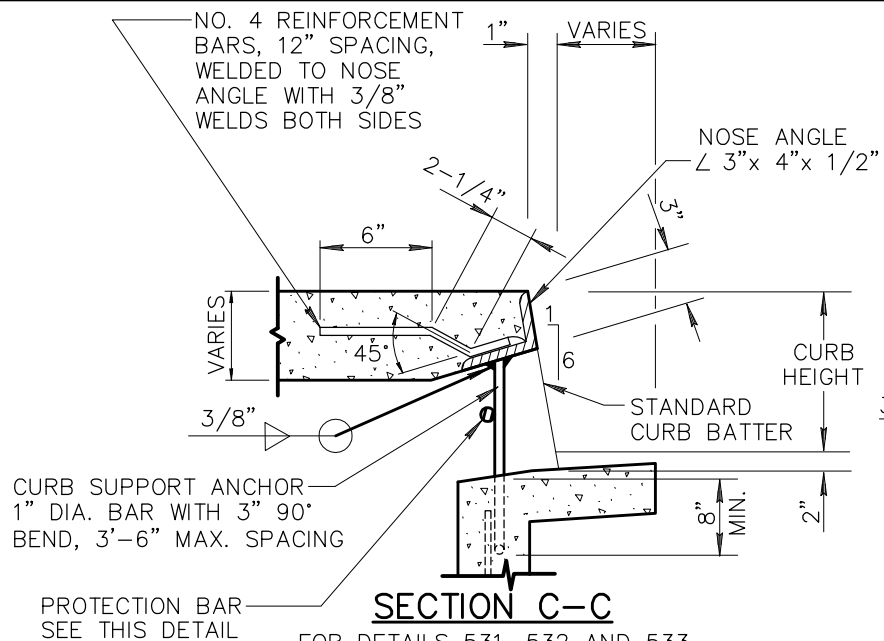
ALTERNATE GRATE STYLES
SUMP LOCATION

REVISED

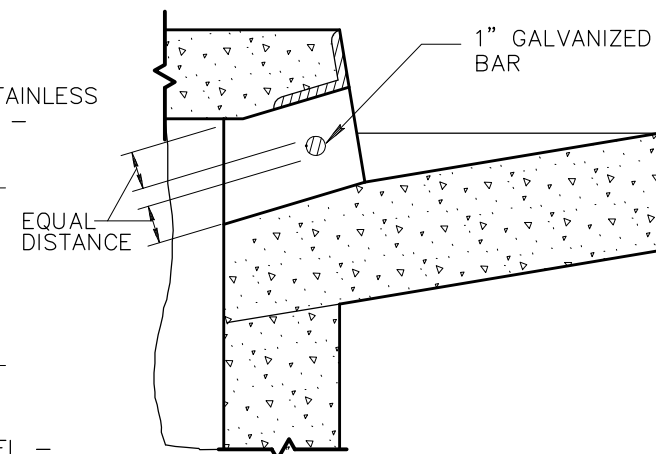
01-01-1998

DETAIL NO.

534-5



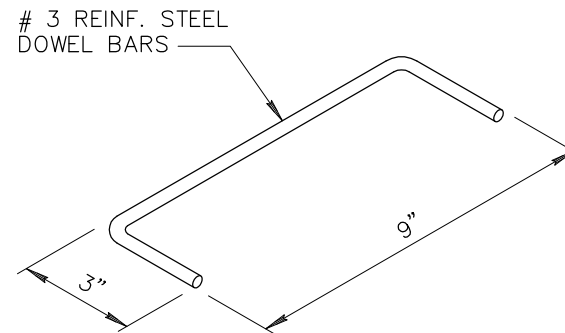
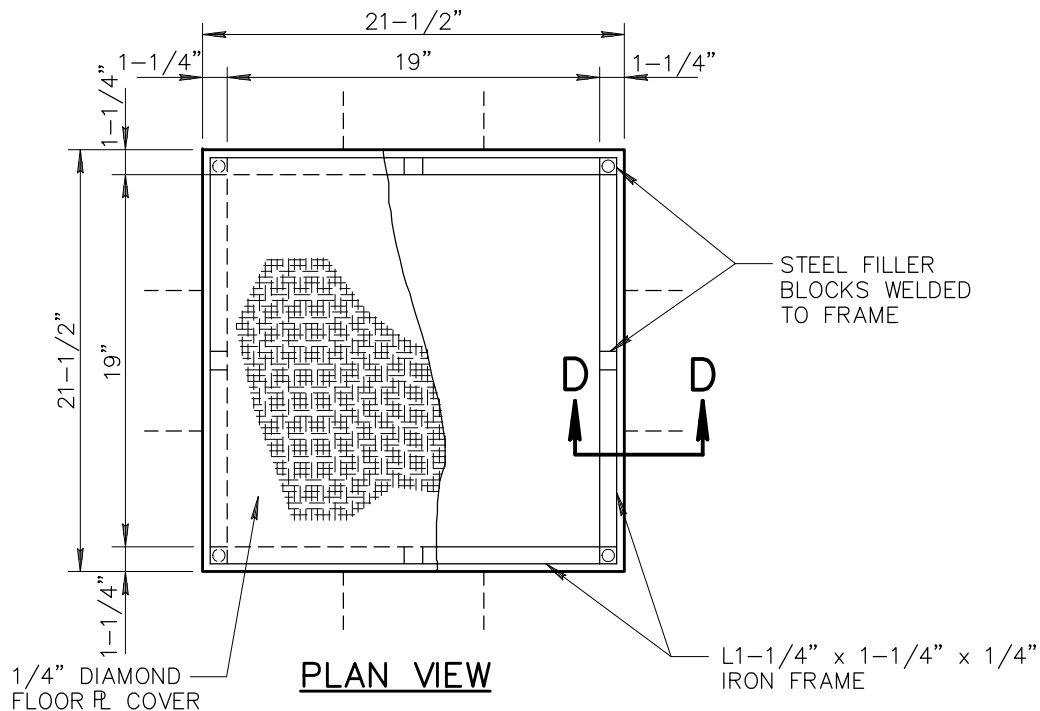
SECTION D-D



PROTECTION BAR

NOTES:

- 1) HORIZONTAL PLAIN ROUND GALVANIZED STEEL PROTECTION BAR SHALL BE USED WHEN CURB FACE IS 9" OR MORE.
- 2) THE BAR SHALL BE EMBEDDED 5" AT EACH END.



DOWEL BAR

DETAIL NO.

536-1



STANDARD DETAIL
ENGLISH

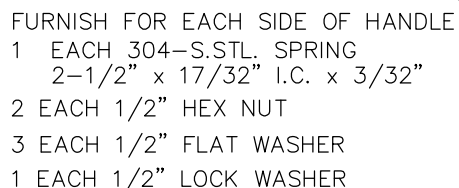
**COMMON DETAILS AND SECTIONS
FOR CURB OPENING CATCH BASINS**

REVISED

01-01-1999

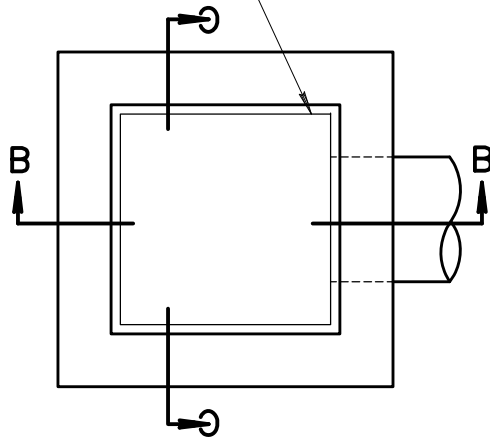
DETAIL NO.

536-1



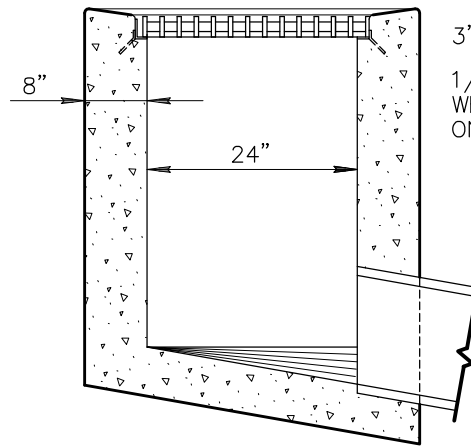
1. FRAME SHALL BE NON-LOCKING.
2. FRAME AND COVER SHALL BE CAST IRON OR ASTM A-36 STRL. HORIZONTAL SURFACE OF COVER IN CONTACT WITH FRAME SHALL BE MACHINED. ASA B-46 ROUGHNESS SHALL NOT EXCEED 1/32".
3. COVER SHALL BE FILLED WITH CONCRETE AND BROOM FINISHED.
4. SMALL VARIATIONS IN DIMENSIONS OF FEATURES OF A MINOR NATURE THAT ARE PART OF THE FOUNDRY'S CASTING ARE PERMISSIBLE.

29" x 29" I.D.
GRATE FRAME



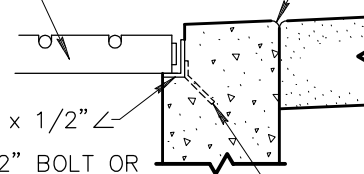
PLAN

SINGLE GRATE



SECTION B-B

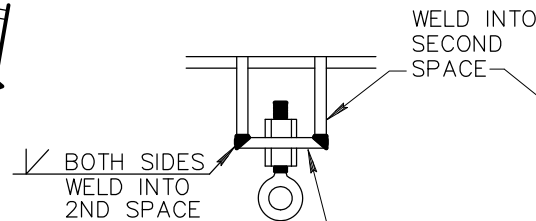
GRATE 1/2" R



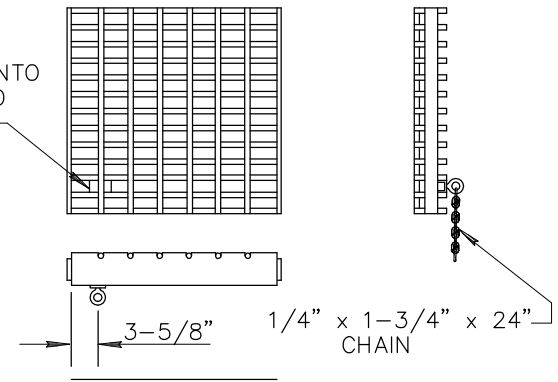
3" x 2-1/2" x 1/2" \angle
1/2" x 3-1/2" BOLT OR
WELDED LUG, 4 EACH -
ONE ON EACH CORNER

DETAIL OF ANGLE FRAME
GRATE SUPPORT

ALL CONCRETE SHALL BE
CLASS 'A' PER SECT. 725.
EXPOSED EDGES SHALL BE
FINISHED WITH A 1/2"
RADIUS.

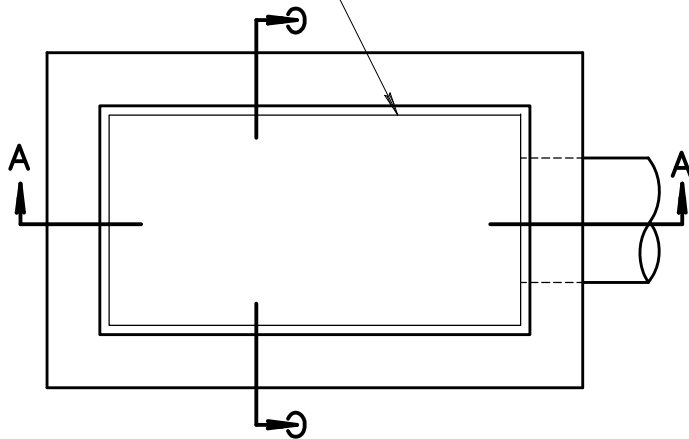


1/2" DIA x 1" EYE BOLT
2-3/8" x 3-1/8" x 1/4"
BEVELED SIDES FOR WELDS



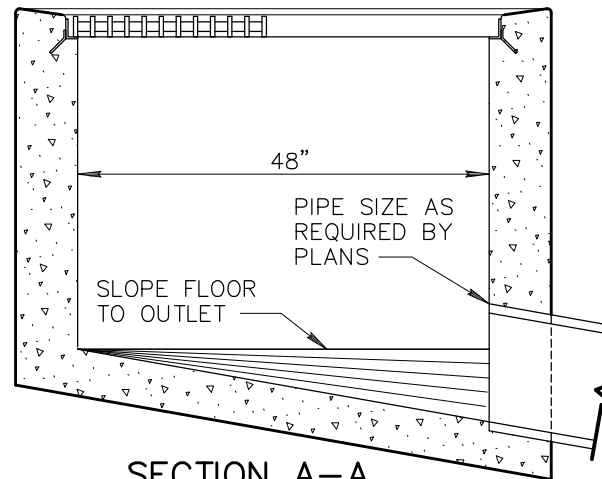
BAR GRATE
SEE DETAIL 539

29" x 53" I.D.
GRATE FRAME



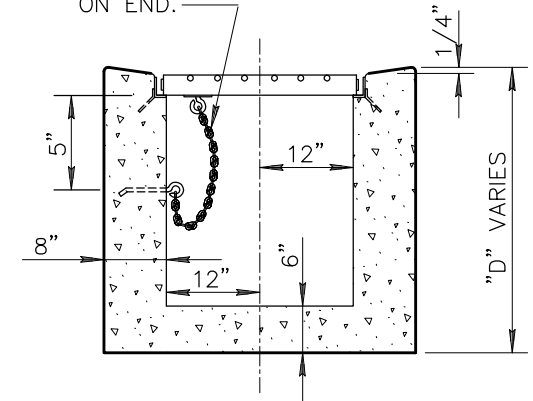
PLAN

DOUBLE GRATE



SECTION A-A

1/4" x 1-3/4" x 24" CHAIN TO 1" x 6"
EYE BOLT IN WALL. BEND BOLT 1"
ON END.



SECTION C-C

DETAIL NO.

537



STANDARD DETAIL
ENGLISH

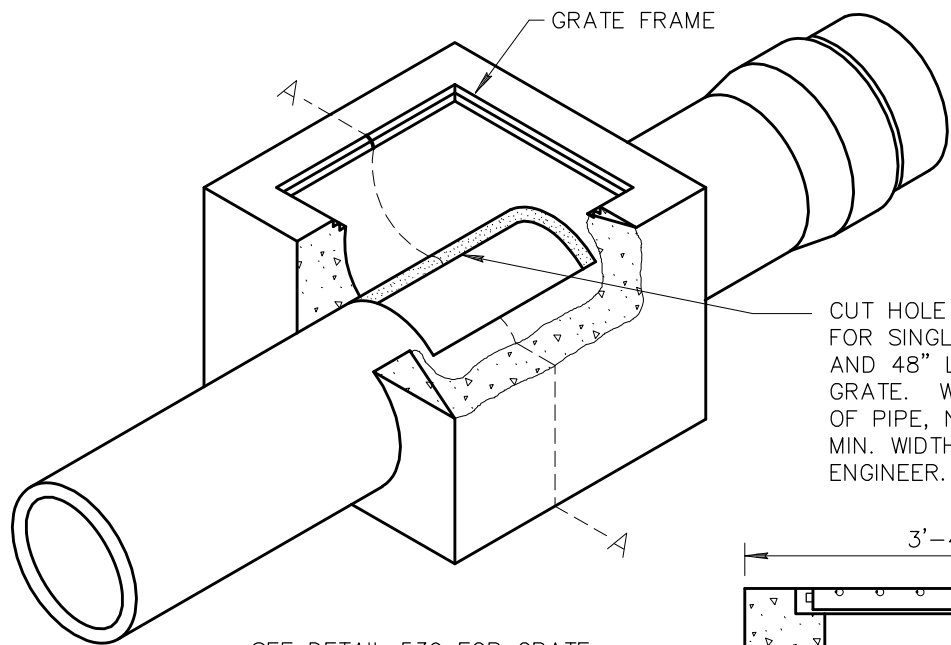
CATCH BASIN - TYPE 'G'

REVISED

01-03-2002

DETAIL NO.

537



WHEN DOUBLE GRATE IS USED
INCREASE THE LENGTH OF THE
STRUCTURE ACCORDINGLY.

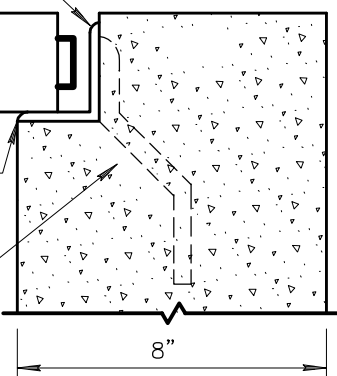
CUT HOLE IN PIPE 24" LONG
FOR SINGLE GRATE STRUCTURES
AND 48" LONG FOR DOUBLE
GRATE. WIDTH DEPENDS ON DIA.
OF PIPE, NOT TO EXCEED 22"
MIN. WIDTH TO BE SET BY PROJECT
ENGINEER.

SEE DETAIL 539 FOR GRATE

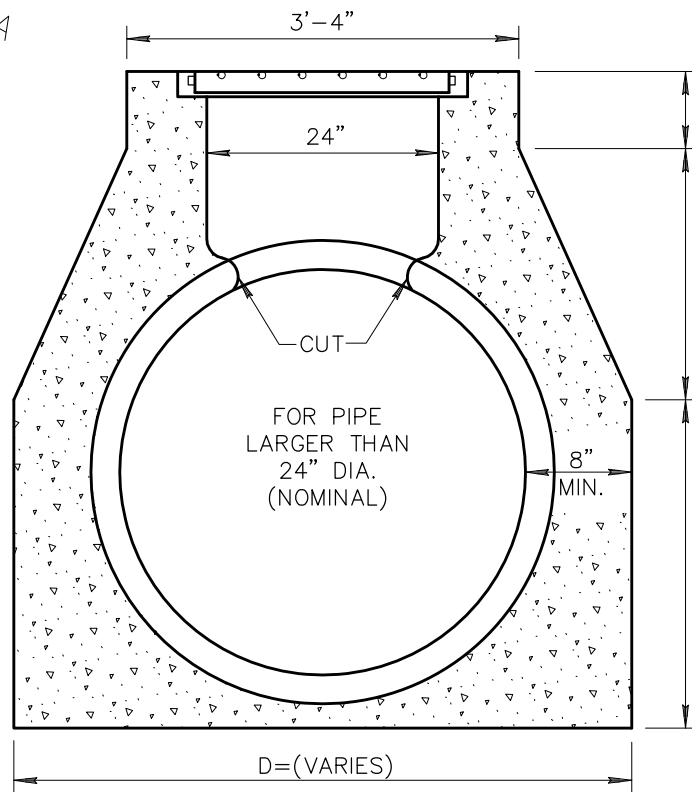
29" x 29" I.D. SINGLE FRAME
29" x 53" I.D. DOUBLE FRAME

3" x 2-1/2" x
1/2" ANGLE
IRON FRAME

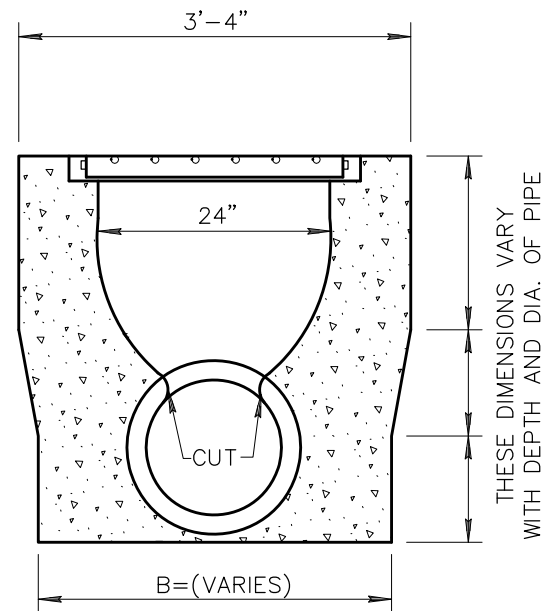
1/2" DIA x 6"
LUGS WELDED
TO FRAME, 4
EACH - 1 ON
EACH CORNER
OF FRAME



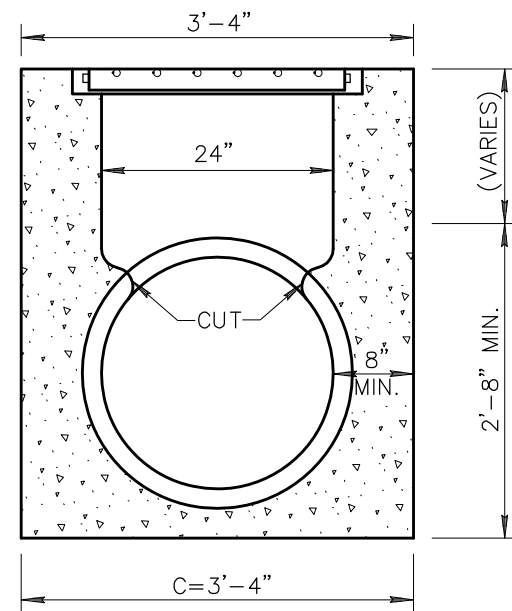
**DETAIL OF ANGLE
FRAME GRATE SUPPORT**



SECTION A-A



SECTION A-A



**SECTION A-A
24" PIPE (NOMINAL)**

DETAIL NO.

538



STANDARD DETAIL
ENGLISH

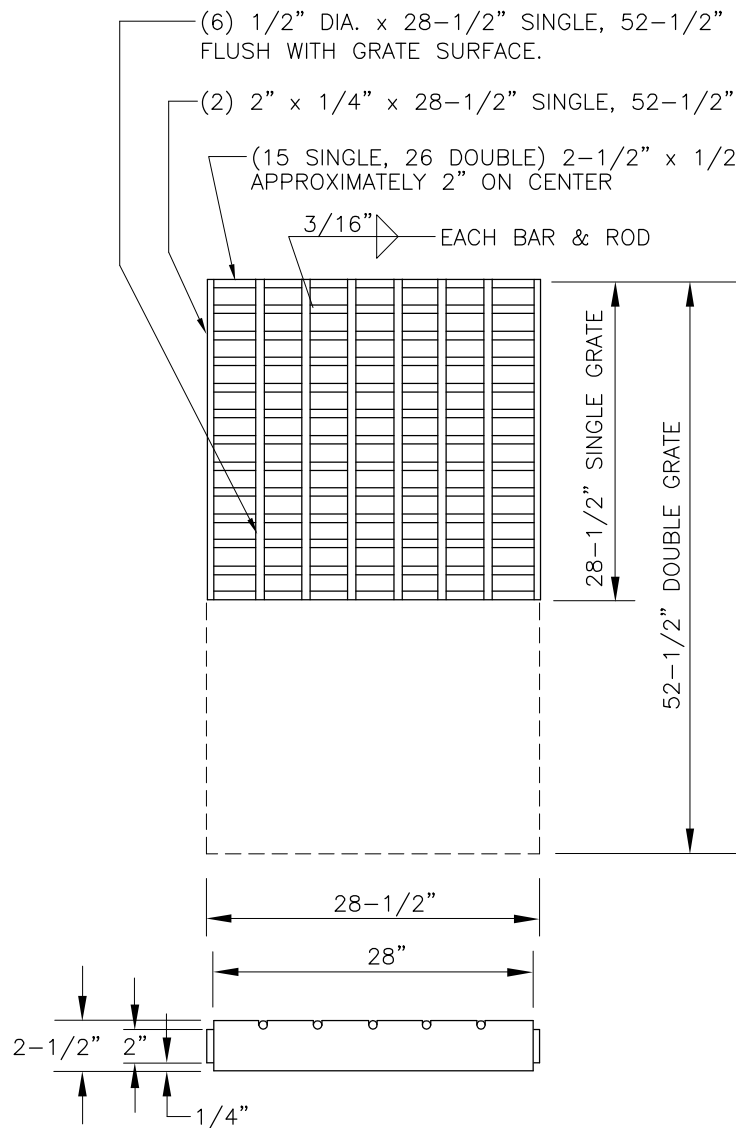
CATCH BASIN - TYPE 'H'

REVISIONS

01-01-1998

DETAIL NO.

538



NOTES:

1. ALL STEEL SHALL BE IN ACCORDANCE WITH A.S.T.M. A-36.
2. WELDING SHALL BE IN ACCORDANCE WITH A.W.S. SPECIFICATIONS.
3. FRAME AND GRATE SHALL BE TESTED FOR ACCURACY OF FIT AND SHALL BE MARKED IN SETS BEFORE DELIVERY.
4. THE COMPLETED ASSEMBLY SHALL BE GIVEN ONE SHOP COAT OF NO. 1 PAINT AND TWO FIELD COATS OF NO. 10 PAINT AS PER SECTION 790.
5. THE GRATE SHALL BE FABRICATED TO WITHIN 1/8" SPECIFIED DIMENSIONS.

DETAIL NO.

539



STANDARD DETAIL
ENGLISH

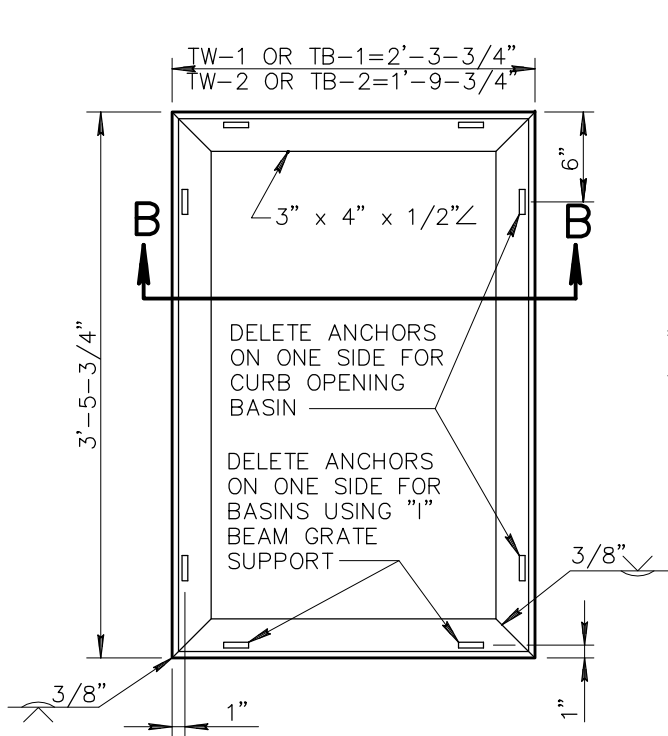
**GRATES FOR CATCH BASINS,
TYPE G AND H**

REVISED

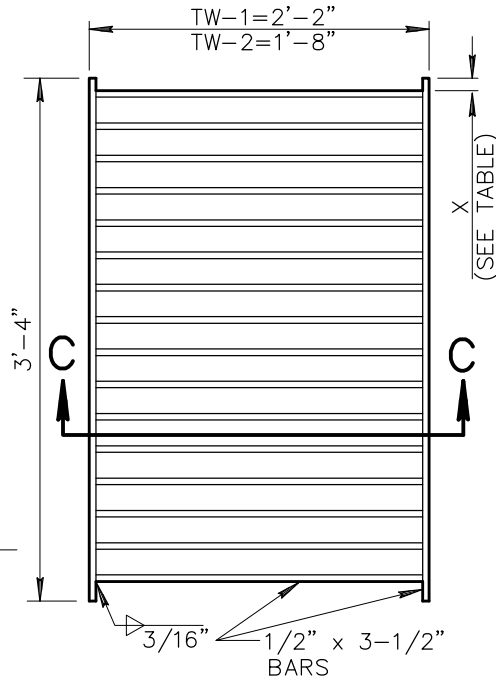
01-01-1998

DETAIL NO.

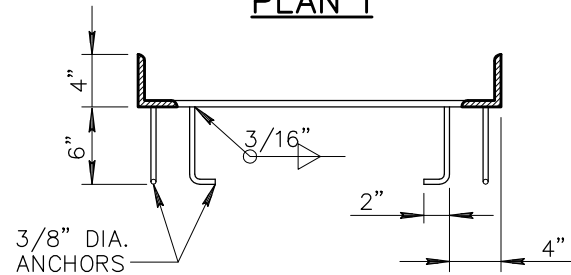
539



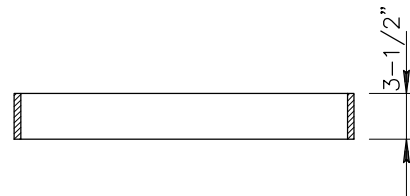
PLAN I



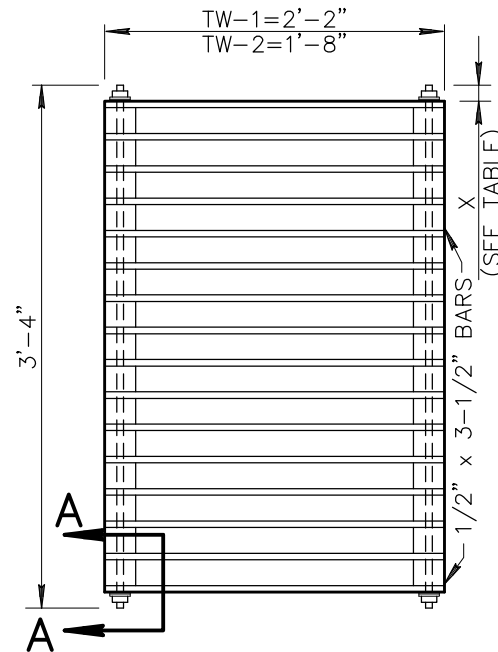
PLAN IA



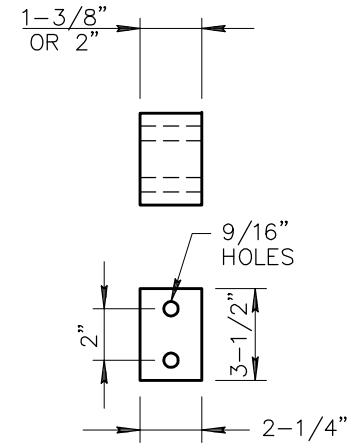
SECTION B-B



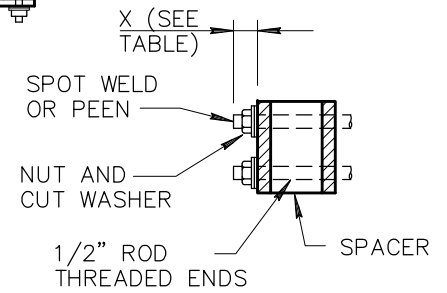
SECTION C-C
GRATE TYPES TW-1 AND TW-2



PLAN IB



BAR SPACER DETAIL



SECTION A-A

GRATE TYPES TB-1 AND TB-2

NOTES:

1. GRATING UNITS AND FRAMES SHALL BE FABRICATED FROM STRUCTURAL STEEL EXCEPT AS NOTED.
2. WELDING SHALL BE IN ACCORDANCE WITH STD. WELDING SPECS.
3. THE COMPLETED ASSEMBLY SHALL BE GIVEN TWO SHOP COATS OF NO. 1 PAINT AS PER SECT. 790.
4. FRAME AND GRATE SHALL FIT TO A MAX. ROCK OF 0.093" AT ANY POINT.
5. RESTRICT USE TO GRADES OF 3% OR LESS.

BAR TABLE

TYPE	CLEAR SPACING	NO. BARS	X	GRATE OPENING ft ²
TW OR TB-1.0	1"	26	1"	3.21
TW OR TB-1.1	1-3/8"	21	1"	3.32
TW OR TB-1.2	2"	16	1"	4.66
TW OR TB-2.0	1"	26	1"	2.32
TW OR TB-2.1	1-3/8"	21	1"	2.41
TW OR TB-2.2	2"	16	1"	2.65

TW INDICATES TRANSVERSE WELDED
TB INDICATES TRANSVERSE BOLTED

DETAIL NO.

540-1



STANDARD DETAIL
ENGLISH

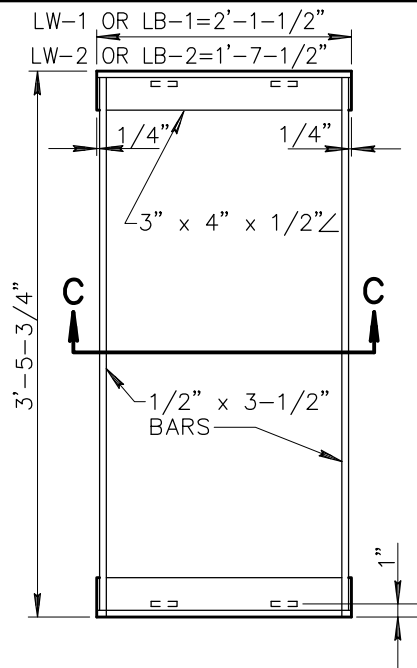
CATCH BASIN GRATES

REVISED

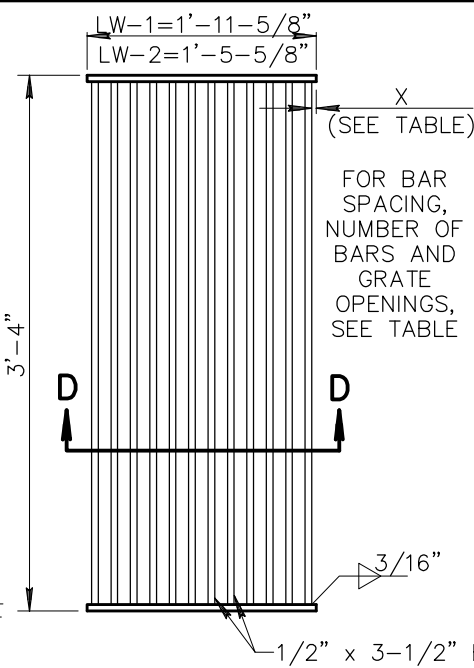
01-01-1998

DETAIL NO.

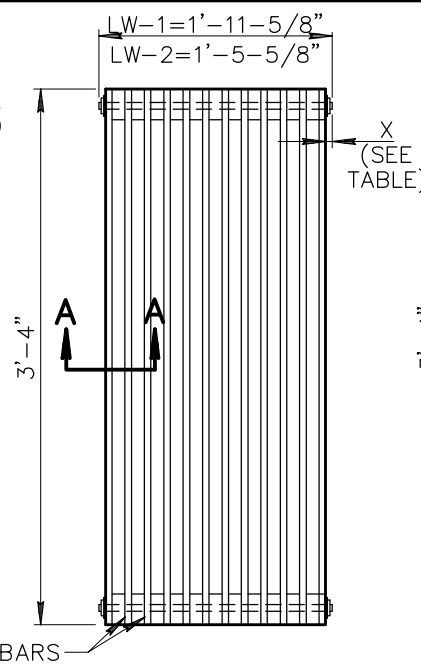
540-1



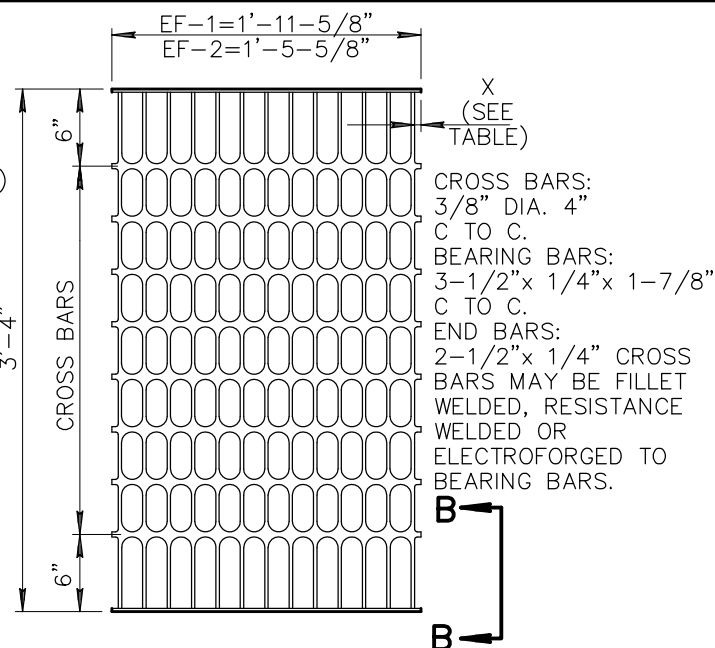
PLAN II



PLAN IIA

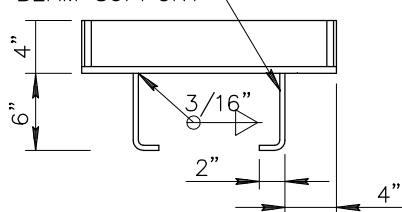


PLAN IIB

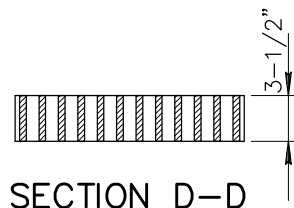


PLAN II

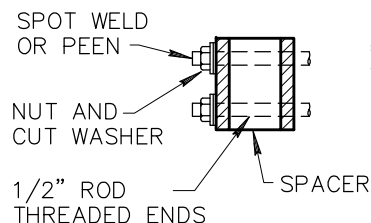
3/8" ANCHOR
DELETE ON END
WHEN USED WITH
I BEAM SUPPORT



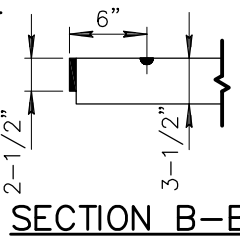
SECTION C-C



SECTION D-D



SECTION A-A

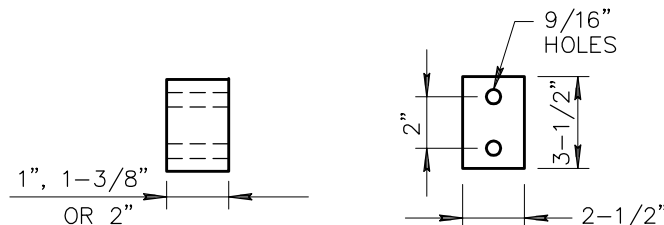


SECTION B-B

NOTES:

1. LW INDICATES LONGITUDINAL WELDED.
2. LB INDICATES LONGITUDINAL BOLTED.
3. EF INDICATES ELECTROFORGED.
4. GRATING UNITS AND FRAMES SHALL BE FABRICATED FROM STRUCTURAL STEEL 'A-36 EXCEPT AS NOTED.
5. ALL WELDING SHALL BE IN ACCORDANCE WITH STANDARD WELDING SPECIFICATIONS.
6. THE COMPLETED ASSEMBLY SHALL BE GIVEN ONE SHOP COAT OF NO. 1 PAINT.
7. FRAMES AND GRATES SHALL FIT TO A MAXIMUM ROCK OF 0.093" AT ANY POINT.
8. GRATE TYPE LW AND EF RESTRICTED TO SLOPES OF 3% OR LESS
9. GRATES TYPE LB USE LONGITUDINAL GRADES IN EXCESS OF 3% OR AS AN ALTERNATE TO TYPES LW OR EF ON GRADES OF 3% OR LESS.

GRATE TYPE	CLEAR BAR SPACING	NO. BARS	X	GRATE OPENING ft ²
LW OR LB-1.0	1"	16	5/16"	3.97
LW OR LB-1.1	1-3/8"	13	5/16"	4.34
LW OR LB-1.2	2"	9	1-9/16"	4.84
EF-1	1-5/8"	13	7/16"	4.66
LW OR LB-2.0	1"	12	5/16"	2.98
LW OR LB-2.1	1-3/8"	9	1-1/16"	3.35
LW OR LB-2.2	2"	7	1-1/16"	3.60
EF-2	1-5/16"	10	1/4"	3.48

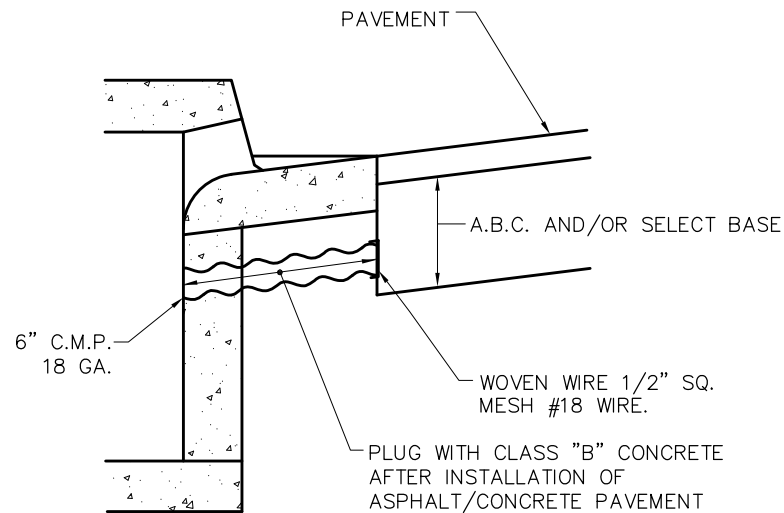


BAR SPACER DETAIL

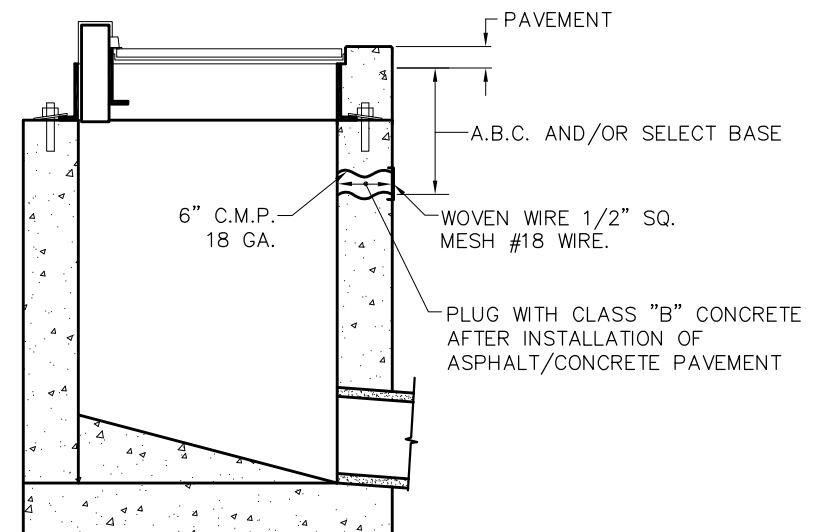
CAST IRON, CAST STEEL
OR STEEL BAR STOCK

NOTES:

1. INSTALL WHEN REQUIRED BY PLANS, SPECIFICATIONS, OR APPROVED BY THE ENGINEER.
2. SEE PROJECT PLANS FOR CATCH BASIN DETAILS AND PAVEMENT STRUCTURAL SECTION.



CURB OPENING INLET



GRATE OPENING INLET

DETAIL NO.

541



STANDARD DETAIL
ENGLISH

CATCH BASIN SUBGRADE DRAIN

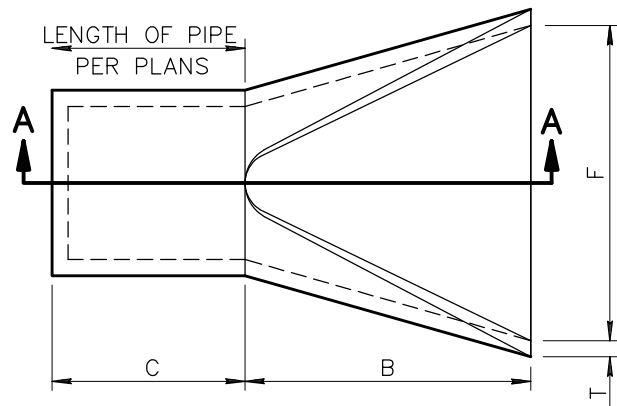
REVISED

01-01-2005

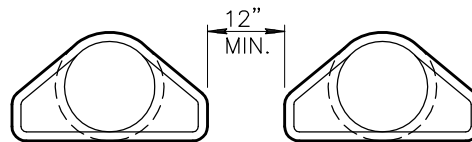
DETAIL NO.

541

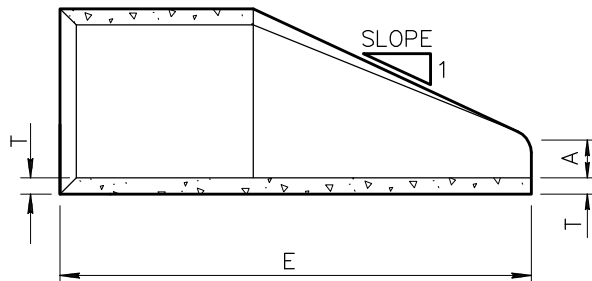
PIPE DIA.	APPROX. WEIGHT (LBS.)	DIMENSIONS – INCHES						APPROX. SLOPE
		T	A	B	C	E	F	
24"	1520	3	9-1/2	43-1/2	30	73-1/2	48	3
27"	1930	3-1/4	10-1/2	49-1/2	24	73-1/2	54	3
30"	2190	3-1/2	12	54	19-3/4	73-3/4	60	3
36"	4100	4	15	63	34-3/4	97-3/4	72	3
42"	5380	4-1/2	21	63	35	98	78	3
48"	6550	5	24	72	26	98	84	3
54"	8240	5-1/2	27	65	33-1/4	98-1/4"	90	2 1/2



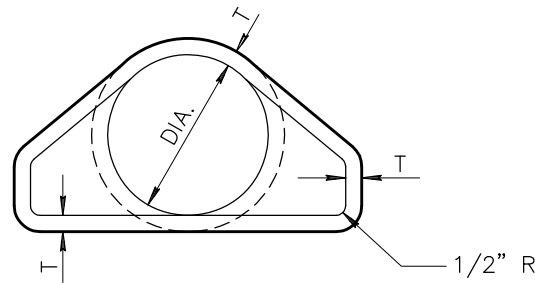
PLAN



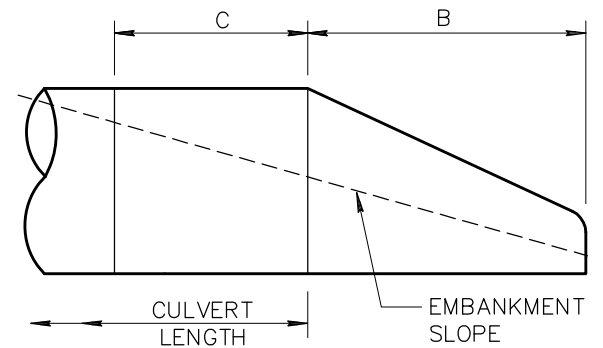
SPACING FOR MULTIPLE INSTALLATION



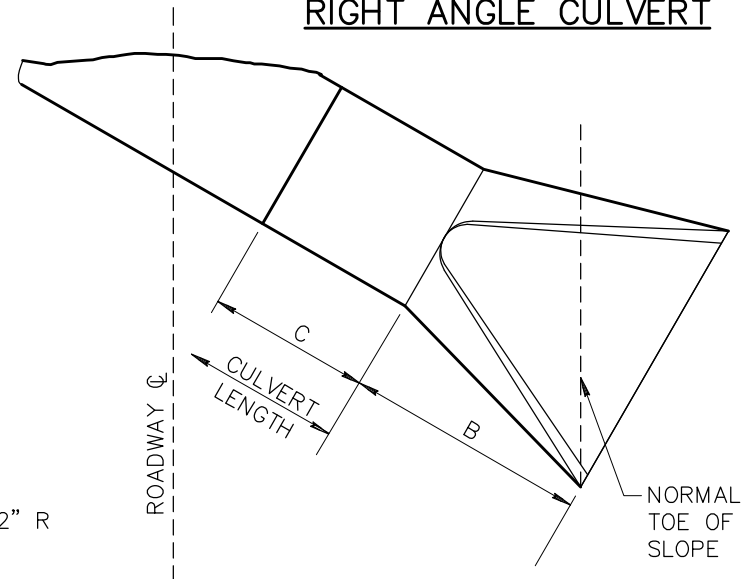
SECTION A-A



FRONT ELEVATION



RIGHT ANGLE CULVERT



SKEWED CULVERT

NOTES

1. DESIGN OF END SECTION SHALL CONFORM TO STANDARD FOR REINFORCED CONCRETE PIPE.
2. END SECTION JOINT CONFORMATION SHALL MATCH THE PIPE JOINTS.
3. EMBANKMENT SLOPE SHALL BE WARPED TO MATCH SLOPE OF END SECTION.
4. CULVERT LENGTH IS AS SHOWN ON PLANS.

DETAIL NO.

545



STANDARD DETAIL
ENGLISH

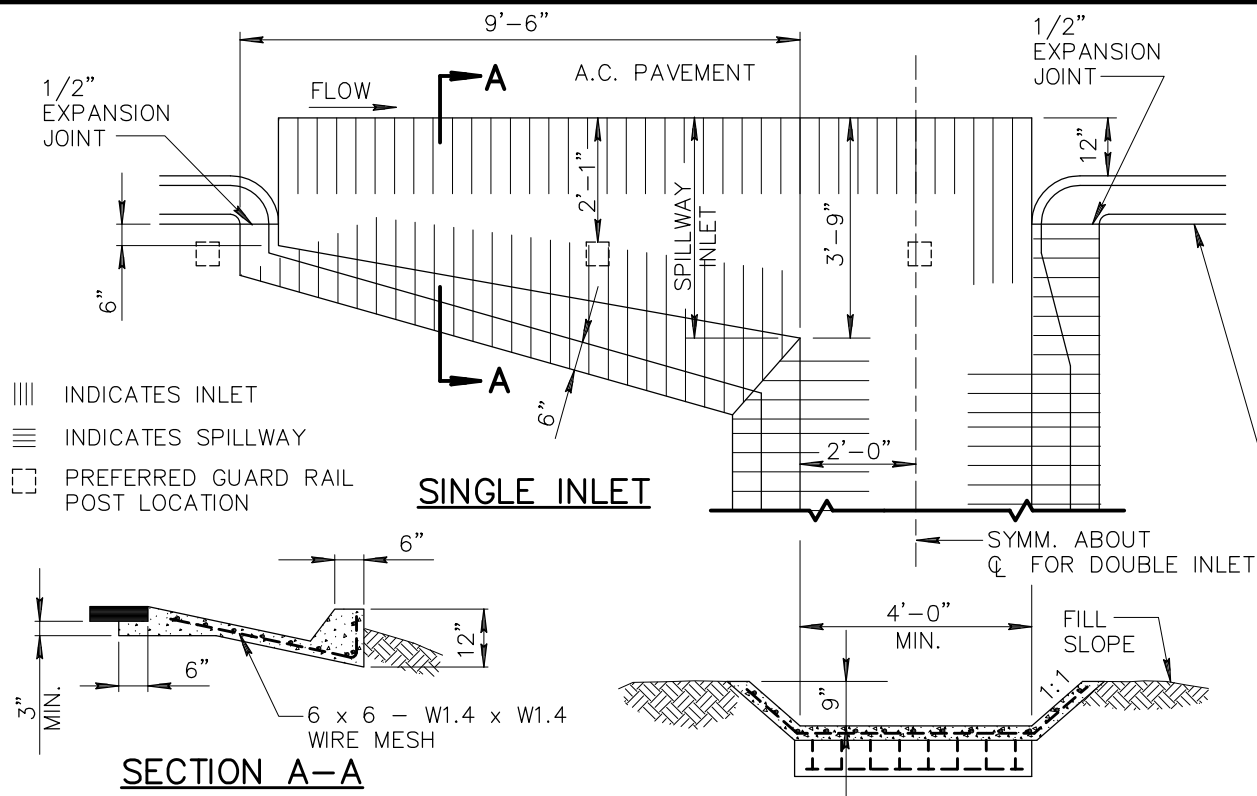
END SECTION—REINFORCED CONCRETE PIPE

REVISED

01-01-1998

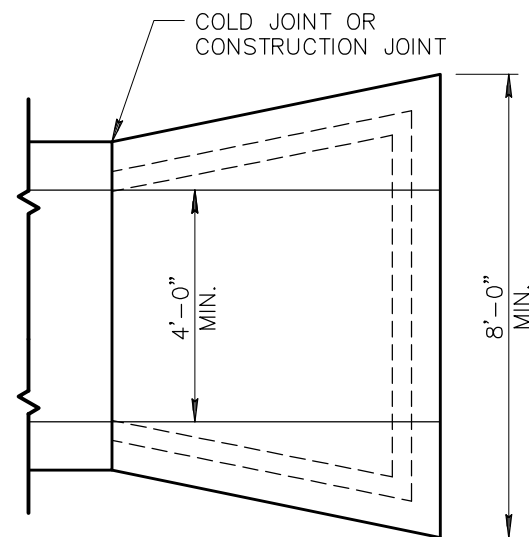
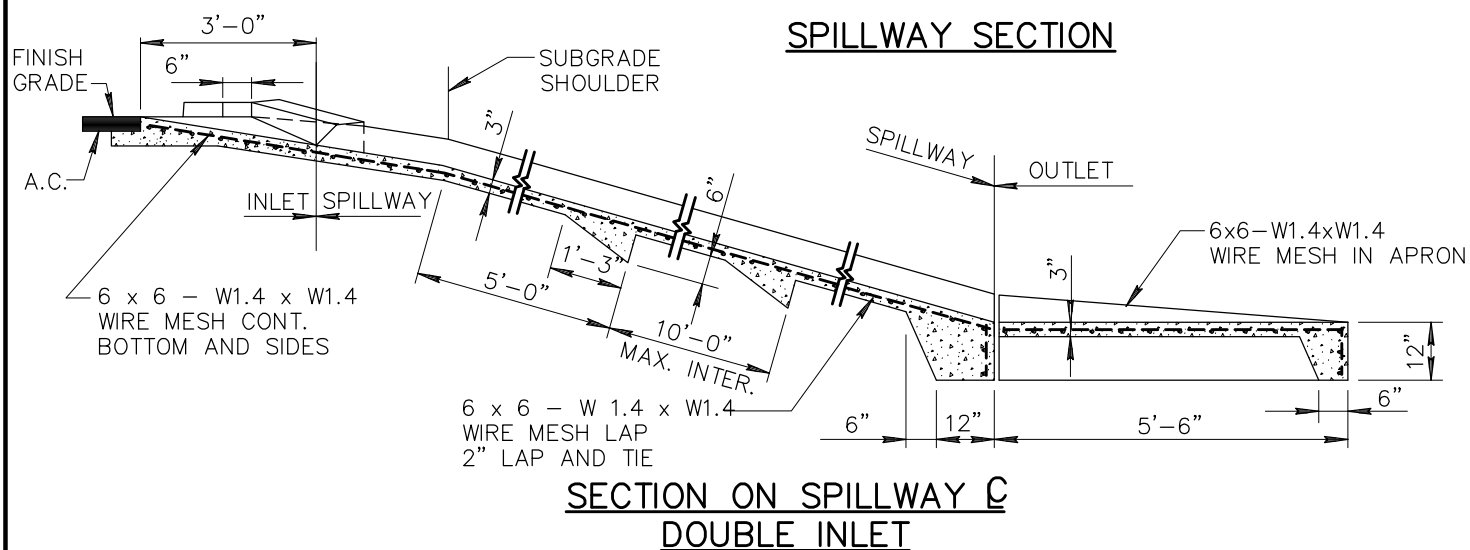
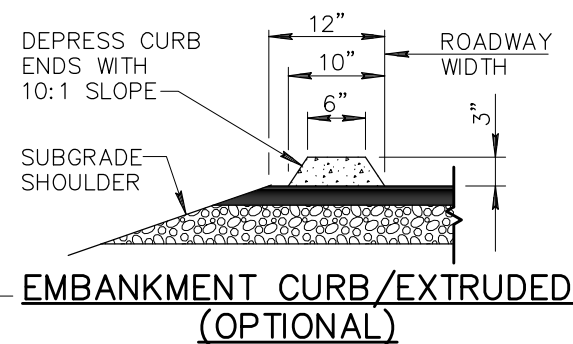
DETAIL NO.

545



NOTES:

1. WHERE ROCK IS ENCOUNTERED THE OUTLET MAY BE OMITTED.
2. ALL PORTIONS OF SPILLWAY TO BE TROWEL FINISHED.
3. CONCRETE FOR THE SPILLWAY INLET, SPILLWAY AND OUTLET SHALL BE CLASS 'B' PER SECT. 725.
4. WHEN THE OUTLET IS USED, THE WIRE MESH SHALL EXTEND THROUGH THE JOINT INTO THE OUTLET IN LIEU OF BENDING INTO THE KEY.



DETAIL NO.

550



STANDARD DETAIL
ENGLISH

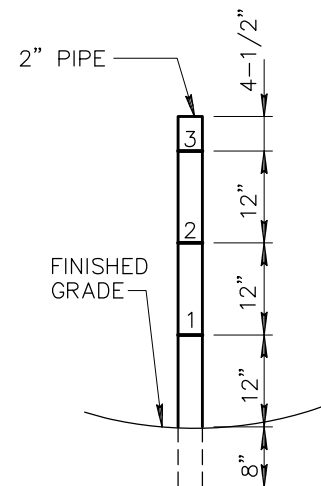
SPILLWAY INLET AND OUTLET

REVISED

01-01-1998

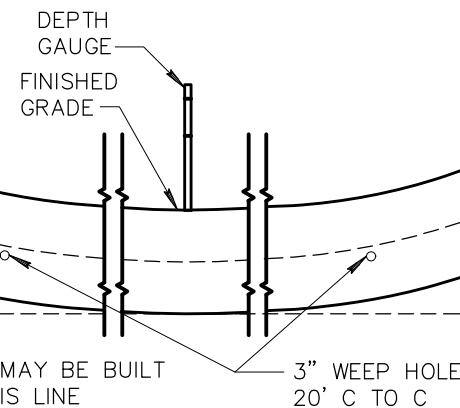
DETAIL NO.

550



DEPTH GAUGE DETAIL

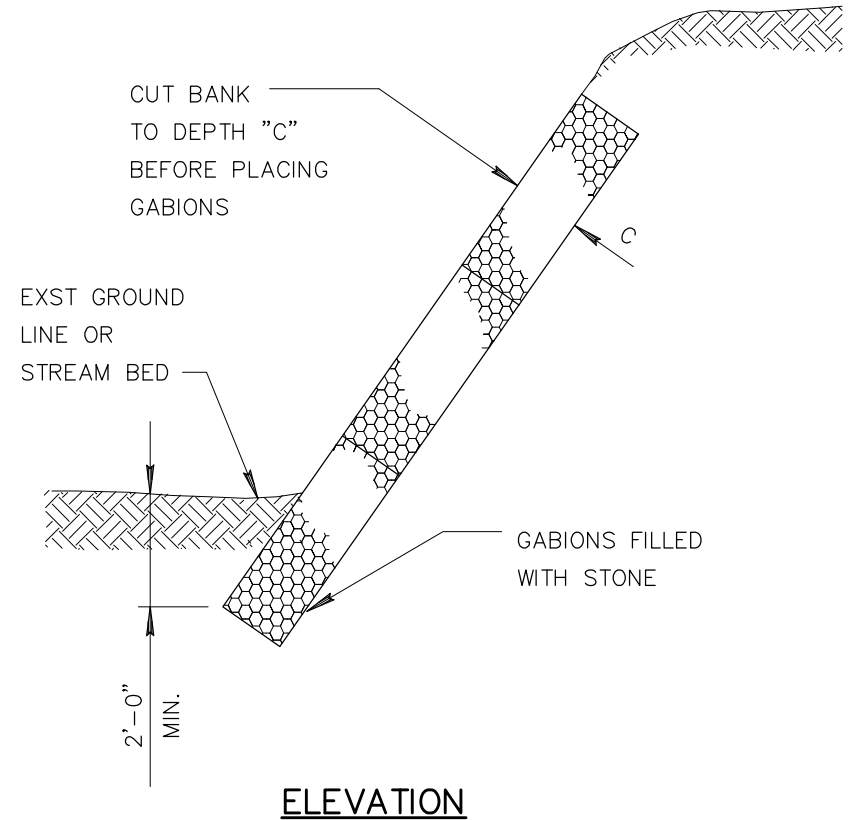
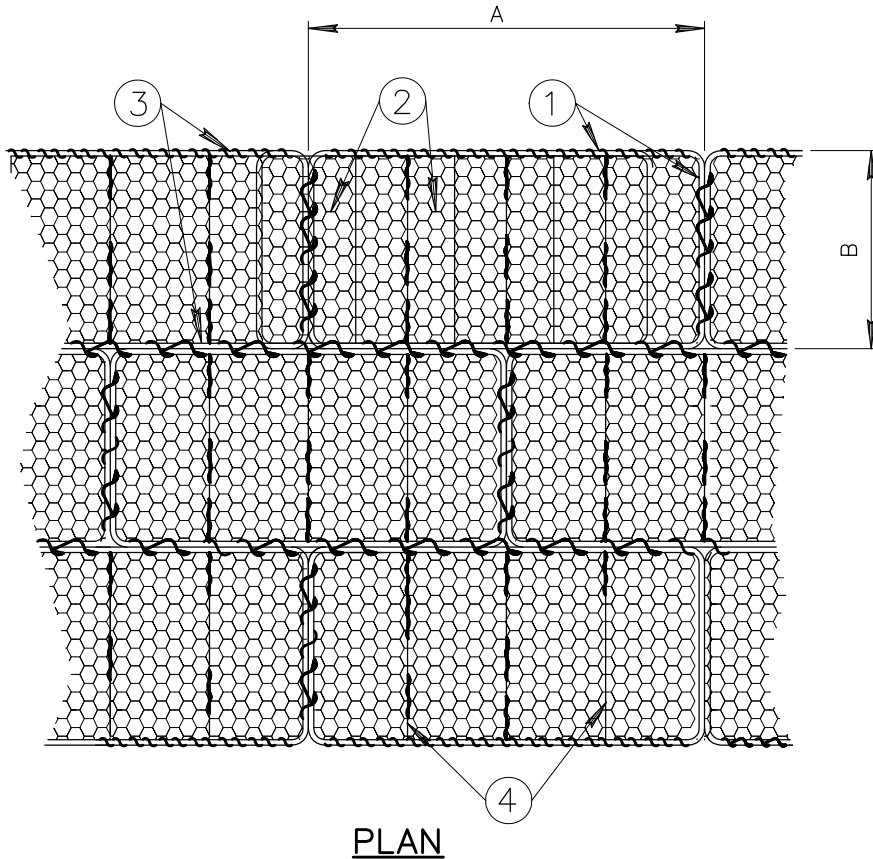
*MIN. DISTANCE
BELOW STREAM BED



NOTES:

1. FORD WALLS SHALL BE CLASS 'A' CONCRETE PER SECT. 725.
2. DEPTH GAUGE SHALL BE PAINTED 2 COATS WHITE ENAMEL. NUMERALS AND MARKERS SHALL BE 1 COAT BLACK ENAMEL.
3. NUMBERS ON DEPTH GAUGE TO BE 2" HIGH.
4. HEIGHT OF DEPTH GAUGE PER PLANS.
5. REINFORCING BARS SHALL BE SET 3" CLEAR FROM SIDES OF CUT-OFF WALLS.
6. COURSE AGGREGATE AT WEEP HOLES SHALL BE ASTM C33 SIZE 57, ENCLOSED IN FILTER FABRIC (SECTION 796, CLASS B), AND EXTENDED Laterally A MINIMUM OF SIX-INCHES (6") ON EACH SIDE OF THE WEEP HOLE.

TYPICAL GABIONS



- ① HEAVY GAUGE FRAME WIRE.
- ② HEAVY GAUGE TRIPLE-TWIST HEXAGONAL MESH (OR EQUAL) FASTENED TO FRAME WIRE.
- ③ CONTINUOUS HEAVY GAUGE WRAPPED AROUND FRAMES TO FASTEN GABIONS TO EACH OTHER.
- ④ PARTITIONS TO PREVENT SHIFTING, NORMALLY ONE PER 3' LENGTH. INSTALLED AT FACTORY.

NOMINAL SIZE COMBINATIONS					
LENGTH	WIDTH	DEPTH			
A	B	C			
6'	3'	1'	1.5'	3'	
9'	3'	1'	1.5'	3'	
12'	3'	1'	1.5'	3'	

NOTE:

OTHER SIZES AVAILABLE FROM MANUFACTURER.

DETAIL NO.

555



STANDARD DETAIL
ENGLISH

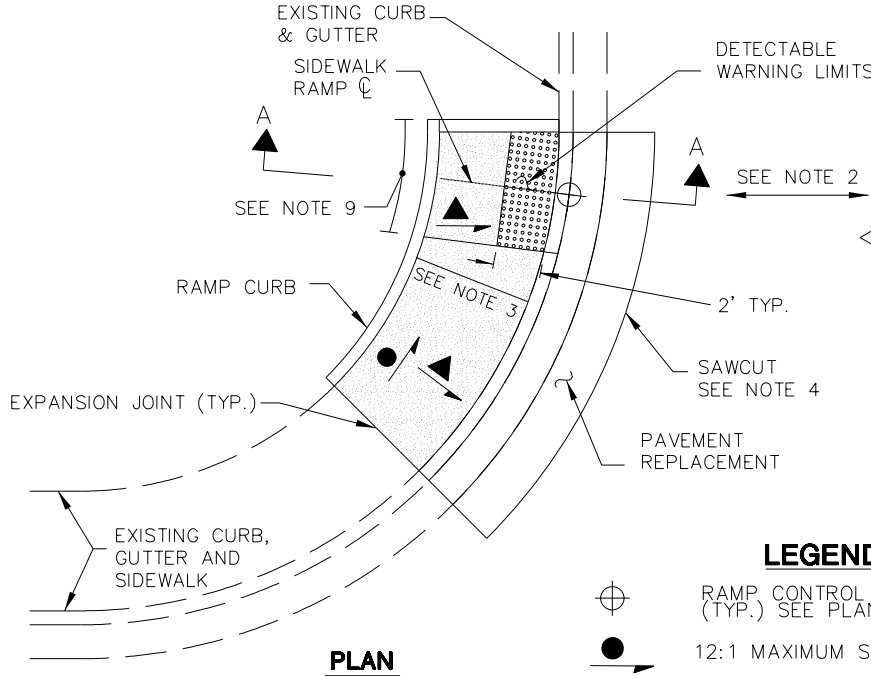
EROSION PROTECTION / GABIONS

REVISED

01-01-2010

DETAIL NO.

555



LEGEND



RAMP CONTROL POINT (TYP.) SEE PLANS



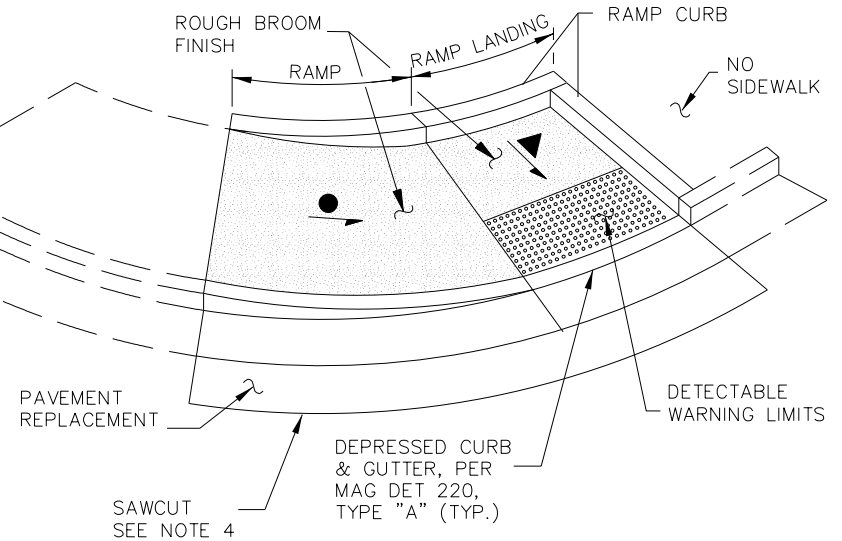
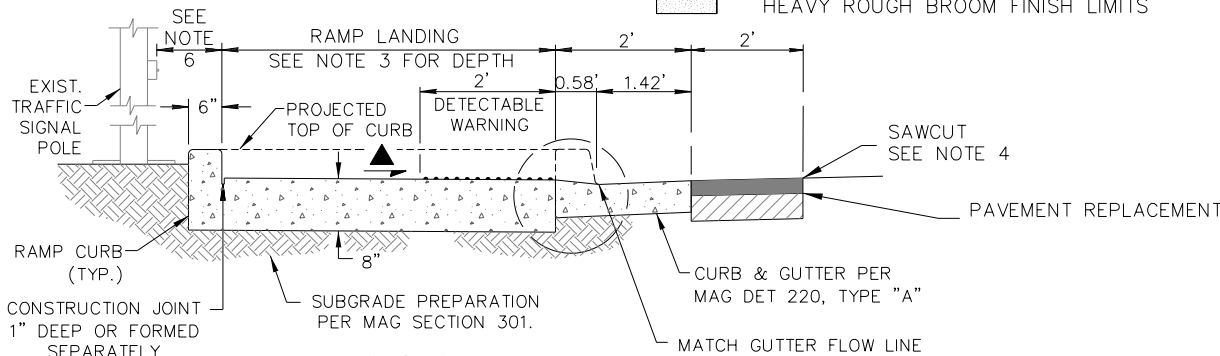
12:1 MAXIMUM SLOPE, 15:1 DESIRED SLOPE



2% MAXIMUM SLOPE, 1.5% MINIMUM SLOPE



8" SIDEWALK RAMP PAYMENT LIMITS AND HEAVY ROUGH BROOM FINISH LIMITS



NOTES:

1. ALL CONCRETE TO BE CLASS "B", MAG SECTION 725.
2. ALL RAMPS AND DETECTABLE WARNING SHALL BE ALIGNED PERPENDICULAR TO THE CURB AT THE RAMP CONTROL POINT. CROSSWALKS SHALL BE ALIGNED PERPENDICULAR TO THE STREET CENTERLINE AS MUCH AS POSSIBLE.
3. RAMP LANDING DEPTH SHALL MATCH SIDEWALK WIDTH, 5' MINIMUM, AS MEASURED RADIALY FROM BACK OF CURB TO FACE OF RAMP CURB.
4. WHEN A CONCRETE APRON EXISTS THE SAWCUT MAY BE MADE IN THE APRON 2' FROM BACK OF EXISTING CURB.
5. SEE PLANS FOR LOCATION OF SIDEWALK RAMP CENTERLINE.
6. PROVIDE 10" MAXIMUM TO FACE OF ANY EXISTING PEDESTRIAN PUSH BUTTON. RAMP CURB AND LANDING MAY NEED TO BE EXTENDED AROUND POLE TO PROVIDE ACCESS TO PUSH BUTTON, OR MOVE BUTTON AS NEEDED.
7. THIS SIDEWALK RAMP DETAIL IS FOR RETROFITTING ONLY AND IS NOT TO BE USED FOR NEW CONSTRUCTION.
8. EACH RAMP RETROFIT REQUIRES A SITE SPECIFIC ASSESSMENT AND FIELD REVIEW BY THE DESIGN ENGINEER TO ENSURE A FUNCTIONAL DESIGN.
9. RAMP WIDTH SHALL MATCH SIDEWALK OR PATH WIDTH, 5' MINIMUM AS MEASURED AT BACK OF RAMP ALONG RAMP CURB.

DETAIL NO.
2233-2

**City of Scottsdale
Standard Details**

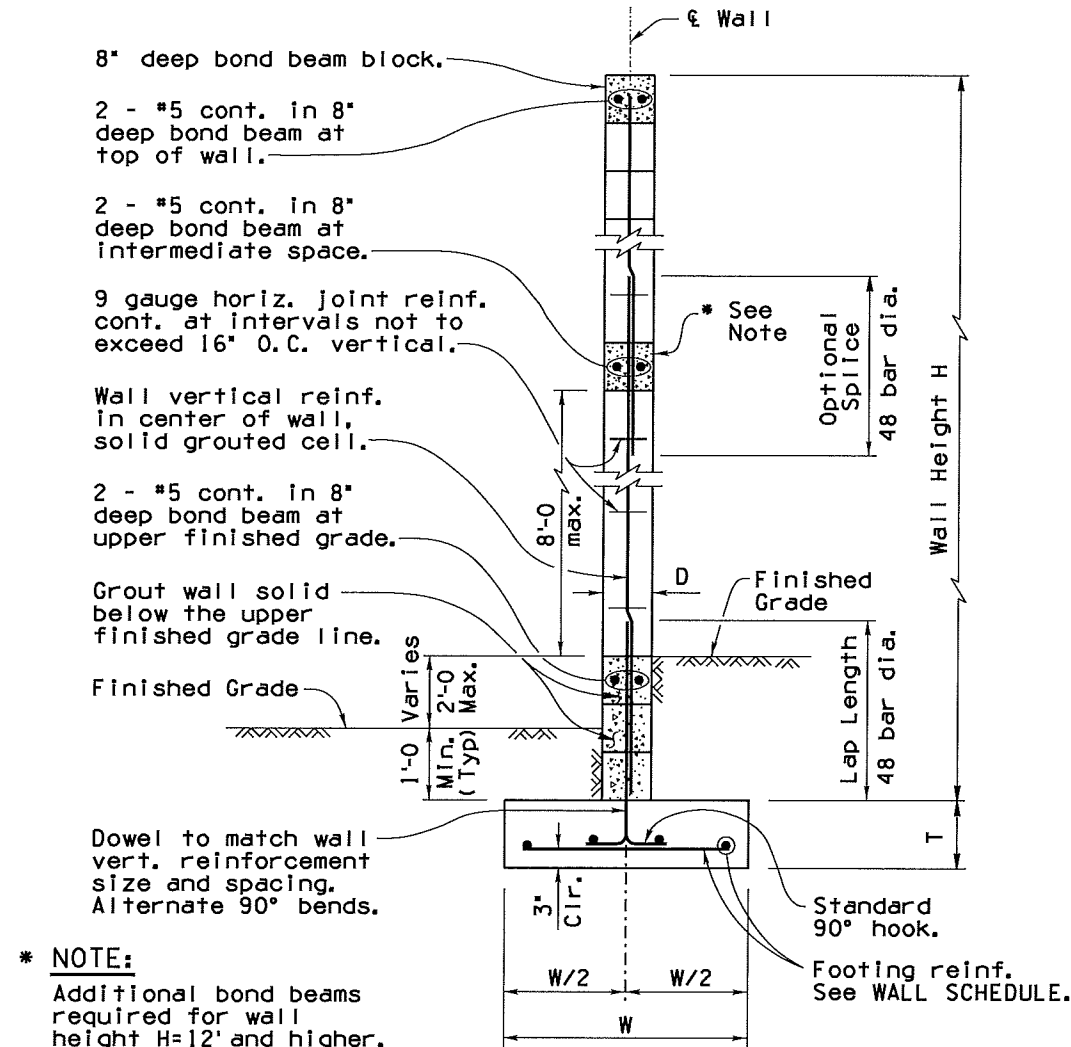
APPROVED BY:
**Scottsdale Standards &
Specifications Committee**

DIRECTIONAL SIDEWALK RAMP RETROFIT - TYPE B

DETAIL NO.
2233-2

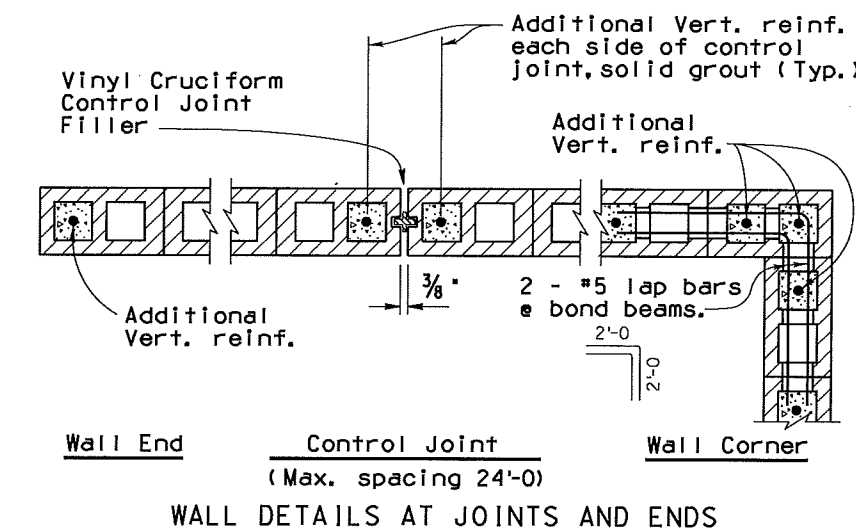
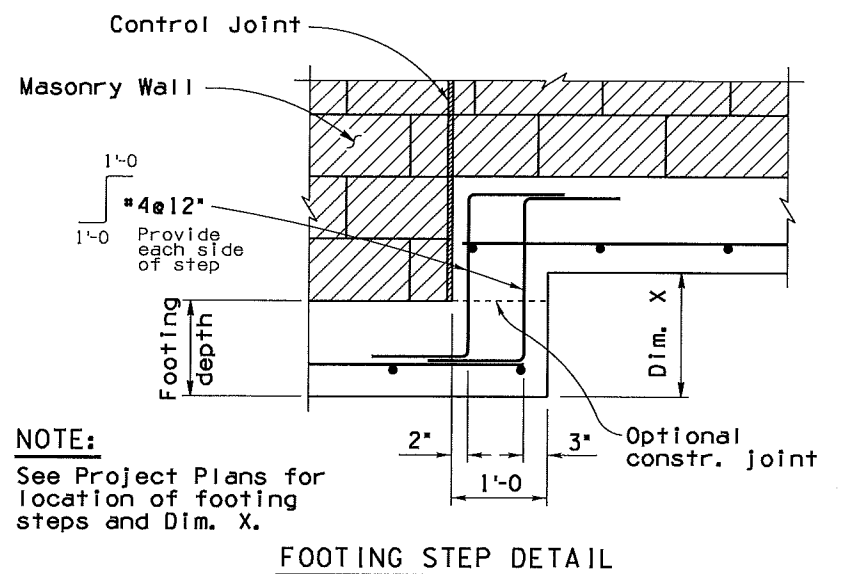
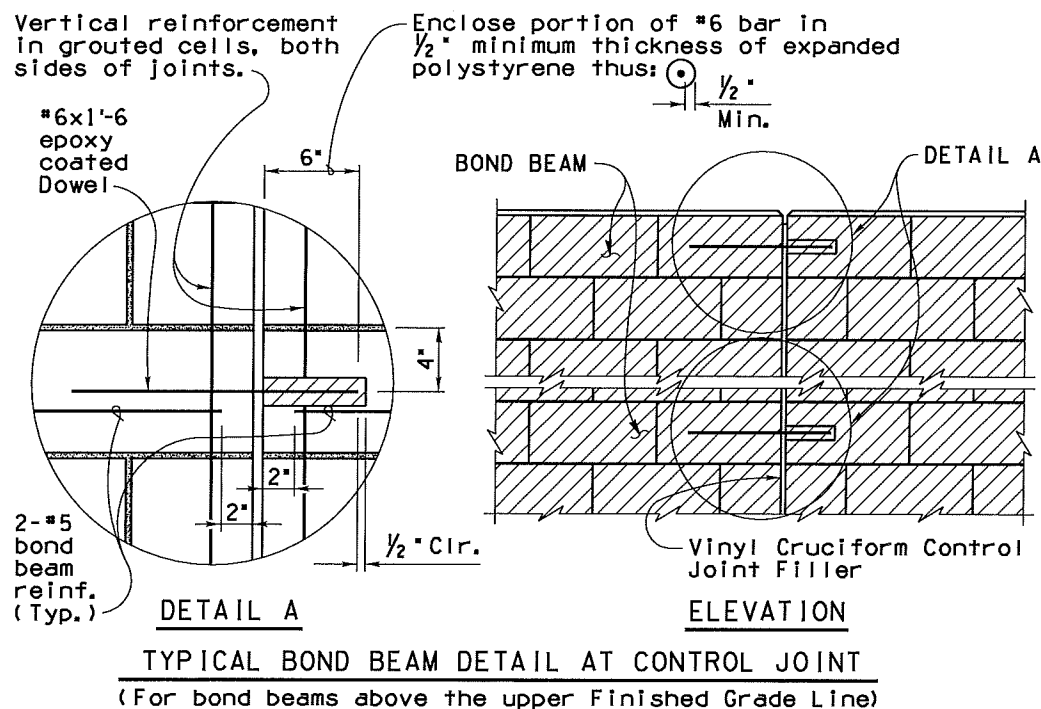
Note to Designer:
The information presented in this Standard Detail has been prepared in accordance with recognized engineering principles and is for general use. It should not be used for specific application without competent professional examination and verification of its suitability and applicability by a licensed professional engineer. Contents within the inner border line shall not be altered.

NO	DESCRIPTION OF REVISIONS	MADE BY	DATE
1	Original Issue	SJM	10-99
4	Revised Reinforcing, General Update	SJM	02-07
5	Revised Notes, General Update	SJM	4-10
6	Revised Detail at Wall Corner, Note	SJM	01-13



* NOTE:
Additional bond beams required for wall height H=12' and higher. Equally space bond beams at 8'-0 max.

TYPICAL WALL SECTION
(For Wall Height 0'-0 to 17'-11)



WALL SCHEDULE							
Wall Height H	Wall Thick D**	Ftg. Depth T	Ftg. Width W	Reinforcing***			Factored Average Soil Bearing Pressure (psf)
				Wall	Footing		
				Vert.	Bottom Trans.	Bottom Long.	
0'-0 to 3'-11	8"	10"	1'-6	*4#24"	*4#24"	2-*4	1,000
4'-0 to 5'-11	8"	10"	2'-0	*4#24"	*4#24"	2-*4	1,200
6'-0 to 7'-11	8"	10"	2'-6	*5#24"	*5#24"	4-*4	1,300
8'-0 to 9'-11	8"	10"	3'-0	*5#24"	*5#16"	4-*4	1,400
10'-0 to 11'-11	8"	1'-0	3'-6	*5#16"	*5#16"	4-*5	1,500
12'-0 to 13'-11	12"	1'-3	4'-6	*5#16"	*5#16"	6-*5	1,600
14'-0 to 15'-11	12"	1'-6	5'-0	*6#16"	*6#16"	6-*5	1,700
16'-0 to 17'-11	12"	1'-6	5'-6	*8#16"	*6#16"	6-*5	1,800

** Nominal Dimension, *** Additional Reinf. required at Control Joints.

GENERAL NOTES:

Construction Specification - Arizona Department of Transportation Standard Specifications for Road and Bridge Construction, latest Edition.
ACI 530.1, Specifications for Masonry Structures.

Design Specifications - AASHTO LRFD Bridge Design Specifications, 6th Edition 2012.

Wind Velocity 80 MPH, Exposure C.
Wind pressure 18.0 psf for wall height under 12'-0.
Wind pressure 25.0 psf for wall height over 12'-0.

Special Inspection is required for all masonry wall construction. Vertical Cells containing reinforcements shall be grouted solid full height. Bond Beams with reinforcements shall be grouted solid full length.

All Concrete shall be Class "S" (f'c = 3,000 psi).

Reinforcing steel shall conform to ASTM Specification A615. All reinforcing shall be furnished as Grade 60 (fy = 60,000 psi).

All bends and hooks shall meet the requirements of AASHTO LRFD Article 5.10. All bend dimensions for reinforcing steel shall be out-to-out of bars. All placement dimensions for reinforcing steel shall be to center of bars unless noted otherwise.

All reinforcing steel shall have 2 inch clear cover unless noted otherwise.

Compact backfill for footing and wall base minimum 100 percent of ASTM D698 maximum dry density.

See Project Plans for wall layout, top of footing and finished grade elevations, footing step and wall joint locations. Height of wall may vary ± 2 inches. Control joints shall occur at intervals not to exceed 24'-0. See Project Plans for wall surface treatment and type of block.

Pay item is measured as wall height H times length of wall, and pay item includes all labor and materials for excavation, backfill, concrete footing and masonry wall with reinforcements.

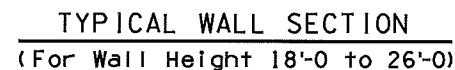
Dimensions shall not be scaled from drawings.

Item No. 9140137 SOUND BARRIER WALL (MASONRY)
Measure: Square Foot

(GENERAL NOTES Continued Next Sheet)

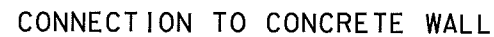
DESIGN APPROVED <i>Shafi U. Hasan</i>		ARIZONA DEPARTMENT OF TRANSPORTATION INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION BRIDGE GROUP STRUCTURE DETAIL	
APPROVED FOR DISTRIBUTION <i>Teon A. Nehme</i>		SOUND BARRIER WALL (MASONRY)	
ROUTE	PROJECT NO.	FA NO.	DRAWING NO. SD 8.02 (1 of 2)
LOCATION			SHEET NO. OF

NO	DESCRIPTION OF REVISIONS	MADE BY	DATE
1	Original Issue	H. Sung	4-03
3	Revise Reinforcing, General Update	H. Sung	02-07
4	General Update	S.J.H.	4-10
5	Added Details for Conn to Conc Wall and Wall Angle Point	S.J.H.	01-13



Nominal Dimension, *** Additional Reinf. required at Control Joints.

TYPICAL SECTIONS THROUGH
VERTICAL WALL REINFORCEMENT



Drill 1 inch diameter hole 6 inches deep for #6 dowel. Epoxy dowel in hole with an approved epoxy adhesive. Epoxy anchorage shall develop a tensile pullout strength of 13 kips. Details of the anchorage system shall be submitted to the Engineer for approval prior to installation.

- 1) Observe, periodically, the placement of the masonry units and the making of the mortar. Verify that the initial bed joint thickness is not less than $\frac{1}{4}$ " or more than 1"; subsequent bed joints shall not be less than $\frac{1}{4}$ " or more than $\frac{5}{8}$ " in thickness.
- 2) Observe all grout placements.
- 3) Verify horizontal joint reinforcing size, location, and spacing.
- 4) Verify that all concrete masonry units are placed in uniform and true course, level and plumb with a tolerance of $\frac{1}{4}$ " in 8 feet, non-cumulative.
- 5) Verify that concrete masonry units are placed to the desired height with joints of uniform thickness. Level, plumb and straighten before the mortar stiffens. Bond shall be plumb throughout.
- 6) Verify that all concrete masonry units are cured by sprinkling twice a day for minimum of 2 days.

DESIGN APPROVED <i>Shafi U. Hasan</i>		ARIZONA DEPARTMENT OF TRANSPORTATION INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION BRIDGE GROUP STRUCTURE DETAIL	
APPROVED FOR DISTRIBUTION <i>Teon A. Nehme</i>		SOUND BARRIER WALL (MASONRY)	
ROUTE	PROJECT NO.	FA NO.	DRAWING NO. SD 8.02 (2 of 2)
LOCATION			SHEET NO. OF