SECTION III-1
TECHNICAL GENERAL PROVISIONS
TABLE OF CONTENTS

Section	Description	Page
100	Contractor Quality Control Program	
	General	GP-1
	Description of Program	GP-2
	Quality Control Organization	GP-2
	Project Progress Schedule	GP-5
	Submittals Schedule	GP-5
	Inspection Requirements	GP-5
	Quality Control Testing Plan	GP-5
	Documentation	GP-6
	Correction Action Requirements	GP-7
	Surveillance by the Engineer	GP-8
	Noncompliance	GP-8
	Method of Measurement Basis of Payment	GP-8
110	Method of Estimating Percentage of Material within Specification Limits (PWL)	
	General	GP-9
	Method of Computing PWL	GP-9
	Example of PWL Calculation	GP-10
	Example of Outlier Calculation (Reference ASTM E 178)	GP-12
	Table 1 – Table for Estimating Percent of Lot Within Limits (PWL)	GP-14

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SECTION 100

CONTRACTOR QUALITY CONTROL PROGRAM

100-01 GENERAL. The Contractor shall establish, provide, and maintain an effective Quality Control Program that details the methods and procedures that will be taken to assure that all materials and completed construction required by this contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified here and elsewhere in the contract technical specifications, the Contractor shall assume full responsibility for accomplishing the stated purpose.

The Contractor's Quality Control Program shall assure compliance with the requirements of General Provisions Section 100 for all work included in the plans and as specified in Section III-2 Technical Special Provisions and Section III-3 Civil Technical Specifications.

The City of Phoenix Materials Laboratory will monitor the performance of and the quantity of the Contractor's Quality Control staffing levels through the duration of the Contract.

The intent of this section is to enable the Contractor to establish a necessary level of control that will:

a. Adequately provide for the production of acceptable quality materials.

b. Provide sufficient information to assure both the Contractor and the Engineer that the specification requirements can be met.

c. Allow the Contractor as much latitude as possible to develop his or her own standard of control.

The Contractor shall be prepared to discuss and present, at the preconstruction conference, their understanding of the quality control requirements. The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the Quality Control Program has been reviewed and accepted by the Engineer. No partial payment will be made for materials subject to specific quality control requirements until the Quality Control Program has been reviewed.

The quality control requirements contained in this section and elsewhere in the contract technical specifications are in addition to and separate from the acceptance testing requirements. Acceptance testing requirements are the responsibility of the City of Phoenix.

Paving projects over $250,000 shall have a Quality Control (QC)/Quality Assurance (QA) workshop with the Engineer, Contractor, subcontractors, testing laboratories, and Owner's representative and the FAA prior to or at start of construction. The workshop shall address QC and QA requirements of the project specifications. The Contractor shall coordinate with the Airport and the Engineer on time and location of the QC/QA workshop.

100-02 DESCRIPTION OF PROGRAM.

a. General Description. The Contractor shall establish a Quality Control Program to perform quality control inspection and testing of all items of work required by the technical specifications, including those performed by subcontractors. This Quality Control Program shall ensure conformance to applicable specifications and plans with respect to materials, workmanship, construction, finish, and functional performance. The Quality Control Program shall be effective for control of all construction work performed under this Contract and shall specifically include surveillance and tests required by the technical specifications, in addition to other requirements of this section and any other activities deemed necessary by the Contractor to establish an effective level of quality control.

b. Quality Control Program. The Contractor shall describe the Quality Control Program in a written document that shall be reviewed by the Engineer prior to the start of any production, construction, or off-site fabrication. The written Quality Control Program shall be submitted to the Engineer for review at least **10** calendar days before the Preconstruction Meeting. The Contractor's Quality Control Plan and Quality Control testing laboratory must be approved in writing by the Engineer prior to the Notice to Proceed (NTP).

The Quality Control Program shall be organized to address, as a minimum, the following items:

a. Quality control organization;
b. Project progress schedule;
c. Submittals schedule;
d. Inspection requirements for each individual pay item and specification;
e. Quality control testing plan for each individual pay item and specification;
f. Documentation of quality control activities for each individual pay item and specification;
g. Requirements for corrective action when quality control and/or acceptance criteria are not met for each individual pay item and specification; and
h. Technician and inspection staffing levels for each type of operation. (i.e. storm drain pipe placement, formation of embankment, grading, asphalt concrete paving, Portland cement concrete paving, saw cutting of joints, sealing of joints, electrical duct bank and conduit installation and the compaction of trenches, the installation and testing of conductor and ground wires and counterpoise, the installation and testing of signs, edge lighting, centerline lighting, verification that in-pavement lights will not conflict with PCCP joints, manholes, handholes, backfilling of all items, etc.)

The Contractor is encouraged to add any additional elements to the Quality Control Program that is deemed necessary to adequately control all production and/or construction processes required by this contract.

100-03 Quality Control Organization. The Contractor Quality Control Program shall be implemented by the establishment of a separate quality control organization. An organizational chart shall be developed to show all quality control personnel and how these personnel integrate with other management/production and construction functions and personnel.

The organizational chart shall identify all quality control staff by name and function, and shall indicate the total staff required to implement all elements of the Quality Control Program, including inspection and testing for each item of work. If necessary, different technicians can be used for

specific inspection and testing functions for different items of work. If an outside organization or independent testing laboratory is used for implementation of all or part of the Quality Control Program, the personnel assigned shall be subject to the qualification requirements of paragraph 100-03a and 100-03b. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.

The quality control organization shall, as a minimum, consist of the following minimum personnel:

a. Program Administrator. The Program Administrator shall be a full-time employee of the Contractor, or a consultant engaged by the Contractor. The Program Administrator shall have a minimum of five (5) years of experience in airport and/or highway construction and shall have had prior quality control experience on a project of comparable size and scope as the contract.

Professional licenses and certifications along with four (4) references shall be provided for work on projects completed within the past ten (10) years. Resumes must be submitted for review for the proposed Program Administrator(s).

Additional qualifications for the Program Administrator shall include at least one (1) of the following requirements:

1) Licensed Professional Civil Engineer with five (5) years of airport or highway grading and drainage, field and laboratory testing, and Quality Control experience acceptable to the Engineer.
2) A certified Engineer-in-Training with eight (8) years experience in airport and highway grading and drainage, field and laboratory testing, and Quality Control experience acceptable to the Engineer.
3) An individual with thirteen (13) years of highway and airport paving experience acceptable to the Engineer and Certified NICET Level IV in an approved field.

The Program Administrator shall have full authority to institute any and all actions necessary for the successful implementation of the Quality Control Program to ensure compliance with the contract plans and technical specifications. The Program Administrator shall report directly to a responsible officer of the construction firm. The Program Administrator will fully cooperate and will work closely with the Construction Engineer and City of Phoenix Materials Laboratory to implement adjustments as needed to the Quality Control Program, and to the adjustments to the number of Quality Control Technicians and Inspectors. The Program Administrator may supervise the Quality Control Program on more than one project provided that person can be at the job site within two (2) hours after being notified of a problem.

b. Quality Control Technicians. A sufficient number of quality control technicians necessary to adequately implement the Quality Control Program shall be provided. These personnel shall be either Engineers, engineering technicians, or experienced craftsman with qualifications in the appropriate field equivalent to NICET Level II or higher construction materials technician or highway construction technician and shall have a minimum of four (4) years of experience in their area of expertise.

Certification at an equivalent level, by a state or nationally recognized organization will be acceptable in lieu of NICET certification.

The quality control technicians shall report directly to the Program Administrator and shall perform the following functions:

1) Inspection of all materials, construction, plant, and equipment for conformance to the civil and electrical technical specifications, and as required by Section 100-0.6 of the General Provisions.
2) Performance of all Quality Control tests as required by the civil and electrical technical specifications and Section 100-0.7 and 100-0.8 of the General Provisions.

c. Minimum Testing Equipment. The Quality Control Technicians shall be equipped with, but not limited to the following test equipment:

1) Calibrated Sand cone equipment (sand cone, jar, plate, and calibrated sand.)
2) Calibrated Speedy Moisture Gauges with Reagents.
3) Calibrated scales (No. 4 and 3/4-inch screens for rock percentage).
4) Equipment to dig sand cone holes (large spoon, screwdriver, soft brush and hammer).
5) Concrete testing equipment meeting required specifications (slump cone, slump plate, 5/8-inch diameter rod, 3/8-inch diameter rod, a large and a small scoop).
6) One Point Proctor Equipment (4-inch diameter mold, 5-pound and 10-pound proctor hammer and a family of curves chart).
7) Wheel barrows.
8) Shovels.
9) Sample bags and buckets.
10) Calibrated Nuclear Density Gauges.
11) Voltmeter, ampere meter and meters to identify live electrical circuits.

d. Staffing Levels. The Contractor shall provide sufficient qualified quality control personnel to monitor each work activity at all times. Where material is being produced in a plant for incorporation into the work, separate plant and field technicians shall be provided at each plant and field placement location. The scheduling and coordinating of all inspection and testing must match the type and pace of work activity. The Quality Control Program shall state where different technicians will be required for different work elements.

The Engineer shall monitor the Contractor's Quality Control.

If a construction activity is found to have an unacceptable level of quality control technicians or inspectors, the activity may be suspended until an approved level of quality control directed is provided. The City of Phoenix may also elect to place their quality acceptance personnel in the quality control role in lieu of suspending the work. In this event, the Contractor shall be notified immediately. The City of Phoenix will track their time and materials, and all costs associated with this will be deducted from the contract per MAG Section 109.5.4.2.

Each week the Contractor shall detail on their three (3) week look ahead schedule, the number of Quality Control technicians and inspectors anticipated for the following three (3) weeks for each work activity. The Engineer shall review the number of Quality Control personnel required for the week.

100-04 PROJECT PROGRESS SCHEDULE. Refer to Article 4.5 for the Project Schedule Requirements.

100-05 SUBMITTALS SCHEDULE. Refer to Section III-2 Technical Special Provisions Section 6 SUBMITTAL PROCEDURES.

100-06 INSPECTION REQUIREMENTS. Quality control inspection functions shall be organized to provide inspections for all definable features of work, as detailed below. All inspections shall be documented by the Contractor as specified by subsection 100–08.

Prior to the start of construction work under each separate specification section and where a change in construction operation is contemplated by the Contractor and prior to a new subcontractor starting work, a coordination meeting will be held with the Engineer, Quality Control Administrator and the City of Phoenix Materials Laboratory, the City of Phoenix Aviation Project Manager and a City of Phoenix Operations representative. Other attendance shall include supervisory, safety and Quality Control representative of all applicable subcontractors. The Aviation Project Manager will chair the meeting. The purpose of the meeting is to ensure the Contractor's personnel have no misunderstandings regarding the Quality Control procedures as well as the technical requirements of the Contract. The following items shall be presented during the meeting:

a. Contract requirements and specifications;
b. Shop drawings, certifications, submittals and record drawings that may apply;
c. Testing and inspection program and procedures;
d. Contractor's Quality Control Program;
e. Familiarity and proficiency of the Contractor's and subcontractor's work force to perform the operation to the required workmanship standards;
f. Safety and Aircraft Operational Area restrictions to be observed;
g. Any other preparatory steps dependent on the particular operation; and
h. The Contractor's means and methods of performing the work.

Inspections shall be performed daily to ensure continuing compliance with contract requirements until completion of the particular feature of work. These shall include the following minimum requirements:

a. During plant operation for material production, quality control test results and periodic inspections shall be used to ensure the quality of aggregates and other mix components, and to adjust and control mix proportioning to meet the approved mix design and other requirements of the technical specifications. All equipment used in proportioning and mixing shall be inspected to ensure its proper operating condition. The Quality Control Program shall detail how these and other quality control functions will be accomplished and used.

b. During field operations, quality control test results and periodic inspections shall be used to ensure the quality of all materials and workmanship. All equipment used in placing, finishing, and compacting shall be inspected to ensure its proper operating condition and to ensure that all such operations are in conformance to the technical specifications and are within the plan dimensions, lines, grades, and tolerances specified. The Program shall document how these and other quality control functions will be accomplished and used.

100-07 QUALITY CONTROL TESTING PLAN. As a part of the overall Quality Control Program, the Contractor shall implement a quality control testing plan, as required by the technical specifications.

The testing plan shall include the minimum tests and test frequencies required by each technical specification Item, as well as any additional quality control tests that the Contractor deems necessary to adequately control production and/or construction processes. The testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

a. Specification item number (for example, P-401)
b. Item description (for example, Plant Mix Bituminous Pavements)
c. Test type (for example, gradation, grade, asphalt content)
d. Test standard (for example, ASTM or American Association of State Highway and Transportation Officials (AASHTO) test number, as applicable)
e. Test frequency (for example, as required by technical specifications or minimum frequency when requirements are not stated)
f. Responsibility (for example, plant technician)
g. Control requirements (for example, target, permissible deviations)
h. The staff required to complete the tests.

The testing plan shall contain a statistically-based procedure of random sampling for acquiring test samples in accordance with ASTM D3665. The Engineer shall be provided the opportunity to witness quality control sampling and testing.

All quality control test results shall be documented by the Contractor as required by subsection 100-08.

100-08 DOCUMENTATION. The Contractor shall maintain current quality control records of all inspections and tests performed. These records shall include factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, causes for rejection, etc.; proposed remedial action; and corrective actions taken.

These records must cover both conforming and defective or deficient features, and must include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. Legible copies of these records shall be furnished to the Engineer daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the Contractor's Program Administrator.

Specific Contractor quality control records required for the contract shall include, but are not necessarily limited to, the following records:

a. Daily Inspection Reports. Each Contractor quality control technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations on a form acceptable to the Engineer. These technician's daily reports shall provide factual evidence that continuous quality control inspections have been performed and shall, as a minimum, include the following:

1) Technical specification item number and description;
2) Compliance with approved submittals;
3) Proper storage of materials and equipment;
4) Proper operation of all equipment;
5) Adherence to plans and technical specifications;
6) Review of quality control tests; and

7) Safety inspection.

The daily inspection reports shall identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.

The daily inspection reports shall be signed by the responsible Quality Control Technician and the Program Administrator. The Engineer shall be provided at least one copy of each daily inspection report on the work day following the day or shift of record.

b. Daily Test Reports. The Contractor shall be responsible for establishing a system that will record all Quality Control test results. Daily test reports shall document the following information:

1) Technical specification item number and description;
2) Test designation;
3) Location;
4) Date of test;
5) Control requirements;
6) Test Results;
7) Causes for rejection;
8) Recommended remedial actions, and;
9) Re-tests.

Test results from each day's work period shall be submitted to the Engineer prior to the start of the next day's work period. When required by the technical specifications, the Contractor shall maintain statistical quality control charts. The daily test reports shall be signed by the responsible Quality Control Technician and the Program Administrator.

100-09 CORRECTIVE ACTION REQUIREMENTS. The Quality Control Program shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process into control. The requirements for corrective action shall include both general requirements for operation of the Quality Control Program as a whole, and for individual items of work contained in the technical specifications.

The Quality Control Program shall detail how the results of quality control inspections and tests will be used for determining the need for corrective action and shall contain clear sets of rules to gauge when a process is out of control and the type of correction to be taken to regain process control.

When applicable or required by the technical specifications, the Contractor shall establish and use statistical quality control charts for individual quality control tests. The requirements for corrective action shall be linked to the control charts.

100-10 SURVEILLANCE BY THE ENGINEER. All items of material and equipment shall be subject to surveillance by the Engineer and the City of Phoenix Materials Laboratory at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate quality control system in conformance with the requirements detailed here and the applicable technical specifications and plans. In addition, all items of materials, equipment and work in place shall be subject to surveillance by the Engineer and the City of Phoenix Materials Laboratory at the site for the same purpose.

Surveillance by the Engineer and the City of Phoenix Materials Laboratory does not relieve the Contractor of performing quality control inspections of either on-site or off-site Contractor's or subcontractor's work.

100-0.11 NONCOMPLIANCE.

a. Notification. The Engineer will notify the Contractor of any noncompliance with any of the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Any notice, when delivered by the Engineer or his/her authorized representative to the Contractor or his/her authorized representative at the site of the work, shall be considered sufficient notice.

b. Noncompliance. In cases where Quality Control activities do not comply with either the Contractor Quality Control Program or the contract provisions, or where the Contractor fails to properly operate and maintain an effective Quality Control Program, as determined by the Engineer, the Engineer may:

1) Order the Contractor to replace ineffective or unqualified quality control personnel or subcontractors.
2) Order the Contractor to stop operations until appropriate corrective actions are taken.
3) Elect to place Quality Acceptance personnel in the quality control role in lieu of suspending the work and charge the Contractor as stipulated in Section 100.03d.

100-11 METHOD OF MEASUREMENT. The Contractor's Quality Control Program will be measured for payment as provided in Civil Technical Specification Item P-100. All costs associated with the Contractor's Quality Control testing laboratory, field and laboratory equipment, supplies and tools will be measured for payment as described in Item P-100.

100-12 BASIS OF PAYMENT. The basis of payment for Contractor's Quality Control will be as provided in Civil Technical Specification Item P-100.

END OF SECTION 100

SECTION 110

METHOD OF ESTIMATING PERCENTAGE OF MATERIAL WITHIN SPECIFICATION LIMITS (PWL)

110-01 GENERAL. When the specifications provide for acceptance of material based on the method of estimating percentage of material within specification limits (PWL), the PWL will be determined in accordance with this section. All test results for a lot will be analyzed statistically to determine the total estimated percent of the lot that is within specification limits. The PWL is computed using the sample average (X) and sample standard deviation (S_n) of the specified number (n) of sublots for the lot and the specification tolerance limits, L for lower and U for upper, for the particular acceptance parameter. From these values, the respective Quality index, Q_L for Lower Quality Index and/or Q_U for Upper Quality Index, is computed and the PWL for the lot for the specified n is determined from Table 1. All specification limits specified in the technical sections shall be absolute values. Test results used in the calculations shall be to the significant figure given in the test procedure.

There is some degree of uncertainty (risk) in the measurement for acceptance because only a small fraction of production material (the population) is sampled and tested. This uncertainty exists because all portions of the production material have the same probability to be randomly sampled. The Contractor's risk is the probability that material produced at the acceptable quality level is rejected or subjected to a pay adjustment. The Owner's risk is the probability that material produced at the rejectable quality level is accepted.

It is the intent of this section to inform the contractor that, in order to consistently offset the contractor's risk for material evaluated, production quality (using population average and population standard deviation) must be maintained at the acceptable quality specified or higher. In all cases, it is the responsibility of the contractor to produce at quality levels that will meet the specified acceptance criteria when sampled and tested at the frequencies specified.

110-02 METHOD FOR COMPUTING PWL. The computational sequence for computing PWL is as follows:

a. Divide the lot into n sublots in accordance with the acceptance requirements of the specification.

b. Locate the random sampling position within the sublot in accordance with the requirements of the specification.

c. Make a measurement at each location, or take a test portion and make the measurement on the test portion in accordance with the testing requirements of the specification.

d. Find the sample average (X) for all sublot values within the lot by using the following formula:

$$X = (x_1 + x_2 + x_3 + \ldots x_n) / n$$

Where: X = Sample average of all sublot values within a lot
x_1, x_2 = Individual sublot values
n = Number of sublots

e. Find the sample standard deviation (S_n) by use of the following formula:

$S_n = [(d_1^2 + d_2^2 + d_3^2 + \ldots d_n^2)/(n-1)]^{1/2}$

Where: S_n = Sample standard deviation of the number of sublot values in the set
d_1, d_2 = Deviations of the individual sublot values x_1, x_2, … from the average value X
that is: $d_1 = (x_1 - X)$, $d_2 = (x_2 - X)$ … $d_n = (x_n - X)$
n = Number of sublots

f. For single sided specification limits (that is, L only), compute the Lower Quality Index Q_L by use of the following formula:

$Q_L = (X - L) / S_n$

Where: L = specification lower tolerance limit

Estimate the percentage of material within limits (PWL) by entering Table 1 with Q_L, using the column appropriate to the total number (n) of measurements. If the value of Q_L falls between values shown on the table, use the next higher value of PWL.

g. For double-sided specification limits (that is, L and U), compute the Quality Indexes Q_L and Q_U by use of the following formulas:

$Q_L = (X - L) / S_n$ AND $Q_U = (U - X) / S_n$

Where: L and U = specification lower and upper tolerance limits

Estimate the percentage of material between the lower (L) and upper (U) tolerance limits (PWL) by entering Table 1 separately with Q_L and Q_U, using the column appropriate to the total number (n) of measurements, and determining the percent of material above P_L and percent of material below P_U for each tolerance limit. If the values of Q_L fall between values shown on the table, use the next higher value of P_L or P_U. Determine the PWL by use of the following formula:

$PWL = (P_U + P_L) - 100$

Where: P_L = percent within lower specification limit
P_U = percent within upper specification limit

EXAMPLE OF PWL CALCULATION

Project: Example Project
Test Item: Item P-401, Lot A.

A. PWL Determination for Mat Density.

1. Density of four random cores taken from Lot A.

A-1 = 96.60
A-2 = 97.55

A-3 = 99.30
A-4 = 98.35
n = 4

2. Calculate average density for the lot.

$X = (x_1 + x_2 + x_3 + . . . x_n) / n$
$X = (96.60 + 97.55 + 99.30 + 98.35) / 4$
X = 97.95 percent density

3. Calculate the standard deviation for the lot.

$S_n = [((96.60 - 97.95)^2 + (97.55 - 97.95)^2 + (99.30 - 97.95)^2 + (98.35 - 97.95)^2)) / (4 - 1)]^{1/2}$
$S_n = [(1.82 + 0.16 + 1.82 + 0.16) / 3]^{1/2}$
$S_n = 1.15$

4. Calculate the Lower Quality Index Q_L for the lot. (L=96.3)

$Q_L = (X - L) / S_n$
$Q_L = (97.95 - 96.30) / 1.15$
$Q_L = 1.4348$

5. Determine PWL by entering Table 1 with Q_L= 1.44 and n= 4.

PWL = 98

B. PWL Determination for Air Voids.

1. Air Voids of four random samples taken from Lot A.

A-1 = 5.00
A-2 = 3.74
A-3 = 2.30
A-4 = 3.25

2. Calculate the average air voids for the lot.

$X = (x_1 + x_2 + x_3 . . . n) / n$
$X = (5.00 + 3.74 + 2.30 + 3.25) / 4$
X = 3.57 percent

3. Calculate the standard deviation S_n for the lot.

$S_n = [((3.57 - 5.00)^2 + (3.57 - 3.74)^2 + (3.57 - 2.30)^2 + (3.57 - 3.25)^2) / (4 - 1)]^{1/2}$
$S_n = [(2.04 + 0.03 + 1.62 + 0.10) / 3]^{1/2}$
$S_n = 1.12$

4. Calculate the Lower Quality Index Q_L for the lot. (L= 2.0)

$Q_L = (X - L) / S_n$

Q_L = (3.57 - 2.00) / 1.12
Q_L = 1.3992

5. Determine P_L by entering Table 1 with Q_L = 1.41 and n = 4.

P_L = 97

6. Calculate the Upper Quality Index Q_U for the lot. (U= 5.0)

$Q_U = (U - X) / S_n$
Q_U = (5.00 - 3.57) / 1.12
Q_U = 1.2702

7. Determine P_U by entering Table 1 with Q_U = 1.29 and n = 4.

P_U = 93

8. Calculate Air Voids PWL

$PWL = (P_L + P_U) - 100$
PWL = (97 + 93) - 100 = 90

EXAMPLE OF OUTLIER CALCULATION (REFERENCE ASTM E 178)

Project: Example Project
Test Item: Item P-401, Lot A.

A. Outlier Determination for Mat Density.

1. Density of four random cores taken from Lot A arranged in descending order.

A-3 = 99.30
A-4 = 98.35
A-2 = 97.55
A-1 = 96.60

2. Use n=4 and upper 5 percent significance level of to find the critical value for test criterion = 1.463.

3. Use average density, standard deviation, and test criterion value to evaluate density measurements.

a. For measurements greater than the average:

If (measurement - average)/(standard deviation) is less than test criterion, then the measurement is not considered an outlier

For A-3, check if (99.30 - 97.95) / 1.15 is greater than 1.463.
Since 1.174 is less than 1.463, the value is not an outlier.

b. For measurements less than the average:

If (average - measurement)/(standard deviation) is less than test criterion, then the measurement is not considered an outlier.

For A-1, check if (97.95 - 96.60) / 1.15 is greater than 1.463.
Since 1.435 is less than 1.463, the value is not an outlier.

NOTE: In this example, a measurement would be considered an outlier if the density were:
Greater than (97.95 + 1.463 x 1.15) = 99.63 percent

OR

less than (97.95 - 1.463 x 1.15) = 96.27 percent.

Table 1. Table for Estimating Percent of Lot Within Limits (PWL)

Percent Within Limits (P_L and P_U)	Positive Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520	1.9994	2.0362
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053	1.8379	1.8630
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993	1.7235	1.7420
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127	1.6313	1.6454
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381	1.5525	1.5635
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4717	1.4829	1.4914
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112	1.4199	1.4265
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554	1.3620	1.3670
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032	1.3081	1.3118
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541	1.2576	1.2602
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075	1.2098	1.2115
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630	1.1643	1.1653
87	1.0597	1.1100	1.1173	1.1192	1.1199	1.1204	1.1208	1.1212
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794	1.0791	1.0789
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399	1.0389	1.0382
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015	1.0000	0.9990
83	0.9939	0.9900	0.9785	0.9715	0.9671	0.9643	0.9624	0.9610
82	0.9749	0.9600	0.9452	0.9367	0.9315	0.9281	0.9258	0.9241
81	0.9550	0.9300	0.9123	0.9025	0.8966	0.8928	0.8901	0.8882
80	0.9342	0.9000	0.8799	0.8690	0.8625	0.8583	0.8554	0.8533
79	0.9124	0.8700	0.8478	0.8360	0.8291	0.8245	0.8214	0.8192
78	0.8897	0.8400	0.8160	0.8036	0.7962	0.7915	0.7882	0.7858
77	0.8662	0.8100	0.7846	0.7716	0.7640	0.7590	0.7556	0.7531
76	0.8417	0.7800	0.7535	0.7401	0.7322	0.7271	0.7236	0.7211
75	0.8165	0.7500	0.7226	0.7089	0.7009	0.6958	0.6922	0.6896
74	0.7904	0.7200	0.6921	0.6781	0.6701	0.6649	0.6613	0.6587
73	0.7636	0.6900	0.6617	0.6477	0.6396	0.6344	0.6308	0.6282
72	0.7360	0.6600	0.6316	0.6176	0.6095	0.6044	0.6008	0.5982
71	0.7077	0.6300	0.6016	0.5878	0.5798	0.5747	0.5712	0.5686
70	0.6787	0.6000	0.5719	0.5582	0.5504	0.5454	0.5419	0.5394
69	0.6490	0.5700	0.5423	0.5290	0.5213	0.5164	0.5130	0.5105
68	0.6187	0.5400	0.5129	0.4999	0.4924	0.4877	0.4844	0.4820
67	0.5878	0.5100	0.4836	0.4710	0.4638	0.4592	0.4560	0.4537
66	0.5563	0.4800	0.4545	0.4424	0.4355	0.4310	0.4280	0.4257
65	0.5242	0.4500	0.4255	0.4139	0.4073	0.4030	0.4001	0.3980
64	0.4916	0.4200	0.3967	0.3856	0.3793	0.3753	0.3725	0.3705
63	0.4586	0.3900	0.3679	0.3575	0.3515	0.3477	0.3451	0.3432
62	0.4251	0.3600	0.3392	0.3295	0.3239	0.3203	0.3179	0.3161
61	0.3911	0.3300	0.3107	0.3016	0.2964	0.2931	0.2908	0.2892
60	0.3568	0.3000	0.2822	0.2738	0.2691	0.2660	0.2639	0.2624
59	0.3222	0.2700	0.2537	0.2461	0.2418	0.2391	0.2372	0.2358
58	0.2872	0.2400	0.2254	0.2186	0.2147	0.2122	0.2105	0.2093
57	0.2519	0.2100	0.1971	0.1911	0.1877	0.1855	0.1840	0.1829
56	0.2164	0.1800	0.1688	0.1636	0.1607	0.1588	0.1575	0.1566
55	0.1806	0.1500	0.1406	0.1363	0.1338	0.1322	0.1312	0.1304
54	0.1447	0.1200	0.1125	0.1090	0.1070	0.1057	0.1049	0.1042
53	0.1087	0.0900	0.0843	0.0817	0.0802	0.0793	0.0786	0.0781
52	0.0725	0.0600	0.0562	0.0544	0.0534	0.0528	0.0524	0.0521
51	0.0363	0.0300	0.0281	0.0272	0.0267	0.0264	0.0262	0.0260
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Percent Within Limits (P_L and P_U)	Positive Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
49	-0.0363	-0.0300	-0.0281	-0.0272	-0.0267	-0.0264	-0.0262	-0.0260
48	-0.0725	-0.0600	-0.0562	-0.0544	-0.0534	-0.0528	-0.0524	-0.0521
47	-0.1087	-0.0900	-0.0843	-0.0817	-0.0802	-0.0793	-0.0786	-0.0781
46	-0.1447	-0.1200	-0.1125	-0.1090	-0.1070	-0.1057	-0.1049	-0.1042
45	-0.1806	-0.1500	-0.1406	-0.1363	-0.1338	-0.1322	-0.1312	-0.1304
44	-0.2164	-0.1800	-0.1688	-0.1636	-0.1607	-0.1588	-0.1575	-0.1566
43	-0.2519	-0.2100	-0.1971	-0.1911	-0.1877	-0.1855	-0.1840	-0.1829
42	-0.2872	-0.2400	-0.2254	-0.2186	-0.2147	-0.2122	-0.2105	-0.2093
41	-0.3222	-0.2700	-0.2537	-0.2461	-0.2418	-0.2391	-0.2372	-0.2358
40	-0.3568	-0.3000	-0.2822	-0.2738	-0.2691	-0.2660	-0.2639	-0.2624
39	-0.3911	-0.3300	-0.3107	-0.3016	-0.2964	-0.2931	-0.2908	-0.2892
38	-0.4251	-0.3600	-0.3392	-0.3295	-0.3239	-0.3203	-0.3179	-0.3161
37	-0.4586	-0.3900	-0.3679	-0.3575	-0.3515	-0.3477	-0.3451	-0.3432
36	-0.4916	-0.4200	-0.3967	-0.3856	-0.3793	-0.3753	-0.3725	-0.3705
35	-0.5242	-0.4500	-0.4255	-0.4139	-0.4073	-0.4030	-0.4001	-0.3980
34	-0.5563	-0.4800	-0.4545	-0.4424	-0.4355	-0.4310	-0.4280	-0.4257
33	-0.5878	-0.5100	-0.4836	-0.4710	-0.4638	-0.4592	-0.4560	-0.4537
32	-0.6187	-0.5400	-0.5129	-0.4999	-0.4924	-0.4877	-0.4844	-0.4820
31	-0.6490	-0.5700	-0.5423	-0.5290	-0.5213	-0.5164	-0.5130	-0.5105
30	-0.6787	-0.6000	-0.5719	-0.5582	-0.5504	-0.5454	-0.5419	-0.5394
29	-0.7077	-0.6300	-0.6016	-0.5878	-0.5798	-0.5747	-0.5712	-0.5686
28	-0.7360	-0.6600	-0.6316	-0.6176	-0.6095	-0.6044	-0.6008	-0.5982
27	-0.7636	-0.6900	-0.6617	-0.6477	-0.6396	-0.6344	-0.6308	-0.6282
26	-0.7904	-0.7200	-0.6921	-0.6781	-0.6701	-0.6649	-0.6613	-0.6587
25	-0.8165	-0.7500	-0.7226	-0.7089	-0.7009	-0.6958	-0.6922	-0.6896
24	-0.8417	-0.7800	-0.7535	-0.7401	-0.7322	-0.7271	-0.7236	-0.7211
23	-0.8662	-0.8100	-0.7846	-0.7716	-0.7640	-0.7590	-0.7556	-0.7531
22	-0.8897	-0.8400	-0.8160	-0.8036	-0.7962	-0.7915	-0.7882	-0.7858
21	-0.9124	-0.8700	-0.8478	-0.8360	-0.8291	-0.8245	-0.8214	-0.8192
20	-0.9342	-0.9000	-0.8799	-0.8690	-0.8625	-0.8583	-0.8554	-0.8533
19	-0.9550	-0.9300	-0.9123	-0.9025	-0.8966	-0.8928	-0.8901	-0.8882
18	-0.9749	-0.9600	-0.9452	-0.9367	-0.9315	-0.9281	-0.9258	-0.9241
17	-0.9939	-0.9900	-0.9785	-0.9715	-0.9671	-0.9643	-0.9624	-0.9610
16	-1.0119	-1.0200	-1.0124	-1.0071	-1.0037	-1.0015	-1.0000	-0.9990
15	-1.0288	-1.0500	-1.0467	-1.0435	-1.0413	-1.0399	-1.0389	-1.0382
14	-1.0448	-1.0800	-1.0817	-1.0808	-1.0800	-1.0794	-1.0791	-1.0789
13	-1.0597	-1.1100	-1.1173	-1.1192	-1.1199	-1.1204	-1.1208	-1.1212
12	-1.0736	-1.1400	-1.1537	-1.1587	-1.1613	-1.1630	-1.1643	-1.1653
11	-1.0864	-1.1700	-1.1909	-1.1995	-1.2043	-1.2075	-1.2098	-1.2115
10	-1.0982	-1.2000	-1.2290	-1.2419	-1.2492	-1.2541	-1.2576	-1.2602
9	-1.1089	-1.2300	-1.2683	-1.2860	-1.2964	-1.3032	-1.3081	-1.3118
8	-1.1184	-1.2600	-1.3088	-1.3323	-1.3461	-1.3554	-1.3620	-1.3670
7	-1.1269	-1.2900	-1.3508	-1.3810	-1.3991	-1.4112	-1.4199	-1.4265
6	-1.1342	-1.3200	-1.3946	-1.4329	-1.4561	-1.4717	-1.4829	-1.4914
5	-1.1405	-1.3500	-1.4407	-1.4887	-1.5181	-1.5381	-1.5525	-1.5635
4	-1.1456	-1.3800	-1.4897	-1.5497	-1.5871	-1.6127	-1.6313	-1.6454
3	-1.1496	-1.4100	-1.5427	-1.6181	-1.6661	-1.6993	-1.7235	-1.7420
2	-1.1524	-1.4400	-1.6016	-1.6982	-1.7612	-1.8053	-1.8379	-1.8630
1	-1.1541	-1.4700	-1.6714	-1.8008	-1.8888	-1.9520	-1.9994	-2.0362

END OF SECTION 110

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SECTION III-2
TECHNICAL SPECIAL PROVISIONS
TABLE OF CONTENTS

Section	Description	Page
1.0	**WORK RESTRICTIONS**	
	1.1 Traffic Control and Regulations	TSP-1
	1.2 Haul Permit	TSP-2
	1.3 Underground Facilities	TSP-2
	1.4 Protection of Existing Facilities	TSP-3
	1.5 Security Fence and Gates	TSP-3
2.0	**SPECIAL PROJECT PROCEDURES**	
	2.1 Operational Safety and Marking	TSP-4
	2.2 Red Obstruction Lights	TSP-4
	2.3 Yellow Warning Lights and Checkered Flags for Vehicles	TSP-4
	2.4 Aircraft Traffic Regulations	TSP-4
	2.5 Stockpiled Material	TSP-4
	2.6 Construction Surveying Layout	TSP-4
	2.7 Change Order Request Markups and Worksheet	TSP-4
	2.8 Utility Locating	TSP-4
3.0	**ADMINISTRATIVE REQUIREMENTS**	
	3.1 Standard Specifications and Details	TSP-4
	3.2 Plans and Specifications	TSP-5
	3.3 Construction Schedule	TSP-5
	3.4 Unforeseen Extra Work & Allowances	TSP-6
	3.5 Extensions of Contract Time	TSP-6
	3.6 Claims for Additional Time or Cost	TSP-7
	3.7 Coordination Between Contractors	TSP-10
	3.8 Archaeological Features	TSP-10
	3.9 MAG Specification Modifications	TSP-10
	3.10 Retention of Records	TSP-14
4.0	**CONSTRUCTION SCHEDULING**	
	4.1 Sequence of Construction	TSP-15
5.0	**WEB BASED CONSTRUCTION MANAGEMENT**	TSP-17
6.0	**SUBMITTAL PROCEDURES**	
	6.1 Shop Drawings and Submittals	TSP-17
7.0	**STORM WATER POLLUTION PREVENTION PROCEDURES**	TSP-22
8.0	**CONSTRUCTION QUALITY CONTROL**	TSP-22
9.0	**TEMPORARY FACILITIES AND CONTROLS**	
	9.1 Water	TSP-22
	9.2 Power	TSP-23
	9.3 Project Field Offices	TSP-23
	9.4 Telephone Service	TSP-23
	9.5 Sanitary Facilities	TSP-23

9.6 Parking TSP-24

10.0 TEMPORARY ENVIRONMENTAL CONTROLS
10.1 Storm Water Pollution Prevention Program TSP-24
10.2 Lead Based Paint and Other Environmental Issues TSP-24
10.3 Disposal of Surplus Material Which Does Not Contain Asbestos.... TSP-25

11.0 MISCELLANEOUS CITY OF PHOENIX MODIFICATIONS TO MAG TECHNICAL SPECIFICATIONS
11.1 Aluminum Manhole Cover TSP-25
11.2 Gray Iron Castings TSP-25
11.3 Modification of MAG Uniform Standard Detail 522, Manhole Shaft TSP-25

12.0 WORK DONE BY CITY FORCES TSP-25

13.0 UTILITY LOCATING (ALLOWANCE) TSP-25

14.0 EXISTING UTILITY RELOCATION AND UNFORESEEN ELECTRICAL CONDITIONS (ALLOWANCE) TSP-26

15.0 EXISTING MONITORING WELLS, WATER SERVICE LINES, AND UTILITIES PROTECTION TSP-26

16.0 SOIL CONDITIONS TSP-27

SECTION III-2
TECHNICAL SPECIAL PROVISIONS

1.0 WORK RESTRICTIONS

1.1 TRAFFIC CONTROL AND REGULATIONS. All traffic and/or traffic control devices on this project shall be provided, maintained and/or controlled by the Contractor, as specified in the 2007 City of Phoenix *Traffic Barricade Manual,* (or latest edition), with revisions as shown below:

a. The following shall be considered major streets:

- Litchfield Road;
- Yuma Road;
- MC 85.

b. Permission to restrict City streets, sidewalks and alleys (street closure permits) shall be requested in accordance with the following:

- City of Phoenix Right-of-Way Management Program (City Code: Article XV);
- City of Phoenix Right-of-Way Management Brochure;
- 2007 City of Phoenix Barricade Manual (or latest edition);
- City of Goodyear Traffic Control Permit Application

c. Off peak hours at Phoenix Goodyear Airport are from 21:00 hours to 06:00 hours for lane restrictions.

d. No complete road closures are allowed.

e. The Contractor shall submit for each construction phase, a Landside Traffic Control Plan containing traffic control drawings with barricade layouts to the City of Goodyear and the City of Phoenix Aviation Department for approval. This submittal must be transmitted to the City of Goodyear and the Aviation Department a minimum of one (1) week prior to instituting the particular Traffic Control Plan.

f. Any damage by the Contractor to major streets shall have full repairs performed the same day that the damage occurred.

g. Measurement and Payment for a Uniformed Off-Duty Officer (meeting MAG Standard Specification 401) shall be incidental to Item M-003. Refer to the Civil Technical Specifications, Item M-003.

Delete MAG Subsection 401.6, MEASUREMENT in its entirety and substitute the following:

> "Measurement for Landside Traffic Control will be incidental to other items of work. No separate measurement will be made for flagmen and pilot cars. Monthly partial payments will be made uniformly over the Contract Time, provided that the work under traffic control/regulations is maintained satisfactorily to the City of Goodyear and the

Engineer. Uniformed, off duty law enforcement officers will be incidental to Civil Technical Specification Item M-003."

Delete MAG Subsection 401.7, PAYMENT in its entirety and substitute the following:

"The basis of payment for Landside Traffic Control will be paid for on a lump sum basis for traffic control devices, and shall include full compensation for furnishing all labor, flagmen, pilot cars, barricades, materials, construction gates, tools, mechanical vacuum sweepers, equipment and incidentals to safely control traffic. Monthly payments will be calculated by dividing the lump sum amount by the Contract Time in months.

Payment will be made under:

Item M-003-8.1 Airport Safety and Security"

1.2 HAUL PERMIT. Obtaining the haul permit and the approval by the City of Goodyear or Phoenix Street Transportation does not release the Contractor from strict compliance with MAG Subsection 108.5, Limitation of Operations. On any project, when the quantity of fill or excavation to be hauled exceeds 10,000 cubic yards, or when the duration of the haul is for more than twenty (20) working days, the Contractor shall:

a. Obtain and pay for a written haul permit from the applicable City of Phoenix or Goodyear Development Services Department.

b. Obtain approval of the proposed haul route, number of trucks, etc., by the applicable City of Phoenix or Goodyear Street Transportation Department.

1.3 UNDERGROUND FACILITIES. The Contractor will make whatever investigation it deems necessary to verify the location of underground utility facilities, by providing a private utility locating company to verify the location of all on-site utilities prior to construction. The utility locator company shall mark all utilities that may or may not conflict with construction. The Contractor shall field survey these utilities and plot this information on the Record Drawings that the Contractor will be preparing. If such facilities are not in the location shown in the drawings, then (regardless of whether this is discovered prior to or during construction) the Contractor's remedies, if any, pursuant to Article 6.3, Chapter 2, Title 40, A.R.S. (A.R.S. 40-360.21 through 40-360.32, "Underground Facilities"), shall be the Contractor's sole remedy for extra work, delays, and disruption of the job, or any other claim based on the location of utility facilities. Locations of utility facilities are shown on drawings and where furnished by the City, are to be regarded as preliminary information only, subject to further investigation by the Contractor. The City does not warrant the accuracy of these locations, and the Contractor, by entering into this Contract, expressly waives and disclaims any claim or action against the City under any theory for damage resulting from location of utility facilities.

The Contractor shall be responsible for obtaining all utility location information, and for performing all requirements as prescribed in A.R.S. 40-360.21 through .32, for all underground facilities, including those that have been installed on the current project, until the project is accepted by the City.

At least two (2) working days prior to commencing any excavation, the Contractor shall call the Blue Stake Center, between the hours of 7:00 a.m. and 4:30 p.m., Monday through Friday, for information relative to the location of buried utilities that are located on landside. The number to be called is as follows: Maricopa County: (602) 263-1100.

Several utility owners, including the City of Phoenix, Goodyear Tire, Arizona Department of Environmental Quality (ADEQ), and others do have utilities in the proposed work area and these utilities shall be located and potholed by the Contractor prior to starting construction. The Contractor is advised that many underground monitoring, extraction and injection wells exist within the project work limits. These wells are to be protected by the Contractor and left in an undisturbed condition. Any inadvertent damage must be reported immediately to the Aviation Department Environmental Section. The Contractor will be responsible for returning any damaged monitoring, extraction or injection wells to a pre-construction condition. See Civil Technical Specification Item U-200 for method of measurement and basis of payment.

1.4 PROTECTION OF EXISTING FACILITIES. Prior to the start of the construction, periodically as requested, and at the completion of the project, a representative of the Aviation Department and the Contractor's authorized representative will inspect the excavation and embankment areas, staging area, haul roads and job site to evaluate the condition of existing facilities. The City may videotape these inspections. The Contractor will be held responsible for any damage to existing facilities in accordance with MAG Uniform Standard Specifications Section 107.9. The Quality Control Program Administrator and the Contractor shall video tape and inspect the condition of existing facilities. The video tape and the written report shall be submitted to the Engineer, documenting the results of the inspection performed prior to the start of the work.

There are existing ground monitoring wells throughout the Airport owned by the City of Phoenix, Goodyear Tire and Rubber and Arizona Department of Environmental Quality (ADEQ). The Contractor shall provide lighted barricades around the existing ground monitoring wells that are within the construction limits, prior to the start of construction.

Existing ground monitoring wells shall be protected in-place by the Contractor. The environmental division of the Aviation Department will complete the grade adjustments to the ground monitoring wells as necessary. However, the cost of repairs due to damage caused by the Contractor shall be borne solely by the Contractor. The Contractor shall coordinate all adjustments or repairs to the ground monitoring wells with the Environmental Division.

1.5 SECURITY FENCES AND GATES. All existing security fences and gates affected by the work shall be maintained by the Contractor until final completion and acceptance of the work. Existing security fence and gates that interfere with construction operations shall not be relocated or dismantled until permission is obtained from the City of Phoenix Airside Operations, through the Engineer. The duration that the security fence or gate may be left relocated or dismantled shall be agreed upon.

The Contractor shall submit to the City a Security Gate Access Plan for review prior to the work and prior to relocation or removal of any security gates or fence. The Contractor shall restore all security fences and gates that are affected by the work, to their original or to a better condition.

2.0 SPECIAL PROJECT PROCEDURES

2.1 OPERATIONAL SAFETY & MARKINGS. Refer to Civil Technical Specifications Item M-003 Airport Safety and Security and the Construction Safety and Phasing Plan approved by the FAA for the project.

2.2 RED OBSTRUCTION LIGHTS. Refer to Civil Technical Specifications Item M-003 Airport Safety and Security and the Construction Safety and Phasing Plan approved by the FAA for the project.

2.3 YELLOW WARNING LIGHTS & CHECKERED FLAGS FOR VEHICLES. Refer to Civil Technical Specifications Item M-003 Airport Safety and Security and the Construction Safety and Phasing Plan approved by the FAA for the project.

2.4 AIRCRAFT TRAFFIC REGULATIONS. Aircraft traffic will continue to use existing runways, aprons and taxiways during the time that work under this contract is being performed. Refer to Civil Technical Specifications Item M-003 Airport Safety and Security and the Construction Safety and Phasing Plan approved by the FAA for the project.

2.5 STOCKPILED MATERIAL. Refer to Civil Technical Specifications Item M-003 Airport Safety and Security and the Construction Safety and Phasing Plan approved by the FAA for the project.

2.6 CONSTRUCTION SURVEYING LAYOUT. Refer to Civil Technical Specifications Item P-100 Contractor Quality Control and Construction Surveys.

2.7 CHANGE ORDER REQUEST MARKUPS AND WORKSHEET. Refer to the City of Phoenix Supplementary Conditions in Section 17 CHANGE ORDER REQUEST MARKUPS AND WORKSHEEF for limitations on Contractor and Subcontractor markups and allowable costs.

2.8 UTILITY LOCATING. Refer to Civil Technical Specification U-200 LOCATION OF UNDERGROUND UTILITIES for utility locating, relocating and the protection of existing monitoring wells and service lines, including airfield electrical.

3.0 ADMINISTRATIVE REQUIREMENTS

3.1 STANDARD SPECIFICATIONS AND DETAILS. Except as otherwise required in these specifications, bid preparation and construction of this project shall be in accordance with Federal Aviation Administration (FAA) Standards for Specifying Construction of Airports (AC 1505370-10G, Revised 7/21/2014) except Part I, as modified herein, as well as all applicable Maricopa Association of Governments' (MAG) Uniform Standard Specifications and Uniform Standard Details, latest revision, and the City of Phoenix Supplements, latest revision to the MAG Uniform Standard Specifications and Details. The Articles of the Agreement for Construction Services replace MAG Uniform Standard Specification General Condition Section 102 Bidding Requirements and Conditions, and Section 103 Award and Execution of Contract, including the City of Phoenix Supplements for these sections.

3.2 PLANS AND SPECIFICATIONS. The Contractor will be furnished with seven (7) copies of the specifications and seven (7) sets of reduced plans (11" x 17") and two (2) sets of full size plans (22" x 34".) The Contractor may request additional full size plans (22" x 34") or reduced plans (11" x 17"). The Contractor shall keep one (1) copy of the contract documents accessible on the work site at all times. All additional sets shall be paid for by the Contractor.

The City of Phoenix Supplements will govern over the MAG Standard Specifications and Details. In case of a discrepancy or conflict between these Contract Documents and the City of Phoenix Supplements or the MAG Standard Specifications and Details, the Plans will govern over both the City of Phoenix Supplements and MAG Standard Specifications and Details. The Technical Provisions and Special Provisions will govern over the City of Phoenix Supplements and the MAG Standard Specifications and Details. The following is the precedence of the Contract Documents:

a. Technical Special Provisions and Special Provisions

b. Technical Specifications including Civil and Electrical

c. Cited Standards for Materials and Testing

d. Cited Federal Aviation Administration (FAA) Advisory Circulars

e. General Provision Specifications

f. Plans

g. City of Phoenix Supplement to MAG Standard Specifications and Details

h. MAG Uniform Standard Specifications and Details for Public Works Construction

Calculated dimensions will govern over scaled dimensions. The Contractor shall not take advantage of any apparent error or omission on the Plans or Specifications. In the event the Contractor discovers any apparent error or discrepancy, he shall immediately call upon the Engineer for his/her interpretation and decision, and such decision shall be final.

Electronic files (CAD files) are not a part of the contract documents. Information contained on CAD files may not be compatible with the coordinates, elevations, details, and dimensions shown on the Project Plans. The Contractor may be provided with CAD files, however, the Contractor shall survey and construct the project from the information shown on the Project Plans, and as specified in the Project Specifications and Contract Documents.

3.3 CONSTRUCTION SCHEDULE. Refer to the City of Phoenix Specifications (Bid Proposal) for project schedule requirements. There will be no work (with exception to vacuum sweeping for the cleanup of foreign object debris) as described in the following:

a. The night shift on New Year's Eve, all day on New Year's Day, the night shift on New Year's Day.

b. The night shift prior to Labor Day, all day on Labor Day, the night shift on Labor Day

c. The night shift prior to Memorial Day, all day on Memorial Day, the night shift on Memorial Day

d. The night shift prior to the 4th of July, all day on the 4th of July, the night shift on the 4th of July

e. The night shift prior to Thanksgiving Day, all day on Thanksgiving Day, the night shift on Thanksgiving Day, the Sunday day shift and the Sunday night shift following Thanksgiving

f. The night shift on Christmas Eve, all day on Christmas Day, the night shift on Christmas Day

All work during moratorium dates must be pre-approved by the City of Phoenix Project Manager.

The Contractor shall develop their schedule, plan their work, and provide sufficient workforce, materials, and equipment to complete all work within the allotted contract time utilizing five (5) day work weeks and multiple shift operations as needed.

3.4 UNFORESEEN EXTRA WORK & ALLOWANCES. Unforeseen extra work, if any, shall be approved by the City of Phoenix Project Manager or the Engineer, for example, by negotiated price, or by time and materials, in accordance with the Change Order Request Markups and Work Sheet, as provided in the Supplementary Conditions.

Several contract items identified contain the word Allowance in the description of the item. These contract items are for work to be performed, but the actual quantities cannot be determined. The Contractor shall perform the work as directed by the Engineer for these items. Measurement and payment will be based on the actual quantities of work performed.

3.5 EXTENSIONS OF CONTRACT TIME. MAG General Condition Specification 108.7, DETERMINATION AND EXTENSION OF CONTRACT TIME, is deleted in its entirety and the following paragraph substituted:

a. Weather Delay. "Extensions of time due to adverse weather conditions not reasonably anticipated will be granted only if such inclement weather prevents the execution of critical path items of work at the time of the inclement weather. Extensions of time for weather delays will be considered only if such actual monthly inclement weather exceeds the monthly average for that month as shown in Table 1 below. The extension would be considered on the day after the rainfall exceeds the monthly average listed in Table 1. The Contractor shall base his CPM Schedule using at least three (3) weather delay days per month between January and March, and at least one (1) weather delay day per month between April and December. These weather days will not be considered for an extension of contract time."

The Contractor shall request an extension of time in writing within forty-eight (48) hours after the event that caused the delay. This written notification is required regardless if the request is based on inclement weather or based on other factors. No extension of time will granted if the written request is not received within forty-eight (48) hours.

TABLE 1 – City of Phoenix Average Monthly Precipitation Data.

Month	*Average Monthly Precipitation (inches)*
January	0.67
February	0.68
March	0.88
April	0.22
May	0.12
June	0.13
July	0.83
August	0.96
September	0.86
October	0.65
November	0.66
December	1.00

3.6 CLAIMS FOR ADDITIONAL TIME OR COST. Delete MAG Section 110 and substitute the following:

a. Notice of Claim for Additional Time. Claims for additional time must be made by the Contractor per Article 6 of the Agreement between Owner and Contractor (Agreement). Notice of any Contractor claims of time extension entitlement due to extra work must be included in the Contractors change order request regarding the extra work. Failure to provide the notice required by this section shall constitute a waiver of any entitlement the Contractor may otherwise have. Notices shall include: (1) the nature of the delay; (2) the critical path activities being affected; (3) the probable effect of the delay on progress of the work; (4) a description of efforts the Contractor intends to make to mitigate the delay, and; (5) a cost estimate. If the notice includes adverse weather delays, the notice shall be made within 48 hours and also include data substantiating the adverse weather.

1) **Critical Path**. No extension of time shall be granted to the Contractor for a delay caused by the Owner, Engineer, other contractors or any other party, or other causes beyond the Contractor's control, unless the delay affects the critical path of the Project as defined on a critical path method schedule or monthly update provided to the Owner before the delaying occurrence and then only to the extent that the delay affects the critical path. If the delay event forces a previously non-critical path activity onto the project critical path, this change must be shown on the next monthly update and expressly identified in the narrative report. Failure to so identify critical path changes shall be deemed to waive the Contractor's right to recover any costs associated with the delay event's impact on the activity. Delays not identified on the Contractor's next monthly update shall be waived. No extension of time shall be granted to the Contractor to the extent that, notwithstanding the existence of any such circumstance beyond the Contractor's control, delay would have resulted in any event due to a concurrent unexcused delay.

2) **Changes in the Work.** For changes in the work that significantly affect the time and progress of the work, any time extensions shall be requested no later than when the change in the work is requested. Any change order negotiated and signed by the Contractor and

Owner that does not include an express time extension shall be deemed conclusive

evidence that no time extensions related to the changed work is warranted and the Contractor shall forever waive its right to claim entitlement to such a time extension.

Change order requests shall include all costs necessary to perform the extra work within the contract period unless a time extension is granted. This shall include but not be limited to necessary acceleration costs. The Contractor may reserve the right to request a time extension at a later date. However, if the Contractor elects to do so, the Engineer will withhold ten (10) percent of the change order amount until the Contractor submits a critical path method schedule analysis that complies with all Contract requirements and identifies the resultant delay. If the Contractor fails to timely do so, the Owner may use the withheld amount to perform a schedule analysis to identify the resulting delay.

3) **Overhead Costs During Time Extensions.** The Contractor and Owner contemplate that the entire contract period may be reasonably necessary to complete this Contract's scope of work. It is the contemplation of the parties that any home office or field overhead or supervision costs necessary to perform work during the entire contract period is incorporated into the Contractor's overall Bid. The Contractor shall not be entitled to recover home office or field overhead and supervision costs during the performance period, even if the Contractor originally planned to complete the work before the contract period expired. Acceptance by the Owner of schedules showing early completion by the Contractor shall not constitute a waiver of this provision.

b. Notice of Claim for Additional Cost. If the Contractor wishes to make a claim for an increase in the contract sum, written notice shall be given before proceeding to execute the work. The written notice shall be given to the City within five (5) calendar days after the occurrence of the event giving rise to the claim. Prior notice is not required for claims relating to an emergency endangering life or property. The Contractor shall provide notice of claims relating to emergencies within five (5) days after the occurrence of the emergency. Failure to strictly comply with this notice requirement shall constitute waiver of such claims.

c. Out-of-Sequence Work. The Contractor and Owner contemplate that changes in the Contractor's schedule and the performance of out-of-sequence work may be necessary for the beneficial and timely completion of the project, safety of the flying public or convenience of the Owner. The Contractor expressly waives any claim for additional costs resulting from out-of-sequence work beneficial to the overall project.

d. Continuing Contract Performance. Pending final resolution of a claim, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract other than amounts in dispute.

e. Claim Documentation. Within thirty (30) calendar days after the Contractor submits a notice of claim, the Contractor shall submit a "Claim," which shall include the following documentation:

1) The date of the occurrence and the nature and circumstances of the issue for which the notice of claim was given.

2) The identity of any documents and the substance of any oral communication related to the issue.

3) The basis for an assertion that the work required is a change from the original Contractor work or schedule.

4) The 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 required.

d. Adjustments to delivery schedule(s), staging, and contract time due to the dispute, and

e. An estimate of time within which the Owner must respond to the notice to minimize cost, delay, or disruption of issue.

5) A previously submitted project schedule demonstrating that any affected activities were identified as on the project's critical path or were made critical by the delay.

6) Any other items or information germane to the dispute.

7) "I,_____, being the_____ (must be an officer) of _____ (Contractor), declare under penalty of perjury under the laws of the State of Arizona, and do personally certify and attest that: I have thoroughly reviewed the attached Claim for additional compensation and/or extension of time, and know it's contents, and said claim is made in good faith; the supporting data is truthful and accurate; that the amount requested accurately reflects the contract adjustment for which the Contractor believes the City of Phoenix is liable; and. further, that I am familiar with Federal Acquisition Regulation (FAR) clause 52.214-27, found in 48 CFR Part 52; and further know and understand that submission or certification of a false claim may lead to fines, imprisonment, and/or other severe legal consequences."

By: _____
Title: _____
Date: _____

The Contractor's written certification, under oath: If any subcontractor or any lower tier subcontractor wishes to make a Claim, the subcontractor shall also provide the certification (in addition to the General Contractor).

f. Claims for Consequential Damages. The Contractor waives claims against the Owner for consequential damages arising out of or relating to this contract. This waiver includes the

Contractor's principal office expenses including the compensation of personnel stationed there, financing losses, business and reputation and lost profits.

g. Claim Review. Claims shall be submitted to the Engineer, who will review the Claim and provide a recommendation to the Owner. The Engineer's recommendation shall not be binding on the Owner. The Owner may meet with the Contractor review the claim.

h. Owner's Audit Rights. The submission of a Claim by the Contractor shall entitle the Owner to audit all Contractor records and documents relating to the project, including but not limited to the Contractor's bid documents, job cost records and ledgers, payrolls, schedules, communications with its subcontractor and material suppliers and subcontract agreements. The Contractor's failure to timely provide these documents shall constitute a material breach of the Contract.

3.7 COORDINATION BETWEEN CONTRACTORS. There may be other Contractors operating in the vicinity that could affect this project. The Contractor shall coordinate his work with others to minimize conflicts in construction operations.

3.8 ARCHAEOLOGICAL FEATURES. Although the City of Phoenix Aviation Department has made every effort prior to construction to identify all cultural resources in the project area, previously unidentified archaeological materials may be found during the construction of this project.

If human remains are encountered during any phase of the construction, the Contractor shall suspend all work in the vicinity of the find and shall take steps to secure the protection of the remains. The Archaeological Consultant and the City of Phoenix Archaeologist shall be contacted immediately to determine an appropriate course of action. In the event of suspension of work pursuant to this Special Provision, the Contractor may be entitled to an adjustment of contract time.

If satisfactory fulfillment of the Contract involves alterations to the contract time that affect the Contractor's completion time, the Contractor may request a supplemental agreement that extends that Contract time. The supplemental agreement shall be in the form of a Request for Extension of Contract time and shall include the Contractor's revised schedule and all other pertinent data. The request shall show why an increase of Contract time is warranted.

An extension of contract time will not be considered unless the work affected by the Archaeological investigation and suspension of a construction activity becomes a critical item on the Contractor's CPM schedule.

3.9 MAG SPECIFICATION MODIFICATIONS. In addition to any other modifications to the MAG specifications contained elsewhere in this Contract, the following changes are made:

a. MAG Section 104.2.4 is deleted and replaced with:

> "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. The Contracting Agency shall be

entitled to a reduction in cost equal to one-hundred percent of any cost reductions to the Contractor caused by the change. In no event shall a Contractor requested change result in any additional cost to the Contracting Agency. The Contractor assumes sole responsibility and liability for changes it requests and the Contracting Agency's approval of a proposed change shall not create any liability on the part of the Contracting Agency."

b. MAG Section 105.11 is deleted and replaced with:

"105.11 REMOVAL OF UNACCEPTABLE, UNATHORIZED AND COVERED WORK:

(A) *Duty to Uncover Work:* If a portion of the work is covered contrary to the Engineer's request or to requirements specifically expressed in the Contract, the Engineer may order in writing that it either be uncovered for observation and/or replaced. The cost of uncovering or replacing the work shall be solely at the Contractor's expense. The Contractor shall not be entitled to any associated time extensions or impact costs associated with such a request.

(B) *Cost of Uncovering Work:* If a portion of the work has been covered that the Engineer has not specifically requested to observe prior to its being covered or the Contract does not provide for inspection, the Engineer may request the Contractor to uncover the work. If the uncovered work is in compliance with Contract requirements, the Contracting Agency shall bear the cost of uncovering and replacing the work. If the uncovered work is not in compliance with Contract requirements, the Contractor shall bear such costs.

(C) *Duty to Correct Rejected Work:* Work done contrary to the instruction of the Engineer, work done beyond the lines shown on the plans, or as given, any extra work done without authority, unacceptable work, poor workmanship, work done with defective materials, work damaged through carelessness or found unacceptable by the Engineer, whether observed before or after substantial completion of the work and whether or not fabricated, installed or completed shall be promptly corrected by the Contractor. The Contractor shall bear all costs of correcting such work, including the replacement or repair of other work affected, additional testing and inspection costs, and additional Engineer costs. The Contractor shall not be entitled to recover any impact costs or delay damages and shall not be entitled to any time extensions in any way relating to correcting the work. Work rejected by the Engineer shall be promptly corrected. All work rejected before final acceptance shall be corrected prior to final payment.

(D) *One Year Duty to Correct Work:* Without limiting the Owner's statutory, common law, or other contractual rights, if within one (1) year after the date of final acceptance, or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty or guarantee required by the Contract, any defective work or work not in accordance with the Contract shall be promptly corrected by the Contractor after written notice by the Engineer or Owner to do so. The Contractor shall bear all costs of correcting such work, including replacement or repair of other work affected by the defect and any other damages resulting from such defect. This obligation shall survive Final Payment to the Contractor.

(E) *Owner's Right* to *Correct Non-Conforming Work:* If the Contractor fails to correct nonconforming or defective work within a reasonable time, the Owner may correct it with its own forces. If the Contractor does not correct the work within a reasonable time, the Owner may provide written notice to the Contractor and then remove and store the salvable materials or equipment at the Contractor's expense. If the Contractor does not pay the Owner's expenses within ten (10) days thereafter, the Owner may sell such materials and equipment and shall deduct its expenses, including additional services by the Engineer.

(F) *Acceptance of Non-Conforming Work:* If the Owner prefers to accept defective or non-conforming work rather than require its removal and correction, the Owner shall be entitled to recover one-hundred and fifty (150) percent of the cost of removing and correcting the work. Such adjustment shall be effected whether or not final payment has been made."

c. Delete MAG Section 108.1(A)

d. Delete MAG Section 108.4 and substitute the following:

"The Contractor shall furnish the Engineer a construction schedule and monthly updates to the schedule. The Engineer's review of the Contractor's schedule is for purposes of: (1) determining the Contracting Agency's staffing requirements; (2) to ensure general compliance with the contract documents as it relates to the completion of all work; (3) to monitor and evaluate the construction status for purposes of approving progress payments; (4) to evaluate project delays and claims for additional time and compensation; and (5) to identify methods for mitigating delay impacts. In the event the schedule does not contain sufficient information to meet the above purpose, or does not comply with the Contract's schedule and monthly update requirements, the Contractor shall resubmit a new schedule or update with the required information. The Contractor shall not change an accepted construction schedule 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 responsibility remains the Contractor's obligation. When the schedule shows a completion prior to the 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, including extended field and home office overhead and supervision costs. The Contracting Agency shall not be liable to the Contractor for any damages for delay if the Contractor complete the work prior to expiration of the original Contract completion date or as modified by approved change orders, if any."

e. Delete MAG section 108.11 and substitute the following:

"A. *Termination for Convenience:* The Owner may, without cause, terminate the Contract for its convenience, even if the Contractor has not failed to perform any part

of the Contract. Termination of the Contract shall be effected by written notice to the Contractor. Upon receipt of such notice, the Contractor shall, unless the notice directs otherwise:

1. Immediately discontinue the work and the placing of all orders and subcontracts in connection with this Contract;

2. Immediately cancel all of the existing orders and subcontracts made hereunder;

3. Immediately transfer to the Owner all materials, supplies, work in progress, appliances, facilities, machinery and tools acquired by the Contractor in connection with the performance of the Contract, and take such action as may be necessary or as the Owner may direct for protection and preservation of the Work relating to this Contract;

4. Deliver all plans, Drawings, Specifications and other necessary information to the Owner;

5. Take all necessary steps to secure the project site and work.

B. *Contractor's Exclusive Remedy:* If the Owner terminates the Contract for convenience, the following shall be the Contractor's exclusive remedy.

1. Reimbursement of all actual expenditures and costs approved by the Owner as having been made or incurred in performing the work;

2. Reimbursement of expenditures made and costs incurred with the Owner's prior written approval in settling or discharging outstanding commitments entered into by the Contractor in performing the Contract; and

3. Payment of profit, in so far as profits is realized hereunder, of an amount equal to the actual profit on the entire Contract at the time of termination multiplied by the percentage of the completed work. In no event shall the Contractor be entitled to anticipated fees or profits on Work not required to be performed.

C. *Warranties, Guarantees and Indemnities to Remain in Effect.* All obligations of the Contractor under the Contract with respect to completion of the work, including but not limited to all warranties, guarantees and indemnities, shall apply to all work completed or substantially completed by the Contractor prior to a convenience or for cause termination by the Owner. Notwithstanding the above, any termination by the Owner or payments to the Contractor shall be without prejudice to any claims or legal remedies that the Owner may have against the Contractor for any cause.

D. *Conversion of Termination for Cause to Termination for Convenience.* If a termination for convenience by the Owner is determined to be wrongful or improper for any reason, such termination shall automatically be converted to a convenience termination and the Contractor's remedy for such wrongful termination shall be limited to the recoveries for a convenience termination.

E. *Remedy Limited to Damages:* In the event that the Contractor is terminated, whether for cause or convenience, the Contractor's sole remedy shall be for damages. In no event shall the Contractor be entitled to reinstatement or other equitable relief from a court or other forum.

F. *Termination for Cause:* The Owner may terminate the Contract if the Contractor:

1. Fails or refuses to supply enough properly skilled workers or proper materials to ensure compliance with approved schedules or as directed by the Engineer;

2. Fails to make payment to subcontractors for labor or materials in accordance with the respective agreements between the Contractor and subcontractors or A.R.S. § 34-221;

3. Disregards laws, ordinances, rules, regulations or orders of a public authority having jurisdiction;

4. Breaches any provision of the Contract;

5. Fails to furnish the Owner with satisfactory assurances evidencing the Contractors ability to complete the work in compliance with all Contract requirements;

6. Fails to comply with approved schedules or fails to comply with Contract schedule requirements; or

7. Fails after commencement of the work to proceed diligently and continuously with the construction and completion of the work for more than seven (7) days, except as permitted under the Contract.

G. *Contractor Right to Receive Payment:* When the Owner terminates the Contract for cause, the Contractor shall not be entitled to receive further payment until the work is finished. If it appears the Contractor would have sustained a loss on the entire Contract had it been completed, the Contractor shall not be entitled to any profit and an appropriate adjustment shall be made reducing the Contractor's payment to reflect the Contractor's anticipated rate of loss for the entire Contract.

H. *Cost of Finishing Work.* If the unpaid balance of the Contract exceeds costs of finishing the work, including compensation to the Engineer and other Owner representatives, such excess shall be paid to the ·Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner shall be certified by the Engineer and this obligation for payment shall survive the Contract's termination."

3.10 RETENTION OF RECORDS. The City of Phoenix, the FAA, the Comptroller General of the United States, or any of their authorized representatives, shall be allowed access to any books, documents, papers, and records of the Contractor which are directly pertinent to the Airport Improvement Program project for the purpose of making audit, examination, excerpts, and transcriptions for a period of three (3) years following completion of the work.

4.0 CONSTRUCTION SCHEDULING

4.1 SEQUENCE OF CONSTRUCTION. The following scheduling requirements are being provided to serve as supplemental information in preparation of the bid, as well as the sequencing of construction. It is not the intent of these Special Provisions or the construction plans to dictate to the Contractor his method of construction for this project.

The Contractor shall review these specifications and submit to the Engineer for review prior to construction, his construction plan on how he will meet the project schedule.

a. Limitations of Operations. The Contractor shall conduct all their operations in such a manner so as to maintain a smooth, safe, uninterrupted flow of aircraft and vehicular traffic adjacent to the work site. All pavement removal and subgrade preparation construction shall be conducted in such a manner so as to minimize any potential differential settlement between the edges of new and existing construction as well as between two adjacent construction phases. The phases which are not under construction shall be accessible and operational at all time. Unless noted otherwise on the plans, no work shall be performed within the Runway 3-21 Safety Area unless the Runway is closed or within Taxiway 'A' Safety Area unless the Taxiways are closed. The Contractor shall remove paving and other equipment from the active Runway and Taxiway Safety Areas including the infields each day as required to permit normal airport operations to resume.

Limits of the various phases of work shall be clearly delineated with barricades, barricade lights, mandatory signs, taxiway signs (temporary and permanent) and paint markings as shown on the plans and specified herein, in order to deter aircraft and vehicles from entering the construction areas. The Contractor shall work closely with Airport Operations personnel, City of Phoenix Inspectors and the Engineer to ensure that the work is accomplished with minimal interference with aircraft movements.

Aircraft always have the "right-of-way". When the Contractor is working adjacent to an active apron, runway or taxiway and an aircraft approaches the work area, the Contractor may be required to "pull back" his operations, thus move workers, materials and equipment away from the taxiway or runway, outside of object free area, or as directed by City of Phoenix Inspection personal.

The Contractor shall maintain all active runway and taxiway lighting systems at all times, unless otherwise specified. When temporary bypasses of active circuits are to be constructed in order to work on portions of the circuits, the circuits shall be de-energized and re-energized in conformance with the procedures specified by the City of Phoenix Aviation Department and as specified in Item L-100 Electrical General Requirements.

b. Opening Inspections. When the Contractor requests in writing to open an individual phase of work, or areas that are scheduled to be reopened to aircraft traffic, the Engineer will conduct an observation of the construction area before opening to aircraft traffic. The conditions which observations will consider potentially hazardous and which must be corrected prior to reopening the runway, taxiway or apron prior to the end of a work shift (day shift or night shift as the case may be) include but are not limited to, the following:

1) Trenches, holes, or excavations on, or adjacent to any open taxiway, runway, apron or related safety area.

2) Un-marked or un-lighted holes, trenches or excavations near any runway, apron, taxiway, or related safety area

3) Mounds or piles of earth, temporary stockpiles, construction materials, temporary structures, or other objects on or in the vicinity of any open runway, apron, taxiway object free area, or in a related safety, approach or departure area

4) Vehicles or equipment (whether operating or idle) on any open apron, taxiway, or in any related safety, approach or departure area

5) Vehicles, equipment, excavations, stockpiles, or other materials which could impinge upon Navigational Aid (NAVAID) critical areas and degrade or otherwise interfere with electronic signals from radios or electronic NAVAIDs or interfere with visual NAVAID facilities

6) Objects (whether marked/flagged or not) or activities anywhere on or in the vicinity of the airport which could be distracting, confusing, or alarming to pilots during aircraft operations.

7) Un-flagged or un-lighted low visibility vehicles and equipment including cranes in the vicinity of an active runway, taxiway or apron or near any approach or departure surface

8) Misleading or malfunctioning obstruction lights or barricade lights

9) Inadequate approach/departure surfaces (needed to assure adequate landing/takeoff clearance over obstructions or work or storage areas

10) Inadequate, confusing, or misleading (to user pilots) marking and lighting of any open apron runway, taxiway, or in any related safety, approach or departure area.

11) Water, dirt, debris, or other transient accumulation that temporarily obscures pavement marking, pavement edges, or derogates the visibility of runway/taxiways marking, lighting or of construction and maintenance areas. There is zero tolerance for foreign object debris.

12) Inadequate or improper methods of marking, barricading, or lighting of temporarily closed portions of airport operation areas including unlighted or missing construction and barricade lights

13) Construction materials, trash or other materials with foreign object debris (FOD) potential, whether on aprons, runways, taxiways, service road, public streets or related safety areas. Inspectors will be watchful for debris that can be ingested into aircraft engines creating a potential for FOD. Such items include rock, aggregate, soil, loose polyethylene and other light materials capable of being blown onto aircraft movement areas by wind.

14) Construction/maintenance activities or materials that could hamper airport rescue and fire-fighting vehicle access from fire-fighting stations to all parts of the runway/taxiway system, runway approach and departure areas, or aircraft parking locations.

15) The time allowances for all work is inclusive of the Contractor moving onto the site, performing work activities, performing all dean-up, having the work area and haul routes inspected and approved by the Engineer, and moving off the site. The Contractor shall provide adequate lighting for the needs of the inspection personnel.

16) Any Aircraft Operating Areas (AOA), open apron, runway, taxiway, or in any related safety, approach or departure area that does not pass inspection must remain closed until such time cleanup is performed and approved.

c. Construction Phasing. Typical work to be done during each construction phase is given as supplemental information and is not intended to be a complete listing of all work to be accomplished. All work called for on the plans and all items necessary to construct a complete, operational section of a runway or taxiway within the limits of the work area shall be completed in the individual phase and/or sub-phases, prior to proceeding with the next phase or sub-phase.

5.0 WEB BASED CONSTRUCTION MANAGEMENT

The Contractor and his sub-contractors shall be granted access to and shall be required to use the City of Phoenix project management system Primavera Unifier. Training for personnel in the use of Primavera Unifier shall be scheduled and coordinated with the Design and Construction Services Department.

6.0 SUBMITTAL PROCEDURES

6.1 SHOP DRAWINGS AND SUBMITTALS. The Contractor shall submit electronic copies of all submittals including shop drawings, working drawings or supplementary drawings to the City through Primavera Unifier for review by the Engineer for general conformance in accordance with MAG 105.2 and as modified herein. Refer to Article 2.7 of the Agreement for other information on shop drawings, product data and samples. Each submittal shall be numbered sequentially and shall be submitted as to cause no delay in the work.

A partial list of submittals has been provided below, and it is intended to provide the Contractor with the minimum of required submittals. This list may not be complete, and it may be revised from time to time as the project progresses. Additional submittals may be required throughout the duration of the project at the discretion of the Engineer.

The date when the Contractor provides the submittal(s) to Primavera Unifier shall be included in the Contractor's schedule using a distinct schedule activity ID number for each submittal. All submittals shall have assigned due dates. Due dates shall correspond with the approved CPM schedule start dates for related activities allowing a minimum of fifteen (15) calendar days, or otherwise specified in the Technical Specifications, for the Engineer's review as well as adequate time for fabrication and delivery of the material. The Engineer and the City of Phoenix shall not be held responsible for late or inadequate submittals provided by the Contractor. Failure to submit by the submittal date may result in withholding of payment either in part or in full until the submittals are received. **Materials shall not be incorporated into the work without the submittal reviewed and approved by the Engineer or the material certification reviewed and approved, by the City of Phoenix Materials Laboratory.**

Below please find a list of submittals to be provided to the Engineer, Airport Operations and the City of Phoenix Project Manager prior to receiving an NTP.

Contract Reference Number	**Submittal Description**
N/A	A list designating those portions of the work to be performed by subcontractors and the Contractor's own forces
N/A	A list of subcontractors and material suppliers with an experience statement
N/A	Written safety and security program for the work
N/A	Copy of all executed subcontracts, including material suppliers
N/A	A list of proposed construction equipment with specification details for the following: the asphalt milling machine(s) and the asphalt concrete paver(s) including grade control apparatus, compaction equipment, the asphaltic concrete batch plants (if portable and onsite), light plants, etc. Also, the concrete paver (s) including cure application equipment, structural concrete vibration equipment, the asphaltic concrete paver, compaction equipment, the concrete batch plants.
N/A	Temporary fencing plan for Contractor's staging area.
Information to Bidders No 14	Certification that the control points set by the Engineer are acceptable and adequate to allow for construction staking
Article 2.4.5	Preliminary CPM Contractor's construction schedule
Article 2.4.5	A schedule of values
TSP Paragraph 1.1	A landside barricade plan and traffic control plan for each phase of construction
TSP Paragraph 1.3	Video tape and written report of the conditions of existing facilities, documenting the results of the inspection performed prior to the start of the work
TGP Section 100	Contractor's quality control plan, to be submitted 10-days prior to the pre-construction conference
M-003	A detailed lighting plan for night work
M-003	Contractor's emergency names and phone number list
M-003	Request for runway or taxiway closing, 72-hours advance written notice
M-003	A detailed work plan for each phase and sub-phase of construction including controlling construction equipment and vehicular movements in the air operations area
M-003	A Contractor Safety Plan Compliance Document (SPCD) to indicate how the Contractor will comply with the Construction Safety and Phasing Plan (CSPP)
M-003	A security badge control plan
M-003	Security gate access plan
P-156(A)	Storm water pollution prevention plan notice of intent.
P-156(A)	Dust control plan
P-156(A)	Storm water pollution prevention plan, including certification of compliance form

Below please find a list of submittals to be provided to the Engineer and the City of Phoenix Project Manager on an ongoing basis throughout construction.

Contract Reference Number	Submittal Description
Information to Bidders No 38	Duplicate original certified payroll reports and statement of compliance, with sworn affidavits from the Contractor, submitted weekly
N/A	Three (3) week look-ahead project schedule at weekly construction meetings
N/A	Contractor's quality control records, including daily inspection reports and daily test reports, to be submitted daily
M-003	Request for runway or taxiway closing, 72-hours advance written notice
P-156(A)	Storm water pollution prevention plan inspection and maintenance reports, monthly submission required, or when precipitation exceeds 0.5-inches

Below please find a list of material submittals to be provided to the Engineer and the City of Phoenix Project Manager.

Contract Reference Number	Submittal Description
P-100	Certification from the Contractor's registered land surveyor or professional Engineer that the primary control established are acceptable and adequate to allow the Contractor's construction staking to meet the accuracy requirements of the specifications. Survey Control Verification Letter of acceptance to be delivered 5 days after notice to proceed.
P-152	In place density moisture test results per ASTM 1556
P-153	Controlled low strength material (CLSM) mix design with test data
P-156(A)	Storm water pollution prevention plan notice of termination
P-156(A)	Storm water pollution prevention plan BMP materials to be incorporated into the work
P-209	Certified lab test results for the P-209 crushed aggregate base course
P-209	Material gradation, fractured face(s), percentage of wear, Atterberg Limits, and sodium sulfate soundness loss for crushed aggregate base course
P-209	In place density moisture test results per ASTM 1556
P-401	Course aggregate gradation and lab test results
P-401	Fine aggregate gradation and lab test results
P-401	Mineral Filler data (if used in mix design)
P-401	Asphalt binder lab test results
P-401	Mix design and certified lab test results
P-401	Quality Control Test Results
P-501 (if used)	Portable weather station
P-501 (if used)	Portland cement concrete pavement mix design
P-501 (if used)	A letter of certification for any admixture used in Portland cement concrete pavement
P-501 (if used)	A letter of certification for Portland cement concrete pavement curing compound(s), together with a material safety data sheet(s)
P-501 (if used)	28-day ASR Testing Results
P-501 (if used)	A letter of certification stating that all dowel bars used meet the requirements of the contract documents
P-501 (if used)	Dowel Bars

P-501 (if used)	Certification of compliance signed by the pozzolan supplier identifying the pozzolan and stating the pozzolan delivered is bearing the name and brand of the supplier, the type and source of the pozzolan
P-501 (if used)	Course aggregate gradation and lab test results
P-501 (if used)	Fine aggregate gradation and lab test results
P-501 (if used)	Cement Material Data
P-501 (if used)	Fly Ash Material Data
P-501 (if used)	Mix design and certified lab test results
P-501 (if used)	Quality Control Test Results
P-501 (if used)	A new copy of the sealed and certified weighing and metering devices used for the purpose of proportioning Portland cement, sealed and certified as to accuracy and tolerance prescribed by the weights and measures division of the state of Arizona.
P-603	Certification of compliance for bituminous tack coat requirements
P-604	Certification of compliance for compression joint seal requirements
P-605(A)	Certification of compliance for joint seal filler requirements
P-606	Certification of compliance for adhesive compounds for sealing wire and in pavement lights
P-610	Structural Portland cement concrete mix design(s) and lab test results
P-610	A letter of certification for any admixture used in structural Portland cement concrete
P-610	28-day ASR Testing Results
P-610	Course aggregate gradation and lab test results
P-610	Fine aggregate gradation and lab test results
P-610	Cement Material Data
P-610	Fly Ash Material Data
P-620	Manufacture's certified test reports for all paint shipped to the project
L-100	Shop drawings and material lists of manufacturer’s brochures containing complete dimensional and performance characteristics, installation and operation instructions, etc. for each L-series item, including the FAA specification number, the manufactures name, the manufactures catalog number, and the size, type and/or rating of each item
L-100	Materials list shall be submitted listing each specification paragraph number and stating whether the materials proposed are as specified or are substitutions
L-100	Light bases extensions and rings, blank cover plates and flange rings for L-867/868 bases, transformer housings and junction bases
L-108	Pre-testing results for all cable on the reel prior to installation per FAA-C-1217, Section 5.3 and FAA-C-1391, Section 4.
L-108	Submittal for the bare copper grounding and counterpoise conductor and grounding rods
L-110	Encased and direct bury conduit
L-110	Conduit fittings
L-110	Conduit carrier fittings
All Electrical Installations	Shop drawings shall be submitted showing the installation requirements, such as the foundation size, anchor bolt location, etc. and sign assembly, including all fabrication assembly and internal and external wiring diagrams; tabulation of total volt-ampere (VA) for each light for all guidance signs, the PAPI-4 and similar electrical installations.

General	Manufactures statement of warrantee for each item used on the project.

Below please find a list of submittals to be provided to the Engineer and the City of Phoenix Project Manager at project completion.

Contract Reference Number	**Submittal Description**
N/A	Contractor's affidavit regarding settlement of claims
N/A	Submit a disadvantaged business enterprise (DBE) utilization percent obtained for the project
N/A	Original affidavit acknowledging that all subcontractors, material suppliers, payrolls, bills for materials and equipment, and other indebtedness connected with the work have been paid or otherwise satisfied
N/A	A written consent of the surety to final payment
N/A	Record drawings with a written certification that the drawings are accurate and complete, due at substantial completion
N/A	An Original, with Notary Signature, Full and Final Release and Waiver on Liens from the Contractor and for each subcontractor and material supplier that documents that they have been paid in full
N/A	A lien release documenting that all subcontractors and material suppliers have been paid for the previous months work
N/A	Certificate of final completion
N/A	Written warrantee, due at final completion
TSP Paragraph 6.1	Compact disk containing all the information contained in the submittals. The information shall be submitted in Acrobat Reader PDF format. Cut sheets, shop drawings, and pages from suppliers catalogs must also be furnished in electronic format as indicated above
TSP Paragraph 4.1	A video tape and written report documenting the results of the inspection performed prior to the start of the work

The Contractor shall submit a detailed log of all submittals (e.g., mix designs, material certifications) and shop drawings as required by the Civil and Electrical Technical Specifications and elsewhere in these contract documents. The listing can be developed in a spreadsheet format and shall include:

a. Specification item number

b. Item description

c. Description of submittal

d. Specification paragraph requiring submittal, and

e. Scheduled date of submittal to be returned to Contractor

The Contractor shall certify each submittal and shop drawing by providing an original signed and dated letter to the City, that he has reviewed and approved the submittal and that it conforms to the requirements of the contract documents.

If this original certification is not included, the submittal and/or shop drawing will be returned without any action by the City. At the time of each submittal, the Contractor shall define and delineate in writing on the certification, any deviations from the contract documents.

The City's review will be only for general 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 City will not relieve the Contractor from responsibility for any errors or omissions in the submittal or shop drawings, nor from his responsibility for complying with the contract documents.

After all submittals and shop drawings are reviewed, the Contractor shall furnish a compact disk read only memory (CD ROM) containing all the information contained in the submittal. The information shall be submitted in Acrobat Reader PDF format. Cut sheets, shop drawings, and pages from suppliers catalogs must also be furnished in electronic format as indicated above, or otherwise approved by the City.

7.0 STORM WATER POLLUTION PREVENTION PROCEDURES

Refer to the Civil Technical Specification Item P-156(A).

8.0 CONSTRUCTION QUALITY CONTROL

Refer to Technical General Provision Section 100 Contractor Quality Control Program.

9.0 TEMPORARY FACILITIES AND CONTROLS

9.1 WATER. All water required for and in connection with the work to be performed shall be provided by the Contractor and at the Contractor's expense. The Contractor shall arrange for the installation of an appropriate meter and bear the cost of such installation and the cost of the water.

When the Contractor needs a temporary waterline to the staging area, he shall coordinate the temporary waterline installation with the City of Phoenix Aviation Department Inspection Staff. There shall be no separate pay item for the construction of temporary water lines. These costs shall be included in items for which direct payment is made.

Prior to the actual water line shut down, the Contractor shall follow the following sequence of events:

a. Construct all new waterlines, except for connections to existing water lines.

b. Test the new water line in accordance with MAG and the City of Phoenix Supplemental specifications.

c. Demonstrate that all fittings and waterlines are on site available to connect the new waterline to the existing waterline.

d. Notify all customers in writing who will be out of water.

e. Notify the Fire Department of possible low pressures to fire lines and satisfy Fire Department requirements.

f. Complete the connection of new proposed waterline under this Contract, to existing, with a minimum of disruption to the waterline system.

9.2 POWER. All power for lighting, operation of Contractor's plant or equipment, or for any other use as may be required in the execution of the work to be performed under the provisions of these contract documents shall be provided by the Contractor at his expense. Subject to the approval of the City, he *may* be permitted to connect to existing facilities where available, but he shall meter and bear the cost of such power.

Should electrical power not be immediately available for the Contractor's field offices, batch plant or the engineer's field offices and testing laboratories, the Contractor shall provide a generator(s) until such electrical power is available.

9.3 PROJECT FIELD OFFICES. During the performance of this Contract, the Contractor shall maintain suitable offices, laboratories and testing facilities at the Airport project site (specific site is shown on the plans) that shall be the headquarters of his representative authorized to receive drawings, instructions or other communication or articles.

The Contractor shall be responsible for maintaining the offices and all facilities and equipment therein in good working condition for the full duration of the project. All utility costs shall be the responsibility of the Contractor as well as any fees for permits, cleaning services, sanitary, water, electrical, phone and gas hookups, installation charges, etc.

Any communication given to the said representative or delivered at Contractor's office at the site of the work in his absence shall be deemed to have been delivered to the Contractor. Copies of the drawings, specifications and other Contract Documents shall be kept at Contractor's office at the site of the work and available for use at all times.

Refer to Civil Technical Specification M-002 for project requirements for the Engineer’s field offices and concrete testing facilities.

9.4 TELEPHONE SERVICE. Contractor shall make all necessary arrangements with the telephone utility for telephones in his offices at the site and separate telephones in the office of the Engineer. The Contractor shall pay all monthly charges therefore, including long-distance calls from the office of the Engineer, not to exceed $250.00 per month. Refer to Civil Technical Specification M-002 for telephone service requirements.

9.5 SANITARY FACILITIES. The Contractor shall furnish temporary sanitary facilities at the site, as provided herein, for the needs of all construction workers and others performing work or furnishing services on the project. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest

practical extent. If toilets of the chemically treated type are used, at least one (1) or more toilets will be furnished at each secured site, as required by the Arizona State Department of Health Services. The Contractor shall enforce the use of such sanitary facilities by all personnel at the site.

For construction phases or sub-phases where the work hours are limited and the area is to be re-opened at the end of the work shift, the Contractor shall provide mobile chemically treated facilities to be mobilized and demobilized to the work area daily.

9.6 PARKING. The Contractor shall provide and maintain suitable off-site parking areas outside of the Air Operations Areas for the use of all construction workers and others performing work or furnishing services in connection with the project, as required to avoid any need for parking personal vehicles where they may interfere with public traffic, aircraft and Owner's operations, or construction activities. A preliminary parking area is shown on the plans, however the final location of the Contractor's parking area will be determined in the pre-construction conference. The Contractor shall restore all parking areas to original (pre-construction) condition, including fence, gates and ground surfaces following all construction activities. See also Civil Technical Specification M-003 AIRPORT SAFETY AND SECURITY Section M-003-6.3 VEHICLE PARKING.

10.0 TEMPORARY ENVIRONMENTAL CONTROLS

10.1 STORM WATER POLLUTION PREVENTION PROGRAM. Refer to the Civil Technical Specifications Item P-156(A).

10.2 LEAD BASED PAINT AND OTHER ENVIRONMENTAL ISSUES. The Aviation Department has identified lead-based paint and the potential for jet fuel contamination of the subgrade as potential environmental issues on this project. **The City of Phoenix environmental staff will remove lead-based paint prior to pavement removal at affected taxiways as well as any lead based paint removal required at taxiway hold lines. Environmental staff will also be responsible for the removal of any subgrade soil contaminated by jet fuel.**

The contractor shall make arrangements with the City of Phoenix environmental staff to inspect subgrade conditions during the pavement removal process and trenching for electrical conduits. In the event of suspension of work pursuant to this Special Provision, the Contractor may be entitled to an adjustment of contract time.

If satisfactory fulfillment of the Contract involves alterations to the contract time that affect the Contractor's completion time, the Contractor may request a supplemental agreement that extends that Contract time. The supplemental agreement shall be in the form of a Request for Extension of Contract time and shall include the Contractor's revised schedule and all other pertinent data. The request shall show why an increase of Contract time is warranted.

An extension of contract time will not be considered unless the work affected by an environmental issue and suspension of a construction activity becomes a critical item on the Contractor's CPM schedule.

10.3 DISPOSAL OF SURPLUS MATERIAL WHICH DOES NOT CONTAIN ASBESTOS. No measurement or direct payment will be made for the hauling and disposal of surplus and/or waste material, the cost shall be incidental to the cost of the project. All surplus and/or waste material shall be disposed of by Contractor, at and off-site location such as a landfill, subject to the following conditions:

a. If the City of Phoenix or Goodyear landfills are used, the Contractor shall pay the normal dumping fee.

b. If private property within the City of Phoenix, Goodyear or other incorporated City limits is used, the Contractor shall obtain written permission from the property Owner and deliver a copy of this Agreement to the Engineer prior to any hauling or dumping. All disposal and grading shall be in strict conformance with the City's Grading and Drainage Ordinance. The Contractor shall obtain and pay for the necessary permit(s).

c. If the surplus material is disposed of outside of the City limits, the Contractor shall comply with all applicable laws/ordinances of the agency concerned and be responsible for all cost incurred.

11.0 MISCELLANEOUS CITY OF PHOENIX MODIFICATIONS TO MAG TECHNICAL SPECIFICATIONS

11.1 ALUMINUM MANHOLE COVERS. The Water Services Department has the following stated policy, "MAG Standard Detail 425, 24-inch aluminum manhole frame and cover is not approved by the City of Phoenix.

11.2 GRAY IRON CASTINGS. Delete subsection 787.7 Asphaltum Coating of MAG Specifications.

11.3 MODIFICATION TO MAG UNIFORM STANDARD DETAIL 522, MANHOLE SHAFT. Reference note 5, which calls for installation of manhole steps as required by the agency. The Engineering and Architectural Services Department has adopted the policy that manhole steps are not to be installed in any storm sewer manhole. If steps are provided, they shall be removed and the hole filled with non-shrink grout.

12.0 WORK DONE BY CITY FORCES

There are items of work that are to be performed by the City that the Contractor will have to build into his schedule. This includes paint removal of any paint containing lead, prior to pavement removal, and asbestos testing of the concrete. It is anticipated that the paint removal will take several working days and will need to be completed prior to PCCP removal and before temporary marking of pavement. Coordination between the Contractor and City is a non-pay item.

13.0 UTILITY LOCATING (ALLOWANCE)

See Civil Technical Specification U-200.

14.0 EXISTING UTILITY RELOCATION AND UNFORESEEN ELECTRICAL CONDITIONS (ALLOWANCE)

The Existing Utility Relocation and Unforeseen Electrical Conditions item is provided for the purpose of encumbering funds to cover the costs of utility relocations (monitoring wells, injection well water lines, etc.), adjusting to grade monitoring wells or associated equipment or modifications needed to complete electrical work. This item will be used to relocate any existing utility that is in conflict with the proposed pavement section, exclusive of the subgrade preparation. This item may also be used to address electrical issues. The amount of the allowance is determined by the Owner and is not subject to individual bid pricing. All bidders shall incorporate the amount pre-entered in the bid proposal and shall reflect the same in the total amount bid for this project. It shall be understood that this allowance is an estimate only. It is further understood that authorized work, if any, may be less than the allowance item. The Existing Utility Relocation and Unforeseen Electrical Conditions item will be measured and paid for based on the actual costs billed to the project by the utility agency or contractors used to complete the work as deemed necessary by the Owner.

Payment will be made under:

Item SP-14.1 Relocation of Existing Utilities and Unforeseen Electrical Conditions (allowance) – per Allowance

15.0 EXISTING MONITORING WELLS, WATER SERVICE LINES, AND UTILITIES PROTECTION

This item shall consist of protecting existing monitoring wells, service lines and utilities in the project area. There are monitoring well systems, including service piping and grade mounted boxes in the project area. It is estimated that the piping for these wells is located 30 inches below the existing finished grade. The Contractor shall hand dig to expose the existing slurry encasement of the piping, or the pipe if not slurry encased. The slurry or pipe bedding shall remain intact at the top of the proposed subgrade level. The location of the service lines shall be clearly marked and identified. Heavy equipment traffic shall not be permitted over these lines and the Contractor should use extreme caution when driving any type of equipment over or in the vicinity of these water line trenches.

All utilities in the project area shall be located and clearly identified in the field. Modifications to the depth of the subgrade compaction will be determined by the Engineer.

Should the Contractor damage or interrupt any operation of any utility service or facility by accident or otherwise, he shall immediately notify the proper authority and the Engineer and he shall take all reasonable measures to prevent further damage or interruption of service. The Contractor, in such events, shall cooperate with the utility service or facility owner and the Engineer continuously until such damage has been repaired and service restored to the satisfaction of the utility or facility owner.

The Contractor shall bear all costs of damage and restoration of service to any utility service or facility due to his/her operations whether due to negligence or accident. The Owner reserves the right to deduct such costs from any monies due or which may become due to the Contractor or his/her surety.

Prior to commencement of the project, the Contractor shall contact the Goodyear Tire and Rubber Company (GTRC) to test the monitoring and injection well system. GTRC will also test the system after completion of the unclassified grading and drainage excavation, subgrade preparation, the placing of aggregate base courses and prior to paving.

There will be no separate measurement or payment for Existing Monitoring Wells, Service Lines, and Utilities Protection, the cost for which shall be considered incidental to other items of work.

16.0 SOIL CONDITIONS

The Geotechnical Investigation Report and Laboratory Analysis for this project was prepared by Ninyo & Moore, dated March 21, 2018. The report contains existing pavement thickness summaries, laboratory test summaries along with asphalt core data and graphical bore logs, subgrade treatment recommendations, and new pavement design options.

This report provided a pre-design analysis on existing pavement thickness and subsurface soil conditions, and this information is shown on the plans. However, this information shall not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by borings, corings, cross sections or discussion of the subsurface conditions contained in the reports. The Geotechnical services were provided, the findings obtained and recommendations were prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

END OF SPECIAL PROVISION SPECIFICATIONS

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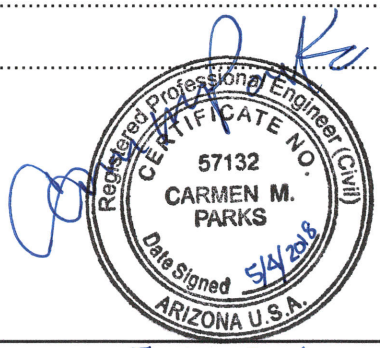
SECTION III-3
CIVIL TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS

Item	Description	Page
M-001	Mobilization/Demobilization	M-001-1
M-002	Engineer's Field Offices and Concrete Curing Facility	M-002-1
M-003	Airport Safety and Security	M-003-1
P-100	Contractor Quality Control and Construction Surveys	P-100-1
P-104	Removal of Existing Pavement and Other Items	P-101-1
P-151	Clearing and Grubbing	P-151-1
P-152	Excavation, Subgrade, and Embankment	P-152-1
P-153	Controlled Low Strength Material (CLSM)	P-153-1
P-156(A)	Temporary Air and Water Pollution, Soil Erosion, and Siltation Control	P-156(A)-1
P-209	Crushed Aggregate Base Course	P-209-1
P-401	Hot Mix Asphalt (HMA) Pavements	P-401-1
P-501	Portland-Cement Concrete Pavement	P-501-1
P-603	Bituminous Tack Coat	P-603-1
P-604	Compression Joint Seals for Concrete Pavements	P-604-1
P-605(A)	Joint Sealing Filler	P-605-1
P-606	Adhesive Compounds Two Component for Sealing Wire & Lights in Pavement	P-606-1
P-610	Structural Portland Cement Concrete	P-610-1
P-620	Runway and Taxiway Painting	P-620-1
P-620(A)	Airfield Paint Removal	P-620(A)-1
U-200	Location of Underground Utilities	U-200-1



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ITEM M-001 MOBILIZATION/DEMOBILIZATION

DESCRIPTION

001-1.1 GENERAL. Mobilization/Demobilization shall consist of preparatory work and operations, including but not limited to, installation of staging area(s) temporary utilities, the movement of personnel, equipment, materials, supplies and incidentals to the project site, and for transportation of buildings, quality control personnel, laboratory field testing equipment, field and engineering offices and tools, testing supplies, haul roads and other facilities necessary to complete the work on the project including providing one (1) or more staging areas with temporary security fence and gate(s). This item is also for the Contractor's operation and material storage for the Contractor. This item is for other work and operations that the Contractor must perform or costs he must incur before beginning work on the project, and for necessary work and costs in completing the construction and demobilizing from the site.

Demobilization costs will include, but not be limited to, removal of temporary utilities to the staging areas removal of temporary field offices and materials laboratories, demobilization of equipment, and the clean-up and restoration of the construction staging area and materials laboratories locations.

001-1.2 CONTRACTOR'S STAGING AREA AND FIELD OFFICE LOCATION. The proposed staging area is shown on the plans. Phoenix Goodyear Airport (GYR) may designate a different but equivalent area prior to occupancy by the Contractor. This area shall be used for the Contractor's operations, the storage of materials, and equipment parking. The staging area shall be kept in a neat and orderly condition at all times. Stockpiling of materials in the staging area(s) shall be kept below all Federal Aviation Regulation (FAR) Part 77 surfaces. Equipment shall only be parked in retracted and lowered condition. The Engineer reserves the right to direct the Contractor to correct any deficiencies in the maintenance of the staging yard and the Contractor shall promptly comply with the directives of the Engineer.

The Contractor's field offices, Engineer's field offices, and the laboratories shall be located in the staging area. The Contractor shall install six (6) feet high temporary chain link fence and gates around the staging area. A temporary fencing plan for the construction area showing the location of offices, equipment and material storage shall be submitted to the Engineer for approval prior to fencing this area. No separate measurement or payment will be made for the fence. This effort shall be part of Mobilization/Demobilization.

001-1.3 SPECIAL STAGING AREA REQUIREMENTS. Due to its location on the Airport and proximity to the GYR runway and taxiways, the following special requirements shall be adhered to:

a. Obstruction Lighting. Equipment of significant heights as determined by the Engineer shall be required to have red obstruction lights provided and maintained by the Contractor. The red obstruction lights shall be 100-watt fixtures, with 360-degree beam spread, in compliance with the Federal Aviation Administration (FAA) specification AC 150/5345-43, L-810. Refer to the Special Provision Specifications for red obstruction lighting.

b. Dust Control. The Contractor shall use all measure to control dust from equipment and stockpiles. Uncontrolled dust from the staging areas shall be grounds for suspension of operation until remedial measures are undertaken. The Contractor shall address dust control of

the staging areas in the dust control plan prior to commencing operations, in accordance with Item P-156. Vacuum sweeping equipment must be equipped and maintained by the Contractor such that excessive dust is not emitted while operating.

c. Material Delivery Limitations. Construction material delivery to the staging area(s) shall be restricted to the hours between 9:00 pm and 6:00 am (off peak hours only). This limitation does not apply to the more isolated deliveries of materials, such as dowel bars, rebar, and expansion joint material. Refer to Technical Special Provision 1.1 for Landside Traffic Control and Regulations, barricade requirements and hauling limitations.

d. Landside Traffic Control. Refer to Technical Special Provision Paragraph 1.1 a. through 1.1 g.

e. Protection and Restoration of Staging Area. The Contractor shall be responsible for all damage or injury to property of any character, in accordance with MAG General Condition Specification 107.9. The Contractor shall protect all existing utilities, fencing, concrete curb, sidewalk and other facilities at the staging area.

f. Dust Palliatives-Soil Areas. If the contractor's staging areas are in unpaved areas, the Contractor shall apply a dust palliative to the soil in the area, in accordance with City of Phoenix/Maricopa County dust abasement regulations prior to substantial completion.

g. Mobile Telephones. As required by the Construction Safety and Phasing Plan and Item M-003 Airport Safety and Security, the Contractor's and each subcontractor's on-site superintendent, and foreman shall have mobile telephones. All mobile telephones shall have a 480, or a 602, or a 623 area code. The mobile telephone numbers shall be provided to the Engineer.

METHOD OF MEASUREMENT

001-2.1 Mobilization/Demobilization shall be measured for payment by the lump sum as a single complete unit of work. The Engineer's Field Office, Laboratory Offices, Laboratory Curing and Testing facilities will be measured separately under Civil Technical Specification Item M-002.

001-2.2 Refer to Technical Special Provision 1.1; the measurement and payment for Uniformed, Off-duty Law Enforcement Officers is incidental to Item M-003.

BASIS OF PAYMENT

001-3.1 Payment for the performance of the Mobilization/Demobilization work as specified above will be made at the contract lump sum price for the item Mobilization/Demobilization. Mobilization/Demobilization shall not exceed five (5) percent of the total construction costs as bid. Total "as bid" construction costs includes the mobilization/demobilization costs. This item shall include the movement of all personnel, all equipment, the establishment of all haul roads, temporary utilities for the staging area, restoration and protection of the site(s), providing and for maintaining temporary fence, gates and incidentals.

Partial payments under this item will be made in accordance with the provisions of Table 1.

TABLE 1 – Payment Schedule for Mobilization/Demobilization.

Mobilization/ Demobilization Payment Numbers	Percent Payment (see Footnote No. 1)	Partial Payment Requirements
1	25% of Lump Sum Amount	After the pre-construction conference, provided that submissions required are provided to the satisfaction of the Engineer and the Engineer Field Office and Laboratory office are functional with equipment and supplies and the Critical Path Method Part I schedule has been submitted. The first payment for mobilization/demobilization shall be contingent upon the engineer receiving the Quality Control Program at least five (5) working days before the pre-construction.
2	25% of Lump Sum Amount	When the Engineer has determined that a significant amount of equipment has been mobilized to the project site which will be used to perform the Contract work. The second payment for mobilization/demobilization shall be contingent upon the Contractor submitting the revised Quality Control Program to the Engineer for review and approval.
3	25% of Lump Sum Amount	On the first progress payment application following completion of five (5) percent of the contract amount.
4	25% of Lump Sum Amount	On the first progress payment application following completion of ten (10) percent of the contract amount.

1. If the price of Mobilization/Demobilization exceeds five (5) percent of the total construction costs as bid, any excess will be paid to the Contractor upon substantial completion of the project.

Payment will be made under:

Item M-001-3.1 Mobilization/Demobilization (Maximum of 5%) – per lump sum.

END OF ITEM M-001

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ITEM M-002 ENGINEER'S FIELD OFFICES, CURING AND TESTING FACILITIES

DESCRIPTION

002-1.1 GENERAL. This item shall consist of furnishing, maintaining and providing a weekly cleaning of a new Engineer's field office, a laboratory office and laboratory testing facilities for the exclusive use of the Engineer, in weatherproof building hereafter described, at locations approved by the Engineer. Unless otherwise approved, the buildings shall be independent of any buildings used by the Contractor and all keys to the buildings shall be turned over to the Engineer.

FIELD OFFICE, LABORATORY CURING AND TESTING FACILITIES.

002-2.1 FIELD OFFICE. The Contractor shall furnish space in one (1) building for the exclusive use of the Engineer as a field office. The building shall be furnished and maintained by the Contractor as specified herein and shall become property of the Contractor when the contract work is completed.

The offices shall be durable, waterproof, dust tight and securable.

The field office shall have ceiling heights of not less than eight (8) feet and a floor space of not less than 720 square feet. The field office shall have at least two (2) office rooms. Conference rooms for the Engineer will be the same as used by the Contractor and shall be large enough to accommodate twenty (20) people for meetings and conferences. The offices shall be provided with sufficient heat, natural and artificial light and air conditioning to maintain thermostatically controlled temperatures between sixty (60) and eighty (80) degrees Fahrenheit. Doors and windows shall be equipped with locks approved by the Engineer, and windows shall contain wrought iron security coverings and blinds. Suitable sanitary facilities meeting Federal, state and local health department requirements shall be provided and maintained and cleaned daily. Bathrooms shall be stocked with lavatory and sanitary supplies at all times during the period of the Contract.

A six (6) feet high chain link fenced area to accommodate at least ten (10) parked vehicles on pavement or aggregate base materials with a double twelve (12) feet lockable gate shall be provided by the Contractor. The Engineer will approve the location of the office(s).

Field offices that are provided by the Contractor must be new and the layout approved by the Aviation Department and the City of Goodyear. They shall be securely blocked and tied down per the manufacturer's recommendations.

In addition, the following equipment and furniture meeting the approval of the Engineer shall be furnished for the Engineers Field Office:

TABLE 1 – Engineer's Field Office Equipment and Furniture.

Quantity	Description of Item or Items
2	Desks (2.5-feet by 5-feet) with armed swivel desk chairs
4	Three shelf bookcases (each shelf to accommodate at least 12" high binders)
2	Four-drawer legal file cabinets
4	Folding tables (2.5-feet by 5-feet)
16	Folding padded chairs
1	Telephone system with basic telephone services
3	Telephones
4	Phone lines (3 for phones and 1 for fax)
1	Equipment cabinet with lock (36-inch by 72-inch by 15-inch minimum)
1	Carbon dioxide fire extinguisher (as required by code for office and copiers)
1	First aid kit (as required by code)
1	Smoke detector (as required by code)
1	Electric water cooler hot and cold dispenser with water and cups supplied as needed.
2	Trash cans (1.2 cubic feet minimum capacity)
1	Plain paper fax machine Panafax UF-550 or approval and paper supplies
1	Copy machine, Sharp AR-337 or approved equal, with 20 bin sorter or approved equal with document feeder with reduction and enlargement, auto document feeder and 20 copy sorting capability and paper supplies for 2,000 combined copies of 8½-inch by 11-inch, 8½-inch by 14-inch and 11-inch by 17-inch per month. Provide service contract/warranty (including toner and replacement cartridges) and maintenance contract for the duration of the Engineer's field office. Supply paper as needed.
1	Ten digit printer desk calculator with printer ribbons
1	Dry erase board, 4-feet by 6-feet (with one set of four markers, eraser, and cleaner)
1	Wall-mounted electric clock
1	Identifying exterior sign, 24-inch by 36-inch minimum, professional lettered with wording acceptable to the Engineer for Field Office
2	Pole mounted fixtures, 1,000 W each, with photo cell control for parking lot lighting security
2	Digital Subscriber Line (DSL) High Speed Internet Connections
1	Refrigerator/freezer, 14 cubic feet
1	Microwave oven
2	Uninterruptible Power Supplies (Battery Backup Units for Computers)
As Needed	Cubed or crushed ice for inspection staff continuous usage

The field office building(s), equipment, materials and furnishings, shall remain fully operational and maintained on the job site until thirty (30) calendar days after substantial completion, unless released at an earlier date by the Engineer.

002-2.2 LABORATORY CONCRETE CURING AND TESTING FACILITY. For the purpose of curing and testing of concrete beams and cylinders, the Contractor shall furnish and maintain a Laboratory Concrete Curing and Testing Facility. This facility shall include furnishing and maintaining curing tanks and a hydraulic concrete testing machine(s) for beams and cylinders. All equipment and supplies shall be furnished and conform to the applicable ASTM standards for curing and testing concrete beams and cylinders. The concrete break machines shall be new, and calibrated and certified after setup in the laboratory facilities. A copy of the concrete break machine certification shall be provided to the Engineer. The Laboratory Concrete Curing and Testing Facility shall be located within or adjacent to the project area subject to the approval of the Engineer. The size of the facility shall be sufficient to store and protect all concrete beams and concrete cylinders in the curing process at any time, and shall be a minimum of seven hundred twenty (720) square feet.

The Laboratory Concrete Curing and Testing Facility shall be provided with satisfactory heat and air conditioning, electrical lights and electrical outlets with adequate voltage and water, as needed for the proper curing of the beams and cylinders.

The Laboratory Concrete Curing and Testing Facility shall remain fully operational and maintained on the job site until all concrete beam and cylinder acceptance tests have been performed following final project acceptance, unless released at an earlier date by the Engineer.

The Contractor shall provide continuous maintenance and refuse removal and disposal. Weekly cleaning and janitorial services shall be provided. The Contractor shall provide all supplies to maintain a functional concrete curing facility for the full duration of the contract.

002-2.3 TEMPORARY UTILITIES. The contractor shall make all arrangements, obtain any necessary permits, install utilities and pay for all installation fees and all monthly billings for the following utilities for the Engineer's Field Office and the Laboratory Concrete Curing Facility.

a. Arizona Public Service or Salt River Project

b. Temporary generator if APS/SRP service are not provided

c. CenturyLink Communications

d. City of Goodyear Water and Wastewater Services

The Contractor shall coordinate and arrange with the appropriate utility owner to install temporary service or connect to existing service. Where the company provides only part of the service, the Contractor shall provide the remainder with matching, compatible materials and equipment; comply with the company's requirements. All work and costs associated with installing and maintaining utilities shall be the responsibility of the Contractor. In the event that the electrical power is not available or initially available for the field offices and testing equipment, the Contractor shall provide generators until such permanent electrical power is available.

METHOD OF MEASUREMENT

002-3.1 This item shall be measured as one lump sum for providing an Engineer's Field Office, a Laboratory Office, and a Laboratory Concrete Curing and Testing Facility, in accordance with this specification.

BASIS OF PAYMENT

002-4.1 Payment for providing the Engineer's Field Office, and Laboratory Concrete Curing and Testing Facility fully equipped as specified herein shall be made at the contract lump sum price bid, which price and payment shall be full compensation for furnishing and maintaining the Offices and Concrete Curing and Testing Facility.

Payment will be made as follows:

a. First Pay Estimate. Sixty percent (60%) of the amount provided in the bid proposal will be paid with the first estimate after the Engineer's Field Office, Laboratory Office, and Laboratory Concrete Curing and Testing Facility are completely furnished and operational to the Engineer's satisfaction.

b. Remainder. The remaining forty percent (40%) will be paid in approximately equal monthly payments based on the duration the Engineer's Field Office, Laboratory Office, and Laboratory Concrete Curing and Testing Facility will be used by the Engineer.

Payment will be made under:

Item M-002-4.1 Engineer's Field Offices and Concrete Curing and Testing Facility – per Lump Sum

END OF ITEM M-002

ITEM M-003 AIRPORT SAFETY AND SECURITY

DESCRIPTION

003-1.1 GENERAL. The Contractor shall carry out their operations in a manner that will cause a minimum of interference with air traffic, and shall cooperate with the FAA, Phoenix Goodyear Airport GYR, and other Contractors working in the area.

All work shall be completed in accordance with the Construction Safety and Phasing Plan (CSPP) adopted for the project, the Contractor prepared Safety Plan Compliance Document (SPCD), and the FAA Advisory Circular 150/5370-2G.

Phasing of the work will be necessary to minimize impacts on airport operations during construction. The GYR priorities for phasing of the work are shown in the CSPP Appendix E, Exhibit B.

Runway 3/21 will be closed when working in the Runway Safety Area (RSA). Construction within the RSA shall take place during night time airport closures between 2100 hours and 0600 hours Sunday through Thursday nights. The airport operations personnel will provide “Lighted X’s” to mark all runway closures in accordance with the provisions of the CSPP and the Construction Contract Documents. **All work within the Runway Safety Area will require that the runway be closed.** All requests for Taxiway and Runway closures are required to be submitted in writing to the GYR Supervisor at least 72 hours in advance.

The preparation of a Safety Plan Compliance Document (SPCD) by the Contractor to indicate how it will comply with the CSPP, the project Supplementary Conditions, Special Provisions and Civil Technical Specification M-003 Airport Safety and Security is included in the Contractor’s scope of work.

Any conflicts between the CSPP, the Contract Documents and M-003 Airport Safety and Security shall be reported to the Aviation Department Project Manager, GYR Aviation Supervisor and the Engineer of Record for resolution. Until resolved, the Contractor shall comply with the most stringent requirement.

The Contractor shall hold weekly airfield coordination meetings with GYR Airport Operations. The Contractor shall also submit a list of emergency names and phone numbers. Additionally, the Contractor shall meet with Airport Operations prior to the start of each shift to discuss the day’s anticipated work activities.

All vehicles shall have flashing amber lights in accordance with the CSPP and Item M-003. All vehicles shall be required to have the headlights and flashing amber lights on at all times while on the airfield.

The Contractor shall be required to supply, place, maintain, move and store the items listed herein, as appropriate, to facilitate construction and protect air traffic. The Contractor shall keep on site an adequate extra supply of these items.

MATERIALS

003-2.1 RED WARNING LIGHTS. Red warning lights shall be flashing lights meeting the requirements of the "Manual on Uniform Traffic Control Devices for Streets and Highways" for Type A and Type B flashers or as shown in the *Airport Construction Safety Manual*. All warning lights used on the airfield shall be RED only.

003-2.2 WARNING MARKERS. (For use on roadways and service roads only) Warning markers shall be the type and size detailed on the plans or shown in the CSPP. Markers shall be equipped with a red warning light per paragraph 003-2.1.

003-2.3 TEMPORARY RUNWAY/TAXIWAY CLOSED DEVICES AND SYMBOL. The airport operations personnel will provide "Lighted X's" to mark all runway closures. The closed devices shall be portable lighted "X", SWEEPSTER Model LX Runway Closure Marker conforming to FAA AC 150/5345-55A *Specification for L-893 Lighted Visual Aid to Indicate Temporary Runway Closure* or approved equal.

All other temporary closure symbols, including vinyl "X's", shall be painted or applied on the pavement surface in accordance with the CSPP, plans and Civil Technical Specification Item P-620.

003-2.4 LOW AND MEDIUM LEVEL BARRIER SYSTEMS. Medium and low-level barriers shall be the Airport Runway Safety Barricade Model AR-1 and AR-2 Multi-Barrier as manufactured by Off The Wall Products, LLC, or approved equal. The AR-1 barrier medium level sections shall be eight (8) feet long and two (2) feet high and the AR-2 low level barrier sections shall be eight (8) feet long and ten (10) inches high and shall have reflective sheeting on the side facing the active airfield. Both sections shall be interlocking and shall be ballasted with water to prevent damage from jet blast. Each barricade section shall be equipped with a Model: SL-H867R Solar Powered Safety lights as manufactured by Leotek Electronics USA Corp., or approved equal. The barriers shall be furnished, maintained and relocated during each phase by the Contractor, and at the completion of the Contract they shall become property of the City.

003-2.5 VACUUM SWEEPER. Vacuum Sweeper shall be Tymco, Model HSP-600 or Elgin Model Crosswind, or approved equal. A sweeper and operator shall be available at all times during construction activities.

003-2.6 SAFETY AREA SUPPORT. Reinforced structural steel plates, precast slabs or other approved material necessary to cover open excavation in the Runway Safety Area shall conform to Paragraph 003-5.1(1)(c)(i). Excavations that cannot be covered to provide the required protection shall be backfilled.

003-2.7 SECURITY CHECK POINTS AND CONTROLLED CROSSINGS. Provide as shown on the plans, in the CSPP, in Appendix A of the SPCD, and as detailed within this specification, the items necessary to control access to the Air Operations Area (AOA) through Entry Gate #2 and control crossings at active taxiways. These items include, but are not limited to the following:

1) Flaggers equipped for day time and night time operations;

2) Marking, symbols, barrier systems and warning markers in accordance with the CSPP and this specification;

RESPONSIBILITIES

003-3.1 CONTROL REQUIREMENTS. The Contractor's responsibilities for work areas are as follows:

1) The Contractor shall be held responsible for controlling his employees, subcontractors, and their employees with regard to traffic movement. The Contractor is required to submit a Safety Plan Compliance Document (SPCD) to indicate how he/she will comply with the Construction Safety and Phasing Plan (CSPP) and how he/she will safely operate within the AOA. This SPCD shall conform to Chapter 2, Safety Plans, *Operational Safety on Airports During Construction,* AC 150/5370-2G and the Aviation Department Airport Construction Safety Manual, June 2006. It shall be submitted and approved by the Airside Operations Manager before the commencement of any construction. Information needed for preparation of the SPCD is located in AC 150/5370-2G, the CSPP and at the end of this section.

2) The Contractor shall rebuild, repair, restore, and make good at his own expense all injuries or damages to any portion of the work occasioned by his use of these facilities before completion and acceptance of his work.

3) **The Contractor shall submit to the Engineer in writing a detailed work plan for each construction phase**. The work plan shall include, but not be limited to, paving sequence, marking sequence, maintenance of airfield electrical and NAVAID power and control circuits. This plan shall be submitted 14 calendar days prior to the start of each construction phase. **No work within the construction phase may commence until the phase work plan is approved.**

4) The Contractor shall submit to the Engineer in writing a plan, by construction phase, for controlling construction equipment and vehicular movements, including material haul roads, in the Air Operations Area (AOA). This plan shall be submitted at the Pre-Construction Meeting and prior to each construction phase. **No work may commence until this plan is approved by GYR Airport Operations.** The plan must include material haul roads.

5) The Contractor shall provide a responsible Traffic Manager whose duty shall be to direct all traffic on or near active runways, taxiways, haul roads, and highways. **Paved surfaces shall be kept clear at all times and specifically must be kept free from all Foreign Object Debris (FOD) which might damage aircraft.**

6) The Contractor shall prepare a security badge control plan for review by Airport Operations. The plan shall be submitted prior to or at the Pre-Construction Meeting. No work may commence until this plan is approved. The plan shall be prepared on the Contractor's company letterhead and signed by the company representative who is authorized to sign the badge applications. The plan shall describe in detail the Contractor's and/or subcontractor's plan to control badges.

7) The Contractor shall ensure that no personnel or equipment enters the active movement areas or their associated Object Free Areas without the appropriate

Airport Operations escort. **Access into movement areas or Object Free Areas without an Airport Operations escort is prohibited!**

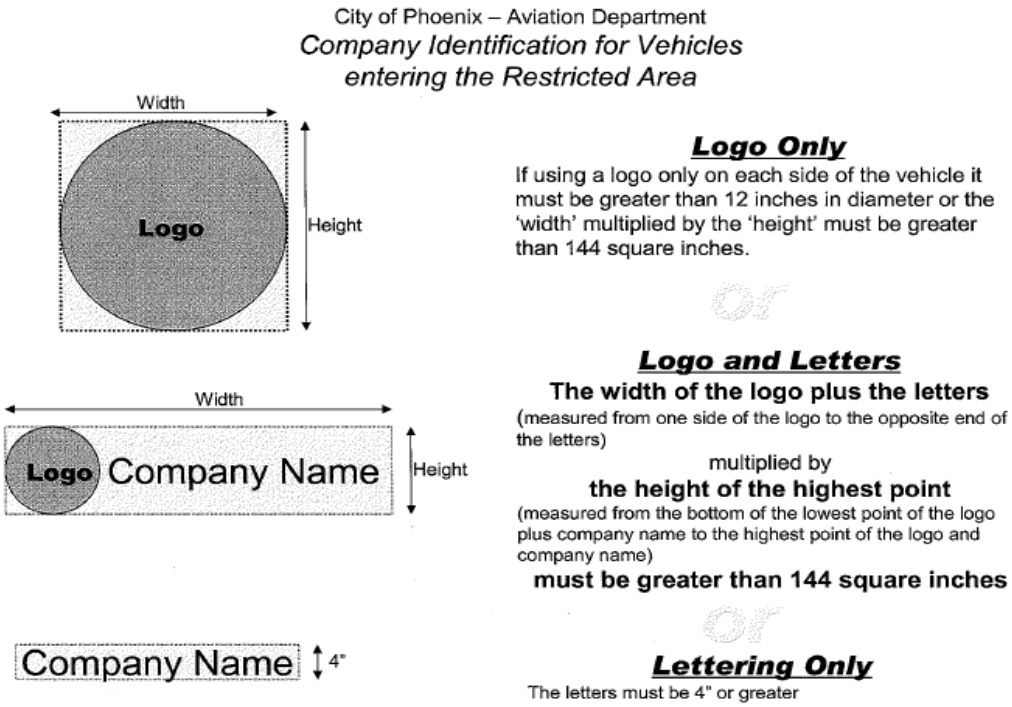
8) The Contractor will be required to coordinate his work so as to satisfy clearance requirements for arrival and departure of aircraft in compliance with the CSPP.

003-3.2 VEHICLE AND PEDESTRIAN CONTROL. Vehicle and access routes for airport construction shall be controlled as necessary to prevent inadvertent or unauthorized entry of persons, vehicles or animals onto Air Operation areas. No vehicle shall enter the AOA except at predetermined locations. The amount of construction traffic will require a flag person to control traffic crossing taxiways and other aircraft movement areas. Contractor personnel who operate vehicles in the AOA shall comply with the Airport Operations rules and regulations for vehicle marking, lighting, and operation. Failure to comply may result in contract non-compliance costs and Notice of Violation assessments, per paragraph 003-3.10.

003-3.3 CONTROL AND WARNING DEVICES. During construction operations near active taxiways or runways the Contractor shall furnish and maintain medium and low level barricades equipped with red warning lights along the edges of the runway and taxiway safety areas to warn construction equipment to stay clear of the active airfield pavement as well as warn pilots of areas having construction hazards. Per paragraph 003-2.4 barricades shall be equipped with red lights acceptable to the Airport Operations. The Contractor shall furnish and maintain warning markers with red warning lights along the edges of the runway safety area as designated and detailed on the plans. The Contractor shall maintain red warning lights and warning flags around all equipment, stockpiles, or other areas as directed by the Engineer and Airport Operations.

The Contractor shall provide the phone numbers of five (5) of its responsible personnel, including the project superintendent, and three (3) each responsible personnel, from the paving and safety subcontractors, each of whom may be contacted in an emergency. Personnel shall be on call 24 hours per day for maintaining construction hazard lighting and barricades. The Contractor shall employ watchmen to maintain and service all traffic control equipment. The project superintendent, foreman and on-site manager for the Contractor and all subcontractors shall have cell phones with a “602”, “480” or “623” area code.

003-3.4 VEHICLE MARKING AND IDENTIFICATION. All permitted vehicles operating in the AOA shall display in full view above the vehicle a 3' x 3' or larger, orange and white checkerboard flag, each checkerboard color being 1' square. Any vehicle operating on the AOA shall be equipped with a flashing amber dome-type light, mounted on top of the vehicle and of such intensity to conform to local codes for maintenance and emergency vehicles. All vehicles operating within the airfield boundary which are approved for unescorted access shall be identified with a painted or magnetic sign on each side of the vehicle bearing the name and logo of the company. The sign shall conform to the requirements below:



Rented or leased vehicles cannot be granted unescorted access unless the above signage is placed on it. All vehicles with unescorted access must have available for inspection, when entering the Restricted area or while in the Restricted area, the current registration and proof of insurance for the vehicle.

Vehicles making only occasional visits to the job site are exempt from the identification requirements contained above provided that the Airside Operations Manager is notified and a properly identified vehicle escorts them into, through, and out of the airport secured area. These and other vehicles needing intermittent identification may be marked with tape or with magnetically attached markers that are commercially available to meet identification size and content requirements.

003-3.5 VEHICLE TRAFFIC AND OPERATIONS. When any vehicle other than those approved for use in the AOA is required to travel to or from the work area or over any portion of the work area, shall be escorted by a vehicle properly identified to operate in the area and be provided with a flag on a staff attached to the vehicle. All construction vehicles/equipment shall have automatic signaling devices to sound an alarm when moving in reverse. All equipment shall be operated within the approved speed limits.

All vehicles and/or construction equipment operating inside the active AOA, but outside of the designated haul roads, shall be escorted by Airport Operations, who will maintain radio contact with the ATCT. Crossing the active runway shall not be permitted. Vehicular traffic routes which need to cross an active taxiway shall be coordinated in advance (at least 72 hours) with Airport Operations to ensure that proper Notices to Airmen (NOTAMs) are in place. These prearranged traffic routes must be controlled by flag-persons as detailed on the plans. Aircraft ***always*** have the right-of-way. Construction equipment shall ***always*** yield to aircraft. Construction vehicle traffic shall ***never*** cross an active taxiway unless escorted by Airport Operations or at the pre-approved crossing points while crossing guards are stationed.

At such a pre-approved taxiway crossing point, the Contractor shall have a flag-person stationed on each side of the crossing point to monitor aircraft movement and to direct construction traffic. The flag-person shall be equipped with handheld signs or flags to assist in directing construction traffic. For nighttime construction operations, the flag-person shall also be equipped with lighted wands and light plants on each side of the taxiway. In addition, one vacuum sweeper and one water truck shall be dedicated to and stationed full time at each active taxiway crossing to maintain the surface of the taxiway free from construction traffic debris. Mud and other material tracked onto taxiway surfaces shall be removed by hand if necessary to achieve its complete removal.

Prior to entering any work site within the AOA, the Contractor will physically meet with Airport Operations to brief each other on the intended activities. The Contractor must also arrange a physical inspection of the work area with Airport Operations prior to leaving any area that has been closed for work, or that has been used for a crossing point or haul route by the Contractor.

003-3.6 VEHICLE PARKING. All vehicles shall be parked and serviced in the designated staging and employee parking areas shown on the plans. The Contractor is responsible for transporting his/her employees from these areas to the jobsite.

003-3.7 RADIO COMMUNICATIONS. The control of vehicular activity on the AOA is of the highest importance. This requires coordination with airport users and Air Traffic Control Tower (ATCT). The Contractor shall have no direct contact with the ATCT. All communications with the ATCT shall be coordinated through Airport Operations. **However, the Contractor must provide radios and properly train his/her personnel, particularly flag-persons, on the proper procedures for monitoring radio frequencies.**

003-3.8 AIRPORT SECURITY REQUIREMENTS. The airport is operated in strict compliance with Federal, State and local rules and regulations, which prohibits unauthorized persons or vehicles in the AOA. Equipment and personnel will be restricted to the work areas defined on the plans. Any violations by Contractor's personnel will subject the Contractor to the contract non-compliance assessments imposed by the Aviation Department.

Airport restricted areas are fenced and must remain fenced at all times. No temporary airport perimeter security fencing is required for this project. If, as the project progress, any temporary security fences and/or gates are required they shall be constructed by the Contractor according to specifications set by Airport Operations. The temporary fence and gate must be approved by Airport Operations before any of the regulated perimeter security fence may be altered. If needed, temporary fencing shall be constructed in accordance with FAA Specification F-162. The gates will remain closed and locked, or if used continuously for ingress and egress, the Contractor will provide approved guards trained by Airport Operations to monitor access to the Airport. The Contractor shall provide guards with a roster of his personnel and ensure that each individual has adequate identification. Contractor locks are not permitted on any airport gate. Gates will be staffed during shift working hours and will be secured when there is no activity at that location. The Contractor will be responsible for a 24-hour advance notification to Airport Operations regarding the scheduling of the use of the various security check point gates. There will be a communications system for emergency responses, security breaches, etc.

Entrance to the airfield is subject to strict security regulations. All vehicles must meet minimum identification requirements and have proof of insurance on file with GYR Airport Operations.

The Contractor shall maintain the security integrity between the public and AOA. All barrier designs and their phasing shall be submitted to the Aviation Department and approved by them in writing prior to erection.

Construction personnel should wear company identification (company badge, shirt, hat, etc. which include the company logo) at all times, subject to the approval by the GYR Operations.

The Contractor shall restrict passage into the Airport Operations Area to badged persons, vehicles and equipment displaying his identification or that of the Airport. Should the Contractor wish to allow visitors, vendors or delivery through his access point, he shall provide an escort in accordance with escort procedures.

The Contractor shall be responsible to provide at his own cost a badged escort for all vehicles that do not operate on a daily basis within the AOA. Escorted vehicles shall not be left unattended. The badged escort shall remain with the escorted vehicle at all times while on the AOA and shall be escorted back and forth to the point of entry. There will be no exceptions to this requirement.

The Contractor is required to submit a plan on how he/she will safely operate within the AOA. This plan shall be submitted and approved by the GYR Airport Operations Manager before the commencement of any construction. The Contractor is required to prepare, submit for approval and maintain during construction a plan for managing Airport Access Cards for his/her employees, subcontractors or any other party recommended by the Contractor for badging. This plan shall be submitted to Airport Operations prior to the Pre-Construction Meeting.

The Contractor will contact Airport Operations**,** telephone (623) 932-4550 (10) days prior to start of construction to submit the necessary airport security information for all vehicles and personnel required inside the restricted area during construction.

003-3.9 VIOLATION OF RESPONSIBILITIES. Any violation of 003-3.1 - 003-3.8 shall be considered a violation of the Contract itself and shall be sufficient cause for halting the work without extending the time limit of the job.

003-3.10 CONTRACT NON-COMPLIANCE ASSESSMENTS. Due to both the safety and security precautions necessary at Phoenix Goodyear Airport, failure of the Contractor to adhere to the prescribed requirements/regulations has consequences that may jeopardize the health, welfare and lives of the customers and employees at Phoenix Goodyear Airport, as well as the Contractor's own employees. Therefore, if the Contractor is found to be in non-compliance with the security, Access Card issuance and airfield safety requirements by either Airport Operation's Personnel or the Engineer or his representatives, Phoenix Goodyear Airport will issue Notices of Violation (NOV).

The Contractor may appeal the NOV; however appeals must be made in writing, and within four **(4)** calendar days of the offending incident, to the Airport Manager. The appeal would need to state, in sufficient detail, why the NOV/circumstances are unwarranted. A final and binding decision on the appeal will be made by the Airport Manager within ten (10) working days of receipt of the appeal. The Contractor will then be notified of this decision in writing. No further appeals to the specific NOV will be considered or accepted.

The penalty could range from temporary or permanent loss of driving privileges, revocation of access card and non-compliance assessments in accordance with Table 1 – Schedule of

Contract Non-Compliance Assessment for Notice of Violation listed below and the applicable amount will be withheld from the Contractor's next monthly payment application following the date of the violation. The Prime Contractor will be held financially responsible for all NOV's issued to their subcontractors or associated with this Contract.

TABLE 1 – Schedule of Contract Non-Compliance Assessment For Notice of Violation

Description of Assessment	First Offense	Second Offense	Third Offense
Not having proper and current Airport Security Badge or not properly displaying Airport Security Badge.	$1,000.00	$5,000.00	$15,000.00
Lost or unreturned Airport Security Badge.	$300.00	$450.00	$600.00
Un-authorized access to AOA by construction personnel or access through construction gate by un-authorized personnel.	$1,000.00	$5,000.00	$15,000.00
Failure to Escort / be Escorted.	$1,000.00	$5,000.00	$15,000.00
Operating a vehicle or mobile construction equipment without a current Ramp Driver's permit.	$1,000.00	$5,000.00	$15,000.00
Failure to stop at a designated Stop, or exceeding the maximum speed limit, or deviating from designated service roadway or haul routes.	$1,000.00	$5,000.00	$15,000.00
Failure to yield to airside personnel or vehicles.	$1,000.00	$5,000.00	$15,000.00
No logo on vehicle or logo is not Correct in name and dimension.	$1,000.00	$5,000.00	$15,000.00
Active runway incursion.	$15,000.00	$20,000.00	$25,000.00
Active taxiway, taxilane or apron incursion.	$10,000.00	$15,000.00	$20,000.00
Active runway or taxiway object free area incursion.	$5,000.00	$10,000.00	$15,000.00
Safety violation, such as insufficient barricades, or no flags or amber beacons on vehicle or equipment. Or no red obstruction lighting on cement silo, batch plants, cranes or other equipment with significant height.	$5,000.00	$10,000.00	$15,000.00
Non-compliance with City's lock- Out tag-out procedures.	$5,000.00	$10,000.00	$15,000.00
Failure to backfill open trenches within time specified.	$5,000.00	$10,000.00	$15,000.00
Failure to provide lighted barricades.	$5,000.00	$10,000.00	$15,000.00
Failure to provide functional temporary edge Lighting.	$5,000.00	$10,000.00	$15,000.00
All other NOV not listed above. $1,000.00	$1,000.00	$5,000.00	$15,000.00

The Phoenix Goodyear Airport Operations has the option to issue warnings on the first offense if the incident justifies it. Individuals involved in a non-compliance violation may be required to surrender their access control card and be escorted off the AOA pending investigations of the matter and the outcome of the possible appeal.

Incursions are defined as "any entrance onto an active runway, taxiway, taxilane or apron that may or may not subject any aircraft or crash fire rescue vehicle to yield, stop or change direction

to avoid the sudden entrance."

The fourth and each subsequent offence for any of the NOV listed above, the contract non-compliance assessment shall remain at the same amount shown for the third offence. Advancing from the first offence to the second offence, or from the second offence to the third offence, etc., shall be considered whether the individual is employed with the prime Contractor or any subcontractor or material supplier.

The above listed NOV Contract Non-Compliance Assessment schedule supersedes the assessment schedule as published in the City of Phoenix Aviation Department's Airport Construction and Safety Manual.

COORDINATION OF CONSTRUCTION ACTIVITIES

003-4.1 WORK SCHEDULING AND ACCOMPLISHMENT. The Contractor shall contact GYR Airport Operations each day before beginning work to coordinate the status and nature of work to be done that day. Access to work sites within the AOA will require daily coordination with Airport Operations prior to gaining access. The Contractor shall also report to Airport Operations at the end of each day to schedule the work he plans to do on the following day.

Violations of any coordination requirements shall be considered a violation of the Contract itself and shall be sufficient cause for halting the work without extending the time limit of the job.

SAFETY REQUIREMENTS

003-5.1 GENERAL. Before entering upon or crossing any runway or taxiway, or aircraft movement area, the Contractor shall receive proper clearance from GYR Airport Operations. Emergencies and operating conditions may necessitate sudden changes, both in airport operations and in the operations of the Contractor. Aircraft operations shall always have priority over any and all of the Contractor's operations. Should runways or taxiways be required for the use of aircraft and should Airport Operations deem the Contractor to be too close to active runways or taxiways the Contractor shall suspend his operations, remove his personnel, plant, equipment, and materials to a safe distance and stand by until the runways and taxiways are no longer required for use by aircraft. There will be no compensation for delays or inefficiencies due to these changes.

The Contractor shall ensure that no personnel or equipment enters into the active movement areas or their associated Object Free Area without the appropriate Airport Operations escort. **Access into movement areas or Object Free Areas without an Airport Operations escort is prohibited!**

Throughout the duration of the job, any practice or situation that Airport Operations or the Engineer determines to be unsafe or a hindrance to regular airport operations shall be immediately rectified.

Any violation of these or the following safety requirements shall be considered a violation of the Contract itself and shall be sufficient cause for halting the work without extending the time limit of the job.

(1) The following publications contain definitions/descriptions of critical airport operating areas. The areas defined below pertain to airfield safety requirements and are

referenced throughout the Contract Documents. Copies of Advisory Circulars may be found at the FAA website:

http://www.faa.gov/airports_airtraffic/airports/resources/advisory_circulars/

and, Federal Aviation Regulations (FARs) can be found at:

http://www.faa.gov/regulations_policies/faa_regulations.

(a) Advisory Circular 150/5370-2G, "Operational Safety on Airports During Construction" Sets forth guidelines to assist airport operators in with the requirements of federally funded construction projects.

(b) FAR Part 77, "Objects Affecting Navigable Airspace," Current Edition: Establishes standards for determining obstructions to navigable airspace. Civil airport imaginary surfaces are defined in the publication. It also sets forth requirements for notice of certain proposed construction or alteration. Notice of construction provides a basis for recommendations for identifying the construction or alteration in accordance with AC 70/7460-1, "Obstruction Marking and Lighting," Current Edition.

(c) AC 150/5300-13A Change 1, "Airport Design" Current Edition: Establishes design, operational and maintenance standards for airports. Standard terms used in the contract plans and specifications are defined below:

(i) Runway Safety Area (RSA) - The defined surface surrounding the runway over which aircraft should, in dry weather, be able to cross at normal operating speeds without incurring significant damage. A safety area is graded, drained and compacted. It is free of any holes, trenches, humps or other significant surface variations or objects, other than those which must be there because of their essential aeronautical function. The safety area requires the capability of supporting maintenance, firefighting, and rescue vehicles under normal (dry) conditions.

Prior to re-opening the runway each morning, the RSA must comply with the following:

1) The area(s) shall be able to support an aircraft at normal operating speeds without the aircraft incurring significant damage.

2) For the first 200 feet beyond the runway ends, the longitudinal grade of the RSA is between 0 and 3 percent, with any slope being downward from the runway ends. For the remainder of the RSA, the maximum allowable downward grade is 5 percent and the maximum allowable upward grade shall not penetrate the 20:1 approach surface from the end of the runway, as defined in FAR Part 77. However, limitations on longitudinal grade changes are plus or minus 2 percent per 100 feet.

3) For the RSA during construction (200 feet from runway centerline and up to 200 feet from the runway ends), the transverse grade from the edge of the runway pavement is 1.5 to 5 percent downward. For areas beyond 200 feet from the runway ends, the maximum allowable transverse grade shall be 5%, upward or downward. Transverse grade changes should be warped smoothly.

4) The maximum permissible drop-off at the edge of the runway pavement is 3 inches.

(ii) Object Free Area (OFA) – An area on the ground centered on a runway, taxiway, or taxilane centerline provided to enhance the safety of aircraft operations by having the area free of objects, except for objects that need to be located in the OFA for air navigations or aircraft ground maneuvering purposes.

(iii) Obstacle Free Zone (OFZ) – The OFZ is the airspace below 150 feet above the established airport elevation and along the runway and extended runway centerline that is required to be clear of all objects, except for frangible visual NAVAIDs that need to be located in the OFZ because of their function, in order to provide clearance protection for aircraft landing or taking off from the runway, and for missed approaches. The OFZ is subdivided as follows:

1) Runway OFZ. The airspace above a surface centered on the runway centerline.
2) Inner-approach OFZ. The airspace above a surface centered on the extended runway centerline. It applies to runways with an approach lighting system.
3) Inner-transitional OFZ. The airspace above the surfaces located on the outer edges of the runway OFZ and the inner-approach OFZ. It applies to runways with approach visibility minimums lower than ¾-statute mile.

(iv) Taxiway Safety Area (TSA) – A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway.

(iv) The dimensioning of RSA's, OFA's and OFZ's are determined by the type of aircraft utilizing the runways and taxiways. AC 150/5300-13A provides detailed information for determing the required dimensioning for various safety areas. For the Phoenix Goodyear Airport, the following are the locations of Runway and Taxiway Safety Areas, Object Free Areas and Obstacle Free Zones.

(1) Runway 3/21: The RSA is 250 feet from each side of the runway centerline and extends 1,000 feet beyond each end of the runways. The OFA is 400 feet from each side of the runway centerline. The OFZ is 200 feet from each side of the runway centerline and beyond the ends of the runway
(2) Group IV aircraft is the Design Aircraft for Phoenix Goodyear Airport. However, much of the aircraft using airport are Group II or III aircraft. Workers and equipment are to provide 25' wingtip clearance during taxiing operations if Taxiway remains open to traffic. The TSA and OFA for the various groups of aircraft are:

<u>Group II – 79' Wingspan</u>
(a) TSA 39.5' from Taxiway Centerline
(b) OFA 65.5' from Taxiway Centerline

Group III – 118' Wingspan
(a) TSA 59' from Taxiway Centerline
(b) OFA 93' from Taxiway Centerline

Group IV – 171' Wingspan
(a) TSA 85.5' from Taxiway Centerline
(b) OFA 129.5' from Taxiway Centerline

(5) The Contractor shall acquaint his supervisors and employees with the airport and operations that are inherent to Phoenix Goodyear Airport and shall conduct his/her construction activities to conform to all routine and emergency air traffic requirements and guidelines for safety specified herein. **The Contractor shall be responsible for providing all safety devices as required for the protection of his personnel.**

(6) Protection of all persons shall be provided throughout the progress of the work. The work shall proceed in such a manner as to provide safe conditions for all workers and personnel. The sequence of operations shall be such that maximum protection is afforded to ensure that personnel and workers in the work area are not subject to any dangerous conditions. The Contractor must provide safety measures to guard against injury.

(7) During the performance of this contract, the airport facility shall remain in use to the maximum extent possible. Use of areas near the Contractor's work will be controlled to minimize disturbance to the Airport's operation. The Contractor shall not allow employees, subcontractors, suppliers, or any other unauthorized person to enter or remain in any airport area which would be hazardous to persons.

(8) All work to be performed which is too close to an active runway, taxiway or apron under operational conditions shall be performed when the runway, taxiway or apron is not in use. Such work shall not be accomplished without prior permission from Airport Operations. Requested closings shall be directed to the Airport Operations in writing at least 72 hours in advance so that the proper Notice-to-Airmen (NOTAM) may be issued. Only Airport Operations have the authority to open or close runways or taxiways.

(9) The Contractor shall be aware of the following types of safety problems and/or hazards. These problems or hazards shall not be permitted. Should any of these problems or hazards arise during construction, the Contractor shall immediately rectify/correct the problem or hazard to the satisfaction of the Engineer and Airport Operations Personnel:

(a) Trenches, holes, or excavations on or adjacent to any open runway or in safety areas.

(b) Unmarked/unlighted holes or excavation in any apron, open taxiway, open taxilane, or related safety area.

(c) Mounds or piles of earth, construction materials, temporary structures, or other objects in the vicinity of any open runway, taxiway, taxilane, or in a related safety, approach, or departure area.

(d) Vehicles or equipment (whether operating or idle) on any open runway, taxiway, taxilane, or in any related safety, approach, or departure area.

(e) Vehicles, equipment, excavations, stockpiles, or other materials which could degrade or otherwise interfere with electronic signals from radios or electronic navigational aids (NAVAIDS).

(f) Runway surfacing projects resulting in excessive lips greater than 1 inch for runways and exceeding 3 inches for edges between the old shoulder and new surfaces at runway edges and ends.

(g) Unmarked utility, NAVAID, weather service, runway lighting, or other power or signal cables that could be damaged during construction.

(h) Objects (whether or not marked or flagged) or activities anywhere on or in the vicinity of the airport which could be distracting, confusing, or alarming to pilots during aircraft operations.

(i) Unflagged/unlighted low visibility items (such as tall cranes, drills, and the like) anywhere in the vicinity of active runways, or in any approach or departure area.

(j) Misleading or malfunctioning obstruction lights or unlighted/unmarked obstructions in an approach to any open runway.

(k) Inadequate approach/departure surfaces needed to assure adequate landing/takeoff clearance over obstructions or work or storage areas.

(l) Inadequate, confusing or misleading (to user pilots) marking/lighting of runways, taxiways, or taxilanes, including displaced or relocated thresholds.

(m) Water, dirt, debris, or other transient accumulation which temporarily obscures pavement marking, pavement edges, or derogates visibility of runway/taxiway marking or lighting.

(n) Inadequate or improper methods of marking, barricading, and lighting of temporarily closed portions of AOA.

(o) Trash or other materials with foreign object damage (FOD) potential, whether on runways, taxiways, or aprons, or in related safety areas.

(p) Inadequate barricading or other marking which is placed to separate construction or maintenance areas form open aircraft operating areas.

(q) Failure to control vehicle and human access to open aircraft operating areas.

(r) Construction/maintenance activities or materials which could hamper the response of aircraft rescue and firefighting (ARFF) equipment from reaching all aircraft or any part of the runway/taxiway system, runway approach and departure areas, and aircraft parking locations.

(s) Bird attractants on airport, such as edibles (food scraps, etc.), miscellaneous trash, or ponded water.

(10) The Contractor shall conduct activities so as not to violate any safety standards contained herein. The Contractor shall inspect all construction and storage areas as often as necessary and promptly take all steps needed to prevent/remedy any unsafe or potentially unsafe conditions/activities discovered.

(11) Before actual commencement of construction activity, the Contractor shall notify Airport Operations and the Engineer in writing of his intentions to begin construction, stating the proposed time, date, and work area in order for the appropriate Notice-to-Airmen (NOTAM) to be issued. Only GYR Airport Operations have the authority to open or close runways or taxiways and to issue NOTAMs. In order to properly communicate these closures Airport Operation must receive these requests 72 hours prior to the scheduled closure. Upon completion of work and return of all related areas to standard conditions, the Contractor shall again notify Airport Operations and the Engineer in writing, and describe the area that is complete and available for normal airport operations.

(12) Debris. Debris, waste and loose material or any other FOD (including dust and dirt) capable of causing damage to aircraft landing gear, propellers or being ingested in jet engines shall not be allowed on active aircraft movement areas or adjacent infield areas. Materials observed to be within these areas shall be removed immediately and/or continuously by the Contractor. The Contractor shall be required to have a sweeping machine and operator on site, ready at all times during construction activity. Where travel on or across runways, ramp areas, taxiways, or aircraft aprons is required, the Contractor shall provide adequate personnel and equipment to keep such surfaces clear of debris at the discretion of the Engineer. Closed pavements shall be swept clean prior to reopening to aircraft traffic. Exposed earth in excavation areas within 75 feet of the centerline immediately adjacent to active taxiways shall be covered to prevent dust from jet blast. Cover material shall be weighted to prevent movement from jet blast.

(13) Flaggers. In accordance with the specifications, the Contractor shall furnish, at his own expense, flaggers as necessary to control his traffic unless otherwise directed by the Engineer.

(14) Trenches, Excavations and Stockpiled Material. Open trenches or excavations exceeding 3" in depth and 3" in width or stockpiled material will not be permitted within the limits of restricted areas of operational runways or taxiways. Covering for open trenches or excavations shall be of sufficient strength to support the weight of the heaviest aircraft operating on the runway or taxiway. Trenches and excavations that cannot be protected by covering shall be backfilled, and re-excavated if necessary at the end of each day or before opening the restricted area to operational use of the runway or taxiway. Open storm drain trenches, electrical duct or conduit trenches, utility trenches or any other trench shall be limited to 500-feet accumulative in length at any time. Open trenches in the runway safety area shall be properly and completely backfilled and compacted in sufficient time before the end of the work shift.

(15) Construction in Proximity to Active Runways and Taxiways.

Runway Sides: If appropriate construction/maintenance NOTAM has been issued, construction is permissible as close as 250 feet from the centerline of the active runway provided that all Airport Operations and FAA criteria are met. The 250 feet shall be clearly marked in the infield areas with approved barricades at 10-foot intervals. Runway Ends: No work will be permitted within 1,000 feet of the active runway threshold.

Taxiway Sides: If appropriate construction/maintenance NOTAM has been issued, construction is permissible as close as the dimensions shown on the Construction Safety and Phasing Plan (CSPP) provided that all Airport Operations and FAA criteria are met. This dimension(s) shall be clearly marked in the infield areas using approved barricades at 10-foot intervals. Personnel and equipment working within taxiway Object Free Areas (OFA) must at all times be able to give way to taxiing aircraft.

(16) Equipment Height Restrictions.

Maximum permissible equipment height varies by location and by construction phase. Maximum equipment height requirements are shown in the CSPP and shall not be exceeded unless prior approval is obtained from the Engineer and Airport Operations. Atop all equipment booms shall be mounted the white and orange checkered flag described in Paragraph 003-3.4. The top ten feet (10') of these booms shall be painted fluorescent orange and they shall be equipped with a red obstruction light. Any crane erections shall be coordinated with Airport Operations and the Engineer during every shift.

(17) Miscellaneous.

(a) Open flame, welding or torch cutting are prohibited unless adequate fire and safety precautions have been taken and the procedure has been approved by the Engineer.

(b) All materials and equipment when not in use shall be placed in approved areas where they will not constitute a hazard to aircraft and not penetrate clearance height restrictions as shown in the CSPP. All equipment shall be parked in the appropriate area(s) when not in use.

(c) The Contractor shall provide the Safety/Security Manager with a current list of all employees working on the airport. The list shall be maintained current by the Contractor and Subcontractors.

(d) For emergencies involving life safety (injuries, fires, security breaches, etc.), the Contractor shall immediately call 602-273-3311, the Sky Harbor Emergency number, and simultaneously or as soon as possible contact Airport Operations followed by notification to the Engineer.

003-5.2 CLOSED RUNWAY AND TAXIWAY MARKING AND LIGHTING. Closed runway and taxiway markings shall be as shown in the CSPP. Closed runway and taxiway marking and lighting materials shall be approved for use by the Engineer prior to placement. Construction

activities shall not begin until the layout of such marking and lighting has been approved by the Engineer.

003-5.3 HAZARD MARKING. Hazard-marking barricades, flashers, etc. should be used: to identify and define the limits of construction making them visible to aircraft, personnel, or vehicles; to identify hazards such as open manholes, small areas under repair, stockpiled material, waste areas, etc.; to prevent aircraft from taxiing onto a closed runway for takeoff; and to identify FAA, airport, and National Weather Service facilities, cables, power lines and other sensitive areas to prevent damage, interference, and facility shutdown.

Traffic Cones shall not be used at any time on the Air Operations Area.

Hazardous areas, in which no part of an aircraft may enter, should be indicated by the use of barricades marked with diagonal, alternating orange and white reflective stripes. During reduced visibility or night hours, the barricades should be supplemented with flashing red lights. The intensity of the lights and spacing for barricades, flags, and lights should be adequate to delineate the hazardous area without ambiguity. The Contractor shall have a designated person on call 24 hours a day for emergency maintenance of airport hazard lighting and barricades.

003-5.4 CONSTRUCTION AREA MARKING AND LIGHTING. Low profile lights, retroreflective taxiway edge markers, low level barriers, and warning flags shall be provided and erected by the Contractor as shown in the CSPP or as directed by the Engineer. All construction areas, including closed runways and taxiways, should be clearly and visibly separated from active air operation areas. Hazard areas, facilities, cables, and power lines should also be clearly identified by the Contractor. The Contractor is responsible for maintaining the condition and visibility of all markers identifying above-mentioned areas and that marking and lighting aids remain in place. Appropriate barriers, lights and signs should be used as necessary to clearly separate all construction/maintenance areas from other parts of the AOA. All barricades, temporary markers, flag line supports, and other objects placed and left in safety areas on any open runway, taxiway, or taxilane should be: as low as possible to the ground; of low mass; easily collapsible upon contact with an aircraft or any of its components; weighted down or sturdily attached to the surface to prevent displacement from prop wash, jet blast, wing vortex, or other surface wind currents; and if affixed to the surface, frangible at ground level.

003-5.5 CONSTRUCTION NEAR NAVIGATIONAL AIDS. Construction materials and equipment shall not be placed or parked where they may interfere with the line-of-sight of the ATCT and navigational aids in operation. GYR Operations shall determine if any materials or equipment will cause any type of interference.

003-5.6 CONSTRUCTION SITE ACCESS AND HAUL ROADS. The Contractor will not be permitted to use any access or haul roads other than those designated on the contract drawings. The Contractor should submit specific proposed ingress and egress routes associated with specific construction activities to the Engineer for evaluation and approval prior to commencing construction activities. Aircraft Rescue and Firefighting (ARFF) right-of-way on access roads, haul roads, taxiways, and runways shall not be impeded at any time.

003-5.7 TRENCHES AND EXCAVATIONS. Gaps or holes between paving lanes, open trenches or excavations are not permitted within an operational runway safety area. Coverings for open trenches or excavations such as reinforced structural steel plates, precast slabs or

other methods should be of sufficient strength to meet the requirements of the RSA found in Paragraph 003-5.1(1)(c). Open trenches and excavations at the construction site outside of the RSA should be prominently marked with red or orange flags, as approved by the Engineer, and lighted with red light units during hours of restricted visibility or darkness.

Excavations and open trenches may be permitted up to the edge of structural taxiways provided the drop-off is adequately signed, marked, and lighted and the appropriate NOTAM is issued.

003-5.8 CONSTRUCTION MATERIALS STOCKPILING AND EQUIPMENT STORAGE. There shall not be any equipment storage in the active runway and active taxiway safety areas or in the infield areas. The Contractor shall remove pavers and other equipment from the active Runway and Taxiway Object Free Areas (OFA) including the infields (staging on apron areas will be allowed with prior approval) before re-opening the runway or taxiway. Stockpiled material or equipment should not be stored near aircraft turning areas or operational movement areas, aprons, or excavations and trenches. Stockpiled materials shall not be stored near NAVAIDs, visual or approach aids, nor shall they obstruct the ATCT's line of sight to any runway or taxiway. The Contractor shall ensure that stockpiled construction materials and equipment do not cause degraded or hazardous conditions to airport operations safety. This includes determining and verifying that stockpiled materials and equipment are stored or parked at an approved location, that they are properly stowed to prevent foreign object debris (FOD), attraction by wildlife, or obstruction of air operations either by their proximity to NAVAIDs or to aircraft movement areas.

003-5.9 OTHER LIMITATIONS ON CONSTRUCTION. Open flame welding or torch cutting operations are prohibited unless adequate fire and safety precautions are provided and have been approved for use by the Engineer. Under no circumstances should flare pots be used near aircraft turning areas.

003-5.10 FOREIGN OBJECT DEBRIS (FOD) MANAGEMENT. Waste and loose materials capable of causing damage to aircraft landing gear or propellers or capable of being ingested in jet engines should not be left or placed on or near active aircraft movement areas. Materials tracked onto these areas should be continuously removed during the construction project. It is also recommended that waste or loose materials which would attract wildlife be carefully controlled and removed on a continuous basis.

A minimum of one (1) operational vacuum sweepers and operators, and one (1) 4M-water trucks with operators, shall be on-site and operating while the Contractor and/or any subcontractor is working.

003-5.11 RUNWAYS AND TAXIWAYS. Nothing shall be placed upon runways, taxiways, taxilanes, or aprons without authorization from Airport Operations.

SAFETY PLAN COMPLIANCE DOCUMENT

003-6.1 CONTRACTOR QUALITY CONTROL. The Contractor shall be responsible for developing and implementing a Safety Plan Compliance Document including inspections necessary to assure compliance with the requirements of this section and the approved Construction Safety and Phasing Plan.

METHOD OF MEASUREMENT

003-7.1 All items specified in this section will be measured as one lump sum.

003-7.2 Measurement and payment for “Landside Traffic Control” and for Uniform Off-Duty Officer as specified in Section III-2 Technical Special Provision Section 1.1 is incidental to Item M-003 Airport Safety and Security.

BASIS OF PAYMENT

003-8.1 Airport safety and security shall be paid for at the contract lump sum price in a proportionate manner, on the basis of current estimates. This price shall constitute full compensation for furnishing material and equipment, including but not limited to flaggers, temporary gates, warning markers, temporary drainage items, low level barriers, other traffic control devices and necessary equipment, safety area support material, and other material and equipment list herein, and the maintenance thereof and all other labor, materials, equipment, tools and incidentals including Landside Traffic Control and Uniform off-duty Officers necessary to accomplish this item.

Payment will be made under:

Item M-003-8.1 Airport Safety and Security – per lump sum

END ITEM M-003

ITEM P-100 CONTRACTOR QUALITY CONTROL AND CONSTRUCTION SURVEYS

DESCRIPTION

100-1.1 CONTRACTOR QUALITY CONTROL. This item shall consist of all work necessary to ensure quality control of the Contractor's work during construction in accordance with General Provision Specification Section 100 and the Civil Technical Specifications.

The Contractor shall be responsible to conduct all quality control testing and inspections as indicated in the these specifications, and for each pay item that is shown in the Proposal, as well as any other test or inspection not specifically listed, but necessary to adequately control the work to the satisfaction of the Aviation Department Project Manager and the City of Phoenix Materials Laboratory. The City of Phoenix Materials Laboratory's quality acceptance test results will be made available to the Contractor upon request. The Contractor shall not depend on the City of Phoenix quality acceptance for the Contractor's Quality Control Program.

The Contractor shall submit his plan for Quality Control Testing and Inspections as required in the Technical Special Provisions, Paragraph 6, for review and approval to the Engineer at least ten (10) working days prior to the pre-construction conference.

100-1.2 CONSTRUCTION SURVEYING LAYOUT. The Contractor shall employ a qualified Land Surveyor that is either an Arizona Registered Land Surveyor or is working under the direction of an Arizona Registered Land Surveyor. The Contractor Surveyor shall set all **construction control** and all construction stakes, establishing lines, grades and elevations to ensure the new pavement elevations match the existing grades and shall be responsible for their conformance with plans and specifications. The Contractor Surveyor will establish survey control points and bench marks for the project and submit for approval a Horizontal and Vertical Control Plan.

a. Initial Verification. Prior to setting any construction stakes, the Contractor's Surveyor shall first set control points for construction, utilizing Airport Control, as shown in project plans. Upon completion of this verify process, the Contractor shall employ an Arizona registered land surveyor to certify in writing that all control points established by the Contractor's Surveyor are acceptable and adequate to allow the Contractor's construction staking to meet the accuracy requirements of the specifications.

b. General Description. The Contractor's Surveyor shall set all stakes including, but not necessarily limited to, centerline stakes, offset stakes, reference point stakes, slope stakes, pavement lines, grade stakes, blue tops for subgrade and subbase course, stakes for airfield lighting, utilities, drainage, pipe, base and pavement courses, paint striping layouts, supplemental bench marks and permanent record drawing elevations of airfield lighting facilities, as well as all other horizontal and vertical controls necessary for complete and accurate layout of the construction work.

Subgrade blue tops shall be at 25-foot stations and 25-foot offset distance (max.) for the following section locations:

a. Runway – minimum 7 per station
b. Taxiways – minimum 5 per station
c. Holding apron areas – minimum 3 per station
d. Roadways – minimum 3 per station

Base Course blue tops at 25 foot stations and 25-foot offset distance (max.) for the following section locations:

a. Runway – minimum 7 per station
b. Taxiways – minimum 5 per station
c. Holding apron areas – minimum 3 per station

Pavement areas:

a. Edge of Pavement hubs and tacks (for string line by Contractor) at 100-foot stations
b. Between Lifts at 25-foot stations for the following section locations:
   (1). Runways – each paving lane width
   (2). Taxiways – each paving lane width
   (3). Holding areas – each paving lane width
c. After finish paving operations at 50-foot stations
   (1). All paved areas – Edge of each paving lane prior to next paving lot
d. Shoulder and safety area blue tops at 50-foot stations and at all break points with maximum of 50 foot offsets

Fence lines at 100-foot stations

Electrical and Communications System locations, lines and grades including but not limited to duct runs, connections, fixtures, signs, lights, VASIs, PAPIs, REILs, Wind Cones, Distance Markers (signs), pull boxes and handholes at 100-foot stations.

Drain lines, cut stakes and alignment on 25-foot stations, inlet and manholes.

Painting and Striping layout (pinned with 1.5 inch PK nails) marked for paint Contractor. (All nails shall be removed after painting).

Laser, or other automatic control devices, shall be checked with temporary control point or grade hub at a minimum of once per 400 feet per pass (i.e., per paving lane).

Contractor shall verify agreement between STATION – OFFSET points for signs, lights, RGL's, striping and marking with the plans and the Civil and Electrical detail sheets and Fixture Schedule shown on Sheet EA–602.

Controls and stakes disturbed or suspect of having been disturbed shall be checked and/or reset as directed by the Engineer without additional cost to the Owner.

c. Materials, Personnel and Equipment. All work shall be done under the direction of an Arizona Registered Land Surveyor employed by the Contractor. All survey crew chiefs shall be a registered civil engineer, a registered land surveyor, an engineer in training or a NICET level III (or greater) certified technician. The Contractor shall furnish all materials, personnel and equipment necessary to perform all surveying, staking and verification of the accuracy of all existing control points, which have been provided by the City. Included in this work shall be all calculations required for the satisfactory completion of the project in conformance with the plans and specifications.

Materials and equipment shall include, but shall not necessarily be limited to, vehicles for transporting personnel and equipment, properly adjusted and accurate survey equipment, stakes, flagging and all other devices necessary for checking, marking, establishing and

maintaining lines, grades and layout to perform the work called for in the contract. The Contractor shall furnish a sufficient quantity of competent personnel to perform the survey work and layout.

The Contractor shall not employ nor engage the services of any person or persons in the employ of the City of Phoenix for the performance of any work as described herein.

d. Discrepancies. Any changes in the grade, alignment, quantities, locations or dimensions proposed by the Contractor due to field conditions shall immediately be brought to the attention of the Engineer. Changes to the project plans will not be allowed without the written approval of the Engineer.

e. Record Drawings. The work shall include establishing and marking the ·Record Drawings· with coordinates and elevations of the completed work, as well as locating existing utilities with coordinates and elevations. Refer to Article 2.10 for project record requirements.

METHOD OF MEASUREMENT

100-2.1 MEASUREMENT FOR CONTRACTOR QUALITY CONTROL to be paid for will be determined by the lump sum amount provided in the bid proposal.

a. Completion for Contractor Monthly Pay Application. Monthly progress payments will be calculated by dividing the lump sum amount bid for quality control by the performance period in months.

b. Schedule of Values. The Contractor shall submit a schedule of values to the Aviation Department Project Manager detailing a cost breakdown of each quality control requirement.

100-2.2 CONSTRUCTION SURVEYING LAYOUT will be measured for payment by the lump sum amount provided in the bid proposal.

a. Completion for Contractor Monthly Pay Application. Monthly progress payments will be calculated by dividing the lump sum amount bid for construction surveys by the performance period in months.

b. Schedule of Values. The Contractor shall submit a schedule of values to the Aviation Department Project Manager detailing a cost breakdown of each construction surveying requirement.

BASIS OF PAYMENT

100-3.1 CONTRACTOR QUALITY CONTROL AND CONSTRUCTION STAKING will be paid for at the lump sum price provided in the bid based on work effort as outlined in the Contractor Quality Control and Construction Surveying Schedule of Values. This lump sum price shall constitute full compensation for furnishing all labor, material, tools, incidental, technicians, inspectors, testing equipment, and field vehicles.

Payment will be made under:

P-100-3.1 Contractor Quality Control – per lump sum

P-100-3.2 Construction Staking – per lump sum

END OF ITEM P-100

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ITEM P-104 REMOVAL OF EXISTING PAVEMENT AND OTHER ITEMS

DESCRIPTION

104-1.1 This item shall consist of saw cutting and the removal of asphalt concrete and Portland cement concrete pavement (PCCP) and the disposal and clean-up of all pavement materials transported to an off-site location by the Contractor.

Also included, is the removal of all other miscellaneous items incidental thereto, whether indicated on the plans or not, hauling and disposing of all debris at an off-site location (landfill) to be provided by the Contractor, and backfill of removed items.

104-1.2 The removal of airfield electrical items (signs and sign bases, light fixtures and base cans, electrical handholes, conduit and conductors) is included in Item L-100.

104-1.3 Pavement replacement is included in Items P-403 and P-501. Where pavement is not replaced, any voids or depressions shall be backfilled with native material.

MATERIALS

104-2.1 All other materials used in conjunction with this work shall be furnished by the Contractor and will be conducted incidental to these P-104 items. Plugs for pipe or duct shall comply with MAG standard details.

CONSTRUCTION METHODS

104-3.1 GENERAL. Existing bituminous pavement to be removed shall be removed the full depth of the asphalt and base course by milling and either immediately stockpiling at a designated stockpile area in the vicinity of the work or hauling off–site. All milled asphalt materials that are not incorporated into the project shall become the property of the Contractor and shall be stockpiled or disposed of properly or recycled.

Existing Portland cement concrete pavement to be removed shall be removed by saw cutting and rubbilization as necessary to remove the existing concrete without damage to adjacent slabs, and immediately hauled off-site. All Portland cement concrete waste material, including rebar and dowels shall become the property of the Contractor and shall be disposed of properly or recycled

Any existing electrical conduits, conductor or grounding cable or ground rods exposed or disturbed during the course of pavement removals shall be removed and abandoned to the extent that it will not interfere with the construction of new pavements on this project. See Section III-4, Electrical Technical Specifications, for temporary and permanent rerouting of runway lighting circuits.

All materials and debris which are to be discarded shall be disposed of by the Contractor to an off-site location (landfill) and in accordance with Local, State, and Federal Rules, Regulations, and Laws.

Upon removal, the remaining site and/or materials shall be prepared in accordance with Items P-152.

104-3.2 PAVEMENT MILLING. All bituminous pavements shall be removed by milling in accordance with these specifications and in conformity with the lines, grades, and typical sections as shown on the plans or as designated by the Engineer.

The Contractor shall remove the designated asphalt concrete by milling Taxiway A pavement to a depth of two inches to the limits shown from STA 26+54 to STA 98+04; Contractor shall remove the pavement full depth (estimated at eight–inches) to the limits shown at existing Ramp 3.

All milled material shall pass the two-inch sieve and must be approved by the Engineer prior to its placement in the infield areas or as directed by the Engineer or GYR Supervisor.

The equipment for removing the pavement shall be a commercially designed and manufactured machine capable of performing the work in a manner satisfactory to the Engineer. The machine(s) shall be power-operated and self-propelled, and shall be sufficient power, traction and stability to remove a thickness of bituminous surface to a specified depth, and provide a uniform profile and cross slope.

The machine shall have an automatic system for controlling grade elevation and cross slope. The machine shall be equipped with a means to effectively control dust generated by the milling operation.

The surface resulting from the milling operation shall be in accordance with the plan grades, and shall be characterized by uniform, continuous longitudinal striations or other uniform patterns and shall not be gouged or torn.

104-3.3 MILLING PLACEMENT. The 2” minus milled asphalt shall be temporarily stockpiled in an approved location and then hauled and placed as directed by the Engineer or GYR Supervisor. The milled asphalt shall be spread to a uniform loose depth so that when compacted, the layer will have a thickness as shown on the plans, plus or minus 0.04 feet. Spreading shall be accomplished with motor graders or other approved means.

104-3.4 PAVEMENT SAW CUTTING. Existing asphalt and PCCP pavement to be removed shall be saw cut by a device capable of making a neat, straight, smooth and vertical cut without damaging adjacent pavement that is not to be removed. The use of roller wheels or “Coulter” wheels for cutting asphalt pavement shall not be allowed. The Engineer’s decision as to the acceptability of the cutting device and manner of operation will be final.

Pavement saw cutting shall be required at match lines to existing pavement that is to remain as specified in section 104-3.6 below. All PCCP that is saw cut shall have the saw cut slurry materials immediately vacuumed and disposed of off-site. PCCP that is saw cut and is proposed to be matched with new PCCP or with a new asphalt pavement shall have all PCCP spall repaired in accordance with section 104-3.5b.

104-3.5 PCCP REMOVAL. All operations shall be carefully controlled to prevent damage to the adjacent concrete pavement and to the underlying material to remain in place. All saw cuts shall be made perpendicular to the slab surface.

No over sawing of adjoining PCCP slabs will be allowed.

Stockpiling of the removed PCCP shall not be allowed in the air operations area. All PCCP material shall be immediately hauled off site and disposed at an approved landfill.

a. Removal of Existing Pavement Slab.

When it is necessary to remove existing concrete pavement and leave adjacent concrete in place the joint between the removal area and adjoining pavement to stay in place, including dowels, tie bars or keys, shall be saw cut full depth.

Where dowels or keys are present, care shall be taken to produce an even, vertical joint face below the dowels or keys. The Contractor shall saw the dowels or keys flush with the joint. New dowels of the size and spacing indicated shall be installed as shown on the drawings by epoxy resin bonding them in holes drilled in the joint face as specified in P–501 paragraph 501-4.10g "Placing dowels and tie bars." Dowels of the size and spacing indicated shall be installed as shown on the drawings by epoxy resin bonding them in holes drilled in the joint face as specified in P–501 paragraph 501–4.10g “Placing dowels and tie bars.” The joint face shall be sawed or otherwise trimmed so that there is no abrupt offset in any direction greater than 1/2-inch and no gradual offset greater than 1 inch when tested in a horizontal direction with a 12 ft. straightedge.

b. Edge Repair. The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Areas that are damaged during construction shall be repaired at no cost to the Owner; repair of previously existing damage areas will be paid for as listed in the bid schedule.

(1) Spall Repair. Spalls shall be repaired where indicated and where directed. Repair materials and procedures shall be as in P-501 specified in subparagraph 501-4.20b(1) "Spall repair."

(2) Underbreak Repair. All underbreaks shall be repaired. First, all delaminated and loose material shall be carefully removed. Next, the underlying material shall be recompacted, without addition of any new material. Finally, the void shall be completely filled with paving concrete, thoroughly consolidated. Care shall be taken to produce an even joint face from top to bottom. Prior to placing concrete, the underlying material shall be thoroughly moistened. After placement, the exposed surface shall be heavily coated with curing compound.

(3) Underlying Material. The underlying material adjacent to the edge of an under the existing pavement which is to remain in place shall be protected from damage or disturbance during removal operations and until placement of new concrete, and shall be shaped as shown on the drawings or as directed. Sufficient material shall be kept in place outside the joint line to prevent disturbance (or sloughing) of material under the pavement that is to remain in place. Any material under the portion of the concrete pavement to remain in place, which is disturbed or loses its compaction shall be carefully removed and replaced with concrete as specified above in subparagraph (2) Underbreak Repair and in Item P-501 subparagraph 501-4.20b.(2) “Underbreak Repair”. The underlying material outside the joint line shall be thoroughly compacted and moist when new concrete is placed.

See Item P-501 for measurement and payment of existing spalled concrete joints.

1.04-3.6 BITUMINOUS PAVEMENT REMOVAL. The Contractor shall use care when removing existing pavement adjacent to pavement that is proposed to remain, such that lower-paving course will not “slough” or be disturbed. If lower paving courses, such as aggregate base

courses, select base courses or native materials are being disturbed at the pavement match line, the Contractor will be required to repair the existing pavement(s) to the satisfaction of the Engineer and at no additional cost to the City of Phoenix.

104-3.7 ELECTRICAL SYSTEM REMOVAL. See Section III-4 Electrical Technical Specifications for the removal of the existing Taxiway A edge lights, taxiway centerline lights, taxiway signs, including foundations, bases, conduit, electrical conductor, counterpoise wire, grounding rods and conductor. Before removal, the Contractor needs to verify that any found cables and wires are either abandoned or designated to be removed and relocated as shown on the electrical plans.

104-3.8 PAVEMENT MATCHING. Existing asphalt and PCCP pavements that are to be matched shall be trimmed to a neat true line, with straight vertical edges free from irregularities using a saw specifically designed for this purpose.

a. Matching Asphalt Pavement. The existing asphalt pavement trimmed shall be cut full depth and be coated with an asphalt cement or emulsified asphalt tack coat immediately prior to constructing the new bituminous base or surface course. No extra payment will be provided for this item and all cost incurred in performing this work shall be incidental to those items for which direct payment is made.

b. Matching Portland Cement Concrete Pavement. The existing Portland cement concrete pavement to match shall be cut full depth and without any irregularities and or spalling of concrete. The saw cut shall not vary more than ¼- inch when tested with a 12-feet straight edge. Irregularities and or spalling of concrete during the full depth cut shall require re-sawing at full depth at no additional cost to the City of Phoenix.

104-3.9 ADJOINING PAVEMENTS DESIGNATED TO REMAIN. The matching edge of all existing pavements designated to remain shall be protected from damage until the finish surface has been complete. Edges which are damaged in the opinion of the Engineer, shall be re-sawn the entire length of the matching joint prior to placing the finished surface. Objects, surfaces and items including the underground utilities designated to remain shall be carefully avoided and left undisturbed. Any damage to these items shall be the responsibility of the Contractor, and shall be corrected to the satisfaction of the Engineer and at no additional cost to the City of Phoenix.

CONTRACTOR QUALITY CONTROL

104-4.1 QUALITY CONTROL PROGRAM. The Contractor shall develop a Quality Control Program in accordance with Section 100 of the General Provision Specifications. The program shall address all elements that affect the quality of the pavement to be milled, including, but not limited to:

a. Fugitive dust control from the milling operation, and;

b. Fugitive dust control from the PCCP removal.

c. Inspection and documentation for saw cut irregularities and existing concrete joint spall repairs.

d. Gradation of the milled asphalt to be placed in the infield areas or as directed by the Engineer or GYR Supervisor.

104-4.2 CORRECTIVE ACTION. The Quality Control Plan shall indicate that appropriate action shall be taken when the milling process is believed to be out of tolerance. The Plan shall contain a set of rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, correction action shall be taken when the following conditions are determined:

a. Fugitive Dust. The Contractor shall supply and operate all necessary equipment and personnel to meet the requirements for dust control. The Contractor shall document dust control procedures in the daily Quality Control reports.

b. Gradation of Milled Asphalt. When the maximum size aggregate exceeds 2-inches the Contractor shall make the appropriate adjustments to control the gradation of the milled asphalt.

METHOD OF MEASUREMENT

104-5.1 Measurement for Milling and Removing Asphalt Concrete Pavement, 2-Inch Thickness and Full–Depth 8-Inch Thickness, shall be made by the number of square yards, completed in conformance with these specifications. Measurement shall be made to the nearest square yard.

104-5.2 Measurement for Saw Cut Portland Cement Concrete Full Depth shall be made by the number of linear feet, completed in conformance with these specifications. Measurement for various depths or thickness shall not be made for the concrete that is saw cut. Measurement shall be made to the nearest foot.

104-5.3 Measurement for Saw Cut Asphalt Concrete Full Depth shall be made by the number of linear feet, completed in conformance with these specifications. Measurement shall be made to the nearest foot.

104-5.3 Measurement for Portland Cement Concrete and Asphalt Concrete pavement removal shall be made by the number of square yards removed, completed in conformance with these specifications. Measurement shall be made to the nearest square yard.

104-5.4 Measurement for Electrical System Removals will be made in accordance with Section III-4 Electrical Technical Specifications.

BASIS OF PAYMENT

104-6.1 Payment for Milling and Removing Asphalt Concrete Pavement shall be made at the contract unit price per square yard of material removed. This price shall be full compensation for furnishing all materials, labor, all milling equipment, tools and incidentals necessary to complete this item, including temporary stockpiling, transportation of millings, and cleanup of waste material and disposal of waste material at an off-site location.

104-6.2 Payment for Saw Cut Portland Cement Concrete Full Depth shall be made at the contract unit price per linear feet. The unit price shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete this item, including

cleanup of waste material and disposal at an off-site location. This price shall include the vacuuming and disposal of the saw cut slurry.

104-6.3 Payment for Saw Cut Asphalt Concrete Full Depth shall be made at the contract unit price per linear feet. The unit price shall be compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete this item, including cleanup of waste materials and disposal at an off-site location.

104-6.4 Payment for Removal of Portland Cement Concrete and Asphalt Concrete Pavement shall be made at the contract unit price per square yard. The unit price shall be compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete this item, including cleanup of waste materials and disposal at an off-site location.

Placing of any unblended asphalt millings in infield areas shall be paid for under Item P-152.

Payment will be made under:

Item P-104-6.1 Mill and Remove Asphalt Concrete Pavement, 2–Inch +/- Depth – per square yard

Item P-104-6.2 Mill and Remove Asphalt Concrete Pavement, 8–Inch +/- Depth – per square yard

Item P-104-6.3 Saw Cut Portland Cement Concrete Full Depth (8–Inch +/- Depth) – per linear feet

Item P-104-6.4 Saw Cut Portland Cement Concrete for Electrical Retrofit – per linear feet

Item P-104-6.5 Remove Portland Cement Concrete Full Depth (8–Inch +/- Depth) – per square yard

Item P-104-6.6 Saw Cut Asphalt Concrete Full Depth (8” +/-) – per linear feet

END OF ITEM P-104

ITEM P-151 CLEARING AND GRUBBING

DESCRIPTION

151-1.1 This item shall consist of clearing or clearing and grubbing, including the disposal of materials, for all areas within the limits designated on the plans or as required by the Engineer.

a. Clearing shall consist of the cutting and removal of all trees, stumps, brush, logs, hedges, the removal of fences and other loose or projecting material from the designated areas. The grubbing of stumps and roots will not be required.

b. Clearing and grubbing shall consist of clearing the surface of the ground of the designated areas of all trees, stumps, down timber, logs, snags, brush, undergrowth, hedges, heavy growth of grass or weeds, fences, structures, debris, and rubbish of any nature, natural obstructions or such material which in the opinion of the Engineer is unsuitable for the foundation of strips, pavements, or other required structures, including the grubbing of stumps, roots, matted roots, foundations, and the disposal from the project of all spoil materials resulting from clearing and grubbing.

CONSTRUCTION METHODS

151-2.1 General. The areas denoted on the plans to be cleared or cleared and grubbed shall be staked on the ground by the Engineer. The clearing and grubbing shall be done at a satisfactory distance in advance of the grading operations.

All spoil materials removed by clearing or by clearing and grubbing shall be disposed of outside the Airport's limits at the Contractor's responsibility except when otherwise directed by the Engineer.

Any broken concrete or masonry that cannot be used in construction and all other materials not considered suitable for use elsewhere, shall be disposed of by the Contractor. In no case shall any discarded materials be left in windrows or piles adjacent to or within the airport limits. The manner and location of disposal of materials shall be subject to the approval of the Engineer and shall not create an unsightly or objectionable view. The Contractor will be required to locate a disposal area outside the airport property limits and, the Contractor shall obtain and file with the Engineer permission in writing from the property owner for the use of private property for this purpose.

Blasting shall not be allowed.

The removal of existing structure and utilities required to permit orderly progress of work shall be accomplished by local agencies, unless otherwise shown on the plans. Whenever a telephone or telegraph pole, pipeline, conduit, sewer, roadway, or other utility is encountered and must be removed or relocated, the Contractor shall advise the Engineer who will notify the proper local authority or owner to secure prompt action.

151-2.2 Clearing. The Contractor shall clear the staked or indicated area of all objectionable materials. Trees unavoidably falling outside the specified clearing limits must be cut up, removed, and disposed of in a satisfactory manner. To minimize damage to trees that are to be

left standing, trees shall be felled toward the center of the area being cleared. The Contractor shall preserve and protect from injury all trees not to be removed. The trees, stumps, and brush shall be cut flush with the original ground surface. The grubbing of stumps and roots will not be required.

Fences shall be removed and disposed of as directed by the Engineer. Fence wire shall be neatly rolled and the wire and posts stored on the airport if they are to be used again, or stored at a location designated by the Engineer if the fence is to remain the property of a local owner or authority.

151-2.3 Clearing and grubbing. In areas designated to be cleared and grubbed, all stumps, roots, buried logs, brush, grass, and other unsatisfactory materials shall be removed, except where embankments exceeding 3-1/2 feet (105 cm) in depth will be constructed outside of paved areas. For embankments constructed outside of paved areas, all unsatisfactory materials shall be removed, but sound trees, stumps, and brush can be cut off flush with the original ground and allowed to remain. Tap roots and other projections over 1-1/2 inches (38 mm) in diameter shall be grubbed out to a depth of at least 18 inches (0.5 m) below the finished subgrade or slope elevation.

Any buildings and miscellaneous structures that are shown on the plans to be removed shall be demolished or removed, and all materials shall be disposed of by removal from the site. The cost of removal is incidental to this item. The remaining or existing foundations, wells, cesspools, and like structures shall be destroyed by breaking down the materials of which the foundations, wells, cesspools, etc., are built to a depth at least 2 feet (60 cm) below the existing surrounding ground. Any broken concrete, blocks, or other objectionable material that cannot be used in backfill shall be removed and disposed of at the Contractor's expense. The holes or openings shall be backfilled with acceptable material and properly compacted.

All holes under embankment areas remaining after the grubbing operation shall have the sides of the holes flattened to facilitate filling with acceptable material and compacting as required in Item P-152. The same procedure shall be applied to all holes remaining after grubbing in areas where the depth of holes exceeds the depth of the proposed excavation.

METHOD OF MEASUREMENT

151-3.1 The quantities of clearing or clearing and grubbing as shown by the limits on the plans or as ordered by the Engineer shall not be measured and paid for separately. The cost of clearing and grubbing shall be incidental to Item P-152 Excavation and Embankment.

BASIS OF PAYMENT

151-4.1 Payment for Clearing and Grubbing shall be included in the unit prices bid for work under Item P-152 Excavation and Embankment. No separate payment shall be made for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

END OF ITEM P-151

ITEM P-152 EXCAVATION, SUBGRADE, AND EMBANKMENT

DESCRIPTION

152-1.1 This item covers excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct safety areas, runways, taxiways, aprons, and intermediate areas as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical sections shown on the plans. Clearing and Grubbing under Item P-151 is an incidental part of this item.

152-1.2 CLASSIFICATION. All material excavated shall be classified as defined below:

a. Unclassified excavation. Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature which is not otherwise classified and paid for under one of the following items.

b. Milled Asphalt Concrete Pavement. Milled asphalt concrete pavement from Taxiway A and Existing Ramp 3 is not unclassified excavation and will not be paid for as part of Item P-152. The cost of milling and stockpiling the milled material is part of Item P-104. Placing of 2” minus unblended asphalt millings in the infield areas and as directed by the Engineer and GYR Supervisor is a part of Item P-152.

152-1.3 UNSUITABLE EXCAVATION. Any material containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material, suitable for topsoil may be used on the embankment slope when approved by the Engineer.

CONSTRUCTION METHODS

152-2.1 GENERAL. Before beginning excavation, grading and embankment operations in any area, the area shall be completely cleared and grubbed in accordance with Item P-151.

The suitability of material to be placed in embankments shall be subject to approval by the Engineer. All unsuitable material shall be disposed of in waste areas shown on the plans. All waste areas shall be graded to allow positive drainage of the area and of adjacent areas. The surface elevation of waste areas shall not extend above the surface elevation of adjacent usable areas of the airport, unless specified on the plans or approved by the Engineer.

When the Contractor’s excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the Engineer notified. At the direction of the Engineer, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Those areas outside of the limits of the pavement areas where the top layer of soil material has become compacted by hauling or other Contractor activities shall be scarified and disked to a depth of 4 inches, to loosen and pulverize the soil.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures, the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the Engineer, who shall arrange for their removal if necessary. The Contractor, at his or her expense, shall satisfactorily repair or pay the cost of all damage to such facilities or structures that may result from any of the Contractor's operations during the period of the contract.

152-2.2 EXCAVATION. No excavation shall be started until the work has been staked out by the Contractor and the Engineer has obtained from the Contractor, the survey notes of the elevations and measurements of the ground surface. All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas designated on the plans or by the Engineer. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes shown on the plans. All unsuitable material shall be disposed of as shown on the plans.

When the volume of the excavation exceeds that required to construct the embankments to the grades indicated, the excess shall be used to grade the areas of ultimate development or disposed as directed by the Engineer. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas.

The grade shall be maintained so that the surface is well drained at all times. When necessary, temporary drains and drainage ditches shall be installed to intercept or divert surface water that may affect the work.

a. Selective Grading. When selective grading is indicated on the plans, the more suitable material designated by the Engineer shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas so that it can be measured for payment as specified in paragraph 152-3.3.

b. Undercutting. Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or any areas intended for turf shall be excavated to a minimum depth of 12 inches below the subgrade or to the depth specified by the Engineer. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed of at locations shown on the plans. This excavated material shall be paid for at the contract unit price per cubic yard for unclassified excavation. The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. The necessary backfill will constitute a part of the embankment. Where rock cuts are made, backfill with select material. Any pockets created in the rock surface shall be drained in accordance with the details shown on the plans.

c. Overbreak. Overbreak, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the Engineer. All overbreak shall be graded or removed by the Contractor and disposed of as directed by the Engineer. The Engineer shall determine if the displacement of such material was unavoidable and his or her decision shall be final. Payment will not be made for the removal and disposal of overbreak that the Engineer determines as avoidable. Unavoidable overbreak will be classified as "Unclassified Excavation."

d. Removal of Utilities. The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by someone other than the Contractor; for example, the utility unless otherwise shown on the plans. All existing foundations shall be excavated at least 2 feet below the top of subgrade or as indicated on the plans, and the material disposed of as directed by the Engineer. All foundations thus excavated shall be backfilled with suitable material and compacted as specified.

e. Compaction requirements. The subgrade under areas to be paved shall be compacted to a depth of as indicated on the plans and to a density of not less than 95 percent of the maximum density as determined by ASTM 1557. The material shall be compacted to -2% to +1% of optimum moisture. The top 12” under PCCP or Asphalt Concrete in the Taxiway or Ramp and top 6” under the Asphalt Concrete Taxiway Shoulders of the subgrade shall be compacted to 95% maximum dry density.

The in-place field density shall be determined in accordance with ASTM D1556 or ASTM D2167. Stones or rock fragments larger than 4 inches in their greatest dimension will not be permitted in the top 6 inches of the subgrade. The finished grading operations, conforming to the typical cross-section, shall be completed and maintained at least 1,000 feet ahead of the paving operations or as directed by the Engineer.

All loose or protruding rocks on the back slopes of cuts shall be pried loose or otherwise removed to the slope finished grade line. All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment shown on the plans or as directed by the Engineer.

Blasting shall not be allowed.

f. Proof rolling. Not used.

152-2.3 BORROW EXCAVATION. Borrow areas within the airport property are indicated on the plans. Borrow excavation shall be made only at these designated locations and within the horizontal and vertical limits as staked or as directed by the Engineer.

When borrow sources are outside the boundaries of the airport property, it shall be the Contractor’s responsibility to locate and obtain the borrow sources, subject to the approval of the Engineer. The Contractor shall notify the Engineer at least 15 days prior to beginning the excavation so necessary measurements and tests can be made. All borrow pits shall be opened up to expose the various strata of acceptable material to allow obtaining a uniform product. All unsuitable material shall be disposed of by the Contractor. Borrow pits shall be excavated to regular lines to permit accurate measurements, and they shall be drained and left in a neat, presentable condition with all slopes dressed uniformly.

152-2.4 DRAINAGE EXCAVATION. Drainage excavation shall consist of excavating for drainage ditches such as intercepting; inlet or outlet ditches; for temporary levee construction; or for any other type as designed or as shown on the plans. The work shall be performed in sequence with the other construction. Intercepting ditches shall be constructed prior to starting adjacent excavation operations. All satisfactory material shall be placed in embankment fills; unsuitable material shall be placed in designated waste areas or as directed by the Engineer. All necessary work shall be performed true to final line, elevation, and cross-section.

The Contractor shall maintain ditches constructed on the project to the required cross-section and shall keep them free of debris or obstructions until the project is accepted.

152-2.5 PREPARATION OF EMBANKMENT AREA. Where an embankment is to be constructed to a height of 4 feet or less, all sod and vegetative matter shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by plowing or scarifying to a minimum depth of 6 inches and shall then be compacted as indicated in paragraph 152-2.6. When the height of fill is greater than 4 feet, sod not required to be removed shall be thoroughly disked and recompacted to the density of the surrounding ground before construction of embankment.

Sloped surfaces steeper than one (1) vertical to four (4) horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.

No direct payment shall be made for the work performed under this section. The necessary clearing and grubbing and the quantity of excavation removed will be paid for under the respective items of work.

152-2.6 FORMATION OF EMBANKMENTS. Embankments shall be formed in successive horizontal layers of not more than 8 inches in loose depth for the full width of the cross-section, unless otherwise approved by the Engineer.

The layers shall be placed, to produce a soil structure as shown on the typical cross-section or as directed by the Engineer. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Earthwork operations shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing, or other unsatisfactory weather conditions in the field. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. The Contractor shall drag, blade, or slope the embankment to provide surface drainage at all times.

The material in each layer shall be within -2%+1% of optimum moisture content before rolling to obtain the prescribed compaction. To achieve a uniform moisture content throughout the layer, the material shall be moistened or aerated as necessary. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken for each 750 square yards of material placed per layer. Based on these tests, the Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content to achieve the specified embankment density.

Rolling operations shall be continued until the embankment is compacted to not less than 90% of maximum density for cohesive soils as determined by ASTM D 1557. Under all areas to be paved, the embankment's subgrade shall be compacted to a depth as specified in Paragraph 152-2.2e.

On all areas outside of the pavement areas, the top 4 inches shall be compacted to a density of 90% maximum density as determined by ATSM D 1557.

The in-place field density shall be determined in accordance with Paragraph 152-3.1 Acceptance Sampling and Testing and the Contractor's Quality Control Testing Program described in Paragraphs 152-4.1 through 152-4.3.

Compaction areas shall be kept separate, and no layer shall be covered by another layer until the proper density is obtained.

During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each layer is placed. Layer placement shall begin in the deepest portion of the embankment fill. As placement progresses, the layers shall be constructed approximately parallel to the finished pavement grade line.

When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portion of the embankment and the other material shall be incorporated under the future paved areas. Stones or fragmentary rock larger than 4 inches in their greatest dimensions will not be allowed in the top 6 inches of the subgrade. Rockfill shall be brought up in layers as specified or as directed by the Engineer and the finer material shall be used to fill the voids with forming a dense, compact mass. Rock or boulders shall not be disposed of outside the excavation or embankment areas, except at places and in the manner designated on the plans or by the Engineer.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in layers not exceeding 2 feet in thickness. Each layer shall be leveled and smoothed with suitable equipment by distribution of spalls and finer fragments of rock. The layer shall not be constructed above an elevation 4 feet below the finished subgrade.

There will be no separate measurement of payment for compacted embankment. All costs incidental to placing in layers, compacting, disking, watering, mixing, sloping, and other operations necessary for construction of embankments will be included in the contract price for excavation, borrow, or other items.

152-2.7 FINISHING AND PROTECTION OF SUBGRADE. After the subgrade is substantially complete, the Contractor shall remove any soft or other unstable material over the full width of the subgrade that will not compact properly. All low areas, holes or depressions in the subgrade shall be brought to grade with suitable select material. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the plans.

Grading of the subgrade shall be performed so that it will drain readily. The Contractor shall protect the subgrade from damage and limit hauling over the finished subgrade to only traffic essential for construction purposes.

All ruts or rough places that develop in the completed subgrade shall be graded and recompacted. No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been approved by the Engineer.

152-2.8 HAUL. All hauling will be considered a necessary and incidental part of the work. The Contractor shall include the cost in the contract unit price for the pay of items of work involved. No payment will be made separately or directly for hauling on any part of the work.

152-2.9 TOLERANCES. In those areas upon which a subbase or base course is to be placed, the top of the subgrade shall be of such smoothness that, when tested with a 12-foot straightedge applied parallel and at right angles to the centerline, it shall not show any deviation in excess of 1/2 inch, or shall not be more than 0.05 feet from true grade as established by grade hubs. Any deviation in excess of these amounts shall be corrected by loosening, adding, or removing materials; reshaping; and recompacting.

On safety areas, intermediate and other designated areas, the surface shall be of such smoothness that it will not vary more than 0.10 feet from true grade as established by grade hubs. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

152-2.10 TOPSOIL. When topsoil is specified or required as shown on the plans or under Item T-905, it shall be salvaged from stripping or other grading operations. The topsoil shall meet the requirements of Item T-905. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of finished construction, the material shall be stockpiled at approved locations. Stockpiles shall not be placed within 200 feet of runway pavement or 60 feet of taxiway pavement and shall not be placed on areas that subsequently will require any excavation or embankment fill. If, in the judgment of the Engineer, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further rehandling.

152-2.11 PLACING UNBLENDED ASPHALT MILLINGS. Under Item P-104, unblended asphalt millings shall be temporarily stockpiled.

Following completion of the Taxiway A rehabilitation and shoulder construction, the asphalt millings shall be spread as directed to serve as erosion and dust control. The millings shall be spread to a depth of 1.5 to 2.0 inches, bladed smooth and compacted with three passes by a vibratory steel wheeled roller. The cost of picking up the millings from the temporary stockpile, spreading them in the infield area, blading smooth and compacting them shall be paid for under “Unclassified Excavation” based on the cubic yards of asphalt millings placed in the infield area.

MATERIAL ACCEPTANCE

152-3.1 ACCEPTANCE SAMPLING AND TESTING. The acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the City of Phoenix Materials Laboratory upon completion of acceptable sampling and testing by the Contractor's Quality Control Program. Embankment materials shall be accepted on a lot basis. One (1) lot shall consist of one thousand (1,000) cubic yards or one (1) day's production, whichever is less.

CONTRACTOR QUALITY CONTROL

152-4.1 QUALITY CONTROL PROGRAM. The Contractor shall develop a Quality Control Program in accordance with Section 100 of the General Provision Specifications. The program shall address all elements that affect the quality of the embankment(s) being formed.

A P-152 Quality Control Testing Plan shall be developed as part of the Quality Control Program.

152-4.2 TESTING FREQUENCY. The Contractor shall establish a minimum testing frequency of one (1) density and moisture test per ASTM D 1556, for each of the following conditions:

a. For each one thousand (1,000) cubic yards of embankment formed, or one (1) day's production, whichever is less, and;

b. For each eight (8) inch loose lift, and;

c. For subgrade compaction, the Contractor shall provide at least one (1) density and moisture test for each 1,000 square yards. For isolated areas or confined areas that are less than 1,000 square yards, there shall be at least one (1) density and moisture test.

152-4.3 QUALITY CONTROL TESTING. The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to this specification and as set forth in the Quality Control Program. The testing program shall include, but not be limited to tests for material density, material moisture content, rolling patterns, and embankment lift thickness.

a. Material Density. The in-place field density shall be determined in accordance with ASTM D 1556 or ASTM D 2167. Nuclear moisture and density methods meeting ASTM D 6938 using Procedure A, the direct transmission method, and ASTM D 6938 to determine the moisture content of the material may be used, provided that at least one (1) out of ten (10) tests are conducted using the ASTM D 1556 method to correlate test results. The nuclear density machine shall be calibrated in accordance with ASTM D 6938.

b. Material Moisture Content. The material in each layer shall be within plus one (1) or minus two (2) percent of optimum moisture content before rolling to obtain the prescribed compaction.

c. Rolling Patterns. Where soils are too coarse to be tested by conventional procedures, they shall be compacted using a minimum roller specification. Each lift shall be subjected to ten (10) coverages with a vibratory roller as specified under "Formation of Embankments" of this section.

d. Embankment Lift Thickness. Embankments and backfill constructed shall be formed in successive horizontal layers of not more than eight (8) inches in loose depth for the full width of the cross section. Samples of embankment materials for quality control testing, both before and after placement and compaction, will be taken for each 1,000 cubic yards.

e. Imported Materials. For materials imported, the Contractor shall submit the name and address of the supplier; approximate amount of material to be imported; location from which the material was excavated or recovered; the gradation and plastic index of the material and a written certification from the material supplier that the borrow material(s) are free of hazardous materials and or substances as defined by local, state and federal environmental regulations. When written certification is not available from the commercial source or the Contractor source that states that the material is free of hazardous materials and/or substances, the Contractor shall arrange for the materials to be tested in accordance with the latest edition of EPA SW846 "Test Methods for Evaluation Solid Waste". Material testing shall include, but not be limited to EPA test methods 8015 petroleum hydrocarbons, 8260 (VOCs), 8270 (SVOCs), 8081/8082 (pesticides/PCBs), 8310 (PAHs), and 6010/7000 series (priority pollutant metals). All sample collections and analysis shall be performed by a state certified laboratory. The

Contractor shall submit the material supplier(s) certifications and/or the certified laboratory results in the Quality Control Report for approval prior to importing any borrow materials onto Phoenix Goodyear Airport.

f. Fugitive Dust. The Contractor shall supply and operate all necessary equipment and personnel to meet the requirements for dust control. The Contractor shall document dust control procedures in the daily Quality Control reports.

METHOD OF MEASUREMENT

152-5.1 SUBGRADE PREPARATION. Subgrade preparation shall be measured by the square yard based on the neat lines shown on the plans and verified by construction surveys completed by the Contractor's surveyor under the supervision of the Engineer.

152-5.2 UNCLASSIFIED EXCAVATION. The quantity of excavation to be paid for shall be the number of cubic yards measured in its original position.

a. For payment specified by the cubic yard, measurement for all excavation shall be computed by the average end area method. The end area is that bound by the original ground line established by field cross sections or the ground line existing after the asphalt milling and blending removal and the final theoretical pay line established by excavation cross sections shown on the plans, subject to verification by the Engineer. After completion of all excavation operations and prior to the placing of base or subbase material, the final excavation shall be verified by the Engineer by means of field cross sections taken randomly at intervals not exceeding 200 linear feet.

In Asphalt Concrete paved shoulder areas, the lower limit of unclassified excavation is the bottom of the P-154 Subbase Course.

Final field cross sections shall be employed if the following changes have been made:

b. Plan width of embankments or excavations are changed by more than plus or minus 1.0 feet; or

c. Plan elevations of embankments or excavations are changed by more than plus or minus 0.5 feet.

BASIS OF PAYMENT

152-6.1 For Portland Cement Concrete or new Asphalt Concrete Taxiway paving "Subgrade Preparation (12-inch Depth)" payment shall be made at the contract unit price per square yard. This price shall be full compensation for scarifying, moisture conditioning, processing and compaction of the bottom of the subgrade, and all labor, equipment, tools, and incidentals necessary to complete the item.

152-6.2 For Taxiway Asphalt Concrete Shoulder paving "Subgrade Preparation (6-inch Depth)" payment shall be made at the contract unit price per square yard. This price shall be full compensation for scarifying, moisture conditioning, processing and compaction of the bottom of the subgrade, and all labor, equipment, tools, and incidentals necessary to complete the item.

152-6.3 For "Unclassified excavation" payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item, including clearing and grubbing and the over excavation of subgrade materials and stockpiling the subgrade material in the reprocessing area.

Payment will be made under:

Item P-152-6.1	Subgrade Preparation under PCCP or new Asphalt Concrete Taxiway or Ramp (12-inch Depth) - per square yard
Item P-152-6.2	Subgrade Preparation under Asphalt Concrete Shoulders (6-inch Depth) – per square yard
Item P-152-6.3	Unclassified Excavation - per cubic yard

TESTING REQUIREMENTS

ASTM D 698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)
ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3)
ASTM D 2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

END OF ITEM P-152

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ITEM P-153 CONTROLLED LOW-STRENGTH MATERIAL (CLSM)

DESCRIPTION

153.1.1 This item shall consist of furnishing, transporting, and placing a controlled low-strength material (CLSM) as flowable backfill in trenches or to replace unsuitable subgrade materials or as directed by the Engineer.

CLSM is a mixture of Portland cement, aggregate and water that, as the cement hydrates, forms a soil replacement. CLSM is a self-compacting, flowable, cementitious material that is primarily used as a backfill or structural fill in lieu of compacted fill or unsuitable native material.

MATERIALS

153-2.1 MATERIALS

a. Portland Cement. Portland cement shall conform to the requirements of ASTM C150 Type II. If for any reason, cement becomes partially set or contains lumps of caked cement, it shall be rejected. Cement salvaged from discarded or used bags shall not be used.

b. Fly Ash. Fly Ash shall conform to ASTM C 618, Class F.

c. Coarse and Fine Aggregate (Sand). Coarse and fine aggregate shall conform to the requirements of ASTM C 33 except for aggregate gradation. Aggregate gradation shall conform to MAG Section 702 Table 702-1 crushed aggregate Base Gradation (1 ¼" minus).

d. Water. Water used in mixing shall be free of oil, salt, acid, alkali, sugar, vegetable matter, or other substances injurious to the finished product.

MIX DESIGN

153-3.1 PROPORTIONING OF MIXTURE AND PRODUCTION TOLERANCES. The aggregates for CLSM shall be Aggregate Base conforming to MAG Section 702. Proportioning of the mixture shall comply with MAG Section 725.7 to conform to the requirements below. A mix design shall be submitted with test data for the Engineer's approval prior to the excavation for which the material is intended for use.

TABLE 1

Cement Content (lbs/cu yd)	Slump	Compressive Strength at 28 days, psi
47.5+/- 5%	6" – 8"	Between 30 and 100 (max)

Notes for Table 1:

1. The values specified in the table are for both mix design requirements and field production. The deviations are for production, testing and sampling tolerances.

2. Slump shall be tested in accordance with ASTM C-143. Flow consistency test can be substituted for the slump test. When used the CLSM shall have a flow consistency between six (6) inches to eight (8) inches as tested in accordance with ASTM D-6103.

3. Compressive strength shall be tested in accordance with ASTM D-4832. The supplier shall provide laboratory and/or field test data to verify the design strength.

4. Sampling shall be in accordance with ASTM D-4832.

5. Unit weight shall be obtained by ASTM D-6023.

6. Temperature shall be taken in accordance with ASTM C-1064.

7. Cement content shall be tested in accordance with ASTM D-5982.

Where CLSM is to be used as backfill around gas pipelines (totally encapsulating the gas pipeline), the material shall meet a minimum permeability coefficient (k) of 1 x 10^{-5} cm/sec or more, based on ASTM D-5982.

153-4.1 MIXING. The total elapsed time between the addition of the water and placement of the complete mix shall not exceed 90 minutes. The Engineer may waive this limitation if the slump is such that the material can be placed without additional water.

Mixing shall continue until the cementitious material and water are thoroughly dispersed throughout the material. Mixes shall be homogeneous, readily peaceable, and uniformly workable. Proportioning of ingredients shall produce consistency, durability, workability, and other required properties appropriate for the intended usage. When the CLSM is mixed other than at the project site, the mixing shall comply with MAG Section 725.8. Where the CLSM is mixed at the job site, the Contractor shall submit for Engineer's approval, the methods, equipment, and procedures for proportioning and mixing the material.

CONSTRUCTION METHODS

153-5.1 PLACEMENT. The controlled low strength material shall be placed directly into the excavation to be filled. 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 excavation prior to and during placing of 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 compacting or vibration may be used to consolidate around structures, pipes, multiple conduits, etc., otherwise no mechanical compaction or vibration shall be required.

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. In addition, 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. The maximum lift thickness shall not exceed four (4) feet under any circumstances.

When 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 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 for control the material's flowability. The bulkhead shall be removed prior to the continuation the backfilling.

CLSM shall NOT be permitted to come in contact with aluminum, copper or brass materials, e.g., aluminum pipes or culverts, copper water pipe e.g., native material, import material, etc. or provide a protective covering or wrapping such a polyethylene wrap per MAG Section 610.5. Pipes smaller than 4 inches can be completely wrapped with tape as per MAG section 610.5.

153-5.2 PROTECTION. When CLSM is placed within the traveled way or otherwise to be covered by paving or embankment materials, the material shall achieve a penetration resistance of 3 inches (indentation diameter) or less with 5 drops at a drop distance of 5 inches prior to covering and opening to traffic or the installation of the surface be delayed for 12 hours, whichever occurs first. Penetration resistance shall be as measured by ASTM Test Method D-6024.

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 C-403, or allowed to set in place for 24 hours, whichever comes first.

Where the Engineer or GYR Supervisor has identified soils as being moisture sensitive, a drainage notch or drain wick shall be placed longitudinally along the centerline of the trench or CLSM placement. The notice or wick shall be constructed within the first hour following placement. Drainage water shall be collected and removed at the end of notch or wick.

MATERIAL ACCEPTANCE

153-6.1 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 1 and/or

b) The aggregate gradation is outside the limits specified in MAG section 702-2.2 – Table 702-1 Aggregate Base.

Rejected material not placed shall be immediately removed from the job site. Rejected material 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.

CONTRACTOR QUALITY CONTROL

153.7.1 The Contractor shall be responsible for developing and implementing a Contractor Quality Control Program including inspection and testing to assure compliance with the requirement of this section in accordance with Technical General Provisions Section 100.

METHOD OF MEASUREMENT

153-8.1 Measurement. No separate measurement for CLSM will be made. Payment for backfilling trenches, pavement replacement, structures and filling abandoned pipes shall be incidental to the specific work function.

BASIS OF PAYMENT

153-9.1 Payment. No separate payment will be made for CLSM. The cost for placing the material shall be included in the unit price bid for the specific work function (backfilling trenches, pavement replacement, duct or conduit installations, catch basins, excavation, laying pipe, placing structure foundation, construction of retaining walls, filling abandoned pipe, etc.).

TESTING REQUIREMENTS

ASTM D 6024	Standard Test Method for Ball Drop on Controlled Low Strength Material to Determine Suitability for Load Application.
ASTM C 143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM D 6103	Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)
ASTM D 4832	Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
ASTM D 5982	Standard Test Method for Determining Cement Content of Fresh Soil-Cement (Heat of Neutralization Method)
ASTM D 6023	Standard Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM)
ASTM C 403	Standard Test Method for Time of Setting of Concrete Mixtures of Penetration Resistance
ASTM C 31	Making and Curing Concrete Test Specimens in the Field
ASTM C 39	Compressive Strength of Cylindrical Concrete

MATERIAL REQUIREMENTS

ASTM C 33	Specification for Concrete Aggregates
ASTM C 150	Specification for Portland Cement
ASTM C 618	Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C595	Standard Specification for Blended Hydraulic Cements

END OF ITEM P-153

ITEM P-156(A) TEMPORARY AIR AND WATER POLLUTION, SOIL EROSION AND SILTATION CONTROL

DESCRIPTION

156(A)-1.1 GENERAL. This project is subject to the terms and conditions of Arizona Pollutant Discharge Elimination System (AZPDES) General Permit No. AZG2013-001 for Storm Water Discharges from Construction Activities. Under the provisions of the AZPDES General Permit, both the City of Phoenix and the Contractor shall be designated as operators, and both must ensure compliance with the terms and conditions of the AZPDES General Permit. AZPDES General Permit No. AZG2013-001 was issued by the Arizona Department of Environmental Quality (ADEQ) on June 3, 2013.

Work under this item shall consist of preparing all required documents and certifications, performing inspections, and furnishing all materials, labor, and equipment necessary to comply with all requirements of AZPDES General Permit No. AZG2013-001 for Storm Water Discharges from Construction Activities. The work shall also include providing, installing, maintaining, removing and disposing of erosion and sediment control measures such as gravel filter berms, dikes, catch basin inlet protection, end-of pipe filtering devices, silt fences, dams, sediment traps and basins, netting, straw bale barriers, slope drains, and other erosion control devices or methods.

PERMIT REQUIREMENTS

156(A)-2.1 Please note that the terms and conditions of AZPDES General Permit No. AZG2013-001, except to the extent that more explicit or more stringent requirements are written directly into the contract documents, have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith.

Both the City of Phoenix and the Contractor are designated as operators of the construction site, and both must complete a Notice of Intent (NOI) to comply with the terms and conditions of AZPDES General Permit No. AZG2013-001 for Storm Water Discharges from Construction Activities. The NOIs must be signed in accordance with the signatory requirements of the AZPDES General Permit, and must contain all required eligibility certifications. The Project Manager for the City of Phoenix will ensure that both the Contractor's and City's completed and signed NOIs are submitted to the ADEQ. NOI forms may be found on the ADEQ website at: http://www.azdeq.gov/node/2964

It shall be the responsibility of the Contractor to prepare a joint Storm Water Pollution Prevention Plan (SWPPP) and ensure its compliance with the minimum conditions of the AZPDES General Permit, including measures to protect impaired or unique waters, measures to protect threatened and/or endangered species, and measures to protect properties eligible for protection under then National Historic Preservation Act. The SWPPP must reflect the Contractor's entire scope of activities at the job site as anticipated for the duration of the construction activities. The Contractor must indicate in the SWPPP those changes in job site requirements and/or the order of work performance that will require modifications to the SWPPP, and include those modifications in the SWPPP.

Once completed, it shall be the responsibility of the City of Phoenix to review and approve the joint SWPPP prior to the start of work. The preconstruction conference shall not be held and the Contractor shall not be allowed to start work until the City of Phoenix has approved the SWPPP as being adequate and in accordance with the requirements of the AZPDES General Permit. The City of Phoenix shall approve or not approve the SWPPP within seven (7) calendar days after receipt of the SWPPP from the Contractor for purposes of review. Failure of the Contractor and the City of Phoenix to reach agreement on the adequacy of the SWPPP prior to the preconstruction conference will delay the start of work. The Contractor shall not be entitled to additional compensation for costs that result from such a delay in the construction start date.

The SWPPP is not to be submitted to the ADEQ unless directed to do so by the City's Project Manager or in response to a direct request from the ADEQ Director (or authorized representative). If the SWPPP must be submitted to the ADEQ for review and approval, authorization to discharge under the AZPDES General Permit may be withheld by ADEQ for up to thirty-two (32) business days after receipt of the SWPPP.

It shall be the responsibility of the Contractor to implement the SWPPP, and ensure day-to-day compliance with the terms and conditions of the SWPPP and the AZPDES General Permit. The Contractor shall, with the approval of the City's Project Manager, update and revise the SWPPP as necessary through the duration of the project to ensure compliance with the AZPDES General Permit requirements.

The Contractor shall retain a copy of the SWPPP and the AZPDES General Permit at a central location on the job site for the use of all operators whenever they are on the construction site. A copy of the signed SWPPP must be retained on the construction site or at another location easily accessible during normal working hours.

All subcontractors and construction site operators having control over only a portion of the construction site shall comply with the requirements of the AZPDES General Permit and the common SWPPP under the supervision of the Contractor. The Contractor shall ensure that all partial site operators having day-to-day operational control of activities necessary to ensure compliance with the SWPPP or other permit requirements submit NOIs to ADWQ as required by the AZPDES General Permit. Subcontractors and partial site operators shall ensure that their activities do not render any other party's pollution prevention plan measures ineffective.

The Contractor shall obtain and incorporate into the SWPPP copes of all NOIs required by the AZPDES General Permit. The Contractor shall ensure that all required documents are complete and accurate, and all required NOIs are received by ADEQ at least two (2) business days before a contractor, subcontractor, or partial site operator is allowed to perform any work at the construction site.

As of June 1, 2017, ADEQ no longer accepts paper application for Stormwater Construction General Permit (CGP) and Multi–Sector General Permit (MSGP) NOI's or NOT's. The Contractor shall use myDEQ at: https://my.azdeq.gov/registration/account/are-you-rco to create a login to be able to submit CGP's and MSGP NOI's or NOT's.

The Contractor shall provide a copy of the Contractor's completed and signed NOI form to the City's Project Manager at the preconstruction conference. The City's Project Manager shall ensure that a copy of the Contractor's completed NOI form, along with a copy of the City's completed NOI form, are incorporated into the SWPPP.

Failure by the Contractor to provide copies of the required completed NOI forms by the time of the preconstruction conference shall cause a delay in the construction start date. The Contractor shall not be entitled to additional compensation for costs that result from such a delay in the construction start date.

The Project Manager for the City of Phoenix shall also send copies of the complete NOI forms to:

Development Services Department
City of Phoenix
200 West Washington Street, 3rd Floor
Phoenix, Arizona 85003-1611

The Contractor must submit an amended NOI if ADEQ provides notification that the previously submitted NOI is incomplete. The amended NOI must be submitted to the ADEQ, the City's Project Manager, and if so directed by the City's Project Manager, to the Development Services Department.

The Contractor may assume coverage under the AZPDES General Permit after acknowledgement of receipt of the NOI by ADEQ unless ADEQ provides notification that the NOI needs additional evaluation. Such notification may be made in writing, electronically, by fax, or by phone; and will typically be made within two (2) business days after receipt of the NOI. The Contractor cannot assume coverage under the permit and must delay the start of construction for a period of thirty-two (32) business days after the receipt of the NOI by ADEQ, unless additional notice is received from ADEQ during this time period. If there is no additional notice, the Contractor may assume coverage under the AZPDES General Permit and initiate construction activities at the end of the 32 business days.

STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS

156(A)-3.1 The SWPPP must be prepared prior to submitting the NOI to ADEQ for coverage under AZPDES General Permit, and the Contractor must implement the SWPPP as written from the initial commencement of construction activity until final stabilization is complete. The SWPPP must be prepared in accordance with good engineering practice, and must:

(a) Identify potential sources of pollution which may reasonably be expect to affect the quality of storm water discharges from the construction site;

(b) Identify, describe and ensure implementation of best management practices (BMPs) that will be used to reduce the amount of pollutants in storm water discharges from the construction site;

(c) Assure compliance with the terms and conditions of AZPDES General Permit No. AZG2008-001 for Storm Water Discharges from Construction Activities; and

(d) Identify the party responsible for on-site implementation of the SWPPP.

Specific requirements for the contents of the SWPPP included identification of all operators of the project site, and the areas over which each operator has control. The SWPPP must also provide a description of the nature of the construction activity that includes:

(a) A description of the project and its intended use after the Notice of Termination (NOT) is filed (e.g. a municipal park, a municipal building, high density housing, a city street, a water treatment plant, a municipal airport, etc.);

(b) A description of the intended sequence of activities that disturb the soil at the site (e.g. grubbing, excavation, grading, utilities, infrastructure installation, etc.);

(c) The total area of the site, and an estimate of the total area of the site expected to be disturbed by excavation, grading, or other activities, including off-site barrow and fill areas;

(d) An estimate of the runoff coefficient of the site for both the pre-construction and post-construction conditions, and data describing the soil and any existent data on the quality of any discharged from the site;

(e) A general location map (e.g. U.S.G.S. quadrangle map, a portion of city or county map, or other map) with enough detail to identify the location of the construction site and the receiving waters within one mile of the site

The SWPPP must contain a legible site map completed to scale that shows the entire site, and identifies:

(a) The directions of storm water flow (e.g. use arrows to show which way or ways storm water will flow on, through, and off the site), and the approximate slopes anticipated after major grading activities;

(b) Areas of soil disturbance and areas of no soil disturbance;

(c) Locations of structural and non-structural controls identified in the SWPPP;

(d) Locations where stabilization practices are expect to occur;

(e) Locations of off-site material, waste, borrow areas, or equipment storage areas;

(f) Locations of all surface water bodies (including wetlands);

(g) Locations where storm water discharges to surface water (including dry washes) and to the City's storm sewer system;

(h) Locations and registration numbers of on-site drywells;

(i) Areas where final stabilization has been accomplished and no further construction-phase permit requirements apply.

The SWPPP must identify the nearest receiving water or waters, including ephemeral and intermittent streams, dry sloughs, and arroyos. If applicable, the SWPPP must also identify the

areal extent and describe any wetlands near the site that could be disturbed or that could potentially receive discharges from the disturbed areas of the project.

The SWPPP must identify the location and describe any storm water or non-storm water discharges at the site associated with activity other than construction and other pollutant sources, such as fueling operations, on-site material storage area, waste piles, etc. This includes discharges from dedicated asphalt plants and dedicated concrete plants that are covered by the AZPDES General Permit.

The SWPPP must identify and address off-site storage areas or borrow areas that are used solely for this construction project.

The SWPPP must describe all pollution control measures that will be implemented as part of the construction project to control pollutants in storm water discharges. For each major activity identified in the project description, the SWPPP must clearly describe appropriate control measures; the general sequence during the construction process when the measures will be implemented; and identify the construction site operator responsible for the implementation of the described control measures.

Off-site material storage areas (including overburden and stockpiles of dirt, borrow areas, etc.) used solely by the Contractor for the permitted construction project are considered a part of the project and must be addressed in the SWPPP.

For purposes of controlling erosion and sediment, the SWPPP must address the following:

(a) Erosion and sediment controls must be designed to retain sediment on the construction site to the extent practicable.

(b) All control measures must be properly selected, installed, and maintained per the manufacturer's specifications and good engineering practices. If periodic inspections or information is discovered that indicates a control has been used inappropriately, or installed incorrectly, the Contractor must replace or modify the control for site situations as soon as practicable and before the next anticipated storm event.

(c) When sediment escapes the construction site, off-site accumulations of sediment must be routinely removed at a frequency sufficient to ensure no adverse effects on water quality.

The SWPPP must describe good housekeeping procedures to prevent litter, construction debris, and construction chemicals exposed to storm water from becoming a pollutant source for storm water discharges.

The SWPPP must include a description of and identify interim and permanent stabilization practices for the construction site, including a schedule of when the practices will be implemented. The SWPPP shall document those areas where existing vegetation will be preserved.

The Contractor must initiate stabilization measures within 14 calendar days in those areas where construction activities have temporarily or permanently ceased, except:

(a) Where stabilization by the 14th day is precluded by snow cover or frozen grown conditions, stabilization measures must be initiated as soon as practicable.

(b) Where construction activity on a portion of the site has temporarily ceased, but earth disturbing activities will resume in that area within the 14 days. In this event, temporary stabilization measures do not have to be initiated on that portion of the site.

(c) When the site is using vegetative stabilization measures and it is during seasonally arid conditions, vegetative stabilization measures must be initiated as soon as practicable.

The Contractor must maintain the following records as part of the SWPPP:

(a) Dates when major grading activities occur;

(b) Dates when construction activities temporarily or permanently cease on a portion of the site;

(c) Dates when stabilization measures are initiated and completed, and the reasons for any delay.

The SWPPP must describe structural practices to divert flows from exposed soils, store flows or otherwise limit runoff and the discharge of pollutants from exposed areas of the site to the degree attainable. Placement of structural practices in floodplains should be avoided to the degree attainable. A combination of sediment and erosion control measures is required to achieve maximum pollutant removal. Sediment basins and velocity dissipation devices must be utilized and placed in accordance with “best management practices” of the AZPDES General Permit.

The SWPPP must include a description of post-construction storm water management measures that will be installed during the construction process to control pollutants in storm water discharges after construction operations have been completed. Structural measures shall be placed on upload soils to the degree attainable, and must be designed and installed consistent with applicable City of Phoenix storm water management requirements.

The SWPPP must identify all allowable sources of non-storm water discharges listed in Part 1.3.2 of AZPDES General Permit No. AZG2013-001 for Storm Water Discharges from Construction Activities except for flows from firefighting activities. Non-storm water discharges are to be eliminated or reduce to the extent feasible. The Contractor must implement appropriate best management practices (BMPs) to minimize pollutants in any non-storm water discharges, and must describe those BMPs in the SWPPP. Except if used in emergency firefighting, super-chlorinated wastewaters must be held on-site until the chorine dissipates, or otherwise de-chlorinated prior to discharge.

The SWPPP must describe:

(a) Measures to prevent the discharge of solid materials, including building materials, to waters of the United States, except as authorized by a permit issued under section 404 of the Clean Water Act;

(b) Measures to minimize off-site vehicle tracking of sediments, to the extent practicable, and the generation of on-site dust;

(c) Construction and waste materials expected to be stored on-site with updates as appropriate. The SWPPP must also include a description of the controls to reduce pollutants from these materials including storage practices to minimize exposure of the materials to storm water, and spill prevention and response practices;

(d) Any pollutant sources from areas other than construction (including storm water discharges from dedicated asphalt plants, dedicated concrete plants, and/or any other non-construction pollutant sources), with details of controls and measures that will be implemented at those sites to minimize pollutant discharges; and

(e) Measures to sufficiently stabilize soil at culvert locations prevent the formation of rills and gullies during construction.

The SWPPP must include a copy of AZPDES General Permit No. AZG2013-001 for Storm Water Discharges from Construction Activities. Copies of the NOI submitted to ADEQ and/or copies of the certificates received from ADEQ specifying the authorization numbers must also be incorporated into the SWPPP as they become available. If any other agreements with state, federal, or local officials exist that would affect the provisions or implementation of the SWPPP, copies of these agreements must also be included in the SWPPP. (Please note, these types of agreements would include grading and drainage approval and/or permits, and storm water management approvals and/or permits issued by the City of Phoenix Development Services Department.)

The SWPPP must be consistent with applicable federal, state, and local requirements for soil and erosion control or storm water management. The SWPPP may incorporate by reference the appropriate elements of soil and erosion or storm water management plans required by the other agencies. A copy of these requirements incorporated by reference must be provided as an attachment to the SWPPP, and must be updated as necessary to remain consistent with any revisions made to the requirements by the responsible agency or agencies. Examples of appropriate requirements include the Phoenix Grading and Drainage Ordinance (Chapter 32A of the Phoenix City Code) and the Phoenix Storm Water Management Ordinance (Chapter 32C of the Phoenix City code).

A schedule for routine inspections of the construction site must be included in the SWPPP. This schedule must comply with the Part 4.1 and Part 4.2 of the AZPDES General Permit.

The Contractor must sign the SWPPP in accordance with Appendix B.9 of the AZPDES General Permit. A copy of the signed SWPPP must be retained on the construction site or at another location easily accessible during normal working hours.

SWPPP IMPLEMENTATION AND CONSTRUCTION REQUIREMENTS

156(A)-4.1 The Contractor shall not begin any construction activity until all applicable SWPPP controls, devices, and practices have been put into place.

In accordance with the terms and conditions of the AZPDES General Permit, the Contractor shall post the following documents at the construction site near the main entrance:

(a) The AZPDES authorization number for the project or a copy of the NOI if an authorization number has not yet been assigned,

(b) The name and telephone number of a local office or site contact person,

(c) A brief description of the construction project, and

(d) The location of the SWPPP if the site is inactive or does not have an on-site location to store the plan, and then name of the contact person for accessing the SWPPP.

The Contractor shall provide adequate and timely maintenance of vegetation, erosion and sediment control measures, and other protective measures and/or best management practices (BMPs) identified in the site plan or SWPPP to ensure that they remain in effective operating condition. Maintenance needs identified through inspections or other means shall be accomplished as soon as practicable and before the next anticipated storm event. If existing protective measures need to be modified or additional measure added, implementation of these changes must be completed before the next anticipated storm event, if practicable. If not practicable, implementation must be completed as soon as it is practicable. Sediment and debris must be removed from sediment traps, sediment ponds, trash racks, and similar structures when the design capacity of the structure has been reduced by fifty (50) percent.

The Contract shall employ qualified personnel as defined by Part 4.1 of the AZPDES General Permit to inspect construction site areas in accordance with the requirements of Part 4.3 of the AZPDES General Permit. All inspection results shall be documented in reports that, at a minimum, include:

(a) The inspection date;

(b) The name, title, and qualifications of the person or persons performing the inspections. The qualifications must be either on or attached to the report. Alternatively, if the SWPPP documents the qualifications of the person or persons performing the inspections, then that portion of the SWPPP may be referenced;

(c) The weather information for the period since the last inspection (or since the start of construction if this is the first inspection), including the best estimate of the beginning of each storm event, the duration of each event, the time that has elapsed since the last storm event, and the approximate amount of rainfall for each event in inches;

(d) The location or locations of discharged of sediment or other pollutants from the site;

(e) The location or locations and identification of BMPs that need to be maintained, failed to operate as designed, or proved inadequate;

(f) The location or locations where additional BMPs that do not exist at the time of the inspection needed to be implemented;

(g) Any corrective actions required, including any changes to the SWPPP that are needed, and the dates for implementation;

(h) Identification of all sources of non-storm water and their associated pollution prevention control measures; and

(i) Identification of material storage areas, and any evidence of or potential for pollutant discharge from such areas.

The Contractor must retain the inspection reports and any records of follow-up action taken for a period of at least three (3) years from the date the permit coverage expires or is terminated. Inspection reports must identify any instance of non-compliance with the terms and conditions of the AZPDES General Permit. Where no instance of non-compliance is identified, the report must contain a certification that the construction project or site is being operated in compliance with the SWPPP and AZPDES General Permit No. AZG22013-001. The report shall be signed in accordance with Appendix B.9 of the permit. Copies of all inspections reports shall be provided to the City's Project Manager at least once each month throughout the duration of the project.

Based on the results of the inspection, the Contractor must modify the SWPPP to include additional or modified BMPs designed to correct problems identified. These revisions must be completed within seven (7) calendar days following the inspection. If existing BMPs needed to be modified, or if additional BMPs are needed, implementation must be completed before the next anticipated storm event. If implementation before the next anticipated storm event is not practicable, implementation must occur as soon as it is practicable.

The Contractor, with the approval of the City's Project Manager, must amend the SWPPP within fifteen (15) business days whenever:

(1) There is a change in design, construction, operation, or maintenance at the construction site that has a significant effect on the discharge of pollutants to the waters of the United States, and such effect has not been previously addressed in the SWPPP; or

(2) Inspections, monitoring (if required), or investigations by the Contractor, the City of Phoenix, state officials, or federal officials determine the discharges are causing or contributing to water quality exceedances, or the SWPPP is ineffective in eliminating or significantly minimizing pollutants in storm water discharges from the construction site.

The SWPPP and all reports required under this contact shall be available to the public in accordance with the requirements of section 308(b) of the Clean Water Act. The Contractor shall make plans and reports available upon request to the ADEQ Director (or authorized representative); State, Tribal, or local agency with approval authority for sediment and erosion control plans, grading plans, or storm water management plans; local government officials; or to the operator of a municipal separate storm sewer receiving discharges from the site in accordance with the terms and conditions of the AZPDES General Permit.

The ADEQ Director (or authorized representative) may notify the Contractor and/or the City of Phoenix at any time that the SWPPP is inadequate, or does not meet one or more of the

requirements of Part 4 of AZDES General Permit. Within fifteen (15) business days of receipt of such notification from ADEQ (or as otherwise provided by ADEQ), the Contractor must make the required changes to the SWPPP and submit to the ADEQ a written certification that the request changes were made and implemented. The ADEQ may request submittal or re-submittal of the SWPPP to verify that all deficiencies have been adequately addressed.

No condition of the AZPDES General Permit or the SWPPP shall release the Contractor from any responsibilities or requirements under any other environmental statues or regulations, including requirements for the prevention or minimization of the discharge of hazardous substances or oil. If there is a release containing a hazardous substance or oil in an amount equal to or greater than the reportable quantities established under federal regulations that has the potential to impact storm water discharges from this site, the Contractor must report the release to the regulatory agencies in accordance with regulatory requirements. In addition, the Contractor must modify the SWPPP within fourteen (14) calendar days after gaining knowledge of the release to provide a description of the release, the circumstances leading to the release, and the date of the release. The SWPPP must identify measures to minimize and/or prevent the occurrence of such releases, and appropriate measures for responding to such releases. The AZPDES General Permit does not authorize the discharge of any substance resulting from on-site spills, or the discharge of oil or chemicals.

The SWPPP (including a copy of AZPDES General Permit No. AZG2013-001) shall be kept on the project site from the date of commencement of construction activities to the date of submittal of the Notice of Termination (NOT). A copy of the SWPPP and the permit shall be retained by the Contractor for a period of at least three (3) years following the date of final stabilization of the construction site. The Contractor shall also retain for the same three-year period all reports required by the AZPDES General Permit and all records of data used to complete the NOI.

It shall be the responsibility of the Contractor to ensure that copies of all documents and records retained by the Contractor in accordance with requirements of the AZPDES permit are also provided to the City's Project Manager.

Within thirty (30) days of the date of final stabilization of the construction site, the Contactor shall submit a completed and properly signed Notice of Termination (NOT) form to the City's Project Manager. With the City of Phoenix's Project Manager permission the contractor shall submit the Contractor's NOT to the ADEQ at the address specified on the NOT form; thereby terminating the Contractor's and the City's AZPDES permit coverage for the project. Copies of the NOT will also be sent to those agencies that received a copy of the NOI. A blank NOT form is enclosed with these projects specifications for use by the Contractor.

DUST CONTROL

156(A)-5.1 GENERAL. The Contractor shall obtain an Earthmoving Permit from the Maricopa County Air Quality Division which must be renewed on an annual basis. The Contractor shall also furnish all labor, equipment and means required to carry out effective measures wherever and as often as necessary to prevent his operations from producing dust in amounts damaging to property, cultivated vegetation and domestic animal, or which would cause a nuisance to persons living or occupying buildings in the vicinity. Airborne dust shall not exceed 20 percent visible emissions as stipulated by Rules 300 and 310 of the Maricopa County Air Pollution Control Rules and Regulations. The Contractor shall be responsible for any damage resulting from any dust originating from activities on or around the excavation sites. Dust abatement

measures shall be continued until the Contractor has met the requirements of the County ordinance and is relieved of further responsibility by the Engineer. This dust abatement program shall include provisions to prevent excessive airborne dust in levels determined to be detrimental to aircraft operations by Phoenix Goodyear Airport and its representatives. Contractor's operations may be halted if aircraft operations are determined to be unsafe. The Contractor shall take the following measures, at a minimum, to control and prevent a dust problem:

1. To control dust on roadways, stockpiles and around the site, the areas shall be treated, as required, with dust suppressants approved by the Aviation Department Environmental Section.

2. Temporary access roads shall be planned so travel on unpaved roads is minimized.

3. Multiple vacuum sweepers shall be required on all paved access roads for dust control.

A Dust Control Plan shall be submitted at the Pre-construction Conference. The plan should include a description of the equipment required, manpower and methods for dust control. Any chemical additives used must be approved by the Aviation Department Environmental Section. The Contractor shall also address in the Dust Control Plan, a method to keep public thoroughfares free of mud, dust and debris at all times.

156(A)-5.2 SITE PREPARATION. The Contractor shall use water trucks at all times to minimize dust to supplement other control measures. The Contractor shall cover trucks when hauling materials, and shall stabilize the surface of stockpiles when not relocating immediately.

156(A)-5.3 CONSTRUCTION. The Contractor shall provide a copy of the Air Quality Management Plan/Dust Control Plan to all adjacent site contractors and subcontractors. The Contractor must also post a copy of the Air Quality Management Plan/Dust Control Plan in a weather resistant location at the construction site where it may be seen by the workers.

The Contactor shall cover trucks when transferring materials and shall use dust suppressants on traveled paths, construction parking and staging areas that are fine grained materials and not paved. The Contractor shall also minimize unnecessary vehicular and machinery activities to reduce dust and shall minimize soil track-out on paved roads and streets by cleaning trucks and equipment before leaving non-paved roads.

156(A)-5.4 POST CONSTRUCTION. The Contractor shall stabilize non-paved areas and shall remove unused materials and stockpiles at the end of construction.

BASIS OF PAYMENT

156(A)-6.1 A Proposal Bid Item for the Contractor's participation in the preparation of the Storm Water Pollution Prevention Plan (SWPPP), the implementation of the SWPPP, and the modification of the SWPPP as necessary for compliance with AZPDES General Permit No. AZG2013-001 for the duration of this construction project is included in these contract documents. Payment shall be made monthly with equal payment during the entire construction period with any retention required by the terms and conditions of the construction contract to be paid after filing of the Notice of Termination (NOT).

No separate measurement or direct payment will be made for preparing the Notice of Intent (NOI), the Notice of Termination (NOT), Inspection and Maintenance Reports, or other documentation required to perform the work, the cost being considered as included in the Lump Sum Bid Item.

Payment will be under:

Item P-156(A)-6.1 Stormwater Pollution Prevention – per lump sum

END OF ITEM P-156(A)

ITEM P-209 CRUSHED AGGREGATE BASE COURSE

DESCRIPTION

209-1.1 This item consists of a base course composed of crushed aggregate base constructed on a prepared course in accordance with these specifications and in conformity to the dimensions and typical cross-sections shown on the plans.

MATERIALS

209-2.1 CRUSHED AGGREGATE BASE. Crushed aggregate shall consist of clean, sound, durable particles of crushed stone or crushed gravel and shall be free from coatings of clay, silt, organic material, or other objectionable materials. Aggregates shall contain no clay lumps or balls. Fine aggregate passing the No. 4 sieve shall consist of fines from the coarse aggregate crushing operation. If necessary, fine aggregate may be added to produce the correct gradation. The fine aggregate shall be produced by crushing stone or gravel that meets the coarse aggregate requirements for wear and soundness.
The coarse aggregate portion, defined as the material retained on the No. 4 sieve, shall not have a loss of greater than 45% when tested per ASTM C131. The sodium sulfate soundness loss shall not exceed 12%, or the magnesium sulfate soundness loss shall not exceed 18%, after five cycles, when tested in accordance with ASTM C88. The aggregate shall contain no more than 15%, by weight, of flat, elongated, or flat and elongated particles per ASTM D4791. A flat particle is one having a ratio of width to thickness greater than three (3); an elongated particle is one having a ratio of length to width greater than three (3). The aggregate shall have at least 90% by weight of particles with at least two fractured faces and 100% with at least one fractured face per ASTM D5821. The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

a. Sampling and testing for initial aggregate base requirements. Samples shall be taken by the Contractor in the presence of the Engineer. Material shall meet the requirements in paragraph 209-2.1 and 209-2.2. This sampling and testing will be the basis for approval of the aggregate base quality requirements. All tests for initial aggregate submittals necessary to determine compliance with the specification requirements will be made by the Contractor at no expense to the City of Phoenix.

In lieu of testing, the Engineer may accept certified state test results indicating that the aggregate meets specification requirements. Certified test results shall be less than 4 months old.

209-2.2 GRADATION REQUIREMENTS. The gradation of the aggregate base material shall meet the requirements of the gradation given in the following table when tested per ASTM C117 and ASTM C136. The gradation shall be well graded from coarse to fine as defined by ASTM D2487 and shall not vary from the lower limit on one sieve to the high limit on an adjacent sieve or vice versa. The fraction of material passing the No. 200 sieve shall not exceed one-half the fraction passing the No. 40 sieve.

The fraction passing the No. 40 sieve shall have a liquid limit no greater than 25 and a plasticity index of not more than 4 when tested in accordance with ASTM D 4318. The fine aggregate shall have a minimum sand equivalent value of 35 when tested in accordance with ASTM D 2419.

Requirements for Gradation of Aggregate Base

Sieve Size	Design Range Percentage by Weight	Contractor's Final Gradation	Job Control Grading Band Tolerances for Contractor's Final Gradation Percent
2 inch	100		0
1-1/2 inch	95-100		±5
1 inch	70-95		±8
3/4 inch	55-85		±8
No. 4	30-60		±8
No. 40	10-30		±5
No. 200	0-8		±3

The "Job Control Grading Band Tolerances for Contractor's Final Gradation" in the table shall be applied to "Contractor's Final Gradation" to establish a job control grading band. The full tolerance still applies if application of the tolerances results in a job control grading band outside the design range.

a. Sampling and testing for gradation. Gradation tests shall be performed by the Contractor per ASTM C136 and sieve analysis on material passing the No. 200 sieve per ASTM C112. The Contractor shall take at least two (2) aggregate base samples per lot to check the final gradation. Sampling shall be per ASTM D75. The lot will be consistent with the lot size used for density. The samples shall be taken from the in-place, un-compacted material in the presence of the Engineer. Sampling points and intervals will be designated by the Engineer.

CONSTRUCTION METHODS

209-3.1 PREPARING UNDERLYING SUBGRADE AND/OR SUBBASE. The underlying subgrade and/or subbase shall be checked and accepted by the Engineer before base course placing and spreading operations begin. Proof rolling of the subgrade or proof rolling of the subbase may be required as directed by the Engineer at the Contractor's expense, if the Contractor fails to ensure proper drainage or to protect the subgrade and/or subbase. Any ruts or soft, yielding areas due to improper drainage conditions, hauling, or any other cause, shall be corrected before the base course is placed. To ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

209-3.2 PRODUCTION. The aggregate shall be uniformly blended and, when at a satisfactory moisture content per paragraph 209-3.4, the approved material may be transported directly to the spreading equipment.

209-3.3 PLACING. The aggregate base material shall be placed on the prepared underlying subgrade and/or subbase and compacted in layers to the thickness shown on the plans. Work shall progress without interruption. The material shall be deposited and spread in lanes in a uniform layer without segregation to such loose depth that, when compacted, the layer shall have

the specified thickness. The aggregate base course shall be constructed in layers of uniform thickness of not less than 3 inches nor more than 6 inches of compacted thickness. The aggregate as spread shall be of uniform grading with no pockets of fine or coarse materials. The aggregate, unless otherwise permitted by the Engineer, shall not be spread more than 2,000 square yards in advance of the rolling. Any necessary sprinkling shall be kept within these limits. Care shall be taken to prevent cutting into the underlying layer during spreading. No material shall be placed in snow or on a soft, muddy, or frozen course. The aggregate base material shall be spread by spreader boxes or other approved devices. This equipment shall have positive thickness controls that spread the aggregate in the required amount to avoid or minimize the need for hand manipulation. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

When more than one layer is required, the construction procedure described herein shall apply similarly to each layer.

209-3.4 COMPACTION. Immediately after completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade. The moisture content of the material during placing operations shall be within ±2 percentage points of the optimum moisture content.

209-3.5 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY. Aggregate base course shall be accepted for density on a lot basis. A lot will consist of one day's production if it does not exceed 2,000 square yards. A lot will consist of one-half day's production if a day's production consists of between 2,000 and 4,000 square yards.

The acceptance sampling and testing necessary to determine conformance with the density requirements specified in this section will be performed by the City of Phoenix Materials Laboratory upon completion of acceptable sampling and testing by the Contractor's Quality Control Program.

Each lot shall be divided into two equal sublots. One test shall be made for each sublot and shall consist of the average of two random locations for density determination. Sampling locations will be determined by the Engineer on a random basis per ASTM D 3665.

The field density of the compacted material shall be at least 100% of the maximum density of laboratory specimens prepared from samples of the base course material delivered to the jobsite. The laboratory specimens shall be compacted and tested in accordance with ASTM D 1557. The in-place field density shall be determined in accordance with ASTM D 1556. Test in accordance with ASTM D 4718 if greater than 30% is retained on the 3/4" sieve. Nuclear moisture and density methods meeting ASTM D 6938 using Procedure A, the direct transmission method, and ASTM D 6938 to determine the moisture content of the material may be used, provided that at least one (1) out of five (5) tests are conducted using the ASTM D 1556 method to correlate test results. The nuclear density machine shall be calibrated in accordance with ASTM D 6938.

If the specified density is not attained, the entire lot shall be reworked and/or recompacted and two additional random tests made at the Contractor's expense. This procedure shall be followed until the specified density is reached.

209-3.6 SURFACE TOLERANCES. After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required

smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches, reshaped and recompacted to grade until the required smoothness and accuracy are obtained and approved by the Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one layer.

a. Smoothness. The finished surface shall not vary more than 3/8 inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.

b. Accuracy. The grade and crown shall be measured on a 50-foot grid and shall be within +0 and -1/2 inch (0.04 feet) of the specified grade.

209-3.7 THICKNESS CONTROL. The thickness of the base course shall be within +0 and -1/2 inch (0.04 feet) of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Engineer. Tests shall be taken at intervals representing no more than 300 square yards per test. Sampling locations will be determined by the Engineer per ASTM D 3665. Where the thickness is deficient by more than 1/2 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches, adding new material of proper gradation, and the material shall be blended and recompacted to grade. Additional test holes may be required to identify the limits of deficient areas. The Contractor shall replace, at his expense, base material where depth tests have been taken.

The use of surveys for thickness determination is also permitted. Surveys shall be completed on a minimum grid of 25 feet. Survey of the top of subbase before placement and top of base course after placement shall be required to determine survey thickness of the base course.

209-3.8 PROTECTION. Perform construction when the atmospheric temperature is above 35°F. When the temperature falls below 35°F, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements. When the aggregates contain frozen materials or when the underlying course is frozen or wet, the construction shall be stopped. Hauling equipment may be routed over completed portions of the base course, provided no damage results. Equipment shall be routed over the full width of the base course to avoid rutting or uneven compaction. The Engineer will stop all hauling over completed or partially completed base course when, in the Engineer's opinion, such hauling is causing damage. Any damage to the base course shall be repaired by the Contractor at the Contractor's expense.

209-3.9 MAINTENANCE. The Contractor shall maintain the base course in a satisfactory condition until the full pavement section is completed and accepted by the Engineer. The surface shall be kept clean and free from foreign material and properly drained at all times. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any base course that is not paved over prior to the onset of winter shall be retested to verify that it still complies with the requirements of this specification. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification.

Equipment used in the construction of an adjoining section may be routed over completed base course, if no damage results and the equipment is routed over the full width of the base course to avoid rutting or uneven compaction.

The Contractor shall remove all survey and grade hubs from the base courses prior to placing any bituminous surface course.

CONTRACTOR QUALITY CONTROL

209-4.1 The Contractor shall be responsible for developing and implementing a Contractor Quality Control Program including inspection and testing to assure compliance with the requirements of this section in accordance with the General Provisions Section 100.
A P-209 Quality Control Testing Plan shall be developed as part of the Quality Control Program.

209-4.2 TESTING FREQUENCY. The Contractor shall establish a minimum testing frequency of two (2) density and moisture tests per ASTM D 1556, for each of the following conditions:

a. For each seven hundred (750) cubic yards of P-209 Base Course placed, or one (1) day's production, whichever is less, and;

b. For each three (3) to six (6) inch loose lift, and;

c. For Base Course compaction, the Contractor shall provide at least two (2) density and moisture tests for each 1,000 square yards. For isolated areas or confined areas that are less than 1,000 square yards, there shall be at least one (1) density and moisture test.

209-4.3 QUALITY CONTROL TESTING. The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to this specification and as set forth in the Quality Control Program. The testing program shall include, but not be limited to tests for gradation, material density, material moisture content, rolling patterns, base course lift thickness, and smoothness and thickness tolerances.

a. Gradation and Atterberg Limits. P-209 Base Course shall be sampled and tested daily as required in P209-2.2a.

b. Material Density. The in-place field density shall be determined in accordance with ASTM D 1556 or ASTM D 2167. Nuclear moisture and density methods meeting ASTM D 6938 using Procedure A, the direct transmission method, and ASTM D 6938 to determine the moisture content of the material may be used, provided that at least one (1) out of five (5) tests are conducted using the ASTM D 1556 method to correlate test results. The nuclear density machine shall be calibrated in accordance with ASTM D 6938.

c. Material Moisture Content. The material in each layer shall be within plus or minus two (2%) percent of optimum moisture content before rolling to obtain the prescribed compaction.

d. P-209 Lift Thickness. P-209 Base Course shall be constructed in successive horizontal layers of not less the three (3) nor more than six (6) inches in loose depth for the full width of the cross section. Samples of P-209 base course materials for quality control testing, both before and after placement and compaction, will be taken for each 750 cubic yards, or daily, whichever is

less.

e. Fugitive Dust. The Contractor shall supply and operate all necessary equipment and personnel to meet the requirements for dust control. The Contractor shall document dust control procedures in the daily Quality Control reports.

METHOD OF MEASUREMENT

209-5.1 The quantity of crushed aggregate base course will be determined by measurement of the number of square yards of material actually constructed and accepted by the Engineer as complying with the plans and specifications. Base materials shall not be included in any other excavation quantities.

BASIS OF PAYMENT

209-6.1 Payment shall be made at the contract unit price per square yard for crushed aggregate base course. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-209-6.1	Crushed Aggregate Base Course (12.5 inches) -per square yard
Item P-209-6.2	Crushed Aggregate Base Course (16 inches) -per square yard

TESTING REQUIREMENTS

ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils

ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3)
ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D4718	Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

END OF ITEM P-209

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ITEM P-401 HOT MIX ASPHALT (HMA) PAVEMENTS

DESCRIPTION

401-1.1 This item shall consist of pavement courses composed of mineral aggregate and asphalt cement binder (asphalt binder) mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the plans. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

MATERIALS

401-2.1 AGGREGATE. Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The aggregates should be free of ferrous sulfides, such as pyrite, that would cause "rust" staining that can bleed through pavement markings. The portion retained on the No. 4 (4.75 mm) sieve is coarse aggregate. The portion passing the No. 4 (4.75 mm) sieve and retained on the No. 200 (0.075 mm) sieve is fine aggregate, and the portion passing the No. 200 (0.075 mm) sieve is mineral filler.

a. Coarse aggregate. Coarse aggregate shall consist of sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the bituminous material and free from organic matter and other deleterious substances. The percentage of wear shall not be greater than 40% when tested in accordance with ASTM C131. The sodium sulfate soundness loss shall not exceed 12%, or the magnesium sulfate soundness loss shall not exceed 18%, after five cycles, when tested in accordance with ASTM C88. Clay lumps and friable particles shall not exceed 1.0% when tested in accordance with ASTM C142.

Aggregate shall contain at least 75 percent by weight of individual pieces having two or more fractured faces and 85 percent by weight having at least one fractured face. The area of each face shall be equal to at least 75% of the smallest midsectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces. Fractured faces shall be achieved by crushing.

The aggregate shall not contain more than a total of 8%, by weight, of flat particles, elongated particles, and flat and elongated particles, when tested in accordance with ASTM D4791 with a value of 5:1

b. Fine aggregate. Fine aggregate shall consist of clean, sound, tough, durable, angular shaped particles produced by crushing stone or gravel that meets the requirements for wear and soundness specified for coarse aggregate. The aggregate particles shall be free from coatings of clay, silt, or other objectionable matter.

The fine aggregate, including any blended material for the fine aggregate, shall have a plasticity index of not more than six (6) and a liquid limit of not more than 25 when tested in accordance with ASTM D4318.

The soundness loss shall not exceed 10% when sodium sulfate is used or 15% when magnesium sulfate is used, after five cycles, when tested per ASTM C88.

Clay lumps and friable particles shall not exceed 1.0%, by weight, when tested in accordance with ASTM C142.

Natural (non-manufactured) sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. The amount of sand to be added will be adjusted to produce mixtures conforming to requirements of this specification. The fine aggregate shall not contain more than 15% natural sand by weight of total aggregates. If used, the natural sand shall meet the requirements of ASTM D1073 and shall have a plasticity index of not more than six (6) and a liquid limit of not more than 25 when tested in accordance with ASTM D4318.

The aggregate shall have sand equivalent values of 45 or greater when tested in accordance with ASTM D2419.

c. Sampling. ASTM D75 shall be used in sampling coarse and fine aggregate, and ASTM C183 shall be used in sampling mineral filler.

401-2.2 MINERAL FILLER. If filler, in addition to that naturally present in the aggregate, is necessary, it shall be hydrated lime meeting the requirements of ASTM D242.

401-2.3 ASPHALT CEMENT BINDER. Asphalt cement binder shall conform to ASTM D6373 Performance Grade (PG) 70-10. A certificate of compliance from the manufacturer shall be included with the mix design submittal.

The supplier's certified test report with test data indicating grade certification for the asphalt binder shall be provided to the Engineer for each load at the time of delivery to the mix plant. A certified test report with test data indicating grade certification for the asphalt binder shall also be provided to the Engineer for any modification of the asphalt binder after delivery to the mix plant and before use in the HMA.

401-2.4 PRELIMINARY MATERIAL ACCEPTANCE. Prior to delivery of materials to the job site, the Contractor shall submit certified test reports to the Engineer for the following materials:

a. Coarse aggregate:
(1) Percent of wear
(2) Soundness
(3) Clay lumps and friable particles
(4) Percent fractured faces
(5) Flat and elongated particles

b. Fine aggregate:
(1) Liquid limit and Plasticity index
(2) Soundness
(3) Clay lumps and friable particles
(4) Percent natural sand
(5) Sand equivalent

c. Mineral filler.

d. Asphalt binder. Test results for asphalt binder shall include temperature/viscosity charts for mixing and compaction temperatures.

The certifications shall show the appropriate ASTM tests for each material, the test results, and a statement that the material meets the specification requirement.

The Engineer may request samples for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

401-2.5 ANTI-STRIPPING AGENT. Any anti-stripping agent or additive if required shall be heat stable, shall not change the asphalt cement viscosity beyond specifications, shall contain no harmful ingredients, shall be added in recommended proportion by approved method, and shall be a material approved by the Department of Transportation of the State in which the project is located.

COMPOSITION

401-3.1 COMPOSITION OF MIXTURE. The HMA mix shall be composed of a mixture of well-graded aggregate, filler and anti-strip agent if required, and asphalt binder. The several aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

401-3.2 JOB MIX FORMULA (JMF). No hot-mixed asphalt (HMA) for payment shall be produced until a JMF has been approved in writing by the Engineer. The asphalt mix-design and JMF shall be prepared by an accredited laboratory that meets the requirements of paragraph 401-3.4. The HMA shall be designed using procedures contained in Asphalt Institute MS-2 Mix Design Manual, 7th Edition. ASTM D6926 shall be used for preparation of specimens using the manually held and operated hammer for the mix design procedure. ASTM D6927 shall be used for testing for Marshall Stability and Flow.

If material variability exceeds the standard deviations indicated, the JMF and subsequent production targets shall be based on a stability greater than shown in Table 1 and the flow shall be targeted close to the mid-range of the criteria in order to meet the acceptance requirements.

The design criteria in Table 1 are target values necessary to meet the acceptance requirements contained in paragraph 401-5.2b. The criteria is based on a production process which has a material variability with the following standard deviations:

Stability = 270 lbs;

Flow (0.01 inch) = 0.015 inches;

Air Voids = 0.65%.

Tensile strength ratio (TSR) of the composite mixture, as determined by ASTM D4867, shall not be less than 75 when tested at a saturation of 70-80% or an anti-stripping agent shall be added to the HMA, as necessary, to produce a TSR of not less than 75 when tested at a saturation of 70-80%. If an anti-strip agent is required, it shall be provided by the Contractor at no additional cost to the Owner.

The JMF shall be submitted in writing by the Contractor at least 14 days prior to the start of paving operations. The JMF shall be developed within the same construction season using aggregates currently being produced.

The submitted JMF shall be stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items as a minimum:

a. Percent passing each sieve size for total combined gradation, individual gradation of all aggregate stockpiles and percent by weight of each stockpile used in the job mix formula.

b. Percent of asphalt cement.

c. Asphalt performance grade and type of modifier if used.

d. Number of blows per side of molded specimen

e. Laboratory mixing temperature.

f. Laboratory compaction temperature.

g. Temperature-viscosity relationship of the PG asphalt cement binder showing acceptable range of mixing and compaction temperatures; and for modified binders include supplier recommended mixing and compaction temperatures.

h. Plot of the combined gradation on a 0.45 power gradation curve.

i. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight verses asphalt content.

j. Specific Gravity and absorption of each aggregate.

k. Percent natural sand.

l. Percent fractured faces.

m. Percent by weight of flat particles**,** elongated particles, and flat and elongated particles (and criteria).

n. Tensile Strength Ratio (TSR).

o. Anti-strip agent (if required).

p. Date the JMF was developed. Mix designs that are not dated or which are from a prior construction season shall not be accepted.

The Contractor shall submit to the Engineer the results of verification testing of three (3) asphalt samples prepared at the optimum asphalt content. The average of the results of this testing shall indicate conformance with the JMF requirements specified in Tables 1 and 3.

When the project requires asphalt mixtures of differing aggregate gradations, a separate JMF and the results of JMF verification testing shall be submitted for each mix.

The JMF for each mixture shall be in effect until a modification is approved in writing by the Engineer. Should a change in sources of materials be made, a new JMF must be submitted within 6 days and approved by the Engineer in writing before the new material is used. After the initial production JMF has been approved by the Engineer and a new or modified JMF is required for whatever reason, the subsequent cost of the Engineer's approval of the new or modified JMF, including a new test strip when required by the Engineer, will be borne by the Contractor. There will be no time extension given or considerations for extra costs associated with the stoppage of production paving or restart of production paving due to the time needed for the Engineer to approve the initial, new or modified JMF.

The Marshall Design Criteria applicable to the project shall meet the criteria specified in Table 1.

Table 1. Marshall Design Criteria

Test Property	Pavements Designed for Aircraft Gross Weights of 60,000 Lbs. or More or Tire Pressures of 100 psi or More
Number of blows	75
Stability, pounds minimum	2150
Flow, 0.01 in. (0.25 mm)	10-16
Target Air voids (%)	3.5
Percent voids in mineral aggregate, minimum	See Table 2

Table 2. Minimum Percent Voids In Mineral Aggregate (VMA)

Aggregate (See Table 3)	Minimum VMA
¾" Minus Gradation (Gradation 2)	15%

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified in Table 3 when tested in accordance with ASTM C136 and ASTM C117.

The gradations in Table 3 represent the limits that shall determine the suitability of aggregate for use from the sources of supply; be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa.

Table 3. Aggregate - HMA Pavements

Sieve Size	Percentage by Weight Passing Sieve
1 inch (25 mm)	--
3/4 inch (19 mm)	100
1/2 inch (12 mm)	79-99
3/8 inch (9 mm)	68-88
No. 4 (4.75 mm)	48-68
No. 8 (2.36 mm)	33-53
No. 16 (1.18 mm)	20-40
No. 30 (0.60 mm)	14-30
No. 50 (0.30 mm)	9-21
No. 100 (0.15 mm)	6-16
No. 200 (0.075 mm)	3-6
Asphalt Percent:	
Stone or gravel	5.0-7.5

The aggregate gradations shown are based on aggregates of uniform specific gravity. The percentages passing the various sieves shall be corrected when aggregates of varying specific gravities are used, as indicated in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition.

401-3.3 RECLAIMED ASPHALT PAVEMENT (RAP). RAP shall not be used.

401-3.4 JOB MIX FORMULA (JMF) LABORATORY. The Contractor's laboratory used to develop the JMF shall be accredited in accordance with ASTM D3666. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for developing the JMF must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

401-3.5 TEST SECTION. Prior to full production, the Contractor shall prepare and place a quantity of HMA according to the JMF. The amount of HMA shall be sufficient to construct a test section 300 feet long and 24 feet wide, placed in two lanes, with a longitudinal cold joint, and shall be of the same depth specified for the construction of the course which it represents. A cold joint for this test section is an exposed construction joint at least four (4) hours old or whose mat has cooled to less than 160°F. The cold joint must be cut back using the same procedure that will be used during production in accordance with 401-4.13. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in construction of the test section shall be the same type and weight to be used on the remainder of the course represented by the test section.

The test section shall be evaluated for acceptance as a single lot in accordance with the acceptance criteria in paragraph 401-5.1 and 401-5.2. The test section shall be divided into equal sublots. As a minimum the test section shall consist of three (3) sublots.

The test section shall be considered acceptable if (1) stability, flow, mat density, air voids, and joint density are 90 percent or more within limits, (2) gradation and asphalt content are within the

action limits specified in paragraphs 401-6.5a and 5b, and (3) the voids in the mineral aggregate are within the limits of Table 2.

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. If the second test section also does not meet specification requirements, both sections shall be removed at the Contractor's expense. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Any additional sections that are not acceptable shall be removed at the Contractor's expense. Full production shall not begin until an acceptable test section has been constructed and accepted in writing by the Engineer. Once an acceptable test section has been placed, payment for the initial test section and the section that meets specification requirements shall be made in accordance with paragraph 401-8.1.

Job mix control testing shall be performed by the Contractor at the start of plant production and in conjunction with the calibration of the plant for the JMF. If aggregates produced by the plant do not satisfy the gradation requirements or produce a mix that meets the JMF, it will be necessary to reevaluate and redesign the mix using plant-produced aggregates. Specimens shall be prepared and the optimum asphalt content determined in the same manner as for the original JMF tests.

Contractor will not be allowed to place the test section until the Contractor Quality Control Program, showing conformance with the requirements of Paragraph 401-6.1, has been approved, in writing, by the Engineer

CONSTRUCTION METHODS

401-4.1 WEATHER LIMITATIONS. The HMA shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 4. The temperature requirements may be waived by the Engineer, if requested; however, all other requirements including compaction shall be met.

Table 4. Surface Temperature Limitations of Underlying Course

Mat Thickness	Base Temperature (Minimum)	
	°F	°C
3 inches or greater	40	4
Greater than 2 inches but less than 3 inches	45	7

401-4.2 HMA PLANT. Plants used for the preparation of HMA shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M156 with the following changes:

Requirements for all plants include:

a. Truck scales. The HMA shall be weighed on approved scales furnished by the Contractor, or on certified public scales at the Contractor's expense. Scales shall be inspected and sealed as

often as the Engineer deems necessary to assure their accuracy. Scales shall conform to the requirements outlined below.

Scales for weighing materials which are required to be proportioned or measured and paid for by weight shall be furnished, erected, and maintained by the Contractor, or be certified permanently installed commercial scales.

Scales shall be accurate within 1/2% of the correct weight throughout the range of use. The Contractor shall have the scales checked under the observation of the inspector before beginning work and at such other times as requested. The intervals shall be uniform in spacing throughout the graduated or marked length of the beam or dial and shall not exceed one-tenth of 1% of the nominal rated capacity of the scale, but not less than 1 pound (454 grams). The use of spring balances will not be permitted.

Beams, dials, platforms, and other scale equipment shall be so arranged that the operator and the inspector can safely and conveniently view them.

Scale installations shall have available ten standard 50-pound (2.3 km) weights for testing the weighing equipment or suitable weights and devices for other approved equipment.

Scales must be tested for accuracy and serviced before use at a new site. Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end.

Scales “overweighing” (indicating more than correct weight) will not be permitted to operate, and all materials received subsequent to the last previous correct weighting-accuracy test will be reduced by the percentage of error in excess of one-half of 1%.

In the event inspection reveals the scales have been under weighing (indicating less than correct weight), they shall be adjusted, and no additional payment to the Contractor will be allowed for materials previously weighed and recorded.

All costs in connection with furnishing, installing, certifying, testing, and maintaining scales; for furnishing check weights and scale house; and for all other items specified in this subsection, for the weighing of materials for proportioning or payment, shall be included in the unit contract prices for the various items of the project.

In lieu of scales, and as approved by the Engineer, HMA weight may be determined by the use of an electronic weighing system equipped with an automatic printer that weighs the total HMA production and as often thereafter as requested by the Engineer.

b. Testing facilities. The Contractor shall ensure laboratory facilities are provided at the plant for the use of the Engineer. The lab shall have sufficient space and equipment so that both testing representatives (Engineer’s and Contractor’s) can operate efficiently. The lab shall meet the requirements of ASTM D3666 including all necessary equipment, materials, calibrations, current reference standards to comply with the specifications and a masonry saw with diamond blade for trimming pavement cores and samples.

The plant testing laboratory shall have a floor space area of not less than 200 square feet (18.5 sq m), with a ceiling height of not less than 7-1/2 feet (2 m). The laboratory shall be weather tight, sufficiently heated in cold weather, air-conditioned in hot weather to maintain temperatures

for testing purposes of 70°F ±5°F. The plant testing laboratory shall be located on the plant site to provide an unobstructed view, from one of its windows, of the trucks being loaded with the plant mix materials. In addition, the facility shall include the minimum:

(1) Adequate artificial lighting.
(2) Electrical outlets sufficient in number and capacity for operating the required testing equipment and drying samples.
(3) A minimum of two (2) Underwriter's Laboratories approved fire extinguishers of the appropriate types and class.
(4) Work benches for testing.
(5) Desk with chairs and file cabinet.
(6) Sanitary facilities convenient to testing laboratory.
(7) Exhaust fan to outside air.
(8) Sink with running water.

Failure to provide the specified facilities shall be sufficient cause for disapproving HMA plant operations.

Laboratory facilities shall be kept clean, and all equipment shall be maintained in proper working condition. The Engineer shall be permitted unrestricted access to inspect the Contractor's laboratory facility and witness quality control activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

c. Inspection of plant. The Engineer, or Engineer's authorized representative, shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

d. Storage bins and surge bins. The HMA stored in storage and surge bins shall meet the same requirements as HMA loaded directly into trucks and may be permitted under the following conditions:

(1) Stored in non-insulated bins for a period of time not to exceed three (3) hours.

(2) Stored in insulated bins for a period of time not to exceed eight (8) hours.

If the Engineer determines that there is an excessive amount of heat loss, segregation, or oxidation of the HMA due to temporary storage, no temporary storage will be allowed.

401-4.3 HAULING EQUIPMENT. Trucks used for hauling HMA shall have tight, clean, and smooth metal beds. To prevent the HMA from sticking to the truck beds, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other material approved by the Engineer. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened.

401-4.3.1 MATERIAL TRANSFER VEHICLE (MTV). Material transfer vehicles are not required.

401-4.4 HMA PAVERS. HMA pavers shall be self-propelled with an activated heated screed, capable of spreading and finishing courses of HMA that will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the HMA uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

If, during construction, it is found that the spreading and finishing equipment in use leaves tracks or indented areas, or produces other blemishes in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued and satisfactory equipment shall be provided by the Contractor.

401-4.4.1 AUTOMATIC GRADE CONTROLS. The HMA paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices that will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within ±0.1%.

The controls shall be capable of working in conjunction with any of the following attachments:

a. Ski-type device of not less than 30 feet (9 m) in length.
b. Taut string-line (wire) set to grade.
c. Short ski or shoe.
d. Laser control.

401-4.5 ROLLERS. Rollers of the vibratory, steel wheel, and pneumatic-tired type shall be used. They shall be in good condition, capable of operating at slow speeds to avoid displacement of the HMA. The number, type, and weight of rollers shall be sufficient to compact the HMA to the required density while it is still in a workable condition.

All rollers shall be specifically designed and suitable for compacting HMA concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used. Depressions in pavement surfaces caused by rollers shall be repaired by the Contractor at their own expense.

The use of equipment that causes crushing of the aggregate will not be permitted.

401-4.6. DENSITY DEVICE. The Contractor shall have on site a density gauge during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. The Contractor shall also supply a qualified technician during all paving operations to calibrate the gauge and obtain accurate density readings for all new HMA. These densities shall be

supplied to the Engineer upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

401-4.7 PREPARATION OF ASPHALT BINDER. The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. The temperature of unmodified asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 325°F when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F when added to the aggregate.

401-4.8 PREPARATION OF MINERAL AGGREGATE. The aggregate for the HMA shall be heated and dried. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler shall not exceed 350°F (175°C) when the asphalt binder is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

401-4.9 PREPARATION OF HMA. The aggregates and the asphalt binder shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95% of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all HMA upon discharge shall not exceed 0.5%.

401-4.10 PREPARATION OF THE UNDERLYING SURFACE. Immediately before placing the HMA, the underlying course shall be cleaned of all dust and debris. A prime coat or tack coat shall be applied in accordance with Item P-602 or P-603, if shown on the plans.

401-4.11 LAYDOWN PLAN, TRANSPORTING, PLACING, AND FINISHING. Prior to the placement of the HMA, the Contractor shall prepare a laydown plan for approval by the Engineer. This is to minimize the number of cold joints in the pavement. The laydown plan shall include the sequence of paving laydown by stations, width of lanes, temporary ramp locations, and laydown temperature. The laydown plan shall also include estimated time of completion for each portion of the work (that is, milling, paving, rolling, cooling, etc.). Modifications to the laydown plan shall be approved by the Engineer.

The HMA shall be transported from the mixing plant to the site in vehicles conforming to the requirements of paragraph 401-4.3. Deliveries shall be scheduled so that placing and compacting of HMA is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to atmospheric temperature.

The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose for the first lift of all runway and taxiway pavements. Successive lifts

of HMA surface course may be placed using a ski, or laser control per paragraph 401-4.4.1, provided grades of the first lift of HMA surface course meet the tolerances of paragraphs 401-5.2b(6) as verified by a survey. Contractor shall survey each lift of HMA surface course and certify to Engineer that every lot of each lift meets the grade tolerances of paragraph 401-5.2b(6) before the next lift can be placed.

The initial placement and compaction of the HMA shall occur at a temperature suitable for obtaining density, surface smoothness, and other specified requirements but not less than 250°F.

Edges of existing HMA pavement abutting the new work shall be saw cut and carefully removed as shown on the drawings and coated with asphalt tack coat before new material is placed against it.

Upon arrival, the HMA shall be placed to the full width by a HMA paver. It shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the HMA mat. Unless otherwise permitted, placement of the HMA shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The HMA shall be placed in consecutive adjacent strips having a minimum width of 15 feet (m) except where edge lanes require less width to complete the area. Additional screed sections shall not be attached to widen paver to meet the minimum lane width requirements specified above unless additional auger sections are added to match. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course.

Transverse joints in adjacent lanes shall be offset a minimum of 10 feet.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the HMA may be spread and luted by hand tools.

Areas of segregation in the surface course, as determined by the Engineer, shall be removed and replaced at the Contractor's expense. The area shall be removed by saw cutting and milling a minimum of 2 inches deep. The area to be removed and replaced shall be a minimum width of the paver and a minimum of 10 feet long.

401-4.12 COMPACTION OF HMA. After placing, the HMA shall be thoroughly and uniformly compacted by power rollers. The surface shall be compacted as soon as possible when the HMA has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross-section, and the required field density is obtained.

To prevent adhesion of the HMA to the roller, the wheels shall be equipped with a scraper and kept properly moistened but excessive water will not be permitted. In areas not accessible to the

roller, the mixture shall be thoroughly compacted with approved power driven tampers. Tampers shall weigh not less than 275 pounds, have a tamping plate width not less than 15 inches, be rated at not less than 4,200 vibrations per minute, and be suitably equipped with a standard tamping plate wetting device.

Any HMA that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

401-4.13 JOINTS. The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid HMA except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated with an asphalt tack coat before placing any fresh HMA against the joint.

Longitudinal joints which have been left exposed for more than four (4) hours; the surface temperature has cooled to less than 175°F; or are irregular, damaged, uncompacted or otherwise defective shall be cut back 3 inches to 6 inches to expose a clean, sound, uniform vertical surface for the full depth of the course. All cutback material shall be removed from the project. Asphalt tack coat or other product approved by the Engineer shall be applied to the clean, dry joint, prior to placing any additional fresh HMA against the joint. Any laitance produced from cutting joints shall be removed by vacuuming and washing. The cost of this work shall be considered incidental to the cost of the HMA.

401-4.14 Saw-cut grooving. Not required for this project.

401-4.15 Diamond grinding. When required, diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the pavement. The saw blades shall be 1/8-inch wide and there shall be a minimum of 55 to 60 blades per 12 inches of cutting head width; the actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Each machine shall be capable of cutting a path at least 3 feet wide. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted. The depth of grinding shall not exceed 1/2 inch and all areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. Areas that have been ground will be sealed with a P-608 surface treatment as directed by the Engineer. It may be necessary to seal a larger area to avoid surface treatment creating any conflict with runway or taxiway markings.

401-4.16 NIGHTTIME PAVING REQUIREMENTS. Paving during nighttime construction shall require the following:

a. All paving machines, rollers, distribution trucks and other vehicles required by the Contractor for his operations shall be equipped with artificial illumination sufficient to safely complete the work.

b. Minimum illumination level shall be twenty (20) horizontal foot-candles and maintained in the following areas:

(1) An area of 30 feet wide by 30 feet long immediately behind the paving machines during the operations of the machines.

(2) An area 15 feet wide by 30 feet long immediately in front and back of all rolling equipment, during operation of the equipment.

(3) An area 15 feet wide by 15 feet long at any point where an area is being tack coated prior to the placement of pavement.

c. As partial fulfillment of the above requirements, the Contractor shall furnish and use, complete artificial lighting units with a minimum capacity of 3,000 watt electric beam lights, affixed to all equipment in such a way to direct illumination on the area under construction.

d. A lighting plan must be submitted by the Contractor and approved by the Engineer prior to the start of any nighttime work.

If the Contractor places any out of specification mix in the project work area, the Contractor is required to remove it at its own expense, to the satisfaction of the Engineer. If the Contractor has to continue placing non-payment HMA, as directed by the Engineer, to make the surfaces safe for aircraft operations, the Contractor shall do so to the satisfaction of the Engineer. It is the Contractor's responsibility to leave the facilities to be paved in a safe condition ready for aircraft operations. No consideration for extended closure time of the area being paved will be given. As a first order of work for the next paving shift, the Contractor shall remove all out of specification material and replace with approved material to the satisfaction of the Engineer. When the above situations occur, there will be no consideration given for additional construction time or payment for extra costs.

MATERIAL ACCEPTANCE

401-5.1 ACCEPTANCE SAMPLING AND TESTING. Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Engineer at no cost to the Contractor except that coring and profilograph testing, as required in this section shall be completed and paid for by the Contractor.

Testing organizations performing these tests, except profilograph, shall be accredited in accordance with ASTM D3666. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for acceptance sampling and testing must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction. All

equipment in Contractor furnished laboratories shall be calibrated by an independent testing organization prior to the start of operations at the Contractor's expense.

a. Hot mixed asphalt. Plant-produced HMA shall be tested for stability, flow, and air voids on a lot basis. Sampling shall be from material deposited into trucks at the plant or from trucks at the job site. Samples shall be taken in accordance with ASTM D979.

A standard lot shall be equal to one day's production or 2000 tons whichever is smaller. If the day's production is expected to exceed 2000 tons, but less than 4000 tons, the lot size shall be 1/2 day's production. If the day's production exceeds 4000 tons, the lot size shall be an equal sized fraction of the day's production, but shall not exceed 2000 tons.

Where more than one plant is simultaneously producing HMA for the job, the lot sizes shall apply separately for each plant.

(1) Sampling. Each lot will consist of four equal sublots. Sufficient HMA for preparation of test specimens for all testing will be sampled by the Engineer on a random basis, in accordance with the procedures contained in ASTM D3665. Samples will be taken in accordance with ASTM D979.

The sample of HMA may be put in a covered metal tin and placed in an oven for not less than 30 minutes nor more than 60 minutes to stabilize to compaction temperature. The compaction temperature of the specimens shall be as specified in the JMF.

(2) Testing. Sample specimens shall be tested for stability and flow in accordance with ASTM D6927. Air voids will be determined by the Engineer in accordance with ASTM D3203. One set of laboratory compacted specimens will be prepared for each sublot in accordance with ASTM D6926 at the number of blows required by paragraph 401-3.2, Table 1. Each set of laboratory compacted specimens will consist of three test specimens prepared from the same sample. The manual hammer in ASTM D6926 shall be used.

Prior to testing, the bulk specific gravity of each test specimen shall be measured by the Engineer in accordance with ASTM D2726 using the procedure for laboratory-prepared thoroughly dry specimens for use in computing air voids and pavement density.

For air voids determination, the theoretical maximum specific gravity of the mixture shall be measured one time for each sublot in accordance with ASTM D2041. The value used in the air voids computation for each sublot shall be based on theoretical maximum specific gravity measurement for the sublot.

The stability and flow for each sublot shall be computed by averaging the results of all test specimens representing that sublot.

(3) Acceptance. Acceptance of plant produced HMA for stability, flow, and air voids shall be determined by the Engineer in accordance with the requirements of paragraph 401-5.2b.

b. In-place HMA. HMA placed in the field shall be tested for mat and joint density on a lot basis. A standard lot shall be equal to one day's production or 2000 tons (1814 metric tons) whichever is smaller. If the day's production is expected to exceed 2000 tons (1814 metric tons), but less than 4000 tons (3628 metric tons), the lot size shall be 1/2 day's production. If the day's

production exceeds 4000 tons, the lot size shall be an equal sized fraction of the day's production, but shall not exceed 2000 tons.

(1) Mat density. The lot size shall be the same as that indicated in paragraph 401-5.1a and shall be divided into four equal sublots. One core of finished, compacted HMA shall be taken by the Contractor from each sublot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D3665. Cores for mat density shall not be taken closer than one foot from a transverse or longitudinal joint.

(2) Joint density. The lot size shall be the total length of longitudinal joints constructed by a lot of HMA as defined in paragraph 401-5.1a. The lot shall be divided into four equal sublots. One core of finished, compacted HMA shall be taken by the Contractor from each sublot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D3665. All cores for joint density shall be taken centered on the joint. The minimum core diameter for joint density determination shall be 5 inches.

(3) Sampling. Samples shall be neatly cut with a diamond core drill bit. Samples will be taken in accordance with ASTM D979. The minimum diameter of the sample shall be 5 inches. Samples that are clearly defective, as a result of sampling, shall be discarded and another sample taken. The Contractor shall furnish all tools, labor, and materials for cutting samples, cleaning, and filling the cored pavement. Cored pavement shall be cleaned and core holes shall be filled in a manner acceptable to the Engineer and within one day after sampling. Laitance produced by the coring operation shall be removed immediately.

The top most lift of HMA shall be completely bonded to the underlying layer. If any of the cores reveal that the surface is not bonded to the layer immediately below the surface then additional cores shall be taken as directed by the Engineer in accordance with paragraph 401-5.1b to determine the extent of any delamination. All delaminated areas shall be completely removed by milling to the limits and depth and replaced as directed by the Engineer at no additional cost.

(4) Testing. The bulk specific gravity of each cored sample will be measured by the Engineer in accordance with ASTM D 2726. Samples will be taken in accordance with ASTM D979. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each sublot sample by the average bulk specific gravity of all laboratory prepared specimens for the lot, as determined in paragraph 401-5.1a(2). The bulk specific gravity used to determine the joint density at joints formed between different lots shall be the lowest of the bulk specific gravity values from the two different lots.

(5) Acceptance. Acceptance of field placed HMA for mat density will be determined by the Engineer in accordance with the requirements of paragraph 401-5.2b(1). Acceptance for joint density will be determined by the Engineer in accordance with the requirements of paragraph 401-5.2b(3).

c. Partial lots. When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot, or when the Contractor and Engineer agree in writing to allow overages or other minor tonnage placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

The last batch produced where production is halted will be sampled, and its properties shall be considered as representative of the particular sublot from which it was taken. In addition, an agreed to minor placement will be sampled, and its properties shall be considered as representative of the particular sublot from which it was taken. Where three sublots are produced, they shall constitute a lot. Where one or two sublots are produced, they shall be incorporated into the next lot, and the total number of sublots shall be used in the acceptance plan calculation, that is, n = 5 or n = 6, for example. Partial lots at the end of asphalt production on the project shall be included with the previous lot.

The lot size for field placed material shall correspond to that of the plant material, except that, in no cases, shall less than three (3) cored samples be obtained, that is, n = 3.

401-5.2 ACCEPTANCE CRITERIA.

a. General. Acceptance will be based on the following characteristics of the HMA and completed pavement as well as the implementation of the Contractor Quality Control Program and test results:

(1) Air voids

(2) Mat density

(3) Joint density

(4) Thickness

(5) Smoothness

(6) Grade

(7) Stability

(8) Flow

Mat density and air voids will be evaluated for acceptance in accordance with paragraph 401-5.2b(1). Stability and flow will be evaluated for acceptance in accordance with paragraph 401-5.2b(2). Joint density will be evaluated for acceptance in accordance with paragraph 401-5.2b(3).

Thickness will be evaluated by the Engineer for compliance in accordance with paragraph 401-5.2b(4). Acceptance for smoothness will be based on the criteria contained in paragraph 401-5.2b(5). Acceptance for grade will be based on the criteria contained in paragraph 401-5.2b(7).

The Engineer may at any time, reject and require the Contractor to dispose of any batch of HMA which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or improper mix temperature. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Engineer, and if it can be demonstrated in the laboratory, in the presence of the Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

b. Acceptance criteria.

(1) Mat density and air voids. Acceptance of each lot of plant produced material for mat density and air voids shall be based on the percentage of material within specification limits (PWL). If the PWL of the lot equals or exceeds 90%, the lot shall be acceptable. Acceptance and payment shall be determined in accordance with paragraph 401-8.1.

(2) Stability and flow. Acceptance of each lot of plant produced HMA for stability and flow shall be based on the PWL. If the PWL of the lot equals or exceeds 90%, the lot shall be acceptable. If the PWL is less than 90%, the Contractor shall determine the reason and take corrective action. If the PWL is below 80%, the Contractor must stop production until the reason for poor stability and/or flow has been determined and adjustments to the HMA are made.

(3) Joint density. Acceptance of each lot of plant produced HMA for joint density shall be based on the PWL. If the PWL of the lot is equal to or exceeds 90%, the lot shall be considered acceptable. If the PWL is less than 90%, the Contractor shall evaluate the reason and act accordingly. If the PWL is less than 80%, the Contractor shall cease operations and until the reason for poor compaction has been determined. If the PWL is less than 71%, the pay factor for the lot used to complete the joint shall be reduced by five (5) percentage points. This lot pay factor reduction shall be incorporated and evaluated in accordance with paragraph 401-8.1.

(4) Thickness. Thickness of each lift of surface course shall be evaluated by the Engineer for compliance to the requirements shown on the plans. Measurements of thickness shall be made by the Engineer using the cores extracted for each sublot for density measurement. The maximum allowable deficiency at any point shall not be more than 1/4 inch (6 mm) less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, shall not be less than the indicated thickness. Where the thickness tolerances are not met, the lot or sublot shall be corrected by the Contractor at his expense by removing the deficient area and replacing with new pavement. The Contractor, at his expense, may take additional cores as approved by the Engineer to circumscribe the deficient area.

(5) Smoothness. The final surface shall be free from roller marks. After the final rolling, but not later than 24 hours after placement, the surface of each lot shall be tested in both longitudinal and transverse directions for smoothness to reveal all surface irregularities exceeding the tolerances specified. The Contractor shall furnish paving equipment and employ methods that produce a surface for each pavement lot having an average profile index meeting the requirements of paragraph 401-8.1d when evaluated with a profilograph; and the finished surface course of the pavement shall not vary more than 1/4 inch when evaluated with a 12-foot straightedge. When the surface course smoothness exceeds specification tolerances which cannot be corrected by diamond grinding of the surface course, full depth removal and replacement of surface course corrections shall be to the limit of the longitudinal placement. Corrections involving diamond grinding will be subject to the final pavement thickness tolerances specified. The Contractor shall apply a surface treatment per Item P-608 or P-609 to all areas that have been subject to grinding as directed by the Engineer.

(a) Transverse measurements. Transverse measurements will be taken for each lot placed. Transverse measurements will be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the Engineer.

(i) Testing shall be continuous across all joints, starting with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. Smoothness readings will not be made across grade changes or cross slope transitions; at these transition areas, the straightedge position shall be adjusted to measure surface smoothness and not design grade or cross slope transitions. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. High spots on final surface course > 1/4 inch in transverse direction shall be corrected with diamond grinding per paragraph 401-4.15 or by removing and replacing full depth of surface course. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding.

(ii) The joint between lots shall be tested separately to facilitate smoothness between lots. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface, with half the straightedge on one side of the joint and the other half of the straightedge on the other side of the joint. Measure the maximum gap between the straightedge and the pavement surface in the area between these two high points. One measurement shall be taken at the joint every 50 feet or more often if directed by the Engineer. Deviations on final surface course > 1/4 inch in transverse direction shall be corrected with diamond grinding per paragraph 401-4.15 or by removing and replacing full depth of surface course. Each measurement shall be recorded and a copy of the data shall be furnished to the Engineer at the end of each days testing.

(b) Longitudinal measurements. Longitudinal measurements will be taken for each lot placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the third points of paving lanes when widths of paving lanes are 20 feet or greater.

(i) Longitudinal Short Sections. Longitudinal Short Sections are when the longitudinal lot length is less than 200 feet and areas not requiring a profilograph. When approved by the Engineer, the first and last 15 feet of the lot can also be considered as short sections for smoothness. The finished surface shall not vary more than 1/4 inch when evaluated with a 12-foot straightedge. Smoothness readings will not be made across grade changes or cross slope transitions; at these transition areas, the straightedge position shall be adjusted to measure surface smoothness and not design grade or cross slope transitions. Testing shall be continuous across all joints, starting with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. Deviations on final surface course > 1/4 inch in longitudinal direction will be corrected with diamond grinding per paragraph 401-4.15 or by removing and replacing full depth of surface course. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding.

(ii) Profilograph Testing. Profilograph testing shall be performed by the contractor using approved equipment and procedures as described as ASTM E1274. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2 inch blanking band. The bump template must span one inch with an offset of 0.4 inches. The profilograph must be calibrated prior to use and operated by a factory or State DOT approved operator. Profilograms shall be recorded on a longitudinal scale of one inch equals 25 feet and a vertical scale of one inch equals one inch. A copy of the reduced tapes shall be furnished to the Engineer at the end of each days testing.

The pavement must have an average profile index meeting the requirements of paragraph 401-8.1d. High spots, or "must grind" spots, on final surface course in longitudinal direction shall be corrected with diamond grinding per paragraph 401-4.15 or by removing and replacing full depth of surface course. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding.

Where corrections are necessary, second profilograph runs shall be performed to verify that the corrections produced an average profile index of 15 inches per mile or less. If the initial average profile index was less than 15 inches, only those areas representing greater than 0.4 inch deviation will be re-profiled for correction verification.

(iii) Final profilograph of taxiway. Final profilograph, full length of taxiway, shall be performed to facilitate testing of smoothness between lots. Profilograph testing shall be performed by the contractor using approved equipment and procedures as described as ASTM E1274.The pavement must have an average profile index meeting the requirements of paragraph 401-8.1d. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2 inch blanking band. The bump template must span one inch with an offset of 0.4 inches. The profilograph must be calibrated prior to use and operated by a factory or State DOT approved, trained operator. Profilograms shall be recorded on a longitudinal scale of one inch equals 25 feet and a vertical scale of one inch equals one inch. A copy of the reduced tapes shall be furnished to the Engineer at the end of each days testing. Profilograph of final taxiway shall be performed one foot right and left of taxiway centerline and 15 feet right and left of centerline. Any areas that indicate "must grind" will be corrected as directed by the Engineer.

Smoothness testing indicated in the above paragraphs except paragraph (iii) shall be performed within 24 hours of placement of material. Smoothness testing indicated in paragraph (iii) shall be performed within 48 hours of paving completion. The primary purpose of smoothness testing is to identify areas that may be prone to ponding of water which could lead to hydroplaning of aircraft. If the contractor's machines and/or methods are producing significant areas that need corrective actions then production should be stopped until corrective measures can be implemented. If corrective measures are not implemented and when directed by the Engineer, production shall be stopped until corrective measures can be implemented.

Profilograph is not required on the paved shoulders or taxiway paving.

(6) Grade. Not used.

c. Percentage of material within specification limits (PWL). The PWL shall be determined in accordance with procedures specified in Section 110 of the General Provisions. The specification tolerance limits (L) for lower and (U) for upper are contained in Table 5.

Table 5. Marshall Acceptance Limits for Stability, Flow, Air Voids, Density

TEST PROPERTY	Pavements Designed for Aircraft Gross Weights of 60,000 lbs. or More or Tire Pressures of 100 psi or More	
Number of Blows	75 blows	
	Specification Tolerance Limits	
	L	U
Stability, minimum (pounds)	1800	--
Flow, 0.01 inch	8	18*
Air Voids Total Mix (%)	2	5
Surface Course Mat Density (%)	96.3	--
Joint Density (%)	93.3	--

* Upper flow limit requirements do not apply for any mix with a polymer-modified binder (where the difference between the upper and lower temperature number is 90°F or greater.

d. Outliers. All individual tests for mat density and air voids shall be checked for outliers (test criterion) in accordance with ASTM E178, at a significance level of 5%. Outliers shall be discarded, and the PWL shall be determined using the remaining test values. The criteria in Table 5 is based on production processes which have a variability with the following standard deviations: Surface Course Mat Density (%), 1.30; Base Course Mat Density (%), 1.55; Joint Density (%), 2.1.

The Contractor should note that (1) 90 PWL is achieved when consistently producing a surface course with an average mat density of at least 98% with 1.30% or less variability, (2) 90 PWL is achieved when consistently producing a base course with an average mat density of at least 97.5% with 1.55% or less variability, and (3) 90 PWL is achieved when consistently producing joints with an average joint density of at least 96% with 2.1% or less variability.

401-5.3 RESAMPLING PAVEMENT FOR MAT DENSITY.

a. General. Resampling of a lot of pavement will only be allowed for mat density, and then, only if the Contractor requests same, in writing, within 48 hours after receiving the written test results from the Engineer. A retest will consist of all the sampling and testing procedures contained in paragraphs 401-5.1b and 401-5.2b(1). Only one resampling per lot will be permitted.

(1) A redefined PWL shall be calculated for the resampled lot. The number of tests used to calculate the redefined PWL shall include the initial tests made for that lot plus the retests.

(2) The cost for resampling and retesting shall be borne by the Contractor.

b. Payment for resampled lots. The redefined PWL for a resampled lot shall be used to calculate the payment for that lot in accordance with Table 6.

c. Outliers. Check for outliers in accordance with ASTM E178, at a significance level of 5%.

401-5.4 LEVELING COURSE. Any course used for trueing and leveling shall meet the aggregate gradation in Table 3, paragraph 401-3.2. The trueing and leveling course shall meet the requirements of paragraph 401-3.2, 401-5.2b(1) for air voids and 401-5.2b(2) for stability and flow but shall not be subject to the density requirements of paragraph 401-5.2b(1) for mat density and 401-5.2b(3) for joint density. The leveling course shall be compacted with the same effort used to achieve density of the test section. The trueing and leveling course shall not exceed the maximum lift thickness associated with each gradation in Table 3, paragraph 401-3.2. The leveling course is the first variable thickness lift of an overlay placed prior to subsequent courses.

CONTRACTOR QUALITY CONTROL

401-6.1 GENERAL. The Contractor shall develop a Quality Control Program in accordance with Section 100 of the General Provisions. The program shall address all elements that affect the quality of the pavement including, but not limited to:

a. Mix design
b. Aggregate grading
c. Quality of materials
d. Stockpile management
e. Proportioning
f. Mixing and transportation
g. Placing and finishing
h. Joints
i. Compaction
j. Surface smoothness
k. Personnel
l. Laydown plan

The Contractor shall perform quality control sampling, testing, and inspection during all phases of the work and shall perform them at a rate sufficient to ensure that the work conforms to the contract requirements, and at minimum test frequencies required by paragraph 401-6.3 and Section 100 of the General Provisions. As a part of the process for approving the Contractor's plan, the Engineer may require the Contractor's technician to perform testing of samples to demonstrate an acceptable level of performance.

No partial payment will be made for materials that are subject to specific quality control requirements without an approved plan.

401-6.2 CONTRACTOR TESTING LABORATORY. The lab shall meet the requirements of ASTM D3666 including all necessary equipment, materials, and current reference standards to comply with the specifications.

401-6.3 QUALITY CONTROL TESTING. The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to these specifications and as set forth in the approved Quality Control Program. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation,

temperatures, aggregate moisture, field compaction, and surface smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

a. Asphalt content. A minimum of two asphalt content tests shall be performed per lot in accordance with ASTM D6307 or ASTM D2172 if the correction factor in ASTM D6307 is greater than 1.0. The asphalt content for the lot will be determined by averaging the test results.

b. Gradation. Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with ASTM D5444, ASTM C136, and ASTM C117.

c. Moisture content of aggregate. The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C566.

d. Moisture content of HMA. The moisture content shall be determined once per lot in accordance with ASTM D1461.

e. Temperatures. Temperatures shall be checked, at least four times per lot, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the HMA at the plant, and the HMA at the job site.

f. In-place density monitoring. The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.

g. Additional testing. Any additional testing that the Contractor deems necessary to control the process may be performed at the Contractor's option.

h. Monitoring. The Engineer reserves the right to monitor any or all of the above testing.

401-6.4 SAMPLING. When directed by the Engineer, the Contractor shall sample and test any material that appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

401-6.5 CONTROL CHARTS. The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for aggregate gradation, asphalt content, and VMA. The VMA for each sublot will be calculated and monitored by the Quality Control laboratory.

Control charts shall be posted in a location satisfactory to the Engineer and shall be kept current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the Engineer may suspend production or acceptance of the material.

a. Individual measurements. Control charts for individual measurements shall be established to maintain process control within tolerance for aggregate gradation, asphalt content, and VMA. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

Control Chart Limits For Individual Measurements		
Sieve	**Action Limit**	**Suspension Limit**
3/4 inch (19 mm)	±6%	±9%
1/2 inch (12 mm)	±6%	±9%
3/8 inch (9 mm)	±6%	±9%
No. 4 (4.75 mm)	±6%	±9%
No. 16 (1.18 mm)	±5%	±7.5%
No. 50 (0.30 mm)	±3%	±4.5%
No. 200 (0.075 mm)	±2%	±3%
Asphalt Content	±0.45%	±0.70%
VMA	-1.00%	-1.50%

b. Range. Control charts for range shall be established to control process variability for the test parameters and Suspension Limits listed below. The range shall be computed for each lot as the difference between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of n = 2. Should the Contractor elect to perform more than two tests per lot, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

Control Chart Limits Based On Range (Based On n = 2)	
Sieve	**Suspension Limit**
1/2 inch (12 mm)	11%
3/8 inch (9 mm)	11%
No. 4 (4.75 mm)	11%
No. 16 (1.18 mm)	9%
No. 50 (0.30 mm)	6%
No. 200 (0.075 mm)	3.5%
Asphalt Content	0.8%

c. Corrective Action. The Contractor Quality Control Program shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The Plan shall contain sets of rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or

(2) Two points in a row fall outside the Action Limit line for individual measurements.

401-6.6 QUALITY CONTROL REPORTS. The Contractor shall maintain records and shall submit reports of quality control activities daily, in accordance with the Contractor Quality Control Program described in General Provisions, Section 100.

METHOD OF MEASUREMENT

401-7.1 MEASUREMENT.

a. HMA Taxiway Overlay and Shoulders and Taxiway Transition Surface Course. Hot mix asphalt concrete pavement shall be measured by the number of tons of HMA surface course and the number of tons of bituminous binder material used in the accepted Taxiway Overlay, Shoulder and Taxiway Transitions Surface Course work. Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage. Measurement for tonnage of bituminous binder material used in the mix shall be based on asphalt extractions from each paved lot.

b. HMA Leveling Course (Allowance). The hot mix asphalt concrete leveling course shall be measured by the number of tons of HMA leveling course, including the bituminous binder material, used to patch or fix the pavement following milling operations and prior to paving the 3-inch overlay. Bituminous binder material incorporated in the leveling course shall not be measured separately.

BASIS OF PAYMENT

401-8.1 PAYMENT.

a. Payment for a lot of **Hot Mix Asphalt Taxiway Overlay and Shoulders and Taxiway Transition Surface Course** meeting all acceptance criteria as specified in paragraph 401-5.2 shall be made based on results of tests for smoothness, mat density and air voids. Payment for acceptable lots shall be adjusted according to paragraph 401-8.1a(1) for mat density and air voids and 401-8.1a(3) for smoothness, subject to the limitation that:

(1) The total project payment for plant mix bituminous concrete pavement shall not exceed 100 percent of the product of the contract unit price and the total number of tons of HMA used in the accepted work (See Note 1 under Table 6).

(2) The price shall be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

(3) Basis of adjusted payment. The pay factor for each individual lot shall be calculated in accordance with Table 6. A pay factor shall be calculated for both mat density and air voids. The lot pay factor shall be the higher of the two values when calculations for both mat density and air voids are 100% or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either mat density or air voids is 100% or higher. The lot pay factor shall be the lower of the two values when calculations for both mat density and air voids are less than 100%. If PWL for joint density is less than 71 percent then the lot pay factor shall be reduced by 5% but be no higher than 95%.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project payment limitation specified in paragraph 401-8.1. Payment in excess of 100% for accepted lots of HMA shall be used to offset payment for accepted lots of bituminous concrete pavement that achieve a lot pay factor less than 100%.

Table 6. Price adjustment schedule[1]

Percentage of material within specification limits (PWL)	Lot pay factor (percent of contract unit price)
96 – 100	106
90 – 95	PWL + 10
75 – 89	0.5 PWL + 55
55 – 74	1.4 PWL – 12
Below 55	Reject [2]

[1] Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment above 100% shall be subject to the total project payment limitation specified in paragraph 401-8.1.

[2] The lot shall be removed and replaced. However, the Engineer may decide to allow the rejected lot to remain. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it shall be paid for at 50% of the contract unit price and the total project payment shall be reduced by the amount withheld for the rejected lot.

(4) Profilograph smoothness. When the final average profile index (subsequent to any required corrective action) does not exceed 7 inches per mile, payment will be made at the contract unit price for the completed pavement. If the final average profile index (subsequent to any required corrective action) exceeds 7 inches per mile, but does not exceed 15 inches per mile, the Contractor may elect to accept a contract unit price adjustment in lieu of reducing the profile index.

(5) Basis of adjusted payment for smoothness. Price adjustment for pavement smoothness will be made in accordance with Table 7. The adjustment will apply to the total tonnage of HMA within a lot of pavement and shall be applied with the following equation:

(Tons of asphalt concrete in lot) × (lot pay factor) × (unit price per ton) × (smoothness pay factor) = payment for lot

Table 7. Profilograph Average Profile Index Smoothness Pay Factor

Inches/miles per 1/10 mile	Short Sections	Pay Factor
0.0 - 7	00.0 - 15.0	100%
7.1 - 9	15.1 - 16	98%
9.1 - 11	16.1 - 17	96%
11.1 - 13	17.1 - 18	94%
13.1 - 14	18.1 - 20	92%
14.1 - 15	20.1 - 22	90%
15.1 and up	22.1 and up	Corrective work required[1]

[1] The Contractor shall correct pavement areas not meeting these tolerances by removing and replacing the defective work. If the Contractor elects to

construct an overlay to correct deficiencies, the minimum thickness of the overlay should be at least three times the maximum aggregate size (approximately four (4) times the nominal maximum aggregate size). The corrective overlay shall not violate grade Criteria and butt joints shall be constructed by sawing and removing the original pavement in compliance with the thickness/ maximum aggregate size ratio. Skin patching shall not be permitted.

Taxiway Overlay and Shoulders and Taxiway Transition HMA placed above the specified grade shall not be included in the quantities for payment.

b. Payment for a lot of **Hot Mix Asphalt Leveling Course** meeting all acceptance criteria as specified in paragraph 401-5.4 shall be made based on results of tests for air voids. Payment for acceptable lots shall be adjusted according to paragraph 401-8.1a(1) air voids, subject to the limitation that the total project payment for bituminous leveling course shall not exceed 100 percent of the product of the contract unit price of leveling course used in the accepted work (See Note 1 under Table 6).

c. Payment. Payment will be made under:

Item P-401-8.1 HMA Taxiway Overlay and Shoulder and Taxiway Surface Course – per ton

Item P-401-8.2 PG 70-10 Asphalt Material – per ton

Item P-401-8.3 HMA Leveling Course including PG 70-10 Asphalt (Allowance)

TESTING REQUIREMENTS

ASTM C29 Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate

ASTM C88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM C117 Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C127 Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate

ASTM C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C136 Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates

ASTM C183 Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement

ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D979	Standard Practice for Sampling Bituminous Paving Mixtures
ASTM D1073	Standard Specification for Fine Aggregate for Bituminous Paving Mixtures
ASTM D2172	Standard Test Method for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D1461	Standard Test Method for Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2489	Standard Practice for Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D2726	Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D2950	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D3203	Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D4867	Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D5444	Standard Test Method for Mechanical Size Analysis of Extracted Aggregate

ASTM D6084	Standard Test Method for Elastic Recovery of Bituminous Materials by Ductilometer
ASTM D6307	Standard Test Method for Asphalt Content of Hot Mix Asphalt by Ignition Method
ASTM D6752	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method
ASTM D6926	Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D6927	Standard Test Method for Marshall Stability and Flow of Bituminous mixtures
ASTM E11	Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
ASTM E178	Standard Practice for Dealing with Outlying Observations
ASTM E1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph
AASHTO T030	Standard Method of Test for Mechanical Analysis of Extracted Aggregate
AASHTO T110	Standard Method of Test for Moisture or Volatile Distillates in Hot Mix Asphalt (HMA)
AASHTO T275	Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Paraffin-Coated Specimens
AASHTO M156	Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
AASHTO T329	Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method
Asphalt Institute Handbook MS-26,	Asphalt Binder
Asphalt Institute MS-2	Mix Design Manual, 7th Edition

MATERIAL REQUIREMENTS

ASTM D242	Standard Specification for Mineral Filler for Bituminous Paving Mixtures
ASTM D946	Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction

ASTM D3381	Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D4552	Standard Practice for Classifying Hot-Mix Recycling Agents
ASTM D6373	Standard Specification for Performance Graded Asphalt Binder

END OF ITEM P-401

ITEM P-501 PORTLAND CEMENT CONCRETE (PCC) PAVEMENT

DESCRIPTION

501-1.1 This work shall consist of pavement composed of portland cement concrete (PCC),with reinforcement constructed on a prepared underlying surface in accordance with these specifications and shall conform to the lines, grades, thickness, and typical cross-sections shown on the plans.

MATERIALS

501-2.1 AGGREGATES.

a. Reactivity. Aggregates shall be tested for deleterious reactivity with alkalis in the cement which may cause excessive expansion of the concrete. Fine and Coarse aggregates to be used in all concrete shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with both ASTM C1260 and ASTM C1567. Aggregate and mix proportion reactivity tests shall be performed for each project.

(1) Coarse and fine aggregate shall be tested separately in accordance with ASTM C1260. The aggregate shall be considered innocuous if the expansion of test specimens, tested in accordance with ASTM C1260, does not exceed 0.10% at 28 days (30 days from casting).

(2) Combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals.

(3) If the expansion of the proposed combined materials test specimens, tested in accordance with ASTM C1567, modified for combined aggregates, or COE CRD C662, does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion of the proposed combined materials test specimens is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

b. Fine aggregate. Fine aggregate shall conform to the requirements of ASTM C33. The minimum sand equivalent shall be 75 when tested in accordance with AASHTO T176. Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33 and shall have a fineness modulus of not less than 2.50 nor more than 3.40. The soundness loss shall not exceed 10% when sodium sulfate is used or 15% when magnesium sulfate is used, after five cycles, when tested per ASTM C88.

The amount of deleterious material in the fine aggregate shall not exceed the limits in the Table on the following page:

Limits for Deleterious Substances in Fine Aggregate for Concrete

Deleterious material	ASTM	Percentage by Mass
Clay Lumps and friable particles	ASTM C142	1.0
Material finer than 0.075mm (No. 200 sieve)	ASTM C117	3.0
Lightweight particles	ASTM C123 using a medium with a density of Sp. Gr. of 2.0	0.5
Total of all deleterious Material		3.0

c. Coarse aggregate. Gradation, within the separated size groups, shall meet the coarse aggregate grading requirements of ASTM C33 when tested in accordance with ASTM C136. When the nominal maximum size of the aggregate is greater than one inch, the aggregates shall be furnished in two size groups.

Aggregates delivered to the mixer shall consist of crushed stone, crushed or uncrushed gravel, air-cooled iron blast furnace slag, crushed recycled concrete pavement, or a combination. The aggregates should be free of ferrous sulfides, such as pyrite, that would cause “rust” staining that can bleed through pavement markings. Steel blast furnace slag shall not be permitted. The aggregate shall be composed of clean, hard, uncoated particles. Dust and other coating shall be removed from the aggregates by washing.

The percentage of wear shall be no more than 40 when tested in accordance with ASTM C131.

The quantity of flat, elongated, and flat and elongated particles in any size group coarser than 3/8 sieve shall not exceed 8% by weight when tested in accordance with ASTM D4791. A flat particle is defined as one having a ratio of width to thickness greater than 5. An elongated particle is one having a ratio of length to width greater than 5.

The soundness loss shall not exceed 12% when sodium sulfate is used or 18% when magnesium sulfate is used, after five cycles, when tested per ASTM C88.

The amount of deleterious material in the coarse aggregate shall not exceed the following limits:

Limits for Deleterious Substances in Coarse Aggregate for Concrete

Deleterious material	ASTM	Percentage by Mass
Clay Lumps and friable particles	ASTM C142	1.0
Material finer than No. 200 sieve (0.075mm)	ASTM C117	1.0
Lightweight particles	ASTM C123 using a medium with a density of Sp. Gr. of 2.0	0.5
Chert (less than 2.40 Sp. Gr.)	ASTM C123 using a medium with a density of Sp. Gr. of 2.0)	1.0
Total of all deleterious Material		3.0

Table 1. Gradation for Coarse Aggregate (ASTM C33)

Sieve Designations (square openings)		Percentage by Weight Passing Sieves	
inch	**mm**	**1-1/2 inch – 3/4 inch**	**3/4 inch – No. 4**
2-1/2	60	-	-
2	50	100	-
1-1/2	38	90-100	-
1	25	20-55	100
3/4	19	0-15	90-100
1/2	13	-	-
3/8	9	0-5	20-55
No. 4	4.75	-	0-10
No. 8	2.36	-	0-5

(1) Aggregate susceptibility to durability (D) cracking. Aggregates that have a history of D-cracking shall not be used.

(2) Combined aggregate gradation. If substituted for the grading requirements specified for coarse aggregate and for fine aggregate and when approved by the Engineer, the combined aggregate grading shall meet the following requirements:

(a) The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in d. below, the point thus determined shall fall within the parallelogram described therein.

(b) The CF shall be determined from the following equation:

CF = (cumulative percent retained on the 3/8 in. sieve) (100) / (cumulative percent retained on the No. 8 sieve)

(c) The Workability Factor WF is defined as the percent passing the No. 8 sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds of cementitious material per cubic meter yard greater than 564 pounds per cubic yard.

(d) A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary.

501-2.2 CEMENT. Cement shall conform to the requirements of ASTM C 150 Type II.

If aggregates are deemed innocuous when tested in accordance with paragraph 501-2.1.a.1 and accepted in accordance with paragraph 501-2.1.a.2, higher equivalent alkali content in the

cement may be allowed if approved by the Engineer and FAA. If cement becomes partially set or contains lumps of caked cement, it shall be rejected. Cement salvaged from discarded or used bags shall not be used.

501-2.3 CEMENTITIOUS MATERIALS.

a. Fly ash. Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than 6%. Only Class F fly ash will be permitted in the mix design. The Supplementary Optional Chemical and Physical Requirements contained in ASTM C 618 shall apply. Table 1A applies when the fly ash is used in concrete containing reactive aggregates and cement to meet a limitation on alkali contents. Table 2A applies when fly ash is used with aggregates that are regarded as deleteriously reactive with alkalis in cement. Class F fly ash for use in mitigating alkali-silica reactivity shall have a Calcium Oxide (CaO) content of less than 13% and a total available alkali content less than 3% per ASTM C311. Fly ash produced in furnace operations using liming materials or soda ash (sodium carbonate) as an additive shall not be acceptable. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the mix design, and shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the Engineer.

501-2.4 JOINT SEAL. The joint seal for the joints in the concrete pavement shall meet the requirements of Item P-604 and shall be of the type specified in the plans.

501-2.5 ISOLATION JOINT FILLER. Premolded joint filler for isolation joints shall conform to the requirements of ASTM D1751, shall be compatible with the specified joint sealant and shall be where shown on the plans. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise specified by the Engineer. It shall be secured to the existing concrete edge by use of Hilti IDP Insulation Anchor System or an equivalent plastic anchor system. When the use of more than one piece is required for a joint, the abutting ends shall be fastened securely and held accurately to shape by fastening as indicated above and to the satisfaction of the Engineer.

501-2.6 STEEL REINFORCEMENT. Reinforcing shall consist of D20 deformed welded wire fabric, Grade 70 conforming to the requirements of ASTM A1064, or No. 4 deformed bar mats conforming to the requirements of ASTM A184 or A704. Welded wire fabric shall be furnished in flat sheets only.

501-2.7 DOWEL AND TIE BARS. Dowel bars shall be plain steel bars conforming to ASTM A615 and shall be free from burring or other deformation restricting slippage in the concrete. Before delivery to the construction site each dowel bar shall be epoxy coated per ASTM A1078. The dowels shall be coated with a bond-breaker recommended by the manufacturer. Dowel sleeves or inserts are not permitted. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the grout hardens.

Tie bars shall be deformed steel bars and conform to the requirements of ASTM A615. Tie bars designated as Grade 60 in ASTM A615 or ASTM A706 shall be used for construction requiring bent bars.

501-2.8 WATER. Water used in mixing or curing shall be potable, clean, free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product, except that non-potable water, or water from concrete production operations, may be used if it meets the requirements of ASTM C1602.

501-2.9 MATERIAL FOR CURING CONCRETE. Curing materials shall be Liquid membrane-forming compounds for curing concrete conforming to the requirements of ASTM C309, Type 2, Class B, or Class A if wax base only.

501-2.10 ADMIXTURES. The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the Engineer may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the Engineer from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

a. Air-entraining admixtures. Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.

b. Water-reducing admixtures. Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.

c. Other admixtures. The use of set retarding, and set-accelerating admixtures shall be approved by the Engineer. Retarding shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

d. Lithium Nitrate. The lithium admixture shall be a nominal 30% aqueous solution of Lithium Nitrate, with a density of 10 pounds/gallon, and shall have the approximate chemical form as shown below:

Constituent	Limit (Percent by Mass)
LiNO3 (Lithium Nitrate)	30 ±0.5
SO4 (Sulfate Ion)	0.1 (max)
Cl (Chloride Ion)	0.2 (max)
Na (Sodium Ion)	0.1 (max)
K (Potassium Ion)	0.1 (max)

Provide a trained manufacturer's representative to supervise the lithium nitrate admixture dispensing and mixing operations.

501-2.11 EPOXY-RESIN. All epoxy-resin materials shall be two-component materials conforming to the requirements of ASTM C881, Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

b. Material for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.

c. Material for use for injecting cracks shall be Type IV, Grade 1.

d. Material for bonding freshly mixed Portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

501-2.12 MATERIAL ACCEPTANCE. Prior to use of materials, the Contractor shall submit certified test reports to the Engineer for those materials proposed for use during construction. The certification shall show the appropriate ASTM test for each material, the test results, and a statement that the material passed or failed.

The Engineer may request samples for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications. The Contractor shall participate in obtaining samples for testing prior to and during production.

MIX DESIGN

501-3.1 GENERAL. No concrete shall be placed until the mix design has been submitted to the Engineer for review and the Engineer has taken appropriate action. The Engineer's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

501-3.2 PROPORTIONS. The laboratory preparing the mix design shall be accredited in accordance with ASTM C1077. The mix design for all Portland cement concrete placed under P-501 shall be stamped or sealed by the responsible professional Engineer of the laboratory. Concrete shall be proportioned to achieve a 28-day flexural strength that meets or exceeds the acceptance criteria contained in paragraph 501-5.2 for a flexural strength of six-hundred fifty (650) psi per ASTM C78. The mix shall be developed using the procedures contained in the Portland Cement Association's (PCA) publication, "Design and Control of Concrete Mixtures".

The minimum cementitious material shall be adequate to ensure a workable, durable mix. The minimum cementitious material (cement plus fly ash) shall be 564 pounds per cubic yard. The ratio of water to cementitious material, including free surface moisture on the aggregates but not including moisture absorbed by the aggregates shall not be more than 0.45 by weight.

Flexural strength test specimens shall be prepared in accordance with ASTM C192 and tested in accordance with ASTM C78. The mix determined shall be workable concrete having a maximum allowable slump between one and two inches as determined by ASTM C143. For slip-form concrete, the slump shall be between 1/2 inch and 1-1/2 inch. At the start of the project, the Contractor shall determine a maximum allowable slump for slip-form pavement which will produce in-place pavement to control the edge slump. The selected slump shall be applicable to both pilot and fill-in lanes.

Before the start of paving operations and after approval of all material to be used in the concrete, the Contractor shall submit a mix design showing the proportions and flexural strength obtained from the concrete at seven (7) and 28 days. The mix design shall include copies of test reports, including test dates, and a complete list of materials including type, brand, source, and

amount of cement, fly ash, coarse aggregate, fine aggregate, water, and admixtures. The mix design shall be submitted to the Engineer at least 30 days prior to the start of operations. The submitted mix design shall not be more than 90 days old. Production shall not begin until the mix design is approved in writing by the Engineer, and the Contractor has demonstrated "proofing of the mix" by providing plant trials.

The mixes as designed, including all admixtures, shall be tested in accordance with ASTM C 157. Minimum shrinkage shall be no greater than 0.04 percent.

If a change in sources is made, or admixtures added or deleted from the mix, a new mix design must be submitted to the Engineer for approval. Previously approved mix designs older than ninety (90) days may not be approved without the development of new trial batches.

The results of the mix design shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic yard basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition. The recommended mixture proportions shall be accompanied by test results demonstrating that the proportions selected will produce concrete of the qualities indicated. Trial mixtures having proportions, slumps, and air content suitable for the work shall be based on methodology described in PCA's publication, Design and Control of Concrete Mixtures, modified as necessary to accommodate flexural strength.

The submitted mix design shall be stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items as a minimum:

a. Coarse, fine, and combined aggregate gradations and plots including fineness modulus of the fine aggregate.

b. Reactivity Test Results.

c. Coarse aggregate quality test results, including deleterious materials.

d. Fine aggregate quality test results, including deleterious materials.

e. Mill certificates for cement and supplemental cementitious materials.

f. Certified test results for all admixtures, including Lithium Nitrate if applicable.

g. Specified flexural strength, slump, and air content.

h. Recommended proportions/volumes for proposed mixture and trial water-cementitious materials ratio, including actual slump and air content.

i. Flexural and compressive strength summaries and plots, including all individual beam and cylinder breaks.

j. Correlation ratios for acceptance testing and Contractor Quality Control testing, when applicable.

k. Historical record of test results documenting production standard deviation, when applicable.

501-3.3 CEMENTITIOUS MATERIALS.

a. Fly ash. When fly ash is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30% by weight of the total cementitious material. If fly ash is used in conjunction with slag cement the maximum replacement rate shall not exceed 10% by weight of total cementitious material.

501-3.4 ADMIXTURES.

a. Air-entraining admixtures. Air-entraining admixtures are to be added in such a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained concrete shall be based upon trial mixes with the materials to be used in the work adjusted to produce concrete of the required plasticity and workability. The percentage of air in the mix shall be 3%. Air content shall be determined by testing in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly porous coarse aggregate.

b. Water-reducing admixtures. Water-reducing admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted on trial mixes, with the materials to be used in the work, in accordance with ASTM C494.

c. Other admixtures. Set controlling, and other approved admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted on trial mixes, with the materials to be used in the work, in accordance with ASTM C 494.

d. Lithium nitrate. Lithium nitrate shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements in accordance with paragraph 501-2.10d.

501-3.5 CONCRETE MIX DESIGN LABORATORY. The Contractor's laboratory used to develop the concrete mix design shall be accredited in accordance with ASTM C1077. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for developing the concrete mix design must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

A certification that it meets these requirements shall be submitted to the Engineer prior to the start of mix design and shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A statement that the equipment used in developing the mix design is in calibration.

c. A statement that each test specified in developing the mix design is offered in the

scope of the laboratory's services.

d. A copy of the laboratory's quality control system.

CONSTRUCTION METHODS

501-4.1 EQUIPMENT. Equipment necessary for handling materials and performing all parts of the work shall be approved by the Engineer, but does not relieve the Contractor of the responsibility for the proper operation of equipment and maintaining the equipment in good working condition. The equipment shall be at the jobsite sufficiently ahead of the start of paving operations to be examined thoroughly and approved.

a. Batch plant and equipment. The batch plant and equipment shall conform to the requirements of ASTM C94.

b. Mixers and transportation equipment.

(1) General. Concrete may be mixed at a central plant, or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's nameplate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

(2) Central plant mixer. Central plant mixers shall conform to the requirements of ASTM C94. The mixer shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades. The pickup and throwover blades shall be replaced when they have worn down 3/4 inch or more. The Contractor shall have a copy of the manufacturer's design on hand showing dimensions and arrangement of blades in reference to original height and depth.

(3) Truck mixers and truck agitators. Truck mixers used for mixing and hauling concrete and truck agitators used for hauling central-mixed concrete shall conform to the requirements of ASTM C94.

(4) Nonagitator trucks. Nonagitating hauling equipment shall conform to the requirements of ASTM C94.

(5) Transfer and spreading equipment. Equipment for transferring concrete from the transporting equipment to the paving lane in front of the paver shall be specially manufactured, self-propelled transfer equipment which will accept the concrete outside the paving lane and will transfer and spread it evenly across the paving lane in front of the paver and strike off the surface evenly to a depth which permits the paver to operate efficiently.

c. Finishing equipment. The standard method of constructing concrete pavements shall be with an approved slip-form paving equipment designed and operated to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine so that the end result is a dense and homogeneous pavement which is achieved with a minimum of hand finishing. The paver-finisher shall be a heavy duty, self-propelled machine designed specifically for paving and finishing high quality concrete pavements. It shall weigh at least 2,200 lbs per foot of paving lane width and powered by an engine having at least 6.0 horsepower per foot of lane width.

On projects requiring less than 500 square yards of cement concrete pavement or requiring individual placement areas of less than 500 square yards, or irregular areas at locations inaccessible to slip-form paving equipment, concrete pavement may be placed with approved placement and finishing equipment using stationary side forms. Hand screeding and float finishing may only be used on small irregular areas as allowed by the Engineer.

d. Vibrators. Vibrator shall be the internal type. Operating frequency for internal vibrators shall be between 8,000 and 12,000 vibrations per minute. Average amplitude for internal vibrators shall be 0.025-0.05 inch.

The number, spacing, and frequency shall be as necessary to provide a dense and homogeneous pavement and meet the recommendations of American Concrete Institute (ACI) 309, Guide for Consolidation of Concrete. Adequate power to operate all vibrators shall be available on the paver. The vibrators shall be automatically controlled so that they shall be stopped as forward motion ceases. The Contractor shall provide an electronic or mechanical means to monitor vibrator status. The checks on vibrator status shall occur a minimum of two times per day or when requested by the Engineer.

Hand held vibrators may be used in irregular areas only, but shall meet the recommendations of ACI 309R, Guide for Consolidation of Concrete.

e. Concrete saws. The Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions. The Contractor shall provide at least one standby saw in good working order and a supply of saw blades at the site of the work at all times during sawing operations. Early-entry saws may be used, subject to demonstration and approval of the Engineer.

f. Side forms. Straight side forms shall be made of steel and shall be furnished in sections not less than 10 feet in length. Forms shall have a depth equal to the pavement thickness at the edge, and a base width equal to or greater than the depth. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the Engineer. The top face of the form shall not vary from a true plane more than 1/8 inch in 10 feet, and the upstanding leg shall not vary more than 1/4 inch. The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting.

The Contractor shall provide steel forms for the placement of all concrete adjacent to the thickened edge expansion joints and shall provide steel forms for all irregular PCCP panel edges, such as outside circular reinforced panels. These steel forms shall be mortar tight and shall be designed, constructed, braced and maintained so that the finished concrete will be true to line and elevation such that the finished type "A" joint is constructed within ¼ -inch of a vertical and horizontal plane. Wood forms may be used under special conditions, when approved by the Engineer.

g. Pavers. The paver shall be fully energized, self-propelled, and designed for the specific purpose of placing, consolidating, and finishing the concrete pavement, true to grade,

tolerances, and cross-section. It shall be of sufficient weight and power to construct the maximum specified concrete paving lane width as shown in the plans, at adequate forward speed, without transverse, longitudinal or vertical instability or without displacement. The paver shall be equipped with electronic or hydraulic horizontal and vertical control devices.

501-4.2 FORM SETTING. Forms shall be set sufficiently in advance of the concrete placement to ensure continuous paving operation. After the forms have been set to correct grade, the underlying surface shall be thoroughly tamped, either mechanically or by hand, at both the inside and outside edges of the base of the forms. Forms shall be staked into place sufficiently to maintain the form in position for the method of placement.

Form sections shall be tightly locked and shall be free from play or movement in any direction. The forms shall not deviate from true line by more than 1/8 inch at any joint. Forms shall be so set that they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms shall be cleaned and oiled prior to the placing of concrete.

The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete.

501-4.3 CONDITIONING OF UNDERLYING SURFACE. The compacted underlying surface on which the pavement will be placed shall be widened approximately 3 feet to extend beyond the paving machine track to support the paver without any noticeable displacement. After the underlying surface has been placed and compacted to the required density, the areas that will support the paving machine and the area to be paved shall be trimmed or graded to the plan grade elevation and profile by means of a properly designed machine. The grade of the underlying surface shall be controlled by a positive grade control system using lasers, stringlines, or guide wires. If the density of the underlying surface is disturbed by the trimming operations, it shall be corrected by additional compaction and retested at the option of the Engineer before the concrete is placed except when stabilized subbases are being constructed. If damage occurs on a stabilized subbase, it shall be corrected full depth by the Contractor. If traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately before the placement of concrete. The prepared grade shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from concrete. The underlying surface shall be protected so that it will be entirely free of frost when concrete is placed.

501-4.4 CONDITIONING OF UNDERLYING SURFACE, SIDE-FORM AND FILL-IN LANE CONSTRUCTION. The prepared underlying surface shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from the concrete. Damage caused by hauling or usage of other equipment shall be corrected and retested at the option of the Engineers. If damage occurs to a stabilized subbase, it shall be corrected full depth by the Contractor. A template shall be provided and operated on the forms immediately in advance of the placing of all concrete. The template shall be propelled only by hand and not attached to a tractor or other power unit. Templates shall be adjustable so that they may be set and maintained at the correct contour of the underlying surface. The adjustment and operation of the templates shall be such as will provide an accurate retest of the grade before placing the concrete thereon. All excess material shall be removed and wasted. Low areas shall be filled and compacted to a condition similar to that of the surrounding grade. The underlying surface shall be protected so that it will be entirely free from frost when the

concrete is placed. The use of chemicals to eliminate frost in the underlying surface shall not be permitted.

The template shall be maintained in accurate adjustment, at all times by the Contractor, and shall be checked daily.

After the underlying P-209 base course surface has been placed and compacted to the required density, it shall be verified for grade by the Contractor's surveyor, and the tolerance is within plus or minus ½-inch, on a maximum 20-foot by 20-foot grid density to match the PCCP joints. All areas that are out of tolerance shall be corrected by the Contractor and re-verified for tolerance and density. Records of actual survey elevations shall be promptly submitted to the Engineer.

501-4.5 HANDLING, MEASURING, AND BATCHING MATERIAL. The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the work. Stockpiles shall be constructed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the concrete batch plant.

Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipments requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage.

Batching plants shall be equipped to proportion aggregates and bulk cement, by weight, automatically using interlocked proportioning devices of an approved type. When bulk cement is used, the Contractor shall use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer, such as a chute, boot, or other approved device, to prevent loss of cement. The device shall be arranged to provide positive assurance that the cement content specified is present in each batch.

501-4.6 MIXING CONCRETE. The concrete may be mixed at the work site, in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials, except water, are emptied into the drum. All concrete shall be mixed and delivered to the site in accordance with the requirements of ASTM C94.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators, or non-agitating trucks. The elapsed time from the addition of cementitious material to the mix until the concrete is deposited in place at the work site shall not exceed 30 minutes when the concrete is hauled in non-agitating trucks, nor 90 minutes when the concrete is hauled in truck mixers or truck agitators. Retempering concrete by adding water or by other means will not be permitted. With transit mixers additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements provided the addition of water is performed within 45 minutes after the initial mixing operations and provided the water/cementitious ratio specified in the approved mix design is not exceeded, and approved by the Engineer.

501-4.7 LIMITATIONS ON MIXING AND PLACING. No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

a. Artificial Lighting. When paving is to occur at night, portable lighting units sufficient for control and observation of the work shall be in position at the concrete placement site prior to mixing concrete. Portable light plants will not be allowed to be directed at the control tower or directed toward operational aircraft. In addition, adequate lighting shall be provided at the batch plant to facilitate quality control and safe operations.

b. Cold weather. Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

The aggregate shall be free of ice, snow, and frozen lumps before entering the mixer. The temperature of the mixed concrete shall not be less than 50°F at the time of placement. Concrete shall not be placed on frozen material nor shall frozen aggregates be used in the concrete.

When concreting is authorized during cold weather, water and/or the aggregates may be heated to not more than 150°F. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials.

c. Documentation of Weather Data. The Contractor shall provide a continuous and accurate record of air temperature, relative humidity, concrete temperature and wind velocity at the project site with a portable weather station, adjacent to the paving area(s). The data shall be collected and documented by the Contractor continuously for the full duration of the project. The Contractor's quality control staff shall document the weather data in the daily Quality Control Reports and use and implement the data to eliminate the potential for plastic cracking of Portland cement concrete pavement by estimating the evaporation rate from Figure 4.2 in ACI 305R-10.

The documentation and application of the weather data shall apply to P-501 Portland Cement concrete pavement. Refer to Paragraph 501-6.4.e. for manufacturers of the portable weather station and for Contractor Quality Control requirements.

d. Hot weather. During periods of hot weather when the maximum daily air temperature exceeds 85°F, the following precautions shall be taken.

The forms and/or the underlying surface shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 90°F. The aggregates and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not more than the specified maximum.

The finished surfaces of the newly laid pavement shall be kept damp by applying a water-fog or mist with approved spraying equipment until the pavement is covered by the curing medium. The Contractor shall take the following precautions to protect the concrete from an evaporation

rate in excess of 0.2 pounds per square foot per hour determined in accordance with **Figure 4.2 in ACI 305R-10, Hot Weather Concreting** on page P-501-15, which takes into consideration relative humidity, wind velocity, and air temperature:

- When the evaporation rate in less than 0.2 pounds per square foot per hour, one (1) coat of liquid concrete curing compound shall be applied at the rate of one hundred fifty (150) square feet per gallon.

- When the evaporation rate is from 0.2 to 0.4 pounds per square foot per hour, one (1) coat of liquid concrete curing compound shall be applied at the rate of one hundred (100) square feet per gallon.

- When the evaporation rate is greater than 0.4 but less than 0.6 pounds per square foot per hour, two (2) coats of liquid concrete curing compound shall be applied, each coat at the rate of one hundred (100) square feet per gallon.

- When the evaporation rate is 0.6 pounds per square foot per hour, paving operations shall be terminated or not be initiated.

When conditions are such that problems with plastic cracking can be expected, and particularly if any plastic cracking begins to occur, the Contractor shall immediately take such additional measures as necessary to protect the concrete surface. Such measures shall consist of the requirements as shown in Table 3. If these measures are not effective in preventing plastic cracking, paving operations shall be immediately stopped, and all Portland cement concrete pavement that is cracked, shall be removed and replaced by the Contractor at no additional cost to the City of Phoenix.

Based on the results of the Contractor's Quality Control data, as collected and documented from the portable weather station, the following criteria in Table 3 shall apply:

Table 3 Portland Cement Concrete Curing Requirements.

Evaporation Rate (Pounds per S.F. per Hour)	Curing Requirements
Less than 0.20	One (1) Coat Membrane, each at 150 S.F. per Gallon
0.20 to 0.40	One (1) Coat Membrane, each at 100 S.F. per Gallon
0.40 to 0.60	Two (2) coats membrane, each at 100 S.F. per Gallon
Greater than 0.60	Paving Operations Shall be Terminated or Not Started if Adverse Conditions are Anticipated or Measured.

Figure 4.2 in ACI 305R-10, Hot Weather Concreting is on the following page.

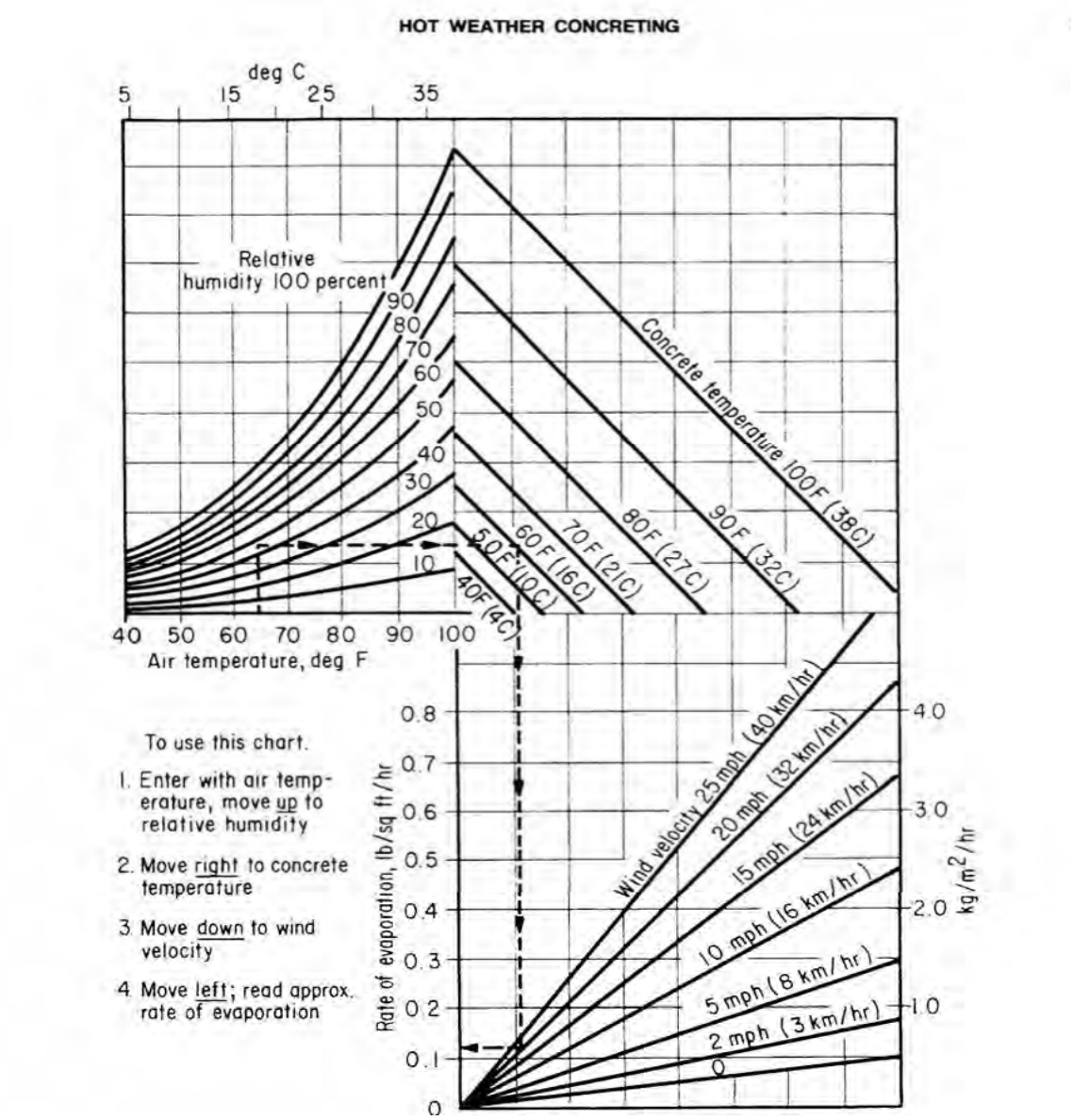

Figure 4.2 ACI 305R-10

e. Temperature management program. Prior to the start of paving operation for each day of paving, the Contractor shall provide the Engineer with a Temperature Management Program for the concrete to be placed to assure that uncontrolled cracking is avoided. As a minimum the program shall address the following items:

(1) Anticipated tensile strains in the fresh concrete as related to heating and cooling of the concrete material.

(2) Anticipated weather conditions such as ambient temperatures, wind velocity, and relative humidity; and anticipated evaporation rate using Figure 11-8, PCA, Design and Control of Concrete Mixtures.

(3) Anticipated timing of initial sawing of joint.

(4) Anticipated number and type of saws to be used.

501-4.8 PLACING CONCRETE. Prior to paving, the Contractor shall verify that all proposed underground facilities are installed and the Contractor shall submit a detailed plan and placement schedule including dates for each paving pass. Changes to the schedule shall be submitted 48-hours prior to actual paving of each pass. All proposed electrical conduits shall be mandreled prior to concrete paving. The elevations and tolerances of the asphaltic or other base materials shall be confirmed to be within the contractual tolerances prior to paving. The Contractor's superintendent, the electrical Contractor's superintendent, the paving Contractor's superintendent, the Quality Control Program Administrator and a Quality Control technician shall sign a certification statement confirming that the above conditions are satisfied, and that all base course lower paving materials are in conformance with specified testing requirements and tolerances, prior to paving. These signed statements shall be submitted to the Engineer prior to paving each shift.

Prior to paving by the side form method or the slip form method, any asphalt or cement treated base courses shall be treated by the Contractor to break the bond between the asphalt or cement treated base and the P-501 Portland cement concrete pavement.

The Contractor has the option of placing the concrete with either side (fixed) forms or slip-forms. At any point in concrete conveyance, the free vertical drop of the concrete from one point to another or to the underlying surface shall not exceed 3 feet. The finished concrete product must be dense and homogeneous, without segregation and conforming to the standards in this specification. Backhoes and grading equipment shall not be used to distribute the concrete in front of the paver. Front end loaders will not be used. All concrete shall be consolidated without voids or segregation, including under and around all load-transfer devices, joint assembly units, and other features embedded in the pavement. Hauling equipment or other mechanical equipment can be permitted on adjoining previously constructed pavement when the concrete strength reaches a flexural strength of 550 psi based on the average of four field cured specimens per 2,000 cubic yards of concrete placed. Also, subgrade and subbase planers, concrete pavers, and concrete finishing equipment may be permitted to ride upon the edges of previously constructed pavement when the concrete has attained a minimum flexural strength of 400 psi.

The Contractor shall have available materials for the protection of the concrete during inclement weather. Such protective materials shall consist of rolled polyethylene sheeting at least 4 mils thick of sufficient length and width to cover the plastic concrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic concrete surface. When rain appears imminent, all paving operations shall stop and all available personnel shall begin covering the surface of the unhardened concrete with the protective covering.

a. Slip-form construction. The concrete shall be distributed uniformly into final position by a self-propelled slip-form paver without delay. The alignment and elevation of the paver shall be

regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of the pavement and/or a series of equally placed longitudinal vibrating units. The space from the outer edge of the pavement to longitudinal unit shall not exceed 9 inches for slip-form and at the end of the dowels for the fill-in lanes the spacing of internal units shall be uniform and shall not exceed 18 inches.

The term internal vibration means vibrating units located within the specified thickness of pavement section.

The rate of vibration of each vibrating unit shall be within 8000 to 12000 cycles per minute and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least one foot. The frequency of vibration or amplitude shall vary proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

Not more than 15% of the total free edge of each 500 foot segment of pavement, or fraction thereof, shall have an edge slump exceeding 1/4 inch, and none of the free edge of the pavement shall have an edge slump exceeding 3/8 inch. (The total free edge of 500 feet of pavement will be considered the cumulative total linear measurement of pavement edge originally constructed as nonadjacent to any existing pavement; that is, 500 feet of paving lane originally constructed as a separate lane will have 1,000 feet of free edge, 500 feet of fill-in lane will have no free edge, etc.). The area affected by the downward movement of the concrete along the pavement edge shall be limited to not more than 18 inches from the edge. When excessive edge slump cannot be corrected before the concrete has hardened, the area with excessive edge slump shall be removed and replaced at the expense of the Contractor as directed by the Engineer.

b. Side-form construction. Side form sections shall be straight, free from warps, bends, indentations, or other defects. Defective forms shall be removed from the work. Metal side forms shall be used except at end closures and transverse construction joints where straight forms of other suitable material may be used.

Side forms may be built up by rigidly attaching a section to either top or bottom of forms. If such build-up is attached to the top of metal forms, the build-up shall also be metal.

Width of the base of all forms shall be equal to or greater than the specified pavement thickness.

Side forms shall be of sufficient rigidity, both in the form and in the interlocking connection with adjoining forms, that springing will not occur under the weight of subgrading and paving equipment or from the pressure of the concrete. The Contractor shall provide sufficient forms so that there will be no delay in placing concrete due to lack of forms.

Before placing side forms, the underlying material shall be at the proper grade. Side forms shall have full bearing upon the foundation throughout their length and width of base and shall be placed to the required grade and alignment of the finished pavement. They shall be firmly supported during the entire operation of placing, compacting, and finishing the pavement.

Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars where these are specified.

Immediately in advance of placing concrete and after all subbase operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing.

Side forms shall remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms have been removed.

Side forms shall be thoroughly cleaned and oiled each time they are used and before concrete is placed against them.

Concrete shall be spread, screeded, shaped and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement will conform to the required cross-section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery.

Concrete for the full paving width shall be effectively consolidated by internal vibrators without causing segregation. Internal type vibrators' rate of vibration shall be not less than 7,000 cycles per minute. Amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete more than one foot (30 cm) from the vibrating element. The Contractor shall furnish a tachometer or other suitable device for measuring and indicating frequency of vibration.

Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

The provisions relating to the frequency and amplitude of internal vibration shall be considered the minimum requirements and are intended to ensure adequate density in the hardened concrete.

c. Consolidation. Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than inches. Excessive vibration shall not be permitted. If the vibrators cause visible tracking in the paving lane, the paving operation shall be stopped and equipment and operations modified to prevent it. Concrete in small, odd-shaped slabs or in isolated locations inaccessible to the gang-mounted vibration equipment shall be vibrated with an approved hand-operated immersion vibrator operated from a bridge spanning the area. Vibrators shall not be used to transport or spread the concrete. Hand-operated vibrators shall not be operated in the concrete at one location for more than 20 seconds. Insertion locations for hand-operated vibrators shall be between 6 to 15 inches on centers. For each paving train, at least one additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) shall require the immediate stopping of the paving operation and adjustment of the equipment or procedures as approved by the Engineer.

If a lack of consolidation of the concrete is suspected by the Engineer, referee testing may be required. Referee testing of hardened concrete will be performed by the Engineer by cutting cores from the finished pavement after a minimum of 24 hours curing. Density determinations will be made by the Engineer based on the water content of the core as taken. ASTM C642 shall be used for the determination of core density in the saturated-surface dry condition. When required, referee cores will be taken at the minimum rate of one for each 500 cubic yards of pavement, or fraction. The Contractor shall be responsible for all referee testing cost if they fail to meet the required density.

The average density of the cores shall be at least 97% of the original mix design density, with no cores having a density of less than 96% of the original mix design density. Failure to meet the referee tests will be considered evidence that the minimum requirements for vibration are inadequate for the job conditions. Additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete conforms to the above requirements.

501-4.9 STRIKE-OFF OF CONCRETE AND PLACEMENT OF REINFORCEMENT. Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the plans and to an elevation that when the concrete is properly consolidated and finished, the surface of the pavement shall be at the elevation shown on the plans. When reinforced concrete pavement is placed in two layers, the bottom layer shall be struck off to such length and depth that the sheet of reinforcing steel fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off, and screeded. If any portion of the bottom layer of concrete has been placed more than 30 minutes without being covered with the top layer or if initial set has taken place, it shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete by mechanical or vibratory means after spreading.

Reinforcing steel, at the time concrete is placed, shall be free of mud, oil, or other organic matter that may adversely affect or reduce bond. Reinforcing steel with rust, mill scale or a combination of both will be considered satisfactory, provided the minimum dimensions, weight, and tensile properties of a hand wire-brushed test specimen are not less than the applicable ASTM specification requirements. Reinforcement shall not be placed by mechanical or vibratory methods. End and side laps of welded wire mesh sheets shall overlap a minimum of fifteen (15) inches.

501-4.10 JOINTS. Joints shall be constructed as shown on the plans and in accordance with these requirements. All joints shall be constructed with their faces perpendicular to the surface of the pavement and finished or edged as shown on the plans. Joints shall not vary more than 1/2 inch from their designated position and shall be true to line with not more than 1/4 inch variation in 10 feet The surface across the joints shall be tested with a 12 feet straightedge as the joints are finished and any irregularities in excess of 1/4 inch shall be corrected before the concrete has hardened. All joints shall be so prepared, finished, or cut to provide a groove of uniform width and depth as shown on the plans.

a. Construction. Longitudinal construction joints shall be slip-formed or formed against side forms as shown in the plans.

Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for more than 30 minutes or it appears that the concrete will obtain its initial set before fresh concrete arrives. The installation of the joint shall be located at a planned contraction or expansion joint. If placing of the concrete is stopped, the Contractor shall remove the excess concrete back to the previous planned joint. When placement of the concrete is stopped, transverse construction joints shall be saw cut for the full depth and width of the paving pass, after the concrete has obtained sufficient strength to prevent spalling.

b. Contraction. Contraction joints shall be installed at the locations and spacing as shown on the plans. Contraction joints shall be installed to the dimensions required by forming a groove or cleft in the top of the slab while the concrete is still plastic or by sawing a groove into the concrete surface after the concrete has hardened. When the groove is formed in plastic concrete the sides of the grooves shall be finished even and smooth with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer's instructions. The groove shall be finished or cut clean so that spalling will be avoided at intersections with other joints. Grooving or sawing shall produce a slot at least 1/8 inch (3 mm) wide and to the depth shown on the plans.

c. Isolation (expansion). Isolation joints shall be installed as shown on the plans. The first concrete panel placed for the expansion joint shall be constructed with steel forms. After the first concrete panel is placed, 1-inch thick premolded joint filler shall extend for the full depth and width of the slab at the joint, except for space for sealant at the top of the slab. The filler shall be securely staked or fastened into position perpendicular to the proposed finished surface with a plastic polypropylene Hilti IDP2/4 insulation anchor. The joint filler shall be placed and positioned against the face of the new concrete, followed by drilling 5/16-inch diameter holes through the joint filler material. The anchors shall then be hammered in place until the attached washer is flush with the joint filler material. The minimum embedment depth shall be 1-1/8". The Hilti IDP2/4 insulation anchors shall be placed at a minimum of two (2) continuous rows and spaced a maximum of two (2) feet on center. A cap shall be provided to protect the top

edge of the filler and to permit the concrete to be placed and finished. After the concrete has been placed and struck off, the cap shall be carefully withdrawn leaving the space over the premolded filler. The edges of the joint shall be finished and tooled while the concrete is still plastic. Any concrete bridging the joint space shall be removed for the full width and depth of the joint.

The finished surface of the face of the concrete expansion joint shall not vary by more than ¼-inch at any point when measured vertically for the full thickness of the expansion joint. Further, the finished surface shall not vary by more than ¼-inch in ten (10) feet when measured horizontally at any point for the entire length of the expansion joint. All expansion joints that fail to conform to these dimensional tolerances shall be saw cut for full length and depth of the expansion joint in order to provide a joint that conforms to all dimensional tolerances prior to adjacent concrete panels being poured.

d. Tie bars. Tie bars shall consist of deformed bars installed in joints as shown on the plans. Tie bars shall be placed at right angles to the centerline of the concrete slab and shall be spaced at intervals shown on the plans. They shall be held in position parallel to the pavement surface and in the middle of the slab depth. When tie bars extend into an unpaved lane, they may be bent against the form at longitudinal construction joints, unless threaded bolt or other assembled tie bars are specified. Tie bars shall not be painted, greased, or enclosed in sleeves. When slip-form operations call for tie bars, two-piece hook bolts can be installed.

e. Dowel bars. Dowel bars or other load-transfer units of an approved type shall be placed across joints as shown on the plans. They shall be of the dimensions and spacings as shown and held rigidly in the middle of the slab depth in the proper horizontal and vertical alignment by an approved assembly device to be left permanently in place. The dowel or load-transfer and joint devices shall be rigid enough to permit complete assembly as a unit ready to be lifted and placed into position. The dowels shall be coated with a bond-breaker or other lubricant recommended by the manufacturer and approved by the Engineer.

f. Dowels bars at longitudinal construction joints shall be bonded in drilled holes.

g. Placing dowels and tie bars. The method used in installing and holding dowels in position shall ensure that the error in alignment of any dowel from its required horizontal and vertical alignment after the pavement has been completed will not be greater than 1/8 inch per feet. Except as otherwise specified below, horizontal spacing of dowels shall be within a tolerance of ±5/8 inch. The vertical location on the face of the slab shall be within a tolerance of ±1/2 inch. The vertical alignment of the dowels shall be measured parallel to the designated top surface of the pavement, except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The horizontal alignment shall be checked with a framing square. Dowels and tie bars shall not be placed closer than 0.6 times the dowel bar or tie bar length to the planned joint line. If the last regularly spaced longitudinal dowel or tie bar is closer than that dimension, it shall be moved away from the joint to a location 0.6 times the dowel bar or tie bar length, but not closer than 6 inches to its nearest neighbor. The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of lubricating oil or light grease before the concrete is placed. Dowels shall be installed as specified in the following subparagraphs.

(1) Contraction joints. Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place, as indicated, by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires. At the Contractor's option, in lieu of the above, dowels and tie bars in contraction joints shall be installed near the front of the paver by insertion into the plastic concrete using approved equipment and procedures. Approval will be based on the results of a preconstruction demonstration, showing that the dowels and tie bars are installed within specified tolerances.

(2) Construction joints. Install dowels and tie bars by the cast-in- place or the drill-and-dowel method. Installation by removing and replacing in preformed holes will not be permitted. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms. The spacing of dowels and tie bars in construction joints shall be as indicated.

(3) Dowels installed in isolation joints and other hardened concrete. Install dowels for isolation joints and in other hardened concrete by bonding the dowels into holes drilled into the hardened concrete. The concrete shall have cured for seven (7) days or reached a minimum flexural strength of 450 psi before drilling commences. Holes 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur to the concrete joint face. Modification of the equipment and operation shall be required if, in the Engineer's opinion, the equipment and/or operation is causing excessive damage. Depth of dowel hole shall be within a tolerance of ±1/2 inch of the dimension shown on the drawings. On completion of the drilling operation, the dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic grout retention ring fitted around the dowel. Dowels required to be installed in any joints between new and existing concrete shall be grouted in holes drilled in the existing concrete, all as specified above.

h. Sawing of joints. Joints shall be cut as shown on the plans. Equipment shall be as described in paragraph 501-4.1. The circular cutter shall be capable of cutting a groove in a straight line and shall produce a slot at least 1/8 inch wide and to the depth shown on the plans. The top of the slot shall be widened by sawing to provide adequate space for joint sealers as shown on the plans. Sawing shall commence, without regard to day or night, as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and before uncontrolled shrinkage cracking of the pavement occurs and shall continue without interruption until all joints have been sawn. The joints shall be sawn at the required spacing. All slurry and debris produced in the sawing of joints shall be removed by vacuuming and washing. Curing compound or system shall be reapplied in the initial sawcut and maintained for the remaining cure period.

501-4.11 FINISHING. Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing,

longitudinal machine floating if used, straightedge finishing, texturing, and then edging of joints. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made or the equipment replaced. Any operations which produce more than 1/8 inch of mortar-rich surface (defined as deficient in plus U.S. No. 4 sieve size aggregate) shall be halted immediately and the equipment, mixture, or procedures modified as necessary. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way, except for fog (mist) sprays specified to prevent plastic shrinkage cracking.

a. Machine finishing with slipform pavers. The slipform paver shall be operated so that only a very minimum of additional finishing work is required to produce pavement surfaces and edges meeting the specified tolerances. Any equipment or procedure that fails to meet these specified requirements shall immediately be replaced or modified as necessary. A self-propelled non-rotating pipe float may be used while the concrete is still plastic, to remove minor irregularities and score marks. Only one pass of the pipe float shall be allowed. If there is concrete slurry or fluid paste on the surface that runs over the edge of the pavement, the paving operation shall be immediately stopped and the equipment, mixture, or operation modified to prevent formation of such slurry. Any slurry which does run down the vertical edges shall be immediately removed by hand, using stiff brushes or scrapers. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

b. Machine finishing with fixed forms. The machine shall be designed to straddle the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

c. Other types of finishing equipment. Clary screeds, other rotating tube floats, or bridge deck finishers are not allowed on mainline paving, but may be allowed on irregular or odd-shaped slabs, and near buildings or trench drains, subject to the Engineer's approval.

Bridge deck finishers shall have a minimum operating weight of 7500 pounds and shall have a transversely operating carriage containing a knock-down auger and a minimum of two immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand finishing is permitted as specified, and only where specifically approved.

d. Hand finishing. Hand finishing methods will not be permitted, except under the following conditions: (1) in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade and (2) in areas of narrow widths or

of irregular dimensions where operation of the mechanical equipment is impractical. Use hand finishing operations only as specified below.

(1) Equipment and screed. In addition to approved mechanical internal vibrators for consolidating the concrete, provide a strike-off and tamping screed and a longitudinal float for hand finishing. The screed shall be at least one foot longer than the width of pavement being finished, of an approved design, and sufficiently rigid to retain its shape, and shall be constructed of metal or other suitable material shod with metal. The longitudinal float shall be at least 10 feet long, of approved design, and rigid and substantially braced, and shall maintain a plane surface on the bottom. Grate tampers (jitterbugs) shall not be used.

(2) Finishing and floating. As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross-section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. In addition to previously specified complete coverage with handheld immersion vibrators, the entire surface shall be tamped with the strike-off and tamping template, and the tamping operation continued until the required compaction and reduction of internal and surface voids are accomplished. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed, consolidated and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces.

e. Straightedge testing and surface correction. After the pavement has been struck off and while the concrete is still plastic, it shall be tested for trueness with a Contractor furnished 12-foot straightedge swung from handles 3 feet longer than one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the centerline and the whole area gone over from one side of the slab to the other, as necessary. Advancing shall be in successive stages of not more than one-half the length of the straightedge. Any excess water and laitance in excess of 1/8 inch thick shall be removed from the surface of the pavement and wasted. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the smoothness requirements of paragraph 501-5.2e(3). Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and until the slab conforms to the required grade and cross-section. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment. This straight-edging is not a replacement for the straightedge testing of paragraph 501-5.2e(3), Smoothness.

501-4.12 SURFACE TEXTURE. The surface of the pavement shall be finished with either a burlap drag, or artificial turf finish for all newly constructed concrete pavements. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. Any imperfections resulting from the texturing operation shall be corrected. If one of the methods is determined to be unsuccessful, the Engineer may direct the Contractor to substitute an alternate method, at no additional cost to the City of Phoenix.

a. Burlap drag finish. If a burlap drag is used to texture the pavement surface, it shall be at least 15 ounces per square yard. To obtain a textured surface, the transverse threads of the

burlap shall be removed approximately one foot from the trailing edge. A heavy buildup of grout on the burlap threads produces the desired wide sweeping longitudinal striations on the pavement surface. The corrugations shall be uniform in appearance and approximately 1/16 inch in depth.

b. Artificial turf finish. If artificial turf is used to texture the surface, it shall be applied by dragging the surface of the pavement in the direction of concrete placement with an approved full-width drag made with artificial turf. The leading transverse edge of the artificial turf drag will be securely fastened to a lightweight pole on a traveling bridge. At least 2 feet of the artificial turf shall be in contact with the concrete surface during dragging operations. A variety of different types of artificial turf are available and approval of any one type will be done only after it has been demonstrated by the Contractor to provide a satisfactory texture. One type that has provided satisfactory texture consists of 7,200 approximately 0.85 inch-long polyethylene turf blades per square foot. The corrugations shall be uniform in appearance and approximately 1/16 inch in depth.

501-4.13 CURING. Immediately after finishing operations are completed and marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured for a 7-day cure period in accordance with one of the methods below. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 hour during the curing period.

When a two-sawcut method is used to construct the contraction joint, the curing compound shall be applied to the sawcut immediately after the initial cut has been made. The sealant reservoir shall not be sawed until after the curing period has been completed. When the one cut method is used to construct the contraction joint, the joint shall be cured with wet rope, wet rags, or wet blankets. The rags, ropes, or blankets shall be kept moist for the duration of the curing period.

a. Impervious membrane method. The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. The curing compound shall not be applied during rainfall. One (1) coat of curing compound shall be applied by mechanical sprayers under pressure at the rate of one (1) gallon to not more than one hundred fifty 150 square feet when the evaporation rate is less than 0.2 pounds per square foot per hour. One (1) coat of curing compound shall be applied by mechanical sprayers under pressure at the rate of one (1) gallon to not more than one hundred (100) square feet when the evaporation rate is between 0.2 and 0.4 pounds per square feet per hour. When the evaporation rate is between 0.4 and 0.6 pounds per square foot per hour, two (2) coats of curing compound shall be applied at a rate of one hundred (100) square feet per gallon. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application the compound shall be stirred continuously by mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. When hand spraying is approved by the Engineer, a double application rate shall be used to ensure coverage. The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film become damaged from any cause, including sawing operations, within the required curing period, the damaged portions shall be repaired immediately with additional compound or other approved means. Upon removal of side forms,

the sides of the exposed slabs shall be protected immediately to provide a curing treatment equal to that provided for the surface. Curing shall be applied immediately after the bleed water is gone from the surface.

b. Concrete protection for cold weather. The concrete shall be maintained at an ambient temperature of at least 50°F for a period of 72 hours after placing and at a temperature above freezing for the remainder of the curing time. The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather; and any concrete damaged shall be removed and replaced at the Contractor's expense.

501-4.14 REMOVING FORMS. Unless otherwise specified, forms shall not be removed from freshly placed concrete until it has hardened sufficiently to permit removal without chipping, spalling, or tearing. After the forms have been removed, the sides of the slab shall be cured as per the methods indicated in paragraph 501-4.13. Major honeycombed areas shall be considered as defective work and shall be removed and replaced in accordance with paragraph 501-5.2(f).

501-4.15 SAW-CUT GROOVING. Not Used

501-4.16 SEALING JOINTS. The joints in the pavement shall be sealed in accordance with Item P-604 or Item P-605.

501-4.17 PROTECTION OF PAVEMENT. The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents until accepted by the Engineer. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, crossovers, and protection of unsealed joints from intrusion of foreign material, etc. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense.

Prior to each shift of paving (day shift and night shift), the Contractor shall submit a detailed written plan for protection of the pavement. As a minimum the plan shall address the Contractor's method of barricading and protecting the pavement panels (slabs) from construction traffic and vehicular traffic until opened to traffic in accordance with Paragraph 501-4.18. Water trucks and other vehicles or equipment having a gross vehicle weight of 4,000 pounds or more will not be permitted on any pavement until the pavement is opened to traffic.

Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least seven (7) days old, or for a longer period if directed by the Engineer.

In paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for seven (7) days and the joints have been sealed or otherwise protected, and the concrete has attained a minimum field cured flexural strength of 550 psi and approved means are furnished to prevent damage to the slab edge.

All new and existing pavement carrying construction traffic or equipment shall be continuously kept completely clean, and spillage of concrete or other materials shall be cleaned up immediately upon occurrence.

Damaged pavements shall be removed and replaced at the Contractor's expense. Slabs shall be removed to the full depth, width, and length of the slab.

501-4.18 OPENING TO CONSTRUCTION TRAFFIC. The pavement shall not be opened to traffic until test specimens molded and cured in accordance with ASTM C31 have attained a flexural strength of 550 psi when tested in accordance with ASTM C78. If such tests are not conducted, the pavement shall not be opened to traffic, or subject to loads and stresses, until 14 days after the concrete was placed. Prior to opening the pavement to construction traffic, all joints shall be saw cut and sealed. As a minimum, backer rod or tape may be used to protect the joints from foreign matter intrusion.

501-4.19 REPAIR, REMOVAL, REPLACEMENT OF SLABS.

a. General. New pavement slabs that are broken or contain cracks or are otherwise defective or unacceptable shall be removed and replaced or repaired, as directed by the Engineer and as specified hereinafter at no cost to the Owner. Spalls along joints shall be repaired as specified. Removal of partial slabs is not permitted. Removal and replacement shall be full depth, shall be full width of the slab, and the limit of removal shall be normal to the paving lane and to each original transverse joint. The Engineer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be 4 inch diameter, shall be drilled by the Contractor and shall be filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with epoxy resin, using approved procedures. Drilling of cores and refilling holes shall be at no expense to the Owner. All epoxy resin used in this work shall conform to ASTM C881, Type V. Repair of cracks as described in this section shall not be allowed if in the opinion of the Engineer the overall condition of the pavement indicates that such repair is unlikely to achieve an acceptable and durable finished pavement. No repair of cracks shall be allowed in any panel that demonstrates segregated aggregate with an absence of coarse aggregate in the upper 1/8 inch of the pavement surface.

b. Shrinkage cracks. Shrinkage cracks, which do not exceed 4 inches in depth, shall be cleaned and then pressure injected with epoxy resin, Type IV, Grade 1, using procedures as approved by the Engineer. Care shall be taken to assure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the Engineer. Shrinkage cracks, which exceed 4 inches in depth, shall be treated as full depth cracks in accordance with paragraphs 4.19b and 4.19c.

c. Slabs with cracks through interior areas. Interior area is defined as that area more than 6 inches from either adjacent original transverse joint. The full slab shall be removed and replaced at no cost to the Owner, when there are any full depth cracks, or cracks greater than 4 inches in depth, that extend into the interior area.

d. Cracks close to and parallel to joints. All cracks essentially parallel to original joints, extending full depth of the slab, and lying wholly within 6 inches either side of the joint shall be treated as specified here. Any crack extending more than 6 inches from the joint shall be treated as specified above in subparagraph c.

(1) Full depth cracks present, original joint not opened. When the original un-cracked joint has not opened, the crack shall be sawed and sealed, and the original joint filled with epoxy resin as specified below. The crack shall be sawed with equipment specially designed to follow random cracks. The reservoir for joint sealant in the crack shall be formed by sawing to a depth of 3/4 inches, ±1/16 inch, and to a width of 5/8 inch, ±1/8 inch. Any equipment or procedure which causes raveling or spalling along the crack shall be modified or replaced to prevent such raveling or spalling. The joint sealant shall be a liquid sealant as specified. Installation of joint seal shall be as specified for sealing joints or as directed. If the joint sealant reservoir has been sawed out, the reservoir and as much of the lower saw cut as possible shall be filled with epoxy resin, Type IV, Grade 2, thoroughly tooled into the void using approved procedures.

If only the original narrow saw cut has been made, it shall be cleaned and pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures. If filler type material has been used to form a weakened plane in the transverse joint, it shall be completely sawed out and the saw cut pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures. Where a parallel crack goes part way across paving lane and then intersects and follows the original joint which is cracked only for the remained of the width, it shall be treated as specified above for a parallel crack, and the cracked original joint shall be prepared and sealed as originally designed.

(2) Full depth cracks present, original joint also cracked. At a joint, if there is any place in the lane width where a parallel crack and a cracked portion of the original joint overlap, the entire slab containing the crack shall be removed and replaced for the full lane width and length.

e. Removal and replacement of full slabs. Where it is necessary to remove full slabs, unless there are dowels present, all edges of the slab shall be cut full depth with a concrete saw. All saw cuts shall be perpendicular to the slab surface. If dowels, or tie bars are present along any edges, these edges shall be sawed full depth just beyond the end of the dowels or tie bars. These joints shall then be carefully sawed on the joint line to within one inch of the depth of the dowel or tie bar.

The main slab shall be further divided by sawing full depth, at appropriate locations, and each piece lifted out and removed. Suitable equipment shall be used to provide a truly vertical lift, and approved safe lifting devices used for attachment to the slabs. The narrow strips along doweled edges shall be carefully broken up and removed using light, hand-held jackhammers, 30 pound or less, or other approved similar equipment.

Care shall be taken to prevent damage to the dowels, tie bars, or to concrete to remain in place. The joint face below dowels shall be suitably trimmed so that there is not abrupt offset in any direction greater than 1/2 inch and no gradual offset greater than one inch when tested in a horizontal direction with a 12-foot straightedge.

No mechanical impact breakers, other than the above hand-held equipment shall be used for any removal of slabs. If underbreak between 1-1/2 and 4 inches deep occurs at any point along any edge, the area shall be repaired as directed before replacing the removed slab. Procedures directed will be similar to those specified for surface spalls, modified as necessary.

If underbreak over 4 inches deep occurs, the entire slab containing the underbreak shall be removed and replaced. Where there are no dowels or tie bars, or where they have been damaged, dowels or tie bars of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete using procedures as specified. Original damaged dowels or tie bars shall be cut off flush with the joint face. Protruding portions of dowels shall be painted and lightly oiled. All four (4) edges of the new slab shall contain dowels or original tie bars.

Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material (unless it is stabilized) shall be re-compacted and shaped as specified in the appropriate section of these specifications. The surfaces of all four joint faces shall be cleaned of all loose material and contaminants and coated with a double application of membrane forming curing compound as bond breaker. Care shall be taken to prevent any curing compound from contacting dowels or tie bars. The resulting joints around the new slab shall be prepared and sealed as specified for original construction.

f. Repairing spalls along joints. Where directed, spalls along joints of new slabs, and along parallel cracks used as replacement joints, shall be repaired by first making a vertical saw cut at least one inch outside the spalled area and to a depth of at least 2 inch. Saw cuts shall be straight lines forming rectangular areas. The concrete between the saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete and at least 1/2 inch of visually sound concrete. The cavity thus formed shall be thoroughly cleaned with high-pressure water jets supplemented with compressed air to remove all loose material. Immediately before filling the cavity, a prime coat of epoxy resin, Type III, Grade I, shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff-bristle brush. Pooling of epoxy resin shall be avoided. The cavity shall be filled with low slump Portland cement concrete or mortar or with epoxy resin concrete or mortar. Concrete shall be used for larger spalls, generally those more than 1/2 cu. ft. in size, and mortar shall be used for the smaller ones. Any spall less than 0.1 cu. ft. shall be repaired only with epoxy resin mortar or a Grade III epoxy resin. Portland cement concrete and mortar mixtures shall be proportioned as directed and shall be mixed, placed, consolidated, and cured as directed. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions and mixing and placing procedures as recommended by the manufacturer and approved by the Engineer. The epoxy resin materials shall be placed in the cavity in layers not over 2 inches thick. The time interval between placements of additional layers shall be such that the temperature of the epoxy resin material does not exceed 140°F at any time during hardening. Mechanical vibrators and hand tampers shall be used to consolidate the concrete or mortar. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens. Where the spalled area abuts a joint, an insert or other bond-breaking medium shall be used to prevent bond at the joint face. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints, or as required to be routed for cracks. The reservoir shall be thoroughly cleaned and sealed with the sealer specified for the joints. If any spall penetrates half the depth of the slab or more, the entire slab shall be removed and replaced as previously specified. If any spall would require over 25% of the length of any single joint to be repaired, the entire slab shall be removed and replaced. Repair of spalls as described in this section shall not be allowed if in the opinion of the Engineer the overall condition of the pavement indicates that such repair is unlikely to achieve an acceptable and durable finished pavement. No repair of spalls shall be allowed in any panel that demonstrates segregated aggregate with a significant absence of coarse aggregate in the upper one-eighth (1/8th) inch of the pavement surface.

g. Diamond grinding of PCC surfaces. Diamond grinding of the hardened concrete with an approved diamond grinding machine should not be performed until the concrete is 14 days or more old and concrete has reached full minimum strength. When required, diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the pavement. The saw blades shall be 1/8-inch wide and there shall be a minimum of 55 to 60 blades per 12 inches of cutting head width; the actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Each machine shall be capable of cutting a path at least 3 feet wide. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The area corrected by diamond grinding the surface of the hardened concrete should not exceed 10% of the total area of any sublot. The depth of diamond grinding shall not exceed 1/2 inch and all areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. All pavement areas requiring plan grade or surface smoothness corrections in excess of the limits specified above, may require removing and replacing in conformance with paragraph 501-4.19.

501-4.20 EXISTING CONCRETE PAVEMENT REMOVAL AND REPAIR.

All operations shall be carefully controlled to prevent damage to the concrete pavement and to the underlying material to remain in place. All saw cuts shall be made perpendicular to the slab surface.

a. Removal of existing pavement slab. When it is necessary to remove existing concrete pavement and leave adjacent concrete in place, unless there are dowels present, the joint between the removal area and adjoining pavement to stay in place, including dowels or tie bars, shall first be cut full depth with a standard diamond-type concrete saw. If dowels are present at this joint, the saw cut shall be made full depth just beyond the end of dowels. The edge shall then be carefully sawed on the joint line to within one inch of the top of the dowel. Next, a full depth saw cut shall be made parallel to the joint at least 24 inches from the joint and at least 12 inches from the end of any dowels. All pavement between this last saw cut and the joint line shall be carefully broken up and removed using hand-held jackhammers, 30 pounds or less, or the approved light-duty equipment which will not cause stress to propagate across the joint saw cut and cause distress in the pavement which is to remain in place. Where dowels are present, care shall be taken to produce an even, vertical joint face below the dowels. If the Contractor is unable to produce such a joint face, or if underbreak or other distress occurs, the Contractor shall saw the dowels flush with the joint. The Contractor shall then install new dowels, of the size and spacing used for other similar joints, by epoxy resin bonding them in holes drilled in the joint face as specified in paragraph 501-4.10g. All this shall be at no additional cost to the City of Phoenix. Dowels of the size and spacing indicated shall be installed as shown on the drawings by epoxy resin bonding them in holes drilled in the joint face as specified in paragraph 501-4.10g. The joint face shall be sawed or otherwise trimmed so that there is no abrupt offset in any direction greater than 1/2 inches and no gradual offset greater than one inch when tested in a horizontal direction with a 12-foot straightedge.

a. b. Edge repair. The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Areas that are damaged during construction

shall be repaired at no cost to the City of Phoenix; repair of previously existing damaged areas will be paid for under a pavement repair allowance as listed in the bid schedule.

(1) Spall repair. Spalls shall be repaired where indicated and where directed by the Engineer. Repair materials and procedures shall be as previously specified in subparagraph 501-4.19f.

(2) Underbreak repair. All underbreak shall be repaired. First, all delaminated and loose material shall be carefully removed. Next, the underlying material shall be recompacted, without addition of any new material. Finally, the void shall be completely filled with paving concrete, thoroughly consolidated. Care shall be taken to produce an even joint face from top to bottom. Prior to placing concrete, the underlying material shall be thoroughly moistened. After placement, the exposed surface shall be heavily coated with curing compound.

(3) Underlying material. The underlying material adjacent to the edge and under the existing pavement which is to remain in place shall be protected from damage or disturbance during removal operations and until placement of new concrete, and shall be shaped as shown on the drawings or as directed. Sufficient material shall be kept in place outside the joint line to prevent disturbance (or sloughing) of material under the pavement that is to remain in place. Any material under the portion of the concrete pavement to remain in place, which is disturbed or loses its compaction shall be carefully removed and replaced with concrete as specified in paragraph 501-4.20b(2). The underlying material outside the joint line shall be thoroughly compacted and moist when new concrete is placed.

MATERIAL ACCEPTANCE

501-5.1 ACCEPTANCE SAMPLING AND TESTING. All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section, with the exception of coring for thickness determination, will be performed by the City of Phoenix Materials Laboratory at no cost to the Contractor.

The Contractor shall bear the cost of providing curing facilities for the strength specimens, per paragraph 501-5.1a(3), and coring and filling operations, per paragraph 501-5.1b(1). Testing organizations performing these tests shall be accredited in accordance with ASTM C1077. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for acceptance sampling and testing must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

The Contractor shall furnish the Laboratory Curing and Testing Facilities in accordance with Civil Technical Specification Item M-002.

Concrete shall be accepted for strength and thickness on a lot basis.

A lot shall consist of each shift (day shift or night shift) production not to exceed 2,000 square yards. When each shift's production exceeds 2,000 square yards, a second lot will represent the quantities of pavement exceeding 2,000 square yards.

a. Flexural strength.

(1) Sampling. Each lot shall be divided into four equal sublots. One sample shall be taken for each sublot from the plastic concrete delivered to the job site. Sampling locations shall be determined by the City of Phoenix Materials Laboratory in accordance with random sampling procedures contained in ASTM D3665. The concrete shall be sampled in accordance with ASTM C172.

(2) Testing. Two (2) specimens shall be made from each sample. Specimens shall be made in accordance with ASTM C31 and the flexural strength of each specimen shall be determined in accordance with ASTM C78. The flexural strength for each sublot shall be computed by averaging the results of the two test specimens representing that sublot.

Immediately prior to testing for flexural strength, the beam shall be weighed and measured for determination of a sample unit weight. Measurements shall be made for each dimension; height, depth, and length, at the mid-point of the specimen and reported to the nearest 1/10 inch. The weight of the specimen shall be reported to the nearest 0.1 pound. The sample unit weight shall be calculated by dividing the sample weight by the calculated volume of the sample. This information shall be reported as companion information to the measured flexural strength for each specimen.

The samples will be transported while in the molds. The curing, except for the initial cure period, will be accomplished using the immersion in saturated lime water method.

Slump, air content, and temperature tests will also be conducted by the quality assurance laboratory for each set of strength test samples, per ASTM C31.

(3) Curing. The Contractor shall provide adequate facilities for the initial curing of beams. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60° to 80°F, and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in favorable weather, or in heavyweight closed plastic bags, or using other suitable methods, provided the temperature and moisture loss requirements are met.

(4) Acceptance. Acceptance of pavement for flexural strength will be determined by the Engineer in accordance with paragraph 501-5.2b.

b. Pavement thickness.

(1) Sampling. Each lot shall be divided into four equal sublots and one core shall be taken by the Contractor for each sublot. Sampling locations shall be determined by the City of Phoenix Materials Laboratory in accordance with random sampling procedures contained in ASTM D3665. Areas, such as thickened edges, with planned variable thickness, shall be excluded from sample locations.

Cores shall be neatly cut with a core drill. The Contractor shall furnish all tools, labor, and materials for cutting samples and filling the cored hole. Core holes shall be filled by the Contractor with a non-shrink grout approved by the Engineer within one day after sampling.

(2) Testing. The thickness of the cores shall be determined by the City of Phoenix Materials Laboratory by the average caliper measurement in accordance with ASTM C174.

(3) Acceptance. Acceptance of pavement for thickness shall be determined by the Engineer in accordance with paragraph 501-5.2c.

c. Partial lots. When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot, or when the Contractor and Engineer agree in writing to allow overages or minor placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

Where three sublots have been produced, they shall constitute a lot. Where one or two sublots have been produced, they shall be incorporated into the next lot or the previous lot and the total number of sublots shall be used in the acceptance criteria calculation, that is, n=5 or n=6.

d. Outliers. All individual flexural strength tests within a lot shall be checked for an outlier (test criterion) in accordance with ASTM E178, at a significance level of 5%. Outliers shall be discarded, and the percentage of material within specification limits (PWL) shall be determined using the remaining test values.

501-5.2 ACCEPTANCE CRITERIA.

a. General. Acceptance will be based on the following characteristics of the completed pavement discussed in paragraph 501-5.2e:

(1) Flexural strength

(2) Thickness

(3) Smoothness

(4) Grade

(5) Edge slump

(6) Dowel bar alignment

(7) Surface appearance

(8) Concrete Cracking

(9) Alignment of saw cutting

(10) Alignment of all joints

Flexural strength and thickness shall be evaluated for acceptance on a lot basis using the method of estimating PWL. Acceptance using PWL considers the variability (standard deviation) of the material and the testing procedures, as well as the average (mean) value of the test results to calculate the percentage of material that is above the lower specification tolerance limit (L).

Acceptance for flexural strength will be based on the criteria contained in accordance with paragraph 501-5.2e (1). Acceptance for thickness will be based on the criteria contained in paragraph 501-5.2e (2). Acceptance for smoothness will be based on the criteria contained in paragraph 501-5.2e (3). Acceptance for grade will be based on the criteria contained in paragraph 501-5.2e (4). Acceptance for edge slump will be based on the criteria contained in paragraph 501-5.2e (5). Acceptance for dowel bar alignment will be based on the criteria contained in paragraph 501-5.2e (6). Acceptance for surface appearance and concrete cracking will be based on the criteria contained in paragraph 501-5.2e (7). Acceptance for the alignment of saw cutting will be based on the criteria contained in paragraph 501-5.2e (8). Acceptance for the alignment of Type "A" joints will be based on the criteria contained in paragraph 501-5.2e (9).

The Engineer may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of concrete mixture which is rendered unfit for use due to contamination, segregation, or improper slump. Such rejection may be based on only visual inspection. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Engineer, and if it can be demonstrated in the laboratory, in the presence of the Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

b. Flexural strength. Acceptance of each lot of in-place pavement for flexural strength shall be based on PWL. The Contractor shall target production quality to achieve 90 PWL or higher.

c. Pavement thickness. Acceptance of each lot of in-place pavement shall be based on PWL. The Contractor shall target production quality to achieve 90 PWL or higher.

d. Percentage of material within limits (PWL). The PWL shall be determined in accordance with procedures specified in Section 110 of the Technical General Provisions.

The lower specification tolerance limit (L) for flexural strength and thickness shall be:

Lower Specification Tolerance Limit (L)

Flexural Strength	0.93 × strength specified in paragraph 501-3.1
Thickness	Lot Plan Thickness in inches, - 0.50 in

e. Acceptance criteria.

(1) Flexural Strength. If the PWL of the lot equals or exceeds 90%, the lot shall be acceptable. Acceptance and payment for the lot shall be determined in accordance with paragraph 501-8.1.

(2) Thickness. If the PWL of the lot equals or exceeds 90 percent, the lot shall be acceptable. Acceptance and payment for the lot shall be determined in accordance with paragraph 501-8.1.

Tolerances allowed for P-209 base course construction and other provisions of the specifications that may affect thickness shall not be construed to modify concrete thickness requirements. If any core indicates a deficiency in thickness of 0.60 inches or more, that core shall not be used for determining thickness properties of the lot, and additional cores shall be

drilled at intervals not exceeding ten (10) feet in each direction parallel to the paving lane from the deficient core location, until one (1) core is obtained in each direction, that is not deficient by more than 0.60 inches or more. Concrete pavement between these two (2) cores, shall be rejected, and the Contractor shall remove and replace the concrete pavement. The average measurement of the two (2) cores that were not deficient by more than 0.60-inches, shall replace the original deficient core thickness to determine thickness properties (for payment) of the lot.

(3) Smoothness. As soon as the concrete has hardened sufficiently, but not later than 48 hours after placement, the surface of each lot shall be tested in both longitudinal and transverse directions for smoothness to reveal all surface irregularities exceeding the tolerances specified. The Contractor shall furnish paving equipment and employ methods that produce a surface for each section of pavement having an average profile index meeting the requirements of paragraph 501-8.1c when evaluated with a profilograph; and the finished surface of the pavement shall not vary more than 1/4 inch when evaluated with a 12-foot straightedge. When the surface smoothness exceeds specification tolerances which cannot be corrected by diamond grinding of the pavement, full depth removal and replacement of pavement shall be to the limit of the longitudinal placement. Corrections involving diamond grinding will be subject to the final pavement thickness tolerances specified.

(a) Transverse measurements. Transverse measurements will be taken for each lot placed. Transverse measurements will be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the Engineer.

(i) Testing shall be continuous across all joints, starting with one-half the length of the straight edge at the edge of pavement section being tested and then moved ahead one-half the length of the straight edge for each successive measurement. Smoothness readings will not be made across grade changes or cross slope transitions; at these transition areas, the straightedge position shall be adjusted to measure surface smoothness and not design grade or cross slope transitions. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. Deviations on final pavement (greater than) > 1/4 inch in transverse direction shall be corrected with diamond grinding per paragraph 501-4.19g or by removing and replacing full depth of pavement. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding. Each measurement shall be recorded and a copy of the data shall be furnished to the Engineer at the end of each days testing.

(ii) The joint between lots shall be tested separately to facilitate smoothness between lots. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface, with half the straightedge on one side of the joint and the other half of the straightedge on the other side of the joint. Measure the maximum gap between the straightedge and the pavement surface in the area between these two high points. One measurement shall be taken at the joint every 50 feet or more often if directed by the Engineer. Maximum gap on final pavement surface > 1/4 inch in transverse direction shall be corrected with diamond grinding per paragraph 501-4.19g or by removing and replacing full depth of surface. Each measurement shall be recorded and a copy of the data shall be furnished to the Engineer at the end of each days testing.

(b) Longitudinal measurements. Longitudinal measurements will be taken for each lot placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the one third points of paving lanes when widths of paving lanes are 20 ft or greater.

(i) Longitudinal Short Sections. Longitudinal Short Sections are when the longitudinal lot length is less than 200 feet (60m) and areas not requiring a profilograph. When approved by the Engineer, the first and last 15 feet of the lot can also be considered as short sections for smoothness. The finished surface shall not vary more than 1/4 inch when evaluated with a 12-foot straightedge. Smoothness readings will not be made across grade changes or cross slope transitions, at these transition areas, the straightedge position shall be adjusted to measure surface smoothness and not design grade or cross slope transitions. Testing shall be continuous across all joints, starting with one-half the length of the straight edge at the edge of pavement section being tested and then moved ahead one-half the length of the straight edge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. Deviations on final pavement surface > 1/4 inch in longitudinal direction will be corrected with diamond grinding per paragraph 501-4.19g or by removing and replacing full depth of surface. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding. Each measurement shall be recorded and a copy of the data shall be furnished to the Engineer at the end of each days testing.

(ii) Profilograph Testing. Profilograph testing shall be performed by the contractor using approved equipment and procedures as described as ASTM E1274. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate “must grind” bumps and the Profile Index for the pavement using a 0.2 inch blanking band. The bump template must span one inch with an offset of 0.4 inches. The profilograph must be calibrated prior to use and operated by a factory or State DOT approved operator. Profilograms shall be recorded on a longitudinal scale of one inch equals 25 feet and a vertical scale of one inch equals one inch. A copy of the reduced tapes shall be furnished to the Engineer at the end of each days testing.

The surface of Taxiway pavements of continuous placement of 50 feet or more shall be tested and evaluated as described herein. Two passes shall be made in each paving lane greater than 20 feet in width; each pass shall be six feet from and parallel with the centerline of the paving lane. The average of the two passes shall be considered as the profilograph result for the paving lane. For paving lanes less than 20 feet in width, one pass along the centerline shall be required. (A paving lane width is defined as the distance from a longitudinal construction joint to the adjacent longitudinal construction joint or adjacent longitudinal contraction joint, whichever is the smaller width).

If there is a section of 250 feet or less that has not been independently placed, the profilogram for that section shall be included in the evaluation of the previous section. If there is an individual section of 50 to 250 feet in length, a profilogram shall be made for that section and the pay adjustment factors for short sections of paragraph 8.1c shall apply.

Individual sections shorter than 50 feet and the last 15 feet of any section where the Contractor is not responsible for the adjoining section, shall be straight edged in accordance with Section 501.5.2.e.(3)(b).

The pavement must have an average profile index meeting the requirements of paragraph 501-8.1c. Deviations on final surface in longitudinal direction shall be corrected with diamond grinding per paragraph 501-4.19g or by removing and replacing full depth of pavement. All areas represented by high points having a deviation in excess of 0.4 inches in 25 feet or less shall be removed by diamond grinding. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding.

All corrective work shall be completed prior to determination of pavement thickness when evaluated with a profilograph; and the finished surface of the pavement shall not vary more than 1/4 inch when evaluated with a 12-foot straightedge. When the surface smoothness exceeds specification tolerances which cannot be corrected by diamond grinding of the pavement, full depth removal and replacement of pavement shall be to the limit of the longitudinal placement. Corrections involving diamond grinding will be subject to the final pavement thickness tolerances specified.

Where corrections are necessary, second profilograph runs shall be performed to verify that the corrections produced an average profile index of 22 inches per mile or less. If the initial average profile index was less than 22 inches, only those areas representing greater than 0.4 inch deviation will be re-profiled for correction verification. (For the Taxiway 'A' Rehab & Strengthening project, the "Short Sections" Average Profile Index is applicable).

(iii) Final profilograph of Taxiway 'A' Rehabilitation and Strengthening Project. Final profilograph shall be performed to facilitate testing of smoothness between lots. Profilograph testing shall be performed by the contractor using approved equipment and procedures as described as ASTM E1274. The pavement must have an average profile index meeting the requirements of paragraph 501-8.1c. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2 inch blanking band. The bump template must span one inch with an offset of 0.4 inches). The profilograph must be calibrated prior to use and operated by a factory or State DOT approved, trained operator. Profilograms shall be recorded on a longitudinal scale of one inch equals 25 feet and a vertical scale of one inch equals one inch. A copy of the reduced tapes shall be furnished to the Engineer at the end of each days testing. Profilograph of final taxiway rehab shall be performed one foot right and left of taxiway centerline and 15 feet right and left of centerline. Any areas that indicate "must grind" will be corrected as directed by the Engineer.

Smoothness testing indicated in the above paragraphs except paragraph (iii) shall be performed within 48 hours of placement of material. Smoothness testing indicated in paragraph (iii) shall be performed within 48 hours final paving completion. The primary purpose of smoothness testing is to identify areas that may be prone to ponding of water which could lead to hydroplaning of aircraft. If the contractor's machines and/or methods are producing significant areas that need corrective actions then production should be stopped until corrective measures can be implemented. If corrective measures are not implemented and when directed by the Engineer, production shall be stopped until corrective measures can be implemented.

Any corrective work required shall be performed prior to joint sealing and grooving operations. All cost necessary to provide the profilograph and related to furnishing the appropriate profilograms as required in this provision are incidental to concrete pavement construction and no direct compensation will be made therefore.

(4) Grade. An evaluation of the surface grade shall be made by the Engineer for compliance to the tolerances contained below. The finished grade of each lot will be determined by running levels at all joint intersections to determine the alignment and elevation of the completed pavement. Vertical survey shall be conducted on the high point of each joint intersection and compared to the plan elevations to determine the vertical deviation. The Contractor shall pay the cost of surveying and the surveying shall be performed by a licensed surveyor. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Contractor to the Engineer. The Contractor shall pay the costs of surveying the level runs, and this work shall be performed by a licensed surveyor. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Contractor to the Engineer. When the grade exceeds specification tolerances which cannot be corrected by diamond grinding, full depth removal and replacement of pavement shall be to the limit of the pavement that allows for grade correction in accordance with Section 501-4.19. Corrections involving diamond grinding will be subject to the final pavement thickness tolerances specified. Patching shall not be permitted.

Grade shall be evaluated on the first day of placement and then every 5 days or less, so adjustments can be made to paving operations if measurements do not meet specification requirements. The contractor must submit the survey data to the engineer by the following day after measurements have been taken. The engineer must compare the surveyed grades with the grades shown on the contract drawings and document the analysis.

(a) Lateral deviation. Lateral deviation from established alignment of the pavement edge shall not exceed ±0.10 feet in any lane. Lateral deviations greater than 0.10-feet shall be deep saw cut such that the edge of the PCCP construction joint is true in the horizontal and vertical plane. No additional compensation will be made for correcting lateral deviations.

(b) Vertical deviation. Vertical deviation from established grade shall not exceed ±0.04 feet at any point. Vertical deviations that are greater than 0.04-feet shall be corrected by pavement grinding. Grinding equipment that is used for correcting the profile index for smoothness shall be used to correct vertical deviations that are out of tolerance. No additional compensation will be made for correcting vertical deviations. If any vertical deviation is lower than the planned elevation and is greater than 0.04-feet, the PCCP panel shall be removed and replaced at no additional cost to the City of Phoenix.

(5) Edge slump. When excessive edge slump cannot be corrected before the concrete has hardened, the area with excessive edge slump shall be removed and replaced at the expense of the Contractor as directed by the Engineer in accordance with paragraph 501-4.8a.

(6) Dowel Bar Alignment. Dowel bars and assemblies shall be checked for position and alignment. The maximum permissible tolerance on dowel bar alignment in each plane, horizontal and vertical, shall not exceed plus or minus $^1/_2$-inch from the center of the PCCP panel. Dowel bars shall be placed on center, every 18-inches, plus or minus ½-inch horizontally, and plus or minus 1/8-inch vertically.

When dowel bar(s) are known to be out of tolerance, or when dowel bar(s) are suspected to be out of tolerance, the Contractor shall make the correction in alignment prior to casting any concrete. If the dowel bars are suspected to be out of alignment after the concrete is cast, the Contractor shall core the PCCP 10-inches on each side of the joint to determine and measure dowel bar alignment, and at other locations as directed. If the center of the dowel bar(s) is less than 7-inches or more than 8-inches from the finished surface of the PCCP, the Contractor shall remove and replace adjacent PCCP panels to planned joints, at no additional cost to the City of Phoenix. If the center of a dowel bar(s) is measured to be between halfway from the top of the PCCP after coring, and thus within tolerance for dowel bar alignment, then the Contractor will be paid for time and materials for coring and patching the PCCP. All patching of concrete cores shall be done with a 5,000 psi high early strength non-shrink grout.

(7) Surface Appearance and Pavement Cracking. Any concrete that, in the sole discretion of the Engineer, exhibits cracking or honeycombing shall be removed and replaced without any additional cost to the City of Phoenix. Unacceptable cracking will be plastic shrinkage cracks, drying shrinkage cracks, other surface cracks and full depth structural cracks. Any cracked pavement to be removed shall be removed completely to planned joints, regardless of the extent of cracking or honeycombing. Repair, removal and replacements of slabs described in paragraph 501-4.20 shall apply.

(8) Alignment of Pavement Saw Cutting. Misaligned saw cut joints over dowel bar assemblies shall be limited to plus or minus ½-inch from the planned location. Any saw cut joint that is out of tolerance by more than ½-inch shall be deemed unacceptable and the PCCP shall be removed on both sides of the misaligned joint back to planned joints and replaced at no additional costs to the City of Phoenix.

(9) Alignment of Thickened Edge Expansion (Isolation) Joints. Thickened edge expansion joints shall not vary more than ½-inch from their designated position and shall be true to line with not more than ¼-inch variation in twelve (12) feet at any point. The surface across the joint shall be tested by the Engineer with a twelve (12) feet Contractor provided straightedge as the thickened edge expansion joints are finished and any irregularities in excess of ¼-inch shall be corrected by removal and replacement of the PCCP to planned joints.

f. Removal and replacement of concrete. Any area or section of concrete that is removed and replaced shall be removed and replaced back to planned joints. The Contractor shall replace damaged dowels and the requirements for doweled longitudinal construction joints in paragraph 501-4.10 shall apply to all contraction joints exposed by concrete removal. Removal and replacement shall be in accordance with paragraph 501-4.20.

g. Final Acceptance and Payment. Final acceptance and payment shall be determined based on a combination of the foregoing factors and such other tests and criteria as shall be necessary to determine before final acceptance and payment that the in-place concrete pavement meets all requirements set forth in this section and the Contract as a whole and represents concrete pavement of the highest quality as required herein. Such additional testing may include but is not limited to petrographic examination conducted pursuant to ASTM C856. Any one or any combination of the following factors in addition to the acceptance criteria set forth herein shall be sufficient cause for precluding final acceptance and rescission of prior interim acceptance:

(1) Concrete which evidences aggregate loss with any risk of foreign object debris (FOD) shall be considered unacceptable. The tolerance for FOD generation shall be considered zero.

(2) Concrete which is not of a uniform consistency and/or presents segregation or does not demonstrate even distribution of coarse and fine aggregate particles in accordance with Section 501-4.8 shall be considered unacceptable.

(3) Concrete which is broken, cracked, spalled, raveled, torn, or exhibits a weakened surface shall be considered unacceptable unless it is in the sole judgment of the Engineer repairable as set forth herein.

CONTRACTOR QUALITY CONTROL

501-6.1 QUALITY CONTROL PROGRAM. The Contractor shall develop a Quality Control Program in accordance with Section 100 of the General Provisions. The program shall address all elements that affect the quality of the pavement including but not limited to:

a. Mix Design

b. Aggregate Gradation

c. Quality of Materials

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Placing and Consolidation

h. Joints

i. Dowel Placement and Alignment

j. Flexural or Compressive Strength

k. Finishing and Curing

l. Surface Smoothness

m. Continuous Documentation of Weather Data

n. Surface Appearance

o. Survey of P-209 Surface for Grade Tolerance

p. Vibrator Monitoring and Verification

501-6.2 QUALITY CONTROL TESTING. Quality Control daily reports shall include documentation of curing compound application rates for each shift's paving as stipulated by Table 3 of Section 501-4.7(d) compared to the actual rates of curing compound applied. The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to this specification and as set forth in the Quality Control Program. The testing program shall include all the items listed above, but not necessarily be limited to, tests for aggregate gradation, aggregate moisture content, slump, air content, and compressive and flexural strength sampling and testing for applying loads and stresses to the concrete pavement.

A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

a. Fine aggregate.

(1) Gradation. A sieve analysis shall be made at least twice daily in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) Moisture content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C70 or ASTM C566.

b. Coarse Aggregate.

(1) Gradation. A sieve analysis shall be made at least twice daily for each size of aggregate. Tests shall be made in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) Moisture content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C566.

c. Slump. A minimum of four slump tests shall be performed for each lot of material produced in accordance with the lot size defined in paragraph 501-5.1.One test shall be made for each sublot, and additional slump tests shall be performed at a frequency not less than one (1) test for each 250 cubic yards of consecutively placed concrete to confirm conformance with the specified slump tolerances. Slump tests shall be performed in accordance with ASTM C143 from material randomly sampled from material discharged from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

d. Air content. Four air content tests, shall be performed for each lot of material produced in accordance with the lot size defined in paragraph 501-5.1. One test shall be made for each sublot. Air content tests shall be performed in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

e. Four unit weight and yield tests shall be made in accordance with ASTM C138. The samples shall be taken in accordance with ASTM C172 and at the same time as the air content tests.

f. Flexural and Compressive Strength Testing. The Contractor shall perform Quality Control Tests for both flexural and compressive strengths for applying loads and stresses to the pavement, for each lot. The flexural strength tests for acceptance will be tested by the City of Phoenix Materials Laboratory.

501-6.3 CONTROL CHARTS. The Contractor shall maintain linear control charts for fine and coarse aggregate gradation, slump, moisture content and air content.

Control charts shall be posted in a location satisfactory to the Engineer and shall be kept up to date at all times. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and suspension Limits, or Specification limits, applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a potential problem and the Contractor is not taking satisfactory corrective action, the Engineer may halt production or acceptance of the material.

a. Fine and coarse aggregate gradation. The Contractor shall record the running average of the last five gradation tests for each control sieve on linear control charts. Specification limits contained in Tables 1 and 2 shall be superimposed on the Control Chart for job control.

b. Slump and air content. The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for slump and air content in accordance with the following Action and Suspension Limits.

Control Chart Limits

Control Parameter	Individual Measurements		Range Suspension Limit
	Action Limit	Suspension Limit	
Slip Form:			
Slump	+0 to -1 inch	+0.5 to -1.5 inch	±1.5 inch
Air Content	±1.2%	±1.8%	±2.5%
Side Form:			
Slump	+0.5 to -1 inch	+1 to -1.5 inch	±1.5 inch
Air Content	±1.2%	±1.8%	±2.5%

The individual measurement control charts shall use the mix design target values as indicators of central tendency.

501-6.4 CORRECTIVE ACTION. The Contractor Quality Control Program shall indicate that appropriate action shall be taken when the process is believed to be out of control. The Contractor Quality Control Program shall detail what action will be taken to bring the process into control and shall contain sets of rules to gauge when a process is out of control. As a

minimum, a process shall be deemed out of control and corrective action taken if any one of the following conditions exists.

a. Fine and coarse aggregate gradation. When two consecutive averages of five tests are outside of the specification limits in paragraph 501-2.1, immediate steps, including a halt to production, shall be taken to correct the grading.

b. Fine and coarse aggregate moisture content. Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5%, the scale settings for the aggregate batcher and water batcher shall be adjusted.

c. Slump. The Contractor shall halt production and make appropriate adjustments whenever:

(1) one point falls outside the Suspension Limit line for individual measurements or range

OR

(2) two points in a row fall outside the Action Limit line for individual measurements.

d. Air content. The Contractor shall halt production and adjust the amount of air-entraining admixture whenever:

(1) one point falls outside the Suspension Limit line for individual measurements or range

OR

(2) two points in a row fall outside the Action Limit line for individual measurements.

Whenever a point falls outside the Action Limits line, the air-entraining admixture dispenser shall be calibrated to ensure that it is operating correctly and with good reproducibility.

METHOD OF MEASUREMENT

501-7.1 Portland cement concrete pavement shall be measured by the number of square yards of either plain or reinforced pavement as specified in-place, completed and accepted. Plain and reinforced pavement will be measured as one item. Measurements shall include thickened edges. Measurement shall not include any materials placed beyond the dimensions shown on the plans.

501-7.2 Measurement for the Repair of Spalled Concrete Joints and Concrete Panel Repairs of existing damaged panels shall be measured by either (1) the cost negotiated for the repairs based on Contractor submitted schedule of values or (2) the actual costs of the repair of damaged panels calculated in accordance with the City of Phoenix Supplements to the MAG Uniform Specifications Section 109, as modified by the Contract Documents.

BASIS OF PAYMENT

501-8.1 Payment for the Repair of Spalled Concrete Joints and Payment for Concrete Panel Repairs measured as prescribed above, shall be paid from the Pavement Repair Allowance, based on either (1) the cost negotiated for the repairs of spalled concrete joints

and/or damaged existing concrete panel based on Contractor Schedule of Values or (2) the approved actual costs of the repair, which price and payment shall be full compensation for sawing and removing damaged panels, furnishing, installing, finishing and curing new concrete panels, labor, other materials and incidentals necessary to complete the panel repair work.

501-8.2 Payment for Concrete Panel Replacement. Payment for concrete pavement meeting all acceptance criteria as specified in paragraph 501-5.2 Acceptance Criteria shall be based on results of smoothness, strength and thickness tests. Payment for acceptable lots of concrete pavement shall be adjusted in accordance with paragraph 501-8.1a for strength and thickness and 501-8.1c for smoothness, subject to the limitation that:

The total project payment for concrete pavement shall not exceed 100 percent of the product of the contract unit price and the total number of square yards of concrete pavement used in the accepted work (See Note 1 under Price Adjustment Schedule below). Lot pay factors that do exceed 100 percent may be used to offset lot pay factors that are less than 100 percent.

However, if any lot has cracks, shrinkage cracks or requires spall repair, the deficient portion of the lot shall be repaired and/or removed and replaced as described in Paragraph 501-4.19, Repair, Removal and Replacement of PCCP. Should the lot(s) have a pay factor greater than 100, the pay factor may not be used to offset lower pay factors until such repair and/or removal and replacement has been completed and found to be acceptable by the Engineer

Payment shall be full compensation for all labor, materials, tools, equipment, and incidentals required to complete the work as specified herein and on the drawings.

a. Basis of adjusted payment. The pay factor for each individual lot shall be calculated in accordance with the Price Adjustment Schedule table below. A pay factor shall be calculated for both flexural strength and thickness. The lot pay factor shall be the higher of the two values when calculations for both flexural strength and thickness are 100% or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either flexural strength or thickness is 100% or higher. The lot pay factor shall be the lower of the two values when calculations for both flexural strength and thickness are less than 100%.

Price Adjustment Schedule[1]

Percentage of Materials Within Specification Limits (PWL)	Lot Pay Factor (Percent of Contract Unit Price)
96 – 100	106
90 – 95	PWL + 10
75 – 90	0.5 PWL + 55
55 – 74	1.4 PWL – 12
Below 55	Reject[2]

[1] Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment in excess of 100% shall be subject to the total project payment limitation specified in paragraph 501-8.1.

[2] The lot shall be removed and replaced. However, the Engineer may decide to allow the rejected lot to remain. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it shall be paid for at 50% of the contract unit price and the total project payment limitation shall be reduced by the amount withheld for the rejected lot.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project payment limitation specified in paragraph 501-8.1. Payment in excess of 100% for accepted lots of concrete pavement shall be used to offset payment for accepted lots of concrete pavement that achieve a lot pay factor less than 100%.

b. Basis of adjusted payment for smoothness. Price adjustment for pavement smoothness will apply to the total area of concrete within a section of pavement and shall be applied in accordance the following equation and schedule:

(Square yard in section) × (original unit price per square yard) × PFm = reduction in payment for area within section

Average Profile Index (Inches Per Mile) Pavement Strength Rating			**Contract Unit Price Adjustment (PFm)**
Over 30,000 lbs	**30,000 lbs or Less**	**Short Sections**	
0 - 7	0 - 10	0 - 15	0.00
7.1 - 9	10.1 - 11	15.1 - 16	0.02
9.1 - 11	11.1 - 12	16.1 - 17	0.04
11.1 - 13	12.1 - 13	17.1 - 18	0.06
13.1 - 14	13.1 - 14	18.1 - 20	0.08
14.1 - 15	14.1 - 15	20.1 - 22	0.10
15.1 and up	15.1 and up	22.1 and up	Corrective work required

Note: For the Taxiway 'A' Rehabilitation and Strengthening Project the Pavement Strength Rating is over 30,000 pounds and the "Short Sections" Average Profile Index is applicable.

Payment shall be made under:

Item P-501-8.1 PCC Pavement Repair Allowance – per Allowance

Deleted: Item P-501-8.2 PCC Panel Replacement – This bid item is not a part of this project.

TESTING REQUIREMENTS

ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C70 Standard Test Method for Surface Moisture in Fine Aggregate

ASTM C78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C227	Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C289	Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
ASTM C295	Standard Guide for Petrographic Examination of Aggregates for Concrete
ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland Cement Concrete
ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregates by Drying

ASTM C642 Standard Test Method for Density, Absorption, and Voids in Hardened Concrete

ASTM C666 Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

ASTM C1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

ASTM C1260 Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

ASTM C1567 Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

ASTM C1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

ASTM D3665 Standard Practice for Random Sampling of Construction Materials

ASTM D4791 Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

ASTM E178 Standard Practice for Dealing with Outlying Observations

ASTM E1274 Standard Test Method for Measuring Pavement Roughness Using a Profilograph

U.S. Army Corps of Engineers (USACE) Concrete Research Division (CRD) C662
Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

MATERIAL REQUIREMENTS

ASTM A184 Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement

ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A704 Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement

ASTM A706 Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A714	Standard Specification for High-Strength Low-Alloy Welded and Seamless Steel Pipe
ASTM A775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A996	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A1078	Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving And Structural Construction

ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 305R	Guide to Hot Weather Concreting
ACI 306R	Guide to Cold Weather Concreting
ACI 309R	Guide for Consolidation of Concrete
AC 150/5320-6	Airport Pavement Design and Evaluation
PCA	Design and Control of Concrete Mixtures

END ITEM P-501

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ITEM P-603 BITUMINOUS TACK COAT

DESCRIPTION

603-1.1 This item shall consist of preparing and treating a bituminous or concrete surface with bituminous material in accordance with these specifications and in reasonably close conformity to the lines shown on the plans. This item shall also include the application of bituminous tack coat to the vertical face of existing asphalt and concrete pavement that are proposed to be matched with new asphalt pavement.

MATERIALS

603-2.1 BITUMINOUS MATERIALS. The bituminous material shall be emulsified asphalt indicated in ASTM D3628 as a bituminous application for tack coat appropriate to local conditions and as designated by the Engineer in Table 1.

Table 1 Bituminous Material

Type and Grade	Specification	Application Temperature	
		Deg. F	**Deg. C**
Emulsified Asphalt			
CSS-1	ASTM D 2397	75-130	25-55

CONSTRUCTION METHODS

603-3.1 WEATHER LIMITATIONS. The tack coat shall be applied only when the existing surface is dry and the atmospheric temperature is 50°F (10°C) or above; the temperature has not been below 35°F (2°C) for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the Engineer.

603-3.2 EQUIPMENT. The Contractor shall provide equipment for heating and applying the bituminous material.

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 65.0 psi of tire width to prevent rutting, shoving or otherwise damaging the base, surface or other layers in the pavement structure. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with a pressure range of 25 to 75 psi and with an allowable variation from the specified rate of not more than ±5%, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the bituminous material during the heating process. If the distributor is not equipped with an operable quick shutoff valve, the tack operations shall be started and stopped on building paper. The Contractor shall remove blotting sand prior to asphalt concrete lay down operations at no additional expense to the Owner.

A vacuum power broom and/or power blower suitable for cleaning the surfaces to which the bituminous tack coat is to be applied shall be provided for any required cleaning of the surface to be treated and all surfaces shall be cleaned to the satisfaction of the Engineer.

603-3.3 APPLICATION OF BITUMINOUS MATERIAL. Immediately before applying the tack coat, the full width of surface to be treated shall be swept with a vacuum power broom and/or power blower to remove all loose dirt and other objectionable material.

Emulsified asphalt shall be diluted by the addition of water when directed by the Engineer and shall be applied a sufficient time in advance of the paver to ensure that all water has evaporated before the overlying mixture is placed on the tacked surface.

The bituminous material including vehicle shall be uniformly applied with a bituminous distributor at the rate of 0.05 to 0.10 gallons per square yard depending on the condition of the existing surface. The type of bituminous material and application rate shall be approved by the Engineer prior to application.

After application of the tack coat, the surface shall be allowed to cure without being disturbed for the period of time necessary to permit drying and setting of the tack coat. This period shall be determined by the Engineer. The Contractor shall protect the tack coat and maintain the surface until the next course has been placed.

603-3.4 BITUMINOUS MATERIAL CONTRACTOR'S RESPONSIBILITY. The Contractor shall provide a statement of source and character of the proposed bituminous material which must be submitted and approved by the Engineer before any shipment of bituminous materials to the project.

The Contractor shall furnish the vendor's certified test reports for each carload, or equivalent, of bituminous material shipped to the project. The tests reports shall be provided to and approved by the Engineer before the bituminous material is applied. If the bituminous material does not meet the specifications, it shall be replaced at the Contractor's expense. Furnishing the vendor's certified test report for the bituminous material shall not be interpreted as a basis for final acceptance. Samples may be taken and tested for verification by the Engineer when material is delivered to the site.

603-3.5 FREIGHT AND WEIGH BILLS. The Contractor shall submit waybills and delivery tickets, during progress of the work. Before the final statement is allowed, file with the Engineer certified waybills and certified delivery tickets for all bituminous materials used in the construction of the pavement covered by the contract. Do not remove bituminous material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

QUALITY CONTROL

603-4.1 CONTRACTOR QUALITY CONTROL. The Contractor shall be responsible for developing and implementing a Contractor Quality Control Program including inspection and testing to assure compliance with the Technical General Provisions Section 100.

METHOD OF MEASUREMENT

603-5.1 The Bituminous Tack Coat shall be measured by the gallon of emulsified asphalt, diluted and applied. Volume shall be corrected to the volume at 60°F (16°C) in accordance with ASTM D1250. The bituminous material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10% over the specified application rate. Any amount of bituminous material more than 10% over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the bituminous material is necessary.

BASIS OF PAYMENT

603.5-1 Payment shall be made at the contract unit price per gallon of emulsified bituminous tack coat. This price shall be full compensation for furnishing all materials and for all preparation, delivering, and applying the materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item P-603-5.1 Bituminous Tack Coat (CSS-1) - per gallon

MATERIAL REQUIREMENTS

ASTM D977	Standard Specification for Emulsified Asphalt
ASTM D1250	Standard Guide for Use of the Petroleum Measurement Tables
ASTM D2397	Standard Specification for Cationic Emulsified Asphalt
ASTM D3628	Standard Practice for Selection and Use of Emulsified Asphalts

END ITEM P-603

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ITEM P-604 COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS

DESCRIPTION

604-1.1 This item shall consist of preformed polychloroprene compression seals used for sealing joints of rigid pavements.

MATERIALS

604-2.1 COMPRESSION SEALS. Compression joint seal materials shall be a vulcanized elastomeric compound using polychloroprene as the only base polymer. The material and the manufactured seal shall conform to ASTM D2628 and Corps of Engineers Concrete Research Division (CRD) C548 where jet fuel and/or heat blast resistance is required. The joint seal shall be a labyrinth type seal. The uncompressed depth of the face of the compression seal (that is to be bonded to the joint wall) shall be greater than the uncompressed width of the seal, except that for seals one inch or greater in width, the depth need be only one inch or greater. The actual width of the uncompressed seal for construction and contraction joints shall be 13/16-inch or one inch and for expansion joints shall be 1.25 inches. The tolerance on the seal shall be plus 1/8-inch or minus 1/16-inch.

604-2.2 LUBRICANT/ADHESIVE. Lubricant/adhesive used for the compression elastomeric joint seal shall be a one-component compound conforming to ASTM D2835.

604-2.3 DELIVERY AND STORAGE. Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided at the job site to protect materials from weather and maintain materials at temperatures recommended by the manufacturer.

604-2.4 SUBMITTALS. Certified copies of test results shall be provided 60 days prior to use of material on the project.

a. Construction equipment list. List of proposed equipment to be used in the performance of construction work, including descriptive data shall be provided to the Engineer 60 days prior to use on the project.

b. Manufacturer's instructions. Where installation procedures are required in accordance with the manufacturer's recommendations, printed copies of these recommendations shall be submitted to the Engineer 60 days prior to use on the project. Installation of the material shall not be allowed until the recommendations are received.

c. Test reports. The Contractor shall submit certified copies of the test reports to the Engineer for written approval 60 days prior to use on the project. Printed directions from the manufacturer on recommended installation criteria shall be furnished with the test reports, plus the manufacturer's certification that the selected seal is recommend for the installation on this project. No material will be used until it has been approved by the Engineer.

604-2.5 TEST REQUIREMENTS. Each lot of compression joint seal and lubricant/adhesive shall be sampled, identified, and tested for conformance with the applicable material specification. A lot of preformed seal shall consist of one day's production or 20,000 linear feet for each cross-

section, whichever is less. A lot of lubricant/adhesive shall consist of one day's production. No material shall be used at the project prior to receipt of written notice that the materials meet the laboratory requirements.

Testing of the preformed joint and lubricant/adhesive material shall be the responsibility of the Contractor and shall be performed in an approved independent laboratory and certified copies of the test reports shall be submitted for approval 60 days prior to the use of the materials at the job site. Samples of each lot of material shall also be submitted and will be retained by the Engineer for possible future testing by the City of Phoenix Materials Laboratory should the materials appear defective during or after application. The Contractor shall furnish additional samples of materials, in sufficient quantity to be tested, upon request. Final acceptance will be based on conformance to the specified test requirements and the performance of the in-place materials.

604-3.1 EQUIPMENT. Machines, tools, and equipment used in the performance of the work required by this section shall be approved by the Engineer before the work starts and shall be maintained by the Contractor in satisfactory condition at all times.

a. Joint cleaning equipment.

(**1) Concrete saw.** A self-propelled power saw with water-cooled diamond saw blades shall be provided for cutting joints to the depths and widths specified and for removing filler, existing old joint seal or other material embedded in the joints or adhered to the joint faces.

(**2) Sandblasting equipment.** Sand blasting is not allowed.

(**3) Waterblasting equipment.** Waterblasting equipment shall include a trailer-mounted water tank, pumps, high-pressure hose, a wand with safety release cutoff controls, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary water resupply equipment shall be of sufficient capacity to permit continuous operations. The pumps, hoses, wand, and nozzle shall be of sufficient capacity to permit the cleaning of both walls of the joint and the pavement surface for a width of at least 1/2-inch on either side of the joint. The pump shall be capable of supplying a pressure of at least 3,000. A pressure gauge mounted at the pump shall show at all times the pressure in pounds per square inch (psi) at which the equipment is operating.

b. Sealing equipment. Equipment used to install the compression seal shall place the compression seal to the prescribed depths within the specified tolerances without cutting, nicking, twisting, or otherwise damaging the seal. The equipment shall not stretch or compress the seal more than 2.0% longitudinally during installation. The machine shall be an automatic self-propelled joint seal application equipment and shall be engine powered. The machine shall include a reservoir for the lubricant/adhesive, a device for conveying the lubricant/adhesive in the proper quantities to the sides the preformed seal or the sidewalls of the joint, a reel capable of holding one full spool of compression seal, and a power-driven apparatus for feeding the joint seal through a compression device and inserting the seal into the joint. The equipment shall also include a guide to maintain the proper course along the joint being sealed. The machine shall at all times be operated by an experienced operator.

CONSTRUCTION METHODS

604-4.1 ENVIRONMENTAL CONDITIONS. The ambient temperature and the pavement temperature within the joint wall shall be at least 35°F and rising at the time of installation of the materials. Sealant application will not be permitted if moisture or any foreign material is observed in the joint.

604-4.2 TRIAL JOINT SEAL AND LUBRICANT/ADHESIVE INSTALLATION. Prior to the cleaning and sealing of the joints for the entire project, a test section at least 200 feet long shall be prepared at a location in the project pavement directed by the Engineer using the specified materials and the approved equipment, to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the trial length and before any other joint is sealed, the trial joints will be inspected by the Engineer to determine that the materials and installation meet the requirements specified. If materials or installation do not meet requirements the materials shall be removed, and the joints shall be recleaned and resealed at no cost to the Owner. No other joints shall be sealed until the test installation has been approved by the Engineer. If the trial section is approved, it may be incorporated into the permanent work. All other joints shall be sealed in the manner approved for sealing the trial joints.

604-4.3 PREPARATION OF JOINTS. Immediately before installation of the compression joint seal, the joints shall be thoroughly cleaned to remove all laitance, filler, existing sealer, foreign material and protrusions of hardened concrete from the sides and upper edges of the joint space to be sealed. Cleaning shall be performed using equipment in accordance with paragraph 604-3.1a and shall extend along pavement surfaces at least 1/2 inch on either side of the joint. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water. Demonstrate that the selected cleaning operation meets the cleanliness requirements. Any irregularity in the joint face that would prevent uniform contact between the joint seal and the joint face shall be corrected prior to the installation of the joint seal.

a. Sawing. Joints shall be sawed to clean and to open them to the full specified width and depth. Immediately following the sawing operation, the joint faces and opening shall be thoroughly cleaned using a water jet to remove all saw cuttings or debris remaining on the faces or in the joint opening. Compression seal shall be installed within three (3) calendar days of the time the joint cavity is sawed. Depth of the joint cavity shall be in accordance with manufacturer's instructions. Submit printed copies of manufacturers' instructions 60 days prior to use on the project. The saw cut for the joint seal cavity shall at all locations be centered over the joint line. The nominal width of the sawed joint seal cavity shall be as follows; the actual width shall be within a tolerance of ±1/16-inch:

(**1)** If a nominal 13/16-inch wide compression seal is furnished, the nominal width of the saw cut shall be 8/16-inch wide. However, this shall apply only when the pavement temperature at the time of sawing is between 50 and 115° F. If the pavement temperature at the time of sawing is above this range, the nominal width of the saw cut shall be decreased 1/16-inch. If the pavement temperature at the time of sawing is below this range, the nominal width of the saw cut shall be increased 1/16-inch.

(**2)** If a nominal one inch wide compression seal is furnished, the nominal width of the saw cut shall be 9/16-inch wide. However, this shall apply only when the pavement temperature at the time of sawing is between 55 and 180 °F. If the pavement temperature at the time of sawing is above this range, the nominal width of the saw cut shall be decreased 1/16-inch. If the pavement temperature at the time of sawing is below this range, the nominal width of the saw cut shall be increased 1/16-inch.

(3) The pavement temperature shall be measured and recorded in the presence of the Engineer. Measurement shall be made each day before commencing sawing and at any other time during the day when the temperature appears to be moving out of the allowable sawing range.

b. Sandblast cleaning. Sandblast cleaning is not allowed.

c. Waterblast cleaning. The concrete joint faces and pavement surfaces extending at least ½-inch from the joint edges shall be waterblasted clean. A multiple pass technique shall be used until the surfaces are free of dust, dirt, curing compound, or any residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

d. Rate of progress. Waterblasting of the joint faces and air pressure cleaning of the joints shall be limited to the linear footage of joint that can be sealed during the same workday.

604-4.4 INSTALLATION OF THE COMPRESSION SEAL.

a. Time of installation. Joints shall be sealed within three (3) calendar days of sawing the joint seal cavity and immediately following concrete cure and the final cleaning of the joint walls. Open joints ready for sealing that cannot be sealed under the conditions specified shall be provided with an approved temporary seal to prevent infiltration of foreign material. When rain interrupts the sealing operations, the joints shall be washed, air pressure cleaned and allowed to dry prior to installing the lubricant/adhesive and compression seal.

b. Sequence of installation. Longitudinal joints shall be sealed first, followed by transverse joints. Seals in longitudinal joints shall be installed so that all transverse joint seals will be intact from edge to edge of the pavement. Intersections shall be made monolithic by use of joint seal adhesive and care in fitting the intersection parts together. Extender pieces of seal shall not be used at intersections. Any seal falling short of the intersection shall be removed and replaced with new seal at no additional cost to the Owner.

604-4.5 SEALING OF JOINTS. The joint seal shall be installed using the equipment specified in paragraph 604-3.1b. The sides of the joint seal or the sides of the joint shall be covered with a coating of lubricant/adhesive and the seal installed as specified. Butt joints and seal intersections shall be coated with liberal applications of lubricant/adhesive. Lubricant/adhesive spilled on the pavement shall be removed immediately to prevent setting on the pavement. An in-place joint seal shall be in an upright position and free from twisting, distortion, and cuts. Adjustments shall be made to the installation equipment and procedure, if the stretch exceeds 1%. Any seal exceeding 2% stretch shall be removed and replaced. The joint seal shall be placed at a uniform depth within the tolerances specified. In-place joint seal that fails to meet the specified

requirements shall be removed and replaced with new joint seal in a satisfactory manner at no additional cost to the Owner. The compression joint seal shall be placed to a depth of 3/16 inch, ±1/8-inch, below the pavement surface or below the depth of the groove unless otherwise directed by the Engineer. For beveled joints or joints with a radius at the surface, the preformed joint seal shall be installed at a depth of 1/8-inch, plus or minus 1/8-inch, below the bottom of the edge of the bevel or radius. No part of the seal shall be allowed to project above the surface of the pavement. The seal shall be installed in the longest practicable lengths in longitudinal joints and shall be cut at the joint intersections so as to provide continuous installation of the seal in the transverse joints. The lubricant/adhesive in the longitudinal shall be allowed to set for one (1) hour prior to cutting at the joint intersections to reduce the possibility of shrinkage. For all transverse joints, the minimum length of the preformed joint seal shall be the pavement width from edge to edge.

604-4.6 CLEAN-UP. Upon completion of the project, all unused materials shall be removed from the site, all lubricant/adhesive on the pavement surface shall be removed, and the pavement shall be left in clean condition.

604-4.7 CONTRACTOR FURNISHED MATERIALS. The Contractor shall furnish and deliver to the City of Phoenix at substantial completion the following unused materials:

a. 13/16-inch Preformed Sealant. The Contractor shall furnish to the City of Phoenix all unused 13/16-inch preformed sealant.

b. 1-Inch Preformed Sealant. The Contractor shall furnish to the City of Phoenix all unused 1-inch preformed sealant.

c. Lubricant-Adhesive. The Contractor shall furnish to the City of Phoenix all unused lubricant-adhesive.

CONTRACTOR QUALITY CONTROL

604-5.1 GENERAL. The Contractor shall develop a Quality Control Program in accordance with Section 100 of the General Provisions. The program shall address all elements which affect the quality and durability of the preformed joint sealer, including, but not limited to:

604-5.2 QUALITY CONTROL PROVISIONS.

a. Equipment. The application equipment shall be inspected to assure uniform application of lubricant/adhesive to the sides of the compression joint seal or the walls of the joint. If any equipment causes cutting, twisting, nicking, excessive stretching or compressing of the compression seal, or improper application of the lubricant/adhesive, the operation shall be suspended until causes of the deficiencies are determined and corrected by the Contractor.

b. Procedures. The Contractors Quality Control Program shall address as a minimum: Pavement temperatures; Cleaning and dryness of joints; Inspection of joint width, depth, alignment and dimensional tolerances; Application of lubricant-adhesive in accordance with the Manufacturers recommendations; and proper stretching and tension of the preformed joint sealant.

(1) Quality control provisions shall be provided during the joint cleaning process to prevent or correct improper equipment and cleaning techniques that damage the concrete in any manner. Cleaned joints shall be approved by the Engineer prior to installation of the lubricant/adhesive and compression joint seal.

(**2)** Conformance to stretching and compression limitations shall be determined by the Contractors Quality Control Laboratory and approved by the Engineer. Mark the top surface of the compression seal at one foot intervals in a manner clear and durable to enable length determinations of the seal. After installation, the distance between the marks on the seal shall be measured by the Contractor. If the stretching or compression exceeds the specified limit, the seal shall be removed and replaced with new joint seal at no additional cost to the Owner. The seal shall be removed up to the last correct measurement. The seal shall be inspected by the Contractor a minimum of once per 400 feet of seal for compliance to the shrinkage or compression requirements. Measurements shall also be made at the same interval to determine conformance with depth and width installation requirements. All compression seal that is not in conformance with specification requirements shall be removed and replaced with new joint seal at no additional cost to the City of Phoenix.

c. Inspection. The joint sealing system (compression seal and lubricant/adhesive) shall be inspected Contractors Quality Control Laboratory and approved by the Engineer for proper rate of cure and bonding to the concrete, cuts, twists, nicks, and other deficiencies. Seals exhibiting any defects, at any time prior to final acceptance of the project, shall be removed from the joint, wasted, and replaced in a satisfactory manner, as determined by the Engineer.

604-5.3 QUALITY CONTROL TESTING. The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but not necessarily limited to, tests and inspections for the control of pavement temperature; cleaning and dryness of joints; inspection of joint width, depth and alignment; application of the lubricant; and the stretching and tension of the preformed joint sealant.

METHOD OF MEASUREMENT

604-6.1 MEASUREMENT. No separate measurement will be made for Compression Joint Seals. Payment for each sealing item will be incidental to the P-501 PCCP unit prices for which direct payment is made, including furnishing the unused joint sealant and sealant compound.

BASIS OF PAYMENT

604-7.1 PAYMENT. No separate payment will be made for Compression Joint Seals. The cost for installing each sealing item will be incidental to the P-501 PCCP unit prices for which direct payment is made, including furnishing the unused joint sealant and sealant compound.

TESTING REQUIREMENTS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in this text by basic designation only.

ASTM D2628 Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

ASTM D2835 Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

Corps of Engineers CRD C548 Standard Specification for Jet-Fuel and Heat Resistant Preformed Polychloroprene Elastomeric Joint Seals for Rigid Pavements

UFC 3-250-08FA Standard Practice for Sealing Joints and Cracks in Rigid and Flexible Pavements

END ITEM P-604

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ITEM P-605(A) JOINT SEALING FILLER

DESCRIPTION

605(A)-1.1 This item shall consist of providing and installing a resilient and adhesive joint sealing filler capable of effectively sealing joints and cracks in pavements.

MATERIALS

605(A)-2.1 JOINT SEALERS.

a. PCCP Joint Sealing Filler material shall meet the requirements of FED SPEC SS-S-200E(2)–Sealants, Joint, Two-Component, Jet-Blast Resistant, Cold Applied or ASTM D 1854–Jet Fuel-Resistant Concrete Joint Sealer, Hot-Applied Elastic Type.

b. PCCP to Asphalt Pavement Edge Seal material shall meet the requirements of Arizona Department of Transportation (ADOT) Specification Section 402-7, Edge Sealing.

Each lot or batch of sealing compound shall be delivered to the jobsite in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, the safe heating temperature, and shall be accompanied by the manufacturer's certification stating that the compound meets the requirements of this specification.

CONSTRUCTION METHODS

605(A)-3.1 TIME OF APPLICATION. Joints shall be sealed as soon after completion of the curing period as feasible and before the pavement is opened to traffic, including construction equipment. The pavement temperature shall be above 50°F at the time of installation of the poured joint sealing material.

605(A)-3.2 PREPARATION OF JOINTS.

a. Sawing. All joints shall be sawed in accordance with specifications and plan details. Immediately after sawing the joint, the resulting slurry shall be completely removed from joint and adjacent area by flushing with a jet of water, and by use of other tools as necessary.

b. Sealing. Immediately before sealing, the joints shall be thoroughly cleaned of all remaining laitance, curing compound, and other foreign material. Cleaning of PCCP joints shall be accomplished by Waterblasting as specified in Item P-604 Compression Joint Seals for Concrete Pavements. The PCCP to Asphalt Pavement joint shall be sawed shortly before sealing. Upon completion of cleaning (and sawing the PCCP/Asphalt Edge Joint), the joints shall be blown out with compressed air free of oil and water. Only air compressors with operable oil and water traps shall be used to prepare the joints for sealing. The joint faces shall be surface dry when the seal is applied.

605(A)-3.3 INSTALLATION OF SEALANTS. Joints shall be inspected for proper width, depth, alignment, and preparation, and shall be approved by the Engineer before sealing is allowed. Sealants shall be installed in accordance with the following requirements:

a. Cold Applied Sealants. Cold applied joint sealing compound shall be applied by means of pressure equipment that will force the sealing material to the bottom of the joint and completely fill the joint without spilling the material on the surface of the pavement. A backing material shall be placed as shown on the plans and shall be both non-reactive and non-adhesive to the concrete or the sealant material. Sealant that does not bond to the concrete surface of the joint walls, contains voids, or fails to set to a tack-free condition will be rejected and replaced by the Contractor at no additional cost. Before sealing the joints, the Contractor shall demonstrate that the equipment and procedures for preparing, mixing, and placing the sealant will produce a satisfactory joint seal. This shall include the preparation of two small batches and the application of the resulting material. Any sealant spilled on the surface of the pavement, structures and/or lighting fixtures, shall be removed immediately.

b. Hot Poured Sealants. The joint sealant shall be applied uniformly solid from bottom to top and shall be filled without formation of entrapped air or voids. A backing material shall be placed as shown on the plans and shall be both non-reactive and non-adhesive to the concrete or the sealant material. The heating kettle shall be an indirect heating type, constructed as a double boiler. A positive temperature control and mechanical agitation shall be provided. The sealant shall not be heated to more than 20°F below the safe heating temperature. The safe heating temperature can be obtained from the manufacturer's shipping container. A direct connecting pressure type extruding device with nozzles shaped for insertion into the joint shall be provided. Any sealant spilled on the surface of the pavement, structures and/or lighting fixtures, shall be removed immediately.

Jute, paper, or other moisture absorbing material shall not be used for the backing material. The backing material shall be rubber, butyl rubber, or other approved material that will not react with the joint sealer and will not form a gas when the hot joint sealer is applied.

c. Edge Sealing. This item consists of furnishing all materials and sawing or routing and the sealing of joints between the edges of PCCP that is adjacent to asphalt shoulders. The edge seal shall be routed or saw cut to the depth and width as shown on the plans and the seal materials applied in accordance with the applicable provisions of paragraphs **a** and **b** above and with ADOT Specification Section 402-7, Edge Sealing.

METHOD OF MEASUREMENT

605(A)-4.1 PCCP to Asphalt Edge Seal will be measured by the linear foot of longitudinal or transverse edge sealed in place and accepted by the Engineer.

BASIS OF PAYMENT

605(A)-5.1 PCCP to Asphalt Pavement Edge Sealing. Payment for PCCP to Asphalt pavement edge sealing shall be made at the unit price per linear foot. The price shall be full compensation for furnishing all materials, for all preparation, sawing and thorough cleaning of all joints, drying of the joint, delivering, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-605(A)-5.1 PCCP to Asphalt Pavement Edge Seal – per linear foot

TESTING REQUIREMENTS

ASTM D 412	Test Methods for Vulcanized Rubber and Thermoplastic Elastomers–Tension
ASTM D 1644	Test Methods for Nonvolatile Content of Varnishes

MATERIAL REQUIREMENTS

ASTM D 1854	Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 3406	Joint Sealants, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements
ASTM D 3569	Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant Type, for Portland Cement Concrete Pavements
ASTM D 3581	Joint Sealant, Hot-Applied, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements
ASTM D 5893	Standard Specifications for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
ASTM D 6690	Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements
FED SPEC SS-S-200E(2)	Sealants, Joint, Two-Component, Jet-Blast Resistant, Cold Applied

END ITEM P-605

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ITEM P-606 ADHESIVE COMPOUNDS, TWO-COMPONENT FOR SEALING WIRE AND LIGHTS IN PAVEMENT

DESCRIPTION

606-1.1. This specification covers two types of material; a liquid suitable for sealing electrical wire in saw cuts in pavement and for sealing light fixtures or bases in pavement, and a paste suitable for embedding light fixtures in the pavement. Both types of material are two-component filled formulas with the characteristics specified in paragraph 606-2.4. Materials supplied for use with bituminous concrete pavements must be formulated so they are compatible with the bituminous concrete.

EQUIPMENT AND MATERIALS

606-2.1 Curing. When pre-warmed to 77°F, mixed, and placed in accordance with manufacturer's directions, the materials shall cure at temperatures of 45°F or above without the application of external heat.

606-2.2 Storage. The adhesive components shall not be stored at temperatures over 86°F (30°C).

606-2.3 Caution. Installation and use shall be in accordance with the manufacturer's recommended procedures. Avoid prolonged or repeated contact with skin. In case of contact, wash with soap and flush with water. If taken internally, call doctor. Keep away from heat or flame. Avoid vapor. Use in well-ventilated areas. Keep in cool place. Keep away from children.

606-2.4 Characteristics. When mixed and cured in accordance with the manufacturer's directions, the materials shall have the following properties shown in Table 1.

SAMPLING, INSPECTION, AND TEST PROCEDURES

606-3.1 Tensile properties. Tests for tensile strength and elongation shall be conducted in accordance with ASTM D638.

606-3.2 Expansion. Tests for coefficients of linear and cubical expansion shall be conducted in accordance with ASTM D1168, Method B, except that mercury shall be used instead of glycerine. The test specimen shall be mixed in the proportions specified by the manufacturer, and cured in a glass tub approximately 2 inch long by 3/8 inch in diameter. The interior of the tube shall be precoated with a silicone mold release agent. The hardened sample shall be removed from the tube and aged at room temperature for one (1) week before conducting the test. The test temperature range shall be from 35°F to 140°F.

606-3.3 Test for dielectric strength. Test for dielectric strength shall be conducted in accordance with ASTM D149 for sealing compounds to be furnished for sealing electrical wires in pavement.

Table 1. Property Requirements

Physical or Electrical Property	Minimum	Maximum	ASTM Method
Tensile			
Portland cement concrete	1,000 psi (70 kg/sq cm)		D 638
Bituminous concrete	500 psi (35 kg/sq cm)		
Elongation			
Portland cement concrete		See note [1]	D 638
Bituminous concrete	50%		D 638
Coef. of cub. exp. cu. cm/cu. cm/°C	0.00090	0.00120	D 1168
Coef. of lin. exp. cm/cm/°C	0.000030	0.000040	D 1168
Dielectric strength, short time test	350 volts/mil.		D 149
Arc resistance	125 sec		
Pull-off			
Adhesion to steel	1,000 psi (70 kg/sq cm)		
Adhesion to Portland cement concrete	200 psi (14 kg/sq cm)		
Adhesion to asphalt concrete	No test available.		
Adhesion to aluminum	250 psi		

[1] 20% or more (without filler) for formulations to be supplied for areas subject to freezing.

606-3.4 Test for arc resistance. Test for arc resistance shall be conducted for sealing compounds to be furnished for sealing electrical wires in pavement.

606-3.5 Test for adhesion to steel. The ends of two smooth, clean, steel specimens of convenient size (1 inch by 1 inch by 6 inch) would be satisfactory when bonded together with adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure on a Riehle (or similar) tensile tester. The thickness of adhesive to be tested shall be 1/4 inch.

606-3.6 Adhesion to Portland cement concrete

a. Concrete test block preparation. The aggregate grading shall be as shown in Table 2.

The coarse aggregate shall consist of crushed rock having a minimum of 75% of the particles with at least one fractured face and having a water absorption of not more than 1.5%. The fine aggregate shall consist of crushed sand manufactured from the same parent rock as the coarse aggregate. The concrete shall have a water-cement ratio of 5.5 gallons of water per bag of cement, a cement factor of 6, ±0.5, bags of cement per cubic yard (0.76 cubic meter) of concrete, and a slump of 2-1/2 inch, ±1/2 inch. The ratio of fine aggregate to total aggregate shall be approximately 40% by solid volume. The air content shall be 5.0%, ±0.5%, and it shall be obtained by the addition to the batch of an air-entraining admixture such as Vinsol® resin. The mold shall be of metal and shall be provided with a metal base plate.

Means shall be provided for securing the base plate to the mold. The assembled mold and base plate shall be watertight and shall be oiled with mineral oil before use. The inside measurement of the mold shall be such that several one inch by 2 inch by 3 inch test blocks can be cut from the specimen with a concrete saw having a diamond blade. The concrete shall be prepared and cured in accordance with ASTM C192.

Table 2. Aggregate For Bond Test Blocks

Type	Sieve Size	Percent Passing
Coarse Aggregate	3/4 inch (19 mm)	97 to 100
	1/2 inch (12 mm)	63 to 69
	3/8 inch (9 mm)	30 to 36
	No. 4 (4.75 mm)	0 to 3
Fine Aggregate	No. 4 (4.75 mm)	100
	No. 8 (2.36 mm)	82 to 88
	No. 16 (1.18 mm)	60 to 70
	No. 30 (600 µm)	40 to 50
	No. 50 (300 µm)	16 to 26
	No. 100 (150 µm)	5 to 9

b. Bond test. Prior to use, oven-dry the test blocks to constant weight at a temperature of 220°F to 230°F, cool to room temperature, 73.4°F ±3°F, in a desiccator, and clean the surface of the blocks of film or powder by vigorous brushing with a stiff-bristled fiber brush. Two test blocks shall be bonded together on the one inch by 3 inch sawed face with the adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure in a Riehle (or similar) tensile tester. The thickness of the adhesive to be tested shall be 1/4 inch.

606-3.7 Compatibility with asphalt concrete. Test for compatibility with asphalt in accordance with ASTM D5329.

606-3.8 Adhesive compounds - Contractor's responsibility. The Contractor shall furnish the vendor's certified test reports for each batch of material delivered to the project. The report shall certify that the material meets specification requirements and is suitable for use with Portland cement concrete or bituminous concrete pavements. The report shall be delivered to the Engineer before permission is granted for use of the material. In addition the Contractor shall obtain a statement from the supplier or manufacturer that guarantees the material for one year. The supplier or manufacturer shall furnish evidence that the material has performed satisfactorily on other projects.

606-3.9 Application. Adhesive shall be applied on a dry, clean surface, free of grease, dust, and other loose particles. The method of mixing and application shall be in strict accordance with the manufacturer's recommendations. When used with Item P-605(A), such as light can installation, Item P-605(A) shall not be applied until the Item P-606 has fully cured.

METHOD OF MEASUREMENT

606-4.1 No measurement will be made for Adhesive Compounds for Sealing Wire and Lights in Pavement.

BASIS OF PAYMENT

606-5.1 This item shall be incidental to items in specifications L-108, L-852, L-861 and L-867/868.

TESTING REQUIREMENTS

ASTM C192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM D149	Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D1168	Standard Test Method for Hydrocarbon Waxes Used for Electrical Insulation
ASTM D5329	Standard Test Methods for Sealants and Fillers, Hot-applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements

END OF ITEM P-606

ITEM P-610 STRUCTURAL PORTLAND CEMENT CONCRETE

DESCRIPTION

610-1.1 This item shall consist of plain and reinforced structural portland cement concrete (PCC), prepared and constructed in accordance with these specifications, at the locations and of the form and dimensions shown on the plans. This specification shall be used for all structural and miscellaneous concrete including signage bases.

MATERIALS

610-2.1 GENERAL. Only approved materials, conforming to the requirements of these specifications, shall be used in the work. Materials may be subject to inspection and tests at any time during their preparation or use. The source of all materials shall be approved by the Engineer before delivery or use in the work. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be stored and handled to ensure preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed in them.

The use of pit-run aggregates shall not be permitted unless the pit-run aggregate has been screened and washed, and all fine and coarse aggregates stored separately and kept clean. The mixing of different aggregates from different sources in one storage stockpile or alternating batches of different aggregates shall not be permitted.

a. Reactivity. Fine and Coarse aggregates to be used in all concrete shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with both ASTM C1260 and C1567. Aggregate and mix proportion reactivity tests shall be performed for each project.

(1) Coarse and fine aggregate shall be tested separately in accordance with ASTM C1260. The aggregate shall be considered innocuous if the expansion of test specimens, tested in accordance with ASTM C1260, does not exceed 0.10% at 28 days (30 days from casting).

(2) Combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals. If lithium nitrate is proposed for use with or without supplementary cementitious materials, the aggregates shall be tested in accordance with Corps of Engineers (COE) CRD C662. If lithium nitrate admixture is used, it shall be nominal 30% ±0.5% weight lithium nitrate in water.

(3) If the expansion of the proposed combined materials test specimens, tested in accordance with ASTM C1567, modified for combined aggregates, or COE CRD C662, does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion of the proposed combined materials test specimens is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

610-2.2 COARSE AGGREGATE. The coarse aggregate for concrete shall meet the requirements of ASTM C33. Crushed stone aggregate shall have a durability factor, as determined by ASTM

C666, greater than or equal to 95. The Engineer may consider and reserve final approval of other State classification procedures addressing aggregate durability.

Coarse aggregate shall be well graded from coarse to fine and shall meet the following gradation shown in The table below when tested per ASTM C136.

Gradation for Coarse Aggregate
(ASTM C33 #57 (1 in. to No. 4))

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
	ASTM C33 # 57
1-1/2 in. (37.5 mm)	100
1 in. (25 mm)	95-100
1/2 in. (12.5 mm)	25-60
No. 4 (4.75 mm)	0-10
No. 8 (2.36 mm)	0-5

610-2.2.1 Aggregate susceptibility to durability (D) cracking. Aggregates that have a history of D-cracking shall not be used.

610-2.3 Fine aggregate. The fine aggregate for concrete shall meet the requirements of ASTM C33.

The fine aggregate shall be well graded from fine to coarse and shall meet the requirements of the table below when tested in accordance with ASTM C136:

Gradation for Fine Aggregate

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
3/8 inch (9 mm)	100
No. 4 (4.75 mm)	95-100
No. 16 (1.18 mm)	45-80
No. 30 (0.60 mm)	25-55
No. 50 (0.30 mm)	10-30
No. 100 (0.15 mm)	2-10

Blending will be permitted, if necessary, to meet the gradation requirements for fine aggregate. Fine aggregate deficient in the percentage of material passing the No. 50 mesh sieve may be accepted, if the deficiency does not exceed 5% and is remedied by the addition of pozzolanic or cementitious materials other than Portland cement, as specified in paragraph 610-2.6, Admixtures, in sufficient quantity to produce the required workability as approved by the Engineer.

610-2.4 CEMENT. Cement shall conform to the requirements of ASTM C 150 Type II.

If aggregates are deemed innocuous when tested in accordance with paragraph 610-2.1.a.1 and accepted in accordance with paragraph 610-2.1.a.3, higher equivalent alkali content in the cement may be allowed if approved by the Engineer and FAA. If cement becomes partially set or contains

lumps of caked cement, it shall be rejected. Cement salvaged from discarded or used bags shall not be used.

The Contractor shall furnish vendors' certified test reports for each carload, or equivalent, of cement shipped to the project. The report shall be delivered to the Engineer before use of the cement is granted. All test reports shall be subject to verification by testing sample materials received for use on the project.

610-2.5 WATER. The water used in concrete shall be fresh, clean and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials or other substances deleterious to concrete.

610-2.6 ADMIXTURES. The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the Engineer may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the Engineer from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

a. Air-entraining admixtures. Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.

b. Water-reducing admixtures. Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.

c. Other chemical admixtures. The use of set retarding, and set-accelerating admixtures shall be approved by the Engineer. Retarding shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

610-2.7 PREMOLDED JOINT MATERIAL. Premolded joint material for expansion joints shall meet the requirements of ASTM D 1751.

610-2.8 JOINT FILLER. The filler for joints shall meet the requirements of Item P-605, unless otherwise specified.

610-2.9 STEEL REINFORCEMENT. Reinforcing shall consist of welded steel wire fabric conforming to the requirements of ASTM A-185, welded deformed steel fabric conforming to the requirements of ASTM A 497; deformed bar mats conforming to the requirements of ASTM A 184 or A 704; or deformed intermediate grade 40 billet steel conforming to ASTM A 615 and ASTM B 670.

610-2.10 MATERIALS FOR CURING CONCRETE. Curing materials shall conform to ASTM C309 White-pigmented Liquid Membrane-Forming Compound, Type 2, Class B.

CONSTRUCTION METHODS

610-3.1 GENERAL. The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified here. All machinery and equipment used by the Contractor on the work, shall be of sufficient size to meet the requirements of the work. All work shall be subject to the inspection and approval of the Engineer.

610-3.2 CONCRETE COMPOSITION. The concrete shall develop a compressive strength of 4,000 psi in 28 days as determined by test cylinders made in accordance with ASTM C31 and tested in accordance with ASTM C39. The concrete shall contain not less than 600 pounds of cementitious materials per cubic yard. Up to 25% of the cementitious material may be Class F fly ash. Additional fly ash may be incorporated into a concrete mix design to achieve enhanced performance, upon approval of the Engineer. The concrete shall contain 4% of entrained air, ±1%, as determined by ASTM C231 and shall have a slump of not more than 4 inches as determined by ASTM C143.

610-3.3 ACCEPTANCE SAMPLING AND TESTING. Concrete for each structure will be accepted on the basis of the compressive strength specified in paragraph 610-3.2. The concrete shall be sampled in accordance with ASTM C172. Concrete cylindrical compressive strength specimens shall be made in accordance with ASTM C31 and tested in accordance with ASTM C39. The Contractor shall cure and store the test specimens under such conditions as directed by the Engineer. The City of Phoenix Materials Laboratory will make the actual tests on the specimens at no expense to the Contractor.

610-3.4 QUALIFICATIONS FOR CONCRETE TESTING SERVICE. Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of ASTM C1077 or ASTM E329.

610-3.5 PROPORTIONING AND MEASURING DEVICES. When package cement is used, the quantity for each batch shall be equal to one or more whole sacks of cement. The aggregates shall be measured separately by weight. If aggregates are delivered to the mixer in batch trucks, the exact amount for each mixer charge shall be contained in each batch compartment. Weighing boxes or hoppers shall be approved by the Engineer and shall provide means of regulating the flow of aggregates into the batch box so the required, exact weight of aggregates is obtained.

610-3.6 CONSISTENCY. The consistency of the concrete shall be determined by the slump test specified in ASTM C143.

610-3.7 MIXING. Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of ASTM C94.

610-3.8 MIXING CONDITIONS. The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 40°F without permission of the Engineer. If permission is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 50°F nor more than 100°F. The Contractor shall be held responsible for any defective work,

resulting from freezing or injury in any manner during placing and curing, and shall replace such work at his/her expense.

Retempering of concrete by adding water or any other material shall not be permitted.

The rate of delivery of concrete to the job shall be sufficient to allow uninterrupted placement of the concrete.

610-3.9 FORMS. Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the Engineer. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as shown on the plans. The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. The Contractor shall be responsible for their adequacy.

The internal form ties shall be arranged so no metal will show in the concrete surface or discolor the surface when exposed to weathering when the forms are removed. All forms shall be wetted with water or with a non-staining mineral oil, which shall be applied immediately before the concrete is placed. Forms shall be constructed so they can be removed without injuring the concrete or concrete surface. The forms shall not be removed until at least 30 hours after concrete placement for vertical faces, walls, slender columns, and similar structures. Forms supported by falsework under slabs, beams, girders, arches, and similar construction shall not be removed until tests indicate the concrete has developed at least 60% of the design strength.

610-3.10 PLACING REINFORCEMENT. All reinforcement shall be accurately placed, as shown on the plans, and shall be firmly held in position during concrete placement. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

610-3.11 EMBEDDED ITEMS. Before placing concrete, all embedded items shall be firmly and securely fastened in place as indicated. All embedded items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The concrete shall be spaded and consolidated around and against embedded items. The embedding of wood shall not be allowed.

610-3.12 PLACING CONCRETE. All concrete shall be placed during daylight hours, unless otherwise approved. The concrete shall not be placed until the depth and condition of foundations, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved by the Engineer. Concrete shall be placed as soon as practical after mixing, but in no case later than one (1) hour after water has been added to the mix. The method and manner of placing shall avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. The concrete shall not be dropped from a height of more than 5 feet. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation. Concrete shall be placed on clean, damp surfaces, free from running water, or on a properly consolidated soil foundation.

610-3.13 VIBRATION. Vibration shall follow the guidelines in American Concrete Institute (ACI) Committee 309, Guide for Consolidation of Concrete. Where bars meeting ASTM A775 or A934 are used, the vibrators shall be equipped with rubber or non-metallic vibrator heads. Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs

greater than 4 inches in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 cycles per minute when submerged. Do not use vibrators to transport the concrete in the forms. Penetrate the previously placed lift with the vibrator when more than one lift is required. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete. Vibrators shall be manipulated to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. The vibration at any point shall be of sufficient duration to accomplish compaction but shall not be prolonged to where segregation occurs. Concrete deposited under water shall be carefully placed in a compact mass in its final position by means of a tremie or other approved method and shall not be disturbed after placement.

610-3.14 CONSTRUCTION JOINTS. If the placement of concrete is suspended, necessary provisions shall be made for joining future work before the placed concrete takes its initial set. For the proper bonding of old and new concrete, provisions shall be made for grooves, steps, reinforcing bars or other devices as specified. The work shall be arranged so that a section begun on any day shall be finished during daylight of the same day. Before depositing new concrete on or against concrete that has hardened, the surface of the hardened concrete shall be cleaned by a heavy steel broom, roughened slightly, wetted, and covered with a neat coating of cement paste or grout.

610-3.15 EXPANSION JOINTS. Expansion joints shall be constructed at such points and dimensions as indicated on the drawings. The premolded filler shall be cut to the same shape as the surfaces being joined. The filler shall be fixed firmly against the surface of the concrete already in place so that it will not be displaced when concrete is deposited against it.

610-3.16 DEFECTIVE WORK. Any defective work discovered after the forms have been removed, which in the opinion of the Engineer cannot be repaired satisfactorily, shall be immediately removed and replaced at the expense of the Contractor. Defective work shall include deficient dimensions, or bulged, uneven, or honeycomb on the surface of the concrete.

610-3.17 SURFACE FINISH. All exposed concrete surfaces shall be true, smooth, and free from open or rough areas, depressions, or projections. All concrete horizontal plane surfaces shall be brought flush to the proper elevation with the finished top surface struck-off with a straightedge and floated. Mortar finishing shall not be permitted, nor shall dry cement or sand-cement mortar be spread over the concrete during the finishing of horizontal plane surfaces.

The surface finish of exposed concrete shall be a rubbed finish. If forms can be removed while the concrete is still green, the surface shall be wetted and then rubbed with a wooden float until all irregularities are removed. If the concrete has hardened before being rubbed, a carborundum stone shall be used to finish the surface. When approved, the finishing can be done with a finishing machine.

610-3.18 CURING AND PROTECTION. All concrete shall be properly cured and protected by the Contractor. The concrete shall be protected from the weather, flowing water, and from defacement of any nature during the project. The concrete shall be cured by covering with an approved material as soon as it has sufficiently hardened. Water-absorptive coverings shall be thoroughly saturated when placed and kept saturated for at least three (3) days following concrete placement.

All curing mats or blankets shall be sufficiently weighted or tied down to keep the concrete surface covered and to prevent the surface from being exposed to air currents. Wooden forms shall be kept wet at all times until removed to prevent opening of joints and drying out of the concrete. Traffic shall not be allowed on concrete surfaces for seven (7) days after the concrete has been placed.

610-3.19 DRAINS OR DUCTS. Drainage pipes, conduits, and ducts that are to be encased in concrete shall be installed by the Contractor before the concrete is placed. The pipe shall be held rigidly so that it will not be displaced or moved during the placing of the concrete.

610-3.20 COLD WEATHER PLACING. When concrete is placed at temperatures below 40°F, the Contractor shall provide satisfactory methods and means to protect the mix from injury by freezing. The aggregates, or water, or both, shall be heated to place the concrete at temperatures between 50°F and 100°F.

Calcium chloride shall not be used in any concrete containing steel reinforcement or steel embedded items. Calcium chloride may be incorporated in the mixing water when directed by the Engineer. Not more than 2 pounds of Type 1 nor more than 1.6 pounds of Type 2 shall be added per bag of cement. After the concrete has been placed, the Contractor shall provide sufficient protection such as cover, canvas, framework, heating apparatus, etc., to enclose and protect the structure and maintain the temperature of the mix at not less than 50°F until at least 60% of the design strength has been attained.

610-3.21 HOT WEATHER PLACING. Concrete shall be properly placed and finished with procedures previously submitted. The concrete-placing temperature shall not exceed 95°F when measured in accordance with ASTM C1064. Cooling of the mixing water and aggregates, or both, may be required to obtain an adequate placing temperature. A retarder meeting the requirements of paragraph 501-2.10c Other Admixtures may be used to facilitate placing and finishing. Steel forms and reinforcement shall be cooled prior to concrete placement when steel temperatures are greater than 120°F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature. Submit the proposed materials and methods for review and approval by the Engineer, if concrete is to be placed under hot weather conditions.

610-3.22 FILLING JOINTS. All joints that require filling shall be thoroughly cleaned, and any excess mortar or concrete shall be cut out with proper tools. Joint filling shall not start until after final curing and shall be done only when the concrete is completely dry. The cleaning and filling shall be done with proper equipment to obtain a neat looking joint free from excess filler.

QUALITY CONTROL

610-4.1 CONTRACTOR QUALITY CONTROL. The Contractor shall be responsible for developing and implementing a Contractor Quality Control Program including inspection and testing to assure compliance with the requirements of this section in accordance with General Provisions Section 100.

METHOD OF MEASUREMENT

610-5.1 Portland Cement Concrete shall not be measured, and shall be incidental to the structure or item into which it is incorporated, including but not limited to, drainage structures and airfield electrical items

610-5.2 Reinforcing steel shall not be measured, and shall be considered incidental to the structure or item into which it is incorporated, including but not limited to, drainage structures and airfield electrical items.

BASIS OF PAYMENT

610-6.1 This item shall be incidental to items in the Technical Special Provisions, Civil Technical Specifications and Electrical Technical Specifications where the installation of P-610 Concrete is specified, including but not limited to Items P-104, D-701, D-751, U-200, L-110, L-115(A), L-804, L-849, L-852, L-858, L-867/868 and L-880.

TESTING REQUIREMENTS

ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064	Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

ASTM C1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

ASTM C1260 Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

ASTM C1567 Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregates (Accelerated Mortar-Bar Method)

ASTM E329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

U.S. Army Corps of Engineers USACE) Concrete Research Division (CRD) C662 Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

MATERIAL REQUIREMENTS

ASTM A184 Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement

ASTM A185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A704 Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement

ASTM A706 Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars

ASTM A934 Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars

ASTM A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

ASTM C33 Standard Specification for Concrete Aggregates

ASTM C94 Standard Specification for Ready-Mixed Concrete

ASTM C150 Standard Specification for Portland Cement

ASTM C171 Standard Specification for Sheet Materials for Curing Concrete

ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 309R	Guide for Consolidation of Concrete

END OF ITEM P-610

ITEM P-620 RUNWAY AND TAXIWAY MARKING

DESCRIPTION

620-1.1 This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Engineer. The terms “paint” and “marking material” as well as “painting” and “application of markings” are interchangeable throughout this specification.

Also included in this item are the application of temporary pavement markings and the removal of same temporary markings from asphalt concrete or Portland Cement Concrete (PCC) surfaces.

MATERIALS

620-2.1 MATERIAL ACCEPTANCE. The Contractor shall furnish manufacturer’s certified test reports for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. The reports can be used for material acceptance or the Engineer may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the Engineer upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers 55 gallons or smaller for inspection by the Engineer. Material shall not be loaded into the equipment until inspected by the Engineer.

620-2.2 MARKING MATERIALS. Paint shall be waterborne in accordance with the requirements of paragraph 620-2.2**a**. Paint shall be furnished in White – 37925, Red – 31136, Yellow – 33538 or 33655, and Black – 37038 in accordance with Federal Standard No. 595.

a. Waterborne. Paint shall meet the requirements of Federal Specification TT-P-1952E, Type III – Fast drying time for all markings when tested in accordance with ASTM D711. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. The acrylic resin used for Type III shall be 100% cross linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm-l with intensities equal to those produced by an acrylic resin known to be 100% cross linking.

620-2.3 REFLECTIVE MEDIA. Glass beads shall meet the requirements for Federal Specification TT-B-1325D, Type IV, Gradation A. Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

CONSTRUCTION METHODS

620-3.1 WEATEHR LIMITATIONS.

a. Permanent painting shall be performed only when the surface is dry and when the surface temperature is at least 45°F and rising and the pavement surface temperature is at least 5°F above the dew point or meets the manufacturer’s recommendations. Painting operations shall be discontinued when the surface temperature exceeds the paint manufacturer’s recommendations. Markings shall not be applied when the pavement temperature is greater

than 130°F. Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns.

b. Temporary painting to be removed later may be performed when the surface is dry and when the surface temperature is at least 45° F and rising. Temporary painting which has been applied to permit runways and taxiways to be re-opened for operations and which will become a part of the permanent marking is subject to the same weather limitations as permanent painting in subparagraph **a.** above.

620-3.2 EQUIPMENT. Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless-type marking machine suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. Pavement marking removal and PCCP cure compound removal equipment shall be high pressure water blasting equipment only. Grinding or other methods shall not be permitted.

620-3.3 PREPARATION OF SURFACE. Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other foreign material that would reduce the bond between the paint and the pavement. The area to be painted shall be cleaned by use of a power vacuum broom, as specified in Civil Technical Specification Item M-003, to remove all dirt, laitance, and loose materials. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the Engineer. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

Paint shall not be applied to Portland cement concrete pavement until the areas to be painted are clean of curing material. Waterblasting (high-pressure water) shall be used to remove curing materials.

At least 24 hours prior to remarking existing markings, the existing markings must be removed such that 75% of the existing markings are removed with low (3,500-10,000 psi) waterblaster. After waterblasting, the surface shall be cleaned of all residue or debris either with sweeping or blowing with compressed air or both.

Prior to the initial application of markings, the Contractor shall certify in writing that the surface has been prepared in accordance with the paint manufacturer's requirements, that the application equipment is appropriate for the type of marking paint and that environmental conditions are appropriate for the material being applied. This certification along with a copy of the paint manufacturer's surface preparation and application requirements must be submitted and approved by the Engineer prior to the initial application of markings.

620-3.4 LAYOUT OF MARKINGS. The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans. All paint, except green and black paint, shall receive glass beads.

620-3.5 APPLICATION. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the Engineer. The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m), and marking dimensions and spacings shall be within the following tolerances:

Dimension and Spacing	Tolerance
36 inch or less	±1/2 inch
greater than 36 inch to 6 feet	±1 inch
greater than 6 feet to 60 feet	±2 inch
greater than 60 feet	±3 inch

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate shown in Table 1. The addition of thinner will not be permitted. A period of **30 days** shall elapse between placement of a bituminous surface course or seal coat and application of the paint.

Temporary paint markings which will become a part of the permanent paint marking and which are required to open an area to air traffic operations can be marked in accordance with the time limits specified in the Construction Safety and Phasing Plan (CSSP), generally just before the area is re-opened for air operations. Temporary markings shall be applied at 50 percent of the specified application rates for permanent paint markings in Table 2. Glass beads are not required for temporary markings.

Prior to the initial application of markings, the Contractor shall certify in writing that the surface has been prepared in accordance with the paint manufacturer's requirements, that the application equipment is appropriate for the marking paint and that environmental conditions are appropriate for the material being applied. This certification along with a copy of the paint manufactures application and surface preparation requirements must be submitted to the Engineer prior to the initial application of markings.

620-3.6 TEST STRIP. Prior to the full application of airfield markings, the Contractor shall produce a test strip in the presence of the Engineer. The test strip shall include the application of a minimum of 5 gallons of paint and application of 50 lbs of Type IV glass beads. The test strip shall be used to establish thickness/darkness standard for all markings. The test strip shall cover no more than the maximum area prescribed in Table 1, e.g., for 5 gallons of Waterborne Type III paint shall cover no more than 575 square feet.

Table 1. Application Rates For Paint And Glass Beads
(See Note regarding Red and Pink Paint)

Paint Type	Paint Square feet per gallon, ft^2/gal	Type IV Glass Beads, Pounds per gallon of paint, lb/gal
Waterborne Type III	55 ft^2/gal max	8 lb/gal min

Note: The glass bead application rate for Red and Pink paint shall be reduced by 2 lb/gal for Type IV beads.

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment should be performed.

All emptied containers shall be returned to the paint storage area for checking by the Engineer. The containers shall not be removed from the airport or destroyed until authorized by the Engineer.

620-3.7 Protection and cleanup. After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings.

Temporary markings that are designated to be removed following completion of construction phases in accordance with the CSSP shall be removed as specified in Item P-620(A).

The Contractor shall remove from the work area all debris, waste, loose or unadhered reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the Engineer. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations.

CONTRACTOR QUALITY CONTROL

620-4.1 The Contractor shall be responsible for developing and implementing a Contractor Quality Control Program including inspection and testing to assure compliance with the requirements of this section in accordance with the General Provisions Section 100.

Paint curling and adherence to Paint Manufacturer's recommendations shall be addressed. In 2000 and 2001 the Northwest Mountain Region reported that it and other FAA Regions had been experiencing curling of new airport pavement markings. The curling is typically at the edges of the marking and will chip off under traffic. The problems were with waterborne paints and coincided with changes made to the FAA specification several years before. The exact cause is not known; however, the dry film thicknesses of the paint chips were in excess of 15 mils. The most probable cause is the paint shrinkage during drying creates tensile stresses in the paint film. The thicker films have more shrinkage and overall greater cohesive strength than the thinner films. The tensile forces eventually exceed the adhesion strength at the edges and they de-bond and curl. In some cases, on slurry seals the failure will occur at the weakest plane, between the slurry and the original surface.

The P-620 specification requires that Type I and II waterborne paint be applied at a maximum of 115 square feet per gallon which according to the Northwest Region is equivalent to a minimum of 13.9 mils wet film thickness or about 8.3 mils dry film thickness. Type III is applied at a heavier rate when Type IV Beads are used. TT-P-1952 provides guidance that when Type IV B beads are used, the wet film paint thickness should be 0.381 to 0.477 mm (15 to 18.8 mils).

The Quality Control Program shall address paint and bead manufacturer's recommendations for:

a. Wet film thickness, conversion to mils and square feet per gallon

b. Beads Type IV, Gradation A pounds/gallon of paint and conversion to square feet per pound.

c. Beads Type III (for temporary marking) pounds/gallon of paint and conversion to square feet per pound.

d. Quality control measures to assure the proper application rates of paint and beads.

e. Inspection procedures to verify maximum paint film thickness as recommended by the manufacture and methods to determine the paint film thickness is not exceeded.

METHOD OF MEASUREMENT

620-5.1 The quantity of runway and taxiway markings to be paid for shall be the number of square feet of permanent and temporary markings and surface painted signs completed and accepted by the Engineer.

BASIS OF PAYMENT

620-6.1 Payment shall be made at the contract unit price per square foot for pavement markings, surface painted hold signs, and existing pavement marking removal. This price shall be full compensation for furnishing all materials including paint and glass beads and for all labor, equipment, tools, and incidentals necessary to complete the item.

In the case of Temporary Marking Application and Removal, the cost of removal and obliteration of the temporary paint markings shall be included in the contract unit price per square foot.

Payment will be made under:

Item P-620-6.1 Temporary Airfield Pavement Marking, Yellow (50% Application Rate) – per square foot

Item P-620-6.2 Airfield Pavement Marking, Yellow – per square foot

Item P-620-6.3 Airfield Pavement Marking, White – per square foot

Item P-620-6.4 Airfield Pavement Marking, Black – per square foot

Item P-620-6.5 Airfield Pavement Marking, Red – per square foot

TESTING REQUIREMENTS

ASTM C371	Standard Test Method for Wire-Cloth Sieve Analysis of Nonplastic Ceramic Powders
ASTM D92	Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D711	Standard Test Method for No-Pick-Up Time of Traffic Paint
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

MATERIAL REQUIREMENTS

ASTM D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
40 CFR Part 60, Appendix A-7, Method 24	Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings
29 CFR Part 1910.1200	Hazard Communication
FED SPEC TT-B-1325D	Beads (Glass Spheres) Retro-Reflective

American Association
of State Highway and
Transportation Officials

(AASHTO) M247 Standard Specification for Glass Beads Used in Pavement Markings

FED SPEC TT-P-1952E Paint, Traffic and Airfield Marking, Waterborne

Commercial Item
Description
A-A-2886B Paint, Traffic, Solvent Based

FED STD 595 Colors used in Government Procurement

AC 150/5340-1 Standards for Airport Markings

END OF ITEM P-620

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ITEM P-620(A) AIRFIELD PAINT REMOVAL

DESCRIPTION

620(A)-1.1 This item shall consist of the removal of existing airfield paints including, but not limited to, numbers, markings and stripes on the surface of asphalt or concrete pavements at the locations indicated on the plans or as directed by the Engineer.

MATERIALS

620(A)-2.1 EQUIPMENT. Removal equipment may include high pressure water, media blasting physical removal devices that do not harm the pavement.

CONSTRUCTION METHODS

620(A)-3.1 TEST SECTION. Prior to beginning full-scale removal, the Contractor shall demonstrate to the Engineer the method and effectiveness of the removal process on a section of paint no less than 50 square feet. To be considered acceptable, the process employed must remove the paint without leaving an objectionable shadow as determined solely by the Engineer and not damage the underlying pavement. Where there is to be removal on both concrete and asphalt surfaces, there will be two test sections. The Engineer shall be the sole judge of the acceptability of the process.

620(A)-3.2 REMOVAL. Once the Engineer has accepted the method to be employed, the Contractor shall remove the paint on the designated areas. The removal of markings must include a pre-determined larger size and shape of a removal area that encompasses the old markings and groups adjacent markings together into larger rectangular removal areas. Marking removals must be completed as required in AC 150/5340-1L. Threshold marking removals must remove markings in groups and be rectangular in shaped. Rectangles must be strikingly larger in size when compared to the size of the markings.

620(A)-3.3 CLEANUP. The Contractor shall insure that any residue from the removal operation is removed in a manner acceptable to the Engineer. The City of Phoenix environmental department will test the paint for lead prior to the start of construction. If lead is present, the Contractor shall collect the paint residue and dispose at a suitable facility off Airport property.

620(A)-3.4 REPAIR. Airfield pavements damaged during paint removal shall be repaired/replaced to the satisfaction of Phoenix Aviation and the Engineer. The Contractor shall submit a plan detailing the means and methods for review by the Engineer and Phoenix Aviation Department.

METHOD OF MEASUREMENT

620(A)-4.1 The quantity of airfield paint removal to be paid for shall be the number of square feet of **existing** paint marking and stripes of the various types removed.

The amount of paint removal associated with **temporary marking** shall not be measured separately, but shall be incidental to the cost of temporary marking.

BASIS OF PAYMENT

620(A)-5.1 Payment shall be made at the contract unit price per square foot for existing airfield paint removal. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

620(A)-5.2 In the event that the pavements are damaged during the obliteration process, even after the completion of satisfactory test strips, then the pavements shall be repaired to the satisfaction of the Engineer and Phoenix Aviation Department. Measurement and payment for unanticipated work under item 620(A)-5.2 shall be measured and paid for as an allowance, with work authorized by the City.

Payment will be made under:

Item P-620(A)-5.1 Remove Existing Airfield Markings – per square foot

Item P-620(A)-5.2 Pavement Repair (Allowance) – per Allowance

FAA TECHNICAL REFERENCES

AC 150/5340-1L Standards for Airport Markings

END OF ITEM P-620(A)

ITEM U-200 LOCATION OF UNDERGROUND UTILITIES

DESCRIPTION

200-1.1 SCOPE. This item shall govern the field location of all underground existing utilities in areas to be improved, to avoid conflicts with proposed surface or underground improvements. Utility designating and limited potholing on storm drain alignments within the Runway and Taxiway work zones was conducted during design on electrical, telephone, FAA cable, gas, communication, and APS electric. Work under this section shall include any additional designation and potholing as required to supplement that work and provide additional information as necessary on existing City of Phoenix/Aviation Department underground utilities. This shall include, but not be limited to, the location of electrical and communication ducts, airfield lighting and control cables. It is the intent of this specification to provide for the location of existing utilities and, by hand digging, particularly of direct burial cables for airfield lighting.

a. General Requirements. See Technical Special Provision 1.3 and Supplementary Conditions 15.

b. The contractor is hereby advised that the location of all utilities, as shown on the Plans, may not be complete or exact. The Contractor shall satisfy himself as to the exact location of the utilities by contacting all utility companies before proceeding with the work and by having a private utility locating firm locate and identify all utilities at the work site prior to any construction. The Contractor shall be responsible for any and all costs as a result of damage caused by construction activities to public or private property or utilities.

CONSTRUCTION METHODS

200-1.2 GENERAL.

a. Utilities, utility appurtenances and cable encountered by the Contractor during the construction of this project shall be protected by the Contractor as needed to permit construction and to conform to the finished grades on the project. Use of mechanical equipment of any kind to verify utility locations are expressly prohibited. The Contractor shall immediately repair any damaged utilities at his own expense.

b. Coordinate all contacts with companies maintaining utilities at the Airport through the Engineer prior to any exaction/digging. Provide the Engineer with written documentation of how utility locations were verified.

c. Continuously maintain utilities for facilities and/or systems which are or may be affected by work associated with the project. Prepare and maintain a contingency plan, approved by the Engineer, to restore to service all utilities and/or control/signal cables which may be placed out of service or damaged during performance of the work. The Contractor shall provide the Engineer, Phoenix Goodyear Airport (GYR) Operations and the Aviation Department Project Manager with written reports on all cable cuts.

d. Take all measures necessary to accurately locate all the routing of underground cable and utilities within project areas to be excavated, trenched or drilled. Contractor shall locate underground cables and utilities by designation, and where necessary, potholing and/or hand digging. Once located, place highly visible and durable markers along all such cable and utility

route at intervals of not greater than 25 feet. The Contractor shall maintain these markers in their original location throughout the project. The Contractor shall also be responsible for providing and maintain a field survey and plan of the maker locations and shall replace any disturbed makers at his own expense. Do not use power equipment with teeth when excavating where cables are marked. Obtain Engineer approval of proposed marking device. Use semi-permanent makers which are low profile, frangible and non-metallic within runway/taxiway safety areas and navigational and restricted zones.

e. Utilities located by potholing and/or hand digging shall be surveyed by the Contractor. Coordinates and elevations shall be submitted to the Engineer and marked on the Contractor maintained record drawings.

CONTRACTOR QUALITY CONTROL

200-4.1 The Contractor shall be responsible for developing and implementing a Contractor Quality Control Program including inspection and testing to assure compliance with the requirements of this section in accordance with the General Provisions Section 100.

METHOD OF MEASUREMENT

200-5.1 Measurement for "Underground Utility Location Allowance" shall be by the actual cost of the work. Cost for work for subcontractors (i.e., Utility Designation/Potholing contractor) will be based upon invoiced cost from the subcontractor. Cost shall be calculated in accordance with the City of Phoenix Supplement to the MAG Uniform Specifications, Section 109, as modified by the provisions of Technical Special Provision Paragraph 1.2. Underground Utility Location costs will be subject to daily monitoring and approval by the Engineer.

BASIS OF PAYMENT

200-6.1 Payment for location of underground utilities, measured as prescribed above, shall be paid from the allowance "U-200-6.1 – Underground Utility Location Allowance – Lump Sum" based on approved actual costs. Such payment shall be full compensation for furnishing, all labor, equipment, tools and materials and for the designation, preparation, excavation, backfilling and placing of materials; and for all incidentals necessary. Payment for the costs of each utility location will not be made until satisfactory survey data has been submitted to the Engineer.

Payment will be made under:

Item U-200-6.1 Underground Utility Location Allowance – per Allowance

END ITEM U-200

ELECTRICAL TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

ITEM	DESCRIPTION	PAGE
L-100	Electrical General Requirements.....	L-100 – 1
L-108	Underground Power Cable for Airports.....	L-108 – 1
L-110	Airport Underground Electrical Duct Banks and Conduits.....	L-110 – 1
L-115	Electrical Manholes and Junction Structures.....	L-115 – 1
L-804(L)	LED Elevated Runway Guard Lights.....	L-804(L) – 1
L-852(L)	In-Pavement LED Taxiway Lights.....	L-852(L) -1
L-858(L)	Airport Guidance Lighting Systems (Signage).....	L-858(L) – 1
L-861T(L)	Elevated Medium Intensity LED Taxiway Edge Light.....	L-861T(L) – 1
L-867/868	Light Base and Transformer Housing.....	L-867/868 – 1

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ITEM L-100 ELECTRICAL GENERAL REQUIREMENTS

DESCRIPTION

100-1.1 GENERAL. This Item includes furnishing and installing all material, equipment and apparatus, and all labor, tools, services and equipment required for the demolition/removal of portions of the existing airfield lighting systems, as specified in this specification and as shown in the drawings.

a. The demolition, salvage and/or removal of portions of the existing airfield lighting systems.
b. Temporary airfield lighting systems.

Installation shall be in accordance with Specifications FAA-C-1217 and FAA-C-1391, except as specified herein. Perform all work not included in the FAA Specifications in accordance with the National Electrical Code, applicable local and Phoenix Goodyear Airport standards and regulations.

100-1.2 DEMOLITION AND SALVAGE.

a. Removal and/or salvage of airfield electrical elements is included under this Item shall include the intent, but not be limited to the specific elements, of the following:

(1) Elevated and Inpavement Taxiway Light Fixtures and Isolation Transformers.
(2) Runway Guard Lights
(3) Airfield Guidance Signs and Isolation Transformers

b. Salvaged fixtures shall be carefully removed, protected from damage and stored neatly and cleanly by Contractor during construction until re-installation. Any fixtures damaged that are to remain in-place, or identified as salvage on the plans shall be replaced at Contractor's expense. Salvaged fixtures that are not designated for re-installation shall be returner to Airfield Maintenance unless determined by Airport that they are to become the property of the Contractor and properly disposed of in accordance with applicable ordinances.

c. Demolition (removal and non-salvage to Owner or for re-installation) of other airfield electrical system elements shall include the intent, but not limited to the specific elements, of the following:

(1) Taxiway circuit power cables.
(2) Underground conduits and duct banks, both concrete encased and direct earth buried.
(3) Sign and light fixture concrete encased bases and miscellaneous concrete footings.
(4) Handholes and pullboxes

(5) Grading and backfill associated with removal of the foregoing elements shall be covered under other Items of these specifications (P-152, "Excavation and Embankment").

100-1.3 NEW CONSTRUCTION GRADING AND BACKFILL.

a. Grading and backfill associated with the construction of the new ducts and conduits shall be installed in accordance with P-152, "Excavation and Embankment" P-153, "Controlled Low-Strength Material (CLSM)" and P-610 "Concrete", there will be no separate measurement or payment for any backfill, compaction, or materials for slurry or concrete encased duct banks but shall be considered incidental to the associated item being installed.

100-1.4 RELATED DOCUMENTS. The General Provisions of the Contract, including General and Special Conditions, apply to work specified in this item.

a. Conflicts between Drawing and Specifications (Contract Documents) and between Contract Documents and references within the Contract Documents: Drawings and specifications are complementary. Work called for by one is binding as if called for by both. Prospective Contractors shall, as part of their proposals, enumerate, identify and list conflicts they find to exist within the Contract Documents, and between these Documents and the rules, regulations, standards and codes of the authority having jurisdiction (Airport Authority, City County, etc). local Utility companies and local County or State governing bodies. No Allowance shall subsequently be made to the Contractor by reason of his/her failure to have brought said discrepancies to the attention of the Consultant during the bidding period or by reason of any error on the Contractor's part.

100-1.5 TEMPORARY LIGHTING AND CIRCUITS.

Contractor shall coordinate with Operations and Maintenance at the end of each daylight work shift to verify that all airfield lighting circuits are operational. Contractor shall provide all labor and material for this work.

a. Temporary cable installation shall be protected. Temporary cable (jumpers) and it's installation through the existing conduit system or through temporary conduit, shall all be furnished, installed, and removed by the Contractor at no additional compensation beyond the payment for each demolition item. No separate payment will be made for counterpoise, ground rods, grounding connectors, conduit, trench and backfill, or other protection for the temporary jumper cable. Temporary cable shall not be used in the permanent installation. ***Temporary cable shall not be direct buried.*** Other methods may be used for short term or emergency situations only if approved by the Goodyear Airport Head Airfield Electrician. Where cable in conduit is approved for temporary placement on the surface, the conduit shall be held in place in a manner approved by the Construction Manager, and the Contractor shall provide temporary traffic protection for the cable and/or conduit. Temporary cable locations shall be marked sufficiently to prevent damage from construction equipment.

b. Contractor shall provide and maintain on hand sufficient equipment required to provide temporary lighting and circuit extensions.

100-1.6 SPECIFICATIONS AND STANDARDS. As a supplement to the installation requirements of this item, the following standard specifications and regulations of the issues in effect on the date of this solicitation are incorporated herein by reference and are made a part hereof for electrical work and installation and splicing of underground cables.

NEC	National Electrical Code
FAA-STD-019e	Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities
FAA-C-1391b	Installation and Splicing of Underground Cables
Local Governing Bodies' Codes and Regulations	Public Works Department, City of Phoenix, Maricopa Association of Governments (MAG)

100-1.7 SHOP DRAWINGS AND MATERIAL LISTS. Prior to the installation of any material and equipment and within 30 days of contract award, the Contractor shall submit to the Owner for approval six (6) copies of manufacturers' brochures or electronic PDF, tabbed by specification containing complete dimensional and performance characteristics, wiring diagrams, installation and operation instructions, etc., for the equipment listed in the individual L-Series specification Items. All shop drawings and equipment submittals shall include a signed certification by the contractor that the proposed items are listed in the FAA certification program.

Taxiway signs and related materials covered by FAA Specifications shall have the prior approval of the Federal Aviation Administration, Airport Service, Washington, DC 20591, shall be listed in the latest edition of Advisory Circular 150/5345-53, Airport Lighting Equipment Certification Program, shall be certified by an approved laboratory such as ETL as conforming with applicable FAA standards and requirements, or shall be verified as exceeding FAA standards as required by these specifications.

All new components furnished by the contractor under this project must also be listed as approved in the FAA's Airport Lighting Certification Program, which is available on-line at: http://www.faa.gov/airports/resources/advirsory_circulars/index.cfm/go/document.information/documentID/22802

A materials list shall be submitted listing each specification paragraph number and stating whether the materials proposed are as specified or are substitutions. If the item is a substitute item, a complete submittal as described in the above paragraph shall be provided for that item.

The submittal shall be complete and made in one submission in booklet form with hard-bound cover or electronic PDF, tabbed by specification. Partial submissions will not be reviewed or considered.

100-1.8 SPARE FIXTURE INVENTORY REPLACEMENT. The Contractor shall replace spares or salvaged lighting items that the Contractor uses or damages during construction so that at the end of the project, the stipulated number (minimum) of good working spares shall be delivered to the Owner.

EQUIPMENT AND MATERIALS

100-2.1 EQUIPMENT. Conduits, conduit fittings, conductors, connectors, boxes, wiring devices, panelboards, and circuit breakers shall meet requirements of Specification FAA-C-1217.

100-2.2 CONDUIT, EXTERIOR. Conduits in concrete slabs, in block walls or exterior exposed shall be rigid galvanized steel (RGS). Conduits run on the exterior of the building above or below the grade for the earth grounding system shall be rigid zinc-coated steel. Radius of bends in RGS shall be minimum 12 nominal pipe diameters. Rigid galvanized steel conduit run in concrete or below slab on grade, or in the ground, shall be field wrapped or shall have factory-applied coating as required in Specification FAA-C-1217. Field-made joints, fittings, abrasions and holidays shall be coated or wrapped with material equal to the original coating or wrapping.

100-2.3 CONDUIT, UNDERGROUND. Conduits run underground are specified in Item L-110 of these specifications.

100-2.4 CONDUIT FITTINGS. Each conduit and nipple entrance to junction boxes, panelboards, disconnect switches, duct, raceway, equipment cabinets, and other such electrical enclosures shall be fitted with double locknuts (one each side of metal penetrated) and insulating bushing. Bushings on 1-1/4 inch and larger conduits shall be insulated metallic, type OZ/Gedney Cat. No. IBC Series, or equal; bushings for 3/4 inch and 1 inch shall be plastic insulated T&B rated for 150 C, or equal. All insulated bonding and grounding bushings of conduits for 2400 volts or higher voltages, for conduit going underground, and for conduits going into concrete slabs shall be OZ/Gedney Cat. No. IBC-xxL (fitted with grounding lug), or equal. The bushings shall be connected to the grounding system within the terminating enclosure and not on the underground end. The buried end of each conduit shall be fitted with a thermosetting, plastic-insulated, metallic bushing. All openings where conduits enter junction boxes, other enclosures and shelters shall be sealed weather-tight. The conduit shall be capped, if left empty, or sealed with Ducseal, or equal, around the conductors for exterior conduits.

100-2.5 CONCRETE-ENCASED DUCT. Concrete-encased PVC duct shall be as specified in Item L-110.

100-2.6 CONCRETE DUCT MARKERS. Markers shall be as specified in Item L-110 and as detailed on drawings.

100-2.7 CONCRETE HANDHOLES. Hand holes shall be as specified in Item L-115 and as detailed on drawings.

100-2.8 LIGHT BASES AND TRANSFORMER HOUSING. Base cans, transformer housings and covers shall be specified in item L-867/868 and as detailed on drawings.

CONSTRUCTION METHODS

100-3.1 EXISTING UTILITIES. Prior to any excavation or trenching, locate any existing cables and utilities which will be crossed by the trench. Ensure these utilities are permanently disconnected if they are going to be demolished. The existing service lines shall be exposed by hand-digging in those areas that will be crossed and shall be protected from any possible damage. If any damage occurs, it shall be the Contractor's responsibility to immediately repair such damage with materials and methods approved by the Owner and in compliance with applicable codes and standards, at no additional cost to the Owner. Existing utilities to be abandoned or removed at the point of crossing as shown on the drawings.

100-3.2 DEMOLITION.

A. General Airfield Lighting.

(1) Remove indicated taxiway lights with isolation transformers and light bases. Salvage to Phoenix Goodyear Airport where not designated for re-installation.

(2) Remove indicated airfield cable segments from within conduits and ducts. Existing cable may be sleeved above ground as temporary jumper to facilitate modification to existing conduits.

(3) Remove indicated conduits, ducts, hand holes, manholes and conductors from site and dispose of according to local regulations. Provide backfill and compaction meeting the requirements of P-152. Backfill and compaction shall be incidental to the demolition items. Non – salvageable material, including conduit, concrete hand holes, base cans, and conductors, shall become the property of the Contractor and shall be removed from the site and disposed of according to local regulations.

(4) Salvageable material and equipment, including fixtures and isolation transformers (which are not slated for re-installation), shall be re-installed or turned over to the appropriate airport personnel.

(5) Segments of existing airfield circuit cables between hand holes shall be carefully removed, neatly coiled within the structure where cables have been removed back to and protected during construction until re-installation as indicated on plans.

100-3.3 CONDUCTORS. Installation of underground 5 kV conductors is specified in Item L-108 of these specifications.

100-3.4 GROUNDING. All metal support structures and metal enclosures shall be grounded in accordance with the requirements of the Specifications FAA-C-1217, FAA-C-1391, and FAA-STD-019, and as indicated on the drawings. Grounding of electrical equipment is considered incidental to the respective bid item, no separate payment will be made.

100-3.5 GROUND RODS. Grounding rods shall be 3/4-inch diameter by 10 feet long copper-jacketed steel. Grounding connections shall be by the exothermic weld process, Cadweld or equal. Extruded, drawn or stamped-type ground clamps will not be acceptable. The resistance to ground shall not exceed 25 ohms.

100-3.6 GROUND CONDUCTORS. Equipment grounding conductors shall be insulated copper, except where shown on the project drawings to be bare, and sized as shown on the project drawings; and all grounds will be shown in accordance with Article 250.122 of the National Electrical Code and with FAA-STD-019. Attachment of wire to supports, boxes, etc., shall be accomplished using approved ground lug attached with a separate stainless steel screw, lock washer and nut. Screws used for support of the electrical enclosure shall not be used for connection of the ground wire. Pipe straps shall not be used for ground purposes.

COLOR CODING OF GROUND CONDUCTORS

TYPE OF GROUND CONDUCTOR	COLOR OF INSULATION
Grounding Electrode Conductor	Bare – No Insulation
Equipment Grounding Conductor	Green (safety)

Each of these separate ground conductors is insulated in order to keep it distinct and not allow contact with any other conductor.

Electrical continuity of cable armor or shield shall be maintained. Grounding of the cable armor or shield shall be required at all terminations and shall be accomplished by connecting a #6 AWG solid bare copper wire to the cable armor or shield by means of a compression-type ground clamp installed within the terminating enclosure. Armor or shield ground wire shall be connected to the ground electrode conductor using split bolt connector, Burndy or equal. Grounding of direct earth burial (DEB) armored power and shielding control cable shall be at each end in accordance with FAA-C-1391.

100-3.7 IDENTIFICATION. Conductors shall be identified as per FAA-C-1217, Sections 4.6.4.2.4 and 4.16. Cable tagging and markers shall be identified as per FAA-C-1391, Sections 3.5.1 and 2. Transformers and junction boxes shall be identified by nameplate of nonferrous

metal or rigid plastic, engraved with 3/8-inch high lettering with information as per FAA-C-1217, Section 4.16. Installation of circuit ID tags is considered incidental to the respective bid item, no separate payment will be made.

100-3.8 TESTING AND SUBMITTALS. Equipment and materials list and shop drawings shall be submitted as per FAA-C-1217, Section 5.1. Testing shall be required and performed as per FAA-C-1217, Section 5.3 and FAA-C-1391, Section 4. The Contractor shall pretest all cable on the reel prior to installation and provide a copy of the test results to the Owner. The Contractor shall be responsible for repairs or replacement of any cable found defective after installation.

The Contractor shall test the installed airfield lighting and miscellaneous power cables prior to the start of and at the completion of this project. The results of the testing shall be provided to the Owner and Construction Manager for review and acceptance. The Contractor shall be responsible for repairs or replacement of any cable found defective after installation.

Installation tests in addition to all tests contained in other L-Series Items shall be provided as follows:

Item	Test Required	Manufac-turer's Rep. Present?
5 kV Rated Airfield Lighting and Power Cables (On the Reel, Not Including Equipment)	Megger check 500 to 1000 volts prior to installation. Values of insulation resistance for each reel shall be noted and given to the Construction Manager/ Owner for acceptance. It is expected that the readings will be greater than 1000 meg-ohms (1 gig-ohm).	No
5 kV Rated Airfield Lighting and Power Cables (Installed in This Project)	Megger check at 500 to 1000 volts at the completion of installation. Test every circuit for conductor-to-ground and conductor-to-conductor (between circuits) insulation resistance. Test results shall be tabulated and given to the Construction Manager/Owner for acceptance. It is required that the readings be greater than 100 megohms.	No
5 kV Rated Airfield Lighting and Power Cables (All Circuits Emanating from any Lighting Vault Modified in This Project)	Megger check at 500 to 1000 volts prior to the start of and at the completion of installation. Test every circuit for conductor-to-ground and conductor-to-conductor (between circuits) insulation resistance. Test results shall be tabulated and given to the Construction Manager/Owner for acceptance.	No

Item	Test Required	Manufac-turer's Rep. Present?
5 kV and 600 Volt and Multi-pair Cables	If a power cable puller is used, continuous-tape pull tension readings for each section of cable shall be provided to the Construction Manager for review.	No

100-3.9 NOTIFICATION OF TESTING. The Contractor shall notify the project RE and the City of Phoenix, a minimum of 48 hours in advance of system, or partial system, testing including, but not limited to, installed cable megger testing, and operational testing of any modified lighting circuit.

100-3.10 AIRFIELD LIGHTING VAULT LOCK-OUT TAG-OUT POLICY. The purpose of this procedure is to standardize the lockout tag out procedures between Electrical Contractors, Deer Valley Airport Electricians, Operations and Goodyear Air Traffic Control Tower (ATCT).

(1) Goodyear Airport electricians responding to a lock-out/tag-out request will coordinate with the ATCT through Operations.

(2) After Operations notifies electricians of closures, the Goodyear Airport electricians will turn off the closed runways/taxiways using the airfield computer system.

(3) The contractor will supply an approved breaker-locking device and lock, then lock off the individual breakers for the circuits to be locked out. These items will remain in the vaults in a lock box provided by Goodyear Airport Electrical Section.

(4) The Goodyear Airport Electric Section will lock the panel doors shut with a hasp and an Electrical Section Lock.

(5) The load break elbows and/or S-1 switches will be pulled, locked and placed on the corresponding regulator by the electrical contractor.

(6) The electrical contractor and Goodyear Airport electricians must fill out lock-out forms before leaving the vault.

(7) Upon completion of the lockout, the contractor will remove all locks and install the load breaks. All circuits must be verified operational in the manual mode on the regulator. Operations will perform a complete check the lights in the field, to verify actual operation.

(8) When that has been completed, Goodyear Airport electricians will notify Operations when lock-in is complete and regulators are in remote control; Operations will notify the ATCT that they have control of the airfield lighting.

(9) Complete lock-out/lock-in forms.

This procedural checklist must be followed to the letter.

METHOD OF MEASUREMENT

100-4.1 ELECTRICAL SERVICES. The electrical services to be paid under this Item shall include:

a. Removal of indicated portions of the airfield lighting system including salvage to Goodyear Airport of all lights, runway guard light fixtures, signs and transformers and removal of all conduit and conductors which are not to remain in service. The quantity to be measured shall be for the removal and salvage or demolition of each light, base can, hand hole, concrete duct markers, conduit and cable.

b. Removal, protecting and safely storing of any light fixtures, signs and isolation transformers that are designated for re-installation, including taxiway lights, elevated runway guard lights, power equipment and mounting hardware and existing LED signs including associated frangible legs and floor flanges / mounting feet.

c. A linear foot quantity of existing cable designated for removal with conduit remaining has been estimated and provided for Contractor to account for a lump sum bid price. Cable removal is quantified as an effort to remove any number of conductors from within each conduit in a single run or duct bank. No separate measurement will be made for multiple conductors located in each conduit.

100-4.2 TEMPORARY AIRFIELD LIGHTING SYSTEM. This item shall consist of new L-824, Type C, 1/C or 2/C #8, 5 kV cable which shall include furnishing, installing and removal of temporary cables, temporary sign covers as required. No separate measurement or payment will be made for moving temporary facilities a required to provide Contractor's access to work sites. The use of temporary cables covered under this item shall be limited to "jumpers" as required to maintain circuit continuity. Cable used for temporary application shall not be used for permanent application.

BASIS OF PAYMENT

100-5.1 ELECTRICAL SERVICES. Payment will be made at the contract price for the electrical services completed and accepted. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete this Item. Removal of existing conduits and conductors associated with demolished items shall be

incidental to the costs. The unit price of each of these items shall also include the Contractor's overhead, profit and markup.

Payment will be made under:

Item L-100-5.1	Remove and Salvage In-Pavement Taxiway Centerline Light and Flange, Install Temporary Steel Cover on Existing Base - per each
Item L-100-5.2	Excavate and Remove Existing Pull Box – per each
Item L-100-5.3	Excavate and Remove Existing Conduit and Conductor – per L.F.
Item L-100-5.4	Remove Existing Conductor to Nearest HH/Base Can, Conduit to Remain (Approx. 2605 LF) – per lump sum
Item L-100-5.5	Remove Sign Base– per each
Item L-100-5.6	Remove and Salvage Elevated Taxiway Edge Light and Transformer, Demolish Base Can – per each
Item L-100-5.7	Remove and Salvage In-Pavement Taxiway Edge Light and Transformer, Demolish Base Can– per each
Item L-100-5.8	Remove and Salvage Elevated Runway Guard Light and Transformer, Demolish Base Can – per each
Item L-100-5.9	Excavate and Remove Existing Hand Hole and Reconnect Remaining Conduits – per each
Item L-100-5.10	Remove and Salvage Taxiway Guidance Sign and Isolation Transformer, Demolish Sign Base – per each
Item L-100-5.11	Remove and Salvage Existing Non Lit Sign – per each
Item L-100-5.12	Remove Existing Hand Hole Lid – per each
Item L-100-5.13	Remove and Salvage In-Pavement Taxiway Edge Light, Install Permanent Steel Cover on Existing Base – per each
Item L-100-5.14	Remove and Salvage Taxiway Guidance Sign and Isolation Transformer, Sign Base to Remain – per each
Item L-100-5.15	Remove and Salvage In-Pavement Taxiway Edge Light, Fill with Concrete and Install Steel Cover.

Item L-100-5.16 Remove and Salvage Existing Sign. Reinstall Upon Construction Phase Completion – per each

Item L-100-5.17 Provide Temporary Airfield Power Cable Jumpers and Cover Signs as Required (Approx. 2500 LF) – per lump sum

END OF ITEM L-100

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ITEM L-108 UNDERGROUND POWER CABLE FOR AIRPORTS

DESCRIPTION

108-1.1 This item shall consist of furnishing and installing power cables that are within conduit or duct banks per these specifications at the locations shown on the plans. Also included are the installation of counterpoise wires, ground wires, ground rods and connections, cable splicing, cable marking, cable testing, and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the Engineer. This item shall not include the installation of duct banks or conduit, trenching and backfilling for duct banks or conduit, or furnishing or installation of cable for FAA owned/operated facilities. Requirements and payment for trenching and backfilling for the installation of underground conduit and duct banks is in Item L-110, Airport Underground Electrical Duct Banks and Conduits.

EQUIPMENT AND MATERIALS

108-2.1.1 GENERAL.

a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program per AC 150/5345-53, current version.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Engineer.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Engineer) and replaced with materials that comply with these specifications at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section or electronic PDF, titled by specification section. The Engineer reserves the right to reject any and all

equipment, materials, or procedures that do not meet the system design and the standards and codes, specified in this document.

f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner. The Contractor shall be responsible to maintain a minimum insulation resistance per AC 150/5340-26C, Maintenance Airport Visual aid Facilities, Table 5-1 and paragraph 5.1.3.1, with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period.

g. Only Third Party certified manufacturers, listed in AC 150/5345-53, Appendix 3 Addendum (as required) and meeting the BUY AMERICAN preference requirements can provide equipment and materials specified in the Contract Documents. Documentation certifying compliance with the BUY AMERICAN preference rules for Airport Improvement Program (AIP) cited in 49 USC §50101) shall be included with each equipment and material submittal.

108-2.2 CABLE. Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall conform to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits latest edition. Conductors for use on 6.6 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #8 American wire gauge AWG), L-824 Type C , 5,000 volts, non-shielded, with cross-linked polyethylene insulation . L-824 conductors for use on the L-830 secondary of airfield lighting series circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

Wire for electrical circuits up to 600 volts shall comply with Specification L-824 and/or Federal Specification J-C-30 and shall be type THWN-2, 75°C. Conductors for parallel (voltage) circuits shall be sized and installed in accordance with NFPA-70, National Electrical Code.

Unless noted otherwise, all 600-volt and less non-airfield lighting conductor sizes are based on a 75°C, THWN-2, 600 volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600 volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG.

Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the Contract Documents. All conductors, pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental to the respective pay items provided.

Cable type, size, number of conductors, strand and service voltage shall be as specified in the Contract Document.

108-2.3 BARE COPPER WIRE (COUNTERPOISE, BARE COPPER WIRE GROUND AND GROUND RODS). Wire for counterpoise or ground installations for airfield lighting systems shall be No. 6 AWG bare solid copper wire for counterpoise and/or No. 6 AWG insulated stranded for ground wire per ASTM B3 and ASTM B8, or shall be bare stranded copper wire per ASTM B33. See AC 150/5340-30 for additional details about counterpoise and ground wire types and installation. For voltage powered circuits, the equipment ground conductor shall be minimum No. 6 AWG, 600V rated, Type XHHW insulated, green color, stranded copper equipment ground conductor.

Ground rods shall be copper-clad steel . The ground rods shall be of the length and diameter specified on the plans, but in no case be less than 10 feet long and 3/4 inch in diameter.

108-2.4 CABLE CONNECTIONS. In-line connections or splices of underground primary cables shall be of the type called for on the plans, and shall be one of the types listed below. No separate payment will be made for cable connections.

a. The cast splice. Not Used.

b. The field-attached plug-in splice. Figure 3 of AC 150/5345-26, Specification for L-823 Plug and Receptacle, Cable Connectors, employing connector kits, is acceptable for field attachment to single conductor cable. It shall be the Contractor's responsibility to determine the outside diameter of the cable to be spliced and to furnish appropriately sized connector kits and/or adapters and heat shrink tubing with integral sealant.

c. The factory-molded plug-in splice. Specification for L-823 Connectors, Factory-Molded to Individual Conductors, is acceptable.

d. The taped or heat-shrink splice. Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or Commercial Item Description A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation of the wire being spliced forming a moisture- and dirt-proof seal. Additionally, heat shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory kits that are designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent.

In all the above cases, connections of cable conductors shall be made using crimp connectors using a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made per the manufacturer's recommendations and listings.

All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except that a light base ground clamp connector shall be used for attachment to the light base. See AC 150/5340-30 for additional

information about methods of attaching a ground to a galvanized light base. All exothermic connections shall be made per the manufacturer's recommendations and listings.

108-2.5 SPLICER QUALIFICATIONS. Every airfield lighting cable splicer shall be qualified in making airport cable splices and terminations on cables rated at or above 5,000 volts AC. The Contractor shall submit to the Engineer proof of the qualifications of each proposed cable splicer for the airport cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three (3) years continuous experience in terminating/splicing medium voltage cable.

108-2.6 CONCRETE. Concrete for cable markers shall be per Specification Item P-610, Structural Portland Cement Concrete.

108-2.7 FLOWABLE BACKFILL. Flowable material used to backfill trenches for power cable trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material.

108-2.8 CABLE IDENTIFICATION TAGS. Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed on the plans.

108-2.9 TAPE. Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2 inch wide) and Scotch™ 130C® linerless rubber splicing tape (2-inch wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.

108-2.10 ELECTRICAL COATING. Electrical coating shall be Scotchkote™ as manufactured by 3M™, or an approved equivalent.

108-2.11 EXISTING CIRCUITS. Whenever the scope of work requires connection to an existing circuit, the circuit's insulation resistance shall be tested, in the presence of the Engineer. The test shall be performed per this item and prior to any activity that will affect the respective circuit. The Contractor shall record the results on forms acceptable to the Engineer. When the work affecting the circuit is complete, the circuit's insulation resistance shall be checked again, in the presence of the Engineer. The Contractor shall record the results on forms acceptable to the Engineer. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

108-2.12 DETECTABLE WARNING TAPE. Plastic, detectable, American Wood Preservers Association (AWPA) Red (electrical power lines, cables, conduit and lighting cable) with

continuous legend magnetic tape shall be polyethylene film with a metalized foil core and shall be 3-6 inches wide. Detectable tape is incidental to the respective bid item.

CONSTRUCTION METHODS

108-3.1 GENERAL. The Contractor shall install the specified cable at the approximate locations indicated on the plans. Unless otherwise shown on the plans, all cable required to cross under pavements expected to carry aircraft loads shall be installed in concrete encased duct banks. Wherever possible, cable shall be run without splices, from connection to connection.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers. The Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the Engineer or shown on the plans.

In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for maintenance and test points shall be installed at locations shown on the plans. Cable circuit identification markers shall be installed on both sides of the L-823 connectors installed or at least once in each access point where L-823 connectors are not installed.

Provide not less than 3 feet of cable slack on each side of all connections, isolation transformers, light units, and at points where cable is connected to field equipment. Where provisions must be made for testing or for future above grade connections, provide enough slack to allow the cable to be extended at least one foot vertically above the top of the access structure. This requirement also applies where primary cable passes through empty light bases, junction boxes, and access structures to allow for future connections, or as designated by the Engineer.

Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as manholes, hand holes, pull boxes, junction boxes, etc. Markers shall be of sufficient length for imprinting the cable circuit identification legend on one line, using letters not less than 1/4 inch in size. The cable circuit identification shall match the circuits noted on the construction plans.

108-3.2 INSTALLATION IN DUCT BANKS OR CONDUITS. This item includes the installation of the cable in duct banks or conduit per the following paragraphs. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be per the latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

The Contractor shall make no connections or splices of any kind in cables installed in conduits or duct banks.

Unless otherwise designated in the plans, where ducts are in tiers, use the lowest ducts to receive the cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and that any potential interference is avoided.

Duct banks or conduits shall be installed as a separate item per Item L-110, Airport Underground Electrical Duct Banks and Conduit. The Contractor shall run a mandrel through duct banks or conduit prior to installation of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall be compatible with the conduit size. The Contractor shall swab out all conduits/ducts and clean light bases, manholes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed, the light bases and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, light bases, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of any blockage in the existing ducts.

The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum pulling tensions shall not exceed the cable manufacturer's recommendations. A non-hardening cable-pulling lubricant recommended for the type of cable being installed shall be used where required.

The Contractor shall submit the recommended pulling tension values to the Engineer prior to any cable installation. If required by the Engineer, pulling tension values for cable pulls shall be monitored by a dynamometer in the presence of the Engineer. Cable pull tensions shall be recorded by the Contractor and reviewed by the Engineer. Cables exceeding the maximum allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor's expense.

The manufacturer's minimum bend radius or NEC requirements (whichever is more restrictive) shall apply. Cable installation, handling and storage shall be per manufacturer's recommendations. During cold weather, particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be installed when the temperature is at or

below the manufacturer's minimum installation temperature. At the Contractor's option, the Contractor may submit a plan, for review by the Engineer, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer's minimum cable installation temperature.

Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.

108-3.3 INSTALLATION OF DIRECT-BURIED CABLE IN TRENCHES. Not Used.

108-3.4 CABLE MARKERS FOR DIRECT-BURIED CABLE. Not Used.

108-3.5 SPLICING. Connections of the type shown on the plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

(1) Cast splices. Not Used.

(2) Field-attached plug-in splices. These shall be assembled per the manufacturer's instructions. These splices shall be made by plugging directly into mating connectors. In all cases the joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches on each side of the joint.

(3) Factory-molded plug-in splices. These shall be made by plugging directly into mating connectors. In all cases, the joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches on each side of the joint.

(4) Taped or heat-shrink splices. A taped splice shall be made in the following manner:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch of bare conductor on each side of the connector. Prior to splicing, the two ends of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus 3 inches on each end) is clean. After scraping wipe the entire area with a clean lint-free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. Throughout the rest of the splice less tension should be used. Always attempt to exactly half-lap to produce a uniform buildup.

Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately one inch over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

Heat shrinkable tubing shall be installed following manufacturer's instructions. Direct flame heating shall not be permitted unless recommended by the manufacturer. Cable surfaces within the limits of the heat-shrink application shall be clean and free of contaminates prior to application.

Surfaces of equipment or conductors being terminated or connected shall be prepared in accordance with industry standard practice and manufacturer's recommendations. All surfaces to be connected shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other nonconductive coatings shall be removed to expose base metal. Clean all surfaces at least 1/4 inch beyond all sides of the larger bonded area on all mating surfaces. Use a joint compound suitable for the materials used in the connection. Repair painted/coated surface to original condition after completing the connection.

108-3.6 BARE COUNTERPOISE WIRE INSTALLATION FOR LIGHTNING PROTECTION AND GROUNDING. If shown on the plans or included in the job specifications, bare solid #6 AWG copper counterpoise wire shall be installed for lightning protection of the underground cables. The Engineer shall select one of two methods of lightning protection for the airfield lighting circuit based on the frequency of local lightning:

a. Equipotential – may be used by the Engineer for areas that have high rates of lightning strikes. This is where the counterpoise is bonded to the light base (edge lights included).

b. Isolation – used in areas where lightning strikes are not common. The counterpoise is not bonded to edge light fixtures, in-pavement fixtures are boned to the counterpoise.

(1) Counterpoise wire shall be installed in the same trench for the entire length of buried cable, conduits and duct banks that are installed to contain airfield cables.

(2) For edge light fixtures installed in turf (stabilized soils) and for raceways or cables adjacent to the full strength pavement edge, the counterpoise conductor shall be

installed halfway between the pavement edge and the light base, mounting stake, raceway, or cable.

(3) The counterpoise conductor shall be installed 8 inches minimum below grade.

(4) Each light base or mounting stake shall be provided with a grounding electrode.

(5) When a metallic light base is used, the grounding electrode shall be bonded to the metallic light base or mounting stake with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

(6) For raceways installed under pavement; for raceways and cables not installed adjacent to the full strength pavement edge; for fixtures installed in full strength pavement and shoulder pavement and for optional method of edge lights installed in turf (stabilized soils); and for raceways or cables adjacent to the full strength pavement edge, the counterpoise conductor shall be centered over the raceway or cable to be protected as described below.

(7) The counterpoise conductor shall be installed no less than 8 inches above the raceway or cable to be protected, except as permitted below.

(8) The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.

(9) Where raceway is installed by the directional bore, jack and bore, or other drilling method, the counterpoise conductor shall be permitted to be installed concurrently with the directional bore, jack and bore, or other drilling method raceway, external to the raceway or sleeve.

(10) The counterpoise conductor shall be installed no more than 12 inches above the raceway or cable to be protected.

(11) The counterpoise conductor height above the protected raceway(s) or cable(s) shall be calculated to ensure that the raceway or cable is within a 45-degree area of protection.

(12) The counterpoise conductor shall be bonded to each metallic light base, mounting stake, and metallic airfield lighting component.

(13) All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

(14) The counterpoise wire shall also be exothermically welded to ground rods installed as shown on the plans but not more than 500 feet apart around the entire circuit. The counterpoise system shall be continuous and terminate at the transformer vault or at the power source. It shall be securely attached to the vault or equipment external ground ring or other made electrode-grounding system. The connections shall be made as shown on the plans and in the specifications.

If shown on the plans or in the specifications, a separate equipment (safety) ground system shall be provided in addition to the counterpoise wire using one of the following methods:

(1) A ground rod installed at and securely attached to each light fixture base, mounting stake, and to all metal surfaces at junction/access structures via #6 AWG wire.

(2) For parallel voltage systems only, install a #6 AWG green insulated equipment ground conductor internal to the conduit system and securely attached it to each light fixture base internal grounding lug and to all metal surfaces at junction/access structures. Dedicated ground rods shall be installed and exothermically welded to the counterpoise wires at each end of a duct bank crossing under pavement.

(3) Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

108-3.7 COUNTERPOISE INSTALLATION ABOVE MULTIPLE CONDUITS AND DUCT BANKS. Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise wires above the conduits shall be adequate to provide a complete cone of protection measured 22-1/2 degrees each side of vertical.

Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above the duct bank. Reference details on the construction plans.

108-3.8 COUNTERPOISE INSTALLATION AT EXISTING DUCT BANKS. When airfield lighting cables are indicated on the plans to be routed through existing duct banks, the new counterpoise wiring shall be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and exit the duct bank. The new counterpoise conductor shall be bonded to the existing counterpoise system.

108-3.9 EXOTHERMIC BONDING. Bonding of counterpoise wire shall be by the exothermic welding process. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

Contractor shall demonstrate to the satisfaction of the Engineer, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations and the following:

a. All slag shall be removed from welds.

b. Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not recommended unless the base has been specially modified. Consult the manufacturer's installation directions for proper methods of bonding copper wire to the light base. See also AC 150/5340-30 for galvanized light base exception.

c. If called for in the plans, all buried copper and weld material at weld connections shall be thoroughly coated with 6 mm of 3M™ Scotchkote™, or approved equivalent, or coated with coal tar Bitumastic® material to prevent surface exposure to corrosive soil or moisture.

108-3.10 TESTING. The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the Engineer. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the Engineer. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

a. Earth resistance testing methods shall be submitted to the Engineer for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the Engineer. All such testing shall be at the sole expense of the Contractor.

b. Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The Engineer shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

After installation, the Contractor shall test and demonstrate to the satisfaction of the Engineer the following:

c. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.

d. That all affected circuits (existing and new) are free from unspecified grounds.

e. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than 100 megohms.

f. That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.

g. That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.

h. That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

i. That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the Engineer prior to performing the testing.

Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the Engineer. Where connecting new cable to existing cable, ground resistance tests shall be performed on the new cable prior to connection to the existing circuit.

There are no approved “repair” procedures for items that have failed testing other than complete replacement.

METHOD OF MEASUREMENT

108-4.1 Cable installed in duct bank or conduit shall be measured by the number of linear feet installed with primary connector kits, grounding conductor and grounding connectors ready for operation, and accepted by Owner / Engineer. Separate measurement shall be made for each single cable (1/C), cable pair (2/C) or feeder set, installed in duct bank or conduit with associated ground wire and connections included in Contractor’s price. The measurement for this item shall include additional quantities required for slack. No separate measurement will be made to multiply the number of individual conductors installed in a single conduit, in one installation effort.

108-4.2 Counterpoise wire and connections are considered incidental to the installation of duct bank or conduit, per item L-110. No separate payment will be made.

108-4.3 Ground rods shall be considered incidental to the installation of counterpoise, light base, transformer housing, sign or other grounding. No separate payment will be made.

BASIS OF PAYMENT

108-5.1 Payment will be made at the contract unit price for cable(s) and equipment ground installed in duct bank or conduit, in place by the Contractor and accepted by the Engineer. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors, necessary to complete this item.

Payment will be made under:

Item L-108-5.1	L-824, Type C, 2/C #8 AWG, 5kV Cable w/ #6 Ground – per linear foot
Item L-108-5.2	L-824, Type C, 1/C #8 AWG, 5kV Cable w/ #6 Ground – per linear foot

MATERIAL REQUIREMENTS

AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-53	Airport Lighting Equipment Certification Program
Commercial Item Description A-A-59544	Cable and Wire, Electrical (Power, Fixed Installation)
Commercial Item Description A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic
ASTM B3	Standard Specification for Soft or Annealed Copper Wire
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
ASTM D4388	Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes
FED SPEC J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive

REFERENCE DOCUMENTS

NFPA-70	National Electrical Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems
MIL-S-23586F	Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical

ANSI/IEEE STD 81 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

END OF ITEM L-108

ITEM L-110 AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS

DESCRIPTION

110-1.1 This item shall consist of underground electrical conduits and duct banks (single or multiple conduits encased in concrete or buried in sand) installed per this specification at the locations and per the dimensions, designs, and details shown on the plans. This item shall include furnishing and installing of all underground electrical duct banks and individual and multiple underground conduits. It shall also include all turfing trenching, backfilling, removal, and restoration of any paved or turfed areas; concrete encasement, mandrelling, pulling lines, duct markers, plugging of conduits, and the testing of the installation as a completed system ready for installation of cables per the plans and specifications. This item shall also include furnishing and installing conduits and all incidentals for providing positive drainage of the system. Verification of existing ducts is incidental to the pay items provided in this specification.

EQUIPMENT AND MATERIALS

110-2.1 GENERAL.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

b. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Engineer and replaced with materials that comply with these specifications, at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in project that accrue directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section or electronic PDS's labeled by specification section. The Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes specified in this document.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12)

months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

110-2.2 STEEL CONDUIT. Rigid galvanized steel (RGS) conduit and fittings shall be hot dipped galvanized inside and out and conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242. All RGS conduits or RGS elbows installed below grade, in concrete, permanently wet locations or other similar environments shall be painted with a 10 mil thick coat of asphaltum sealer or shall have a factory bonded polyvinyl chloride (PVC) cover. Any exposed galvanizing or steel shall be coated with 10 mil of asphaltum sealer. When using PVC coated RGS conduit, care shall be exercised not to damage the factory PVC coating. Damaged PVC coating shall be repaired per the manufacturer's written instructions.

110-2.3 PLASTIC CONDUIT. Plastic conduit and fittings-shall conform to the following requirements:

- UL 514B covers W-C-1094-Conduit fittings all types, classes 1 thru 3 and 6 thru 10.
- UL 514C covers W-C-1094- all types, Class 5 junction box and cover in plastic (PVC).
- UL 651 covers W-C-1094-Rigid PVC Conduit, types I and II, Class 4.
- UL 651A covers W-C-1094-Rigid PVC Conduit and high density polyethylene (HDPE) Conduit type III and Class 4.

Underwriters Laboratories Standards UL-651 and Article 352 of the current National Electrical Code shall be one of the following, as shown on the plans:

Type I–Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.

Type II–Schedule 40 PVC suitable for either above ground or underground use.

Type III – Schedule 80 PVC suitable for either above ground or underground use either direct-buried or encased in concrete.

Type III –HDPE pipe, minimum standard dimensional ratio (SDR) 11, suitable for placement with directional boring under pavement.

The type of solvent cement shall be as recommended by the conduit/fitting manufacturer.

110-2.4 SPLIT CONDUIT. Split conduit shall be pre-manufactured for the intended purpose and shall be made of steel or plastic.

110-2.5 CONDUIT SPACERS. Conduit spacers shall be prefabricated interlocking units manufactured for the intended purpose. They shall be of double wall construction made of high grade, high density polyethylene complete with interlocking cap and base pads, They shall be designed to accept No. 4 reinforcing bars installed vertically.

110-2.6 CONCRETE. Concrete shall conform to Item P-610, Structural Portland Cement Concrete, using 1 inch maximum size coarse aggregate with a minimum 28-day compressive strength of 4000 psi. Where reinforced duct banks are specified, reinforcing steel shall conform to ASTM A615 Grade 60. Concrete and reinforcing steel are incidental to the respective pay item of which they are a component part.

110-2.7 FLOWABLE BACKFILL. Flowable material used to back fill conduit and duct bank trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material. Fill shall be designed to achieve a 28-day compressive strength of 200 psi (1.4 MPa) under pavement.

110-2.8 DETECTABLE WARNING TAPE. Plastic, detectable, American Wood Preservers Association (AWPA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend magnetic tape shall be polyethylene film with a metallized foil core and shall be 3-6 inches wide. Detectable tape is incidental to the respective bid item.

CONSTRUCTION METHODS

110-3.1 GENERAL. The Contractor shall install underground duct banks and conduits at the approximate locations indicated on the plans. The Engineer shall indicate specific locations as the work progresses, if required to differ from the plans. Duct banks and conduits shall be of the size, material, and type indicated on the plans or specifications. Where no size is indicated on the plans or in the specifications, conduits shall be not less than 2 inches inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger. All duct bank and conduit lines shall be laid so as to grade toward access points and duct or conduit ends for drainage. Unless shown otherwise on the plans, grades shall be at least 3 inches per 100 feet. On runs where it is not practicable to maintain the grade all one way, the duct bank and conduit lines shall be graded from the center in both directions toward access points or conduit ends, with a drain into the storm drainage system. Pockets or traps where moisture may accumulate shall be avoided. No duct bank or underground conduit shall be less than 18 inches below finished grade. Where under pavement, the top of the duct bank shall not be less than 18 inches below the subgrade.

The Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct bank. An iron-shod mandrel, not more than 1/4 inch smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The Contractor shall swab out all conduits/ducts and clean base can, manhole, pull boxes, etc., interiors IMMEDIATELY prior to pulling cable. Once cleaned and swabbed the light bases, manholes, pull boxes, etc., and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of any blockage in the existing ducts.

For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a duct bank, shall be provided with a 200 pound (90 kg) test polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminants from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed 5 feet.

Unless otherwise shown on the plans, concrete encased duct banks shall be used when crossing under pavements expected to carry aircraft loads, such as runways, taxiways, taxi-lanes, ramps and aprons. When under paved shoulders and other paved areas, conduit and duct banks shall be encased using flow-able fill for protection.

All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches below the required conduit or duct bank depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4 inch sieve. Flow-able backfill may alternatively be used The Contractor shall ascertain the type of soil or rock to be excavated before bidding. All such rock removal shall be performed and paid for under Item P-152.

Underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks and conduits in unpaved areas. Contractor shall submit a sample of the proposed warning tape for approval by the Engineer. If not shown on the plans, the warning tape shall be located 6 inches above the duct/conduit or the counterpoise wire if present.

Joints in plastic conduit shall be prepared per the manufacturer’s recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 feet.

Changes in direction of runs exceeding 10 degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the Engineer, the unsuitable material shall be removed per Item P-152 and replaced with suitable material. Alternatively, additional duct bank supports that are adequate and stable shall be installed, as approved by the Engineer.

All excavation shall be unclassified and shall be considered incidental to the respective L-110 pay item of which it is a component part. Dewatering necessary for duct installation, erosion and turbidity control, per Federal, state, and local requirements is incidental to its respective pay item as a part of Item L-110. The cost of all excavation regardless of type of material encountered shall be included in the unit price bid for the L-110 Item.

Unless otherwise specified, excavated materials that are deemed by the Engineer to be unsuitable for use in backfill or embankments shall be removed and disposed of offsite.

Any excess excavation shall be filled with suitable material approved by the Engineer and compacted per Item P-152.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables) cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

a. Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred.

b. Trenching, etc., in cable areas shall then proceed with approval of the Engineer, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair.

110-3.2 DUCT BANKS. Unless otherwise shown in the plans, duct banks shall be installed so that the top of the concrete envelope is not less than 18 inches below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches below finished grade where installed in unpaved areas.

Unless otherwise shown on the plans, duct banks under paved areas shall extend at least 3 feet beyond the edges of the pavement or 3 feet beyond any under drains that may be installed alongside the paved area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any obstructions are encountered, provisions can be made to avoid them. Unless otherwise shown on the plans, all duct banks shall be placed on a layer of concrete not less than 3 inches thick prior to its initial set. The Contractor shall space the conduits not less than 3 inch apart (measured from outside wall to outside wall). All such multiple conduits shall be placed using conduit spacers applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than 3 inches thick unless otherwise shown on the plans. All conduits shall terminate with female ends for ease of access in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose, the spacers shall be fastened

down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where shown on the plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 5-foot intervals.

All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All excavation shall be included in the contract with price for the duct.

Install a plastic, detectable, color as noted, 3 to 6 inches wide tape, 8 inches minimum below grade above all underground conduit or duct lines not installed under pavement. Utilize the 3-inch wide tape only for single conduit runs. Utilize the 6-inch wide tape for multiple conduits and duct banks. For duct banks equal to or greater than 24 inches in width, utilize more than one tape for sufficient coverage and identification of the duct bank as required.

When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and exposed by hand tools. Prior to being placed in duct, the Engineer shall be notified so that he may inspect the cable and determine that it is in good condition. Where required split duct shall be installed, as shown on the drawings or as required by the Engineer.

110-3.3 CONDUITS WITHOUT CONCRETE ENCASEMENT. Trenches for single-conduit lines shall be not less than 6 inches nor more than 12 inches wide. The trench for 2 or more conduits installed at the same level shall be proportionately wider. Trench bottoms for conduits without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit along its entire length.

Unless otherwise shown on the plans, a layer of fine earth material, at least 4 inches thick (loose measurement) shall be placed in the bottom of the trench as bedding for the conduit. The bedding material shall consist of soft dirt, sand or other fine fill, and it shall contain no particles that would be retained on a 1/4 inch sieve. The bedding material shall be tamped until firm. Flow-able backfill may alternatively be used.

Unless otherwise shown on plans, conduits shall be installed so that the tops of all conduits within the Airport's secured area where trespassing is prohibited are at least 18 inches below the finished grade. Conduits outside the Airport's secured area shall be installed so that the tops of the conduits are at least 24 inches below the finished grade per National Electric Code (NEC), Table 300.5.
When two or more individual conduits intended to carry conductors of equivalent voltage insulation rating are installed in the same trench without concrete encasement, they shall be spaced not less than 3 inches apart (measured from outside wall to outside wall) in a horizontal direction and not less than 6 inches apart in a vertical direction. Where two or more individual conduits intended to carry conductors of differing voltage insulation rating are installed in the same trench without concrete encasement, they shall be placed not less than 3 inches apart (measured from outside wall to outside wall) in a horizontal direction and lot less than 6 inches apart in a vertical direction.

Trenches shall be opened the complete length between normal termination points before conduit is installed so that if any unforeseen obstructions are encountered, proper provisions can be made to avoid them.

Conduits shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches to anchor the assembly into the earth while backfilling. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

110-3.4 MARKERS. The location of each end and of each change of direction of conduits and duct banks shall be marked by a concrete slab marker 2 feet square and 4 - 6 inches thick extending approximately one inch above the surface. The markers shall also be located directly above the ends of all conduits or duct banks, except where they terminate in a junction/access structure or building. Each cable or duct run from a line of lights and signs to the equipment vault must be marked at approximately every 200 feet along the cable or duct run, with an additional marker at each change of direction of cable or duct run.

The Contractor shall impress the word “DUCT” or “CONDUIT” on each marker slab. Impression of letters shall be done in a manner, approved by the Engineer, for a neat, professional appearance. All letters and words must be neatly stenciled. After placement, all markers shall be given one coat of high-visibility orange paint, as approved by the Engineer. The Contractor shall also impress on the slab the number and size of conduits beneath the marker along with all other necessary information as determined by the Engineer. The letters shall be 4 inches high and 3 inches wide with width of stroke 1/2 inch and 1/4 inch deep or as large as the available space permits. Furnishing and installation of duct markers is incidental to the respective duct pay item.

110-3.5 BACKFILLING FOR CONDUITS. For conduits, 8 inches of sand, soft earth, or other fine fill (loose measurement) shall be placed around the conduits ducts and carefully tamped around and over them with hand tampers. The remaining trench shall then be backfilled and compacted per Item P-152 “Excavation and Embankment” except that material used for back fill shall be select material not larger than 4 inches in diameter.

Flow-able backfill may alternatively be used.

Trenches shall not contain pools of water during back filling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the Engineer.

110-3.6 BACKFILLING FOR DUCT BANKS. After the concrete has cured, the remaining trench shall be backfilled and compacted per Item P-152 “Excavation and Embankment” except that the material used for backfill shall be select material not larger than 4 inches in diameter. In addition to the requirements of P-152, where duct banks are installed under pavement, one

moisture/density test per lift shall be made for each 250 linear feet of duct bank or one work period's construction, whichever is less.

Flow-able backfill may alternatively be used.

Trenches shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the Engineer.

110-3.7 RESTORATION. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. All restoration shall be considered incidental to the respective L-110 pay item. Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

METHOD OF MEASUREMENT

110-4.1 Underground conduits and duct banks shall be measured by the linear feet (meter) of conduits and duct banks installed, including counterpoise, encasement, locator tape, trenching and backfill with designated material, and for drain lines, the termination at the drainage structure, all measured in place, completed, and accepted. Separate measurement shall be made for the various types and sizes.

BASIS OF PAYMENT

110-5.1 Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item per the provisions and intent of the plans and specifications.

Payment will be made under:

Item L-110-5.1 Single-way (1) - 2" Conduit, Slurry Encased– per linear foot

Item L-110-5.2 Multiple-way (2) - 2" Conduit, Slurry Encased – per linear foot

Item L-110-5.3 Single-way (1) - 2" Conduit, Concrete Encased – per linear foot

Item L-110-5.4 Multiple-way (2) - 4" Conduit, Concrete Encased – per linear foot

Item L-110-5.5 Multiple-way (2) - 4" Conduit, Concrete Encased (Retrofit in Existing Full Strength Concrete Pavement) – per linear foot

Item L-110-5.6 Single-way (1) - 2" Conduit, Concrete Encased (Retrofit in Existing Full Strength Concrete Pavement) – per linear foot

Item L-110-5.7 Multiple-way (2) - 2" Conduit, Concrete Encased (Retrofit in Existing Full Strength Concrete Pavement)– per linear foot

Item L-110-5.8 Single-way (1) - 2" Conduit, Concrete Encased (Retrofit in Existing Asphalt) – per linear foot

Item L-110-5.9 Multiple-way (2) - 4" Conduit and 2-2” Conduit, Concrete Encased – per linear foot

Item L-110-5.10 Multiple-way (2) - 4" Conduit and 2-2” Conduit, Slurry Encased – per linear foot

Item L-110-5.11 Multiple-way (4) - 2" Directional Bore Concrete Encased – per linear foot

Item L-110-5.12 Multiple-way (2) - 2" Conduit, Concrete Encased – per linear foot

Item L-110-5.13 Extend Existing 4-2” Conduits Slurry Encased and Cap, Install New Duct Marker – per linear foot

MATERIAL REQUIREMENTS

Advisory Circular (AC) 150/5340-30
Design and Installation Details for Airport Visual Aids
AC 150/5345-53 Airport Lighting Equipment Certification Program

ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3))

ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

NFPA-70	National Electrical Code (NEC)		
Underwriters	Laboratories	Standard	6
	Electrical Rigid Metal Conduit - Steel		
Underwriters	Laboratories	Standard	514B
Conduit, Tubing, and Cable Fittings			
Underwriters	Laboratories	Standard	514C
Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers			
Underwriters	Laboratories	Standard	1242
Electrical Intermediate Metal Conduit Steel			
Underwriters	Laboratories	Standard	651
Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings			
Underwriters	Laboratories	Standard	651A
Type EB and A Rigid PVC Conduit and HDPE Conduit			

END OF ITEM L-110

ITEM L-115 ELECTRICAL HANDHOLES AND JUNCTION STRUCTURES

DESCRIPTION

115-1.1 SCOPE. This item shall consist of electrical hand holes and junction structures (pull boxes, junction cans, etc.) installed per this specification, at the indicated locations and conforming to the lines, grades and dimensions shown on the plans or as required by the Engineer. This item shall include the installation of each electrical manhole and/or junction structures with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces to the satisfaction of the Engineer.

Where hand holes are installed in existing pavement, repair/replace pavement in kind. There will be no separate measurement for pavement removals. Cost shall be incidental to pay item.

EQUIPMENT AND MATERIALS

115-2.1 GENERAL.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the Engineer.

b. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Engineer) and replaced with materials that comply with these specifications at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

115-2.2 CONCRETE STRUCTURES. Cast-in-place concrete structures shall be per the details and dimensions shown on the plans. Provide precast concrete structures where shown on the plans. Precast concrete structures shall be an approved standard design of the manufacturer. Precast units shall have mortar or bitumastic sealer placed between all joints to make them watertight. The structure shall be designed to withstand 100,000 lb. dual wheel aircraft loads, unless otherwise shown on the plans. Openings or knockouts shall be provided in the structure as detailed on the plans.

Threaded inserts and pulling eyes shall be cast in as shown.

If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by the Engineer shall be submitted by the Contractor to allow for a full evaluation by the Engineer. The Engineer shall review per the process defined in the General Provisions.

115-2.3 JUNCTION BOXES. Junction boxes shall be L-867 Class 1 (non-load bearing) or L-868 Class 1 (load bearing) airport light bases that are encased in concrete. The light bases shall have a galvanized steel blank cover, gasket, and stainless steel or coated steel hardware per FAA Engineering Brief (EB) #83. Covers shall be 3/8-inch thickness for L-867 and 3/4-inch thickness for L-868.

115-2.4 MORTAR. The mortar shall be composed of one part of Portland cement and two parts of mortar sand, by volume. The Portland cement shall be per the requirements in ASTM C150, Type I. The sand shall be per the requirements in ASTM C144. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15% of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C6. Water shall be potable, reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.

115-2.5 CONCRETE. All concrete used in structures shall conform to the requirements of Item P-610, Structural Portland Cement Concrete.

115-2.6 FRAMES AND COVERS. The frames shall conform to one of the following requirements:

a.	ASTM A48	Gray iron castings
b.	ASTM A47	Malleable iron castings
c.	ASTM A27	Steel castings
d.	ASTM A283, Grade D	Structural steel for grates and frames
e.	ASTM A536	Ductile iron castings
f.	ASTM A897	Austempered ductile iron castings

All castings specified shall withstand a maximum tire pressure of 250 psi and maximum load of 75,000 lbs.

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings specified.

Each frame and cover unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

Each cover shall have the word “ELECTRIC”, “COMM” or other approved designation cast on it. Each frame and cover shall be as shown on the plans or approved equivalent.

115-2.7 REINFORCING STEEL. All reinforcing steel shall be deformed bars of new billet steel meeting the requirements of ASTM A615, Grade 60.

115-2.8 BEDDING/SPECIAL BACKFILL. Hand holes shall be bedded on compacted aggregate base, 12-inch minimum depth, with 3/4-inch gradation. Special backfill shall be as shown on the plans.

115-2.9 FLOWABLE BACKFILL. Flow-able material used to backfill shall conform to the requirements of Item P-153, Controlled Low Strength Material.

115-2.10 CABLE RACKS. All manholes and hand holes shall be fitted on each wall with two (2) 24-inch galvanized inserts for cable racks (Uni-strut P-3000 or equal). Each rack shall be provided with a minimum of two (2) saddle rack type arms with (2) saddles. Rack arms shall be made of non-flammable polymer as manufactured by Underground Devices, Inc., or equal, or as detailed on the drawings.

115-2.11 PLASTIC CONDUIT. Plastic conduit shall comply with Item L-110, Underground Electrical Duct Banks and Conduits.

115-2.12 CONDUIT TERMINATORS. Conduit terminators shall be pre-manufactured for the specific purpose and sized as required or as shown on the plans.

115-2.13 PULLING-IN IRONS. Pulling-in irons shall be manufactured with 7/8 inch diameter hot-dipped galvanized steel or stress-relieved carbon steel roping designed for concrete applications (7 strand, 1/2 inch diameter with an ultimate strength of 270,000 psi (1862 MPa)).

Where stress-relieved carbon steel roping is used, a rustproof sleeve shall be installed at the hooking point and all exposed surfaces shall be encapsulated with a polyester coating to prevent corrosion.

115-2.14 GROUND RODS. Ground rods shall be one piece, copper clad**.** The ground rods shall be of the length and diameter specified on the plans, but in no case shall they be less than 10 feet long nor less than 3/4 inch in diameter. Do not install the ground rod through the drain sump. Install through a prepared opening and grout fill after installation. Locate the ground rod in a corner of the hand hole.

115-2.15 SUMP DRAINS. All manholes and hand holes shall be provided with a 12”x12” drainage sump with grate in the bottom. Knock the bottom out of this sump.

CONSTRUCTION METHODS

115-3.1 UNCLASSIFIED EXCAVATION. It is the Contractor’s responsibility to locate existing utilities within the work area prior to excavation. Damage to utility lines, through lack of care in excavating, shall be repaired or replaced to the satisfaction of the Engineer without additional expense to the Owner.

The Contractor shall perform excavation for structures and structure footings to the lines and grades or elevations shown on the plans or as staked by the Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

All excavation shall be unclassified and shall be considered incidental to the respective L-115 pay item of which it is a component part. Dewatering necessary for L-115 structure installation, erosion and turbidity control, per Federal, state, and local requirements is incidental to its respective pay item as a part of Item L-115. The cost of all excavation regardless of type of material encountered shall be included in the unit price bid for the L-115 Item.

Boulders, logs and all other objectionable material encountered in excavation shall be removed. All rock and other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped or serrated, as directed by the Engineer. All seams, crevices, disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

The Contractor shall provide all bracing, sheeting and shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheeting and shoring shall be included in the unit price bid for the structure.

Unless otherwise provided, bracing, sheeting and shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner that will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.

After each excavation is completed, the Contractor shall notify the Engineer. Structures shall be placed after the Engineer has approved the depth of the excavation and the suitability of the foundation material.

Prior to installation the Contractor shall provide a minimum of 6 inches of sand or a material approved by the Engineer as a suitable base to receive the structure. The base material shall be compacted and graded level and at proper elevation to receive the structure in proper relation to the conduit grade or ground cover requirements, as indicated on the plans.

115-3.2 CONCRETE STRUCTURES. Concrete structures shall be built on prepared foundations conforming to the dimensions and form indicated on the plans. The concrete and construction methods shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the Engineer before the concrete is placed.

115-3.3 PRECAST UNIT INSTALLATIONS. Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of manhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed.

115-3.4 PLACEMENT AND TREATMENT OF CASTINGS, FRAMES AND FITTINGS. All castings, frames and fittings shall be placed in the positions indicated on the Plans or as directed by the Engineer and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

Field connections shall be made with bolts, unless indicated otherwise. Welding will not be permitted unless shown otherwise on the approved shop drawings and written permission is granted by the casting manufacturer.

Erection equipment shall be suitable and safe for the workman.

Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the Engineer and approval of the method of correction shall be obtained. Approved corrections shall be made at Contractor’s expense.

Anchor bolts and anchors shall be properly located and built into connection work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

Pulling-in irons shall be located opposite all conduit entrances into structures to provide a strong, convenient attachment for pulling-in blocks when installing cables. Pulling-in irons shall be set directly into the concrete walls of the structure.

115-3.5 REMOVAL OF SHEETING AND BRACING. In general, all sheeting and bracing used to support the sides of trenches or other open excavations shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a structure shall be withdrawn, unless otherwise directed, before more than 6 inches of material is placed above the top of the structure and before any bracing is removed. Voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

The Engineer may order the Contractor to delay the removal of sheeting and bracing if, in his judgment, the installed work has not attained the necessary strength to permit placing of backfill.

115-3.6 BACKFILLING. After a structure has been completed, the area around it shall be backfilled in horizontal layers not to exceed 6 inches in thickness measured after compaction to the density requirements in Item P-152. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the Engineer.

In lieu of the paragraph above, at the Contractor's option, backfill may be made by the use of P-153 (CLSM) to within 3" of finished grade. In areas where the existing grade treatment is asphalt, finish fill to grade with P-403 asphalt. In areas of exposed earth, finish fill to existing finished grade with P-152. The top of the fill shall meet the existing elevation or as directed by the Engineer.

Backfill shall not be placed against any structure until permission is given by the Engineer. In the case of concrete, such permission shall not be given until tests made by the laboratory under supervision of the Engineer establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

Where required, the Engineer may direct the Contractor to add, at his own expense, sufficient water during compaction to assure a complete consolidation of the backfill. The Contractor shall be responsible for all damage or injury done to conduits, duct banks, structures, property or persons due to improper placing or compacting of backfill.

115-3.7 CONNECTION OF DUCT BANKS. To relieve stress of joint between concrete-encased duct banks and structure walls, reinforcement rods shall be placed in the structure wall and shall be formed and tied into duct bank reinforcement at the time the duct bank is installed.

115-3.8 GROUNDING. A ground rod shall be installed in the floor of all concrete structures so that the top of rod extends 6 inches above the floor. The ground rod shall be installed within one foot of a corner of the concrete structure. Ground rods shall be installed prior to casting the bottom slab. Where the soil condition does not permit driving the ground rod into the earth without damage to the ground rod, the Contractor shall drill a 4 inch diameter hole into the earth to receive the ground rod. The hole around the ground rod shall be filled throughout its length, below slab, with Portland cement grout. Ground rods shall be installed in precast bottom slab of structures by drilling a hole through bottom slab and installing the ground rod. Bottom slab penetration shall be sealed watertight with Portland cement grout around the ground rod.

A grounding bus of 4/0 bare stranded copper shall be exothermically bonded to the ground rod and loop the concrete structure walls. The ground bus shall be a minimum of one foot above the floor of the structure and separate from other cables. No. 2 American wire gauge (AWG) bare copper pigtails shall bond the grounding bus to all cable trays and other metal hardware within the concrete structure.

Connections to the grounding bus shall be exothermic. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete per UL 467. Hardware connections may be mechanical, using a lug designed for that purpose.

115-3.9 CLEANUP AND REPAIR. After erection of all galvanized items, damaged areas shall be repaired by applying a liquid cold-galvanizing compound per MIL-P-21035. Surfaces shall be prepared and compound applied per the manufacturer's recommendations.

Prior to acceptance, the entire structure shall be cleaned of all dirt and debris.

115-3.10 RESTORATION. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. The Contractor shall restore all disturbed areas equivalent to or better than their original condition. All sodding, grading and restoration shall be considered incidental to the respective L-115 pay item.

The Contractor shall grade around structures as required to provide positive drainage away from the structure.

Areas with special surface treatment, such as roads, sidewalks, or other paved areas shall have backfill compacted to match surrounding areas, and surfaces shall be repaired using materials comparable to original materials.

Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

After all work is completed, the Contractor shall remove all tools and other equipment, leaving the entire site free, clear and in good condition.

115-3.11 INSPECTION. Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the plans and this specification. Any indication of defects in materials or workmanship shall be further investigated and corrected. The earth resistance to ground of each ground rod shall not exceed 25 ohms. Each ground rod shall be tested using the fall-of-potential ground impedance test per American National Standards Institute / Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.

115-3.12 DUCT EXTENSION TO EXISTING DUCTS. Where existing concrete encased ducts are to be extended, the duct extension shall be concrete encased plastic conduit. The fittings to connect the ducts together shall be standard manufactured connectors designed and approved for the purpose. The duct extensions shall be installed according to the concrete encased duct detail and as shown on the plans.

METHOD OF MEASUREMENT

115-4.1 NEW ELECTRICAL STRUCTURE. The quantity of new electrical hand-hole structures shall be measured by each type and size of unit completed in place and accepted. The unit price shall be full compensation for all labor, materials, equipment, testing and incidentals necessary to complete the Item as accepted by the Owner.

The work for each unit specifically includes, but is not limited to, the following items:

- All Required Excavation
- Sheeting and Bracing
- Dewatering If Required
- All Required Connections
- Temporary Cables and Connections
- Ground Rod Testing
- All Required Backfilling with On-Site Materials

115-4.2 NEW LID RETROFITS shall be measured by the completed unit installed, in place, completed, and accepted. Separate measurement shall not be made for the various types and sizes.

115-4.3 RGL CIRCUIT ISOLATION. The quantity of new RGL circuit isolation boxes and conduit in electrical hand-hole structures shall be measured by each conduit isolation configuration installed in each structure, in accordance with Plans and Details, completed in place and accepted. The unit price shall be full compensation for all labor, materials, equipment, testing and incidentals necessary to complete the Item as accepted by the Owner.

BASIS OF PAYMENT

115-5.1 NEW ELECTRICAL STRUCTURE. This Item shall consist of each type and size of new electrical handhole structure and will be paid for at the Contract unit price per each, complete and in place. The work shall include furnishing all materials and for all preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other structures as may be required to complete the item as shown on the plans and for all labor, equipment, tools and incidentals necessary to complete the structure.

Payment will be made under:

Item L-115-5.1	New Handhole, Type I, Air Craft Rated (4'x4'x4') Furnished and Installed with Aircraft Rated Lid – per each
Item L-115-5.2	New Handhole, Type 1, Aircraft Rated (4’x4’x4’) Furnished and Installed with Aircraft Rated Lid (Retrofit in Existing Full Strength Concrete Pavement) – per each
Item L-115-5.3	Replace Handhole Lid and Top Section (4’ x 4’) with New Aircraft Rated Lid– per each
Item L-115-5.4	Install RGL Circuit Isolation Boxes and Conduit in New Handhole – per each

MATERIAL REQUIREMENTS

ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program
ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C206	Standard Specification for Finishing Hydrated Lime
FAA EB #83	In Pavement Light Fixture Bolts
MIL-P-21035	Paint High Zinc Dust Content, Galvanizing Repair
NFPA-70	National Electrical Code (NEC)
FED SPEC J-C-30	Cable and Wire, Electrical Power, Fixed Installation (cancelled; replaced by AA-59544 Cable and Wire, Electrical (Power, Fixed Installation))
ASTM B.3	Soft or Annealed Copper Wire

END OF ITEM L-115

ITEM L-804(L) LED ELEVATED RUNWAY GUARD LIGHTS

DESCRIPTION

804(L)-1.1 RELATED DOCUMENTS. The General Provisions of the Contract, including General and Special Conditions and Compensation Conditions, apply to work specified in this Item.

804(L)-1.2 SCOPE. This Item shall consist of installing salvaged LED elevated runway guard lights (RGLs) and isolation transformers on new L-867 base cans in accordance with these specifications and at the locations shown on the plans.

This Item involves the following work.

a. Install all new conduit/duct system (per Item L-110), make connections into new and existing hand holes and install L-867 bases as shown on the plans.

b. Install new Type L-867 base cans at indicated locations. Encase the L-867 base with P-610 concrete according to detail shown on plans.

c. Pull new 5 kV lighting cable Type L-824C between new and existing hand holes, adjacent light bases and splice at both ends to new cable in the hand holes (per Item L-108).

d. Install and connect the salvaged Type L-804(L) LED elevated runway guard lights, aim and test.

804(L)-1.3 IDENTIFICATION NUMBERS. Circuit identification shall be assigned to each permanent light in accordance with the drawings. The placing of these characters shall be accomplished by use of 2-inch diameter nonferrous metal tag, with the characters approximately 1/4-inch in height, stamped in, embedded in the concrete base as detailed on the drawings, so each faces the taxiway.

804(L)-1.4 APPLICABLE DOCUMENTS. Airport lighting equipment and materials covered by advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program per AC 150/5345-53, current version. The publications listed at the end of this Item are incorporated herein by reference and form a part of this Item to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of this solicitation shall

be applicable. In the text of this Item, such publications are referred to by basic designation only. Additional details and specifications pertaining to a specific system are contained in these documents and are to be considered as part of this Item. Perform all work in accordance with these documents except as specified herein. In the event of a conflict between contract documents and the referenced documents, the more stringent rule shall be applied.

804(L)-1.5 SHOP DRAWINGS AND MATERIAL LISTS. Shall be in accordance with Item L-100, Paragraph 100-1.5, for the following equipment:

a. Heavy fixture mounting base plates.
b. L-867 base, per L-867.
c. Isolation transformer.

804(L)-1.6 LOCATION/ELEVATION. Unless otherwise noted on plans, elevated RGLs shall be collocated with the runway holding position marking, on each side of the taxiway located 10' (min) to 17' (max), from the defined taxiway edge to the near side of the installed light fixture. (Refer to Advisory Circular 150/5340-30, current edition).

Elevation of bases shall be coordinated with the existing grading and pavement. The base shall be set so that the light fixture base plate shall be within +1 inch/-0 inch of the finished shoulder pavement or existing surrounding grade.

Contractor may be required to retrofit new light bases in existing asphalt shoulder pavement and restore / repair existing pavement – Refer to plans.

804(L)-1.7 LIGHT BASE AND LIGHT INSTALLATION ALIGNMENT TOOL. The tolerance requirements for: location, elevation, and orientation of all light fixtures are of critical importance and must be maintained. In order to do so the light bases and lights shall be installed using an installation and alignment tool or jig. This tool shall be capable of achieving the final alignment specified and shall be of sufficient strength to support the light base during placement and compaction of concrete around the base. The Contractor shall submit to the RE the proposed installation and alignment tool for approval. Upon approval, the Contractor shall procure a sufficient number of these tools to use in the installation process. No light base or light shall be installed without using an approved installation and alignment tool or jig.

804(L)-1.8 TESTING. All L-804(L) fixtures shall be fully tested by continuous operation for not less than 24 hours as a completed system prior to acceptance. For Mode 1 powered L-804(L)s, the test shall include operating the constant current regulator in each step not less than 10 times at the beginning and end of the 24-hour test. The L-804(L) shall illuminate properly and have the proper flash timing during each portion of the test.

MATERIALS

804(L)-2.1 LIGHT BASE. Type L-867, Size B, one or two-piece, meeting the requirements of FAA AC 150/5345-42.

804(L)-2.2 HARDWARE. All bolts, nuts, washers and lock-washers shall be stainless steel and be long enough to allow for full thread engagement. Install using high temperature anti-seize compound.

804(L)-2.3 PLUG AND RECEPTACLE CABLE CONNECTORS. L-823, Type I, Class A, meeting the requirements of FAA AC 150/5345-26D as required to accommodate the extended length stem.

804(L)-2.4 CONCRETE. Concrete grout used to encase light bases shall meet Specification P-610.

METHOD OF MEASUREMENT

804(L)-3.1 ELEVATED LED RUNWAY GUARD LIGHTS. The quantity to be measured shall be for each elevated runway guard light fixture with appurtenances, including light bases, isolation transformers, grounding and connectors and secondary cable and receptacle assemblies and testing in accordance with the plans and specifications and as accepted by the Owner.

BASIS OF PAYMENT

804(L)-4.1 ELEVATED LED RUNWAY GUARD LIGHTS. Payment for the installation of each salvaged elevated runway guard light shall be made at the contract unit price for installing said fixture. Under Bid Item in the proposal, the unit price shall be full compensation for furnishing and shipping all materials and for all preparation, erection and installation of these materials to complete the Item as accepted by the Owner. The unit price of each of these items shall also include the Contractor's overhead, profit and markup.

For Schedule I (Base Bid), payment will be made under:

Item L-804(L)-4.1	Re-Install Salvaged L-804(L) Elevated Runway Guard Light and Transformer on New L-867 Base Can-- per Each

REFERENCED PUBLICATIONS

804(L)-5.1 FEDERAL AVIATION ADMINISTRATION (FAA) SPECIFICATIONS REFERENCED IN ITEM L-804(L).

AC 150/5340-30J Design and Installation Details for Airport Visual Aids

AC 150/5345-26D Specification for L-823 Plug and Receptacle, Cable Connectors (including Changes 1 & 2)

AC 150/5345-42H Specification for Airport Light Bases, Transformer Housings, Junction Boxes and Accessories (including Change 1)

AC 150/5345-47C Isolation Transformers for Airport Lighting Systems

AC 150/5345-53D Airport Lighting Equipment Certification Program

END OF ITEM L-804(L)

ITEM L-852 INSTALLATION OF LED IN-PAVEMENT TAXIWAY FIXTURES

DESCRIPTION

852-1.1 RELATED DOCUMENTS. The General Provisions of the Contract, including General and Special Conditions apply to work specified in this Item.

852-1.2 GENERAL. This item shall consist of furnishing and installing salvaged and new L-852B(L), L852T(L), and L-852A(L) LED in-pavement fixtures, isolation transformers and coated mounting bolts in accordance with these specifications.

This item shall also include the testing of the installation, insulation resistance testing of affected circuit(s) and all incidentals necessary to place the light fixtures in operation as completed units to the satisfaction of the Airport and Engineer. All wire and cable connections, conduits, fittings and all necessary mounting structures are existing.

This item involves the following work:

a. Install all new or salvaged L-852B(L), L-852D(L), L852T(L), and L-852A(L) LED in-pavement fixtures with new corrosion resistant fluoropolymer coated grade 5, medium carbon steel bolts and appropriately sized 6.6 amp L-830 series isolation transformers complete with connections to existing circuit cables. Where new or salvaged fixtures are installed in existing L-868 base cans, existing L-823 primary connector kits shall remain for reconnection to new isolation transformers.

b. Install all new conduit/duct system (per Item L-110) and stub to each location within pavement base / subgrade as shown on the plans.

c. Core drill new pavement and install Type L-868 bases (with drains) at indicated locations.

d. Encase the L-868 bases with concrete, core or provide rubber block out and provide sealant around top spacers and flanges according to detail shown on plans.

e. Install all new 5 kV lighting cable between lights for circuit segments (per Item L-108), as shown on the plans.

f. After installation has been completed, Contractor shall coordinate with Airfield maintenance for testing operation of the affected circuit(s) including testing insulation resistance testing of affected circuit(s).

852-1.3 LOCATION / ELEVATION. Lights are to be installed on existing bases shall have same orientation, configuration and elevation as existing fixtures and as indicated on the drawings. Lights shall be spaced on centers as indicated on the drawings. Longitudinal tolerance is +/- 6 inches.

Elevation of new in-pavement bases shall be coordinated with the civil paving, grading and drainage drawings. The base shall be set so that the light fixture flange, including pavement dam and spacer rings, shall be within +0/-1/16 inch of the finished pavement.

852-1.4 FAA ADVISORY CIRCULARS. Additional details pertaining to the specific elements covered in this Item are contained in the following FAA Advisory Circulars:

AC 150/5345-26D	Specification for L-823 Plug and Receptacle, Cable Connections (including Changes 1 and 2).
AC 150/5345-42H	Specification for Light Base and Transformer Housings, Junction Boxes and Accessories (including Change 1).
AC 150/5345-46E	Specification for Runway and Taxiway Light Fixtures.
AC 150/5345-47C	Isolation Transformers for Airport Lighting Systems.
AC 150/5345-53D	Airport Lighting Equipment Certification Program

852-1.5 SHOP DRAWINGS AND MATERIAL LISTS. Prior to the installation of any material and equipment and within 30 days of contract award, the Contractor shall submit to the Owner for approval six (6) copies of manufacturers' brochures containing complete dimensional and performance characteristics, wiring diagrams, installation and operation instructions, etc., for the following equipment:

a. L-852A(L) LED In-Pavement Taxiway Centerline fixtures
b. L-852T(L) LED In-Pavement Taxiway Edge Light fixtures
c. L-830, 6.6A, series isolation transformers; appropriately sized wattage.
d. Fluoropolymer coated, grade 5, medium carbon steel bolts.
e. L-868 load bearing bases
f. Flange rings with pavement dams rings
g. Spacer rings
h. Multi-hole adapter rings.
i. M-005 sealant.

In addition to the above specific items, a materials list shall be submitted listing each specification paragraph number and stating whether the materials proposed are as specified or are substitutions. If the item is a substitute item, a complete submittal as described in the above paragraph shall be provided for that item.

The submittal shall be complete and made in one submission in Electronic PDF or booklet form with hard-bound cover. Partial submissions will not be reviewed or considered.

852-1.6 TESTING. Prior to start of Construction, Airfield Maintenance will perform insulation resistance testing of all affected circuits to serve as a baseline for subsequent tests. After installation and operational testing of new fixtures and components, Contractor shall coordinate with Airfield Maintenance to perform insulation resistance testing on each affected circuit.

Insulation resistance testing results performed after installation shall be equal to or greater than testing results prior to construction. Contractor will be required to correct any installation deficiencies to obtain passing insulation resistance readings at their own expense.

Contractor shall coordinate with Operations and /or Airfield Maintenance to perform manual operational testing of each affected circuit at the end of construction or the end of each phase to ensure all newly installed fixtures and existing fixtures are operational on all brightness steps in accordance with item L-100-1.9.

MATERIALS

852-2.1 GENERAL. Airport lighting equipment and materials covered by FAA specifications shall have the prior approval of the Federal Aviation Administration, Airports Service, Washington, D.C. 20590. All in-pavement lights shall meet the requirements of AC 150/5345-46 (current edition), and be suitable for use with 6.6 amp secondary circuits and mount on a 12 inch diameter (Size B) L-868 base can. The reveal above the adjacent pavement surface shall not exceed 0.25".

852-2.2 IN-PAVEMENT LIGHT FIXTURES.
Type L-852A and Type L-852T, meeting the requirements of FAA AC 150/5345-46E. Provide with grounding lug (see drawings). Light source shall be Light Emitting Diode (LED), 6.6 amp input power as indicated in plans.

Bond the light fixture to the light base internal ground lug via a No. 6 AWG stranded copper wire rated for 600 volts with green XHHW, THWN-2, or other suitable insulation, bare stranded conductor or a braided ground strap of equivalent current rating. The bonding conductor length must be sufficient to allow the removal of the light fixture from the light base for routine maintenance. See the light fixture manufacturer's instructions for proper methods of attaching a bonding wire to the fixture. List connections for direct earth burial.

852-2.3 LIGHT BASE.
Type L-868, size B, one piece, meeting the requirements of FAA AC 150/5345-42H.

852-2.4 ISOLATION TRANSFORMER.
Type L-830 sized as required per L-852A and L-852T light manufacturer, 60 hertz, meeting the requirements of FAA AC 150/5345-47C.

852-2.5 HARDWARE.
All bolts, nuts, washers and lock washers for grounding connections shall be stainless steel. Install using medium temperature anti-seize compound.

ALL Fixture and flange / multi-hole adapter ring mounting bolts shall be grade 5, fluoropolymer coated carbon steel, torqued to 25 ft. lbs. per City of Phoenix Airfield Maintenance Standards.

Lock washers for COP installed fixtures shall be stainless steel, one piece 'split' style in lieu of 2-piece anti-vibration type, per City of Phoenix Airfield Maintenance Standards.

852-2.6 LIGHTING CABLE.
See Item L-108. Type L-824C, 5 kV, meeting the requirements of FAA AC 150/5345-7F.

852-2.7 PLUG AND RECEPTACLE CABLE CONNECTORS.
Type I, Class A, meeting the requirements of FAA AC 150/5345-26D.

852-2.8 CONCRETE.
Concrete for backfill shall conform to the requirements of Item P-610 Structural Portland Cement Concrete.

852-2.9 SEALANT.
Sealant used to encase in-pavement transformer/light base spacers and flange rings with pavement dams shall meet FAA Specification M-005 for use in waterproofing non-moving joints in Portland cement concrete pavement.

852-2.10 SPARES. New installations shall include a designated amount of spare L-852T(L) and L-852A(L) fixtures and isolation transformer, which shall be furnished to airport maintenance.

METHOD OF MEASUREMENT

852-3.1 NEW FLUSH LED IN-PAVEMENT TAXIWAY LIGHT FIXTURES. The quantity to be measured shall be for the installation of the new in-pavement LED Taxiway light fixtures and isolation transformers with new mounting hardware, cable connections, grounding and testing in accordance with the plans and specifications and as accepted by the Owner. Grounding and bonding connections between light bases and fixtures including grounding cable or braided ground straps shall be included and is considered incidental to installation of each fixture.

852-3.2 REINSTALL SALVAGED FLUSH LED IN-PAVEMENT TAXIWAY LIGHT FIXTURES ON EXISTING BASE CAN. Payment for the installation of salvaged in-pavement taxiway light fixtures and isolation transformers with new coated mounting bolts on existing L-868 bases with new mounting hardware, cable connections, grounding and testing in accordance with the plans and specifications and as accepted by the Owner. Grounding and bonding connections between light bases and fixtures including grounding cable or braided ground straps shall be included and is considered incidental to installation of each fixture.

852-3.3 REINSTALL SALVAGED FLUSH LED IN-PAVEMENT TAXIWAY LIGHT FIXTURES ON NEW BASE CAN. Payment for the installation of salvaged in-pavement taxiway light fixtures and isolation transformers new L-868 shallow bases with new mounting hardware, cable connections, grounding and testing in accordance with the plans and specifications and as accepted by the Owner. Grounding and bonding connections between light bases and fixtures including grounding cable or braided ground straps shall be included and is considered incidental to installation of each fixture.

852-3.4 NEW LED IN-PAVEMENT TAXIWAY LIGHTS (SPARES). The quantity to be measured shall be per each for the furnishing to the Airport new spare elevated LED inpavement taxiway light fixtures and isolation transformers in accordance with the plans and specifications and as accepted by the Owner.

BASIS OF PAYMENT

852-4.1 FLUSH LED IN-PAVEMENT TAXIWAY LIGHT FIXTURES. Payment for the installation of new in-pavement taxiway light fixtures and isolation transformers on new L-868 bases shall be made at the contract unit price for installing said lights. The unit price shall be full compensation for furnishing all materials and for all preparation, erection and installation of these materials to complete the item. The unit price of each of these items shall also include the Contractor's overhead, profit and markup.

852-4.2 REINSTALL SALVAGED FLUSH LED IN-PAVEMENT TAXIWAY LIGHT FIXTURES ON EXISTING BASE CAN. Payment for the reinstallation of salvaged in-pavement taxiway light fixtures and isolation transformers on existing L-868 bases shall be made at the contract unit price for installing said lights. The unit price shall be full compensation for furnishing all materials and for all preparation, erection and installation of these materials to complete the item. The unit price of each of these items shall also include the Contractor's overhead, profit and markup.

852-4.3 REINSTALL SALVAGED FLUSH LED IN-PAVEMENT TAXIWAY LIGHT FIXTURES ON NEW BASE CAN. Payment for the reinstallation of salvaged in-pavement taxiway light fixtures and isolation transformers on new shallow L-868 bases shall be made at the contract unit price for installing said lights. The unit price shall be full compensation for furnishing all materials and for all preparation, erection and installation of these materials to complete the item. The unit price of each of these items shall also include the Contractor's overhead, profit and markup.

852-4.4 NEW LED IN-PAVEMENT TAXIWAY LIGHTS (SPARES). Payment for the furnishing of each new spare LED inpavement taxiway light and isolation transformer shall be made at the contract unit price for providing spare fixtures to the Owner. The unit price shall be full compensation for furnishing all materials to complete the item as accepted. The unit price of each of these items shall also include the Contractor's overhead, profit and markup.

Payment will be made under:

Item L-852-4.1	Re-Install Salvaged L-852T(L) In-Pavement Taxiway Edge Light and Isolation Transformer on New Shallow L-868 Base Can (Retrofit in Existing Full Strength Concrete Pavement)-- per each
Item L-852-4.2	Re-Install Salvaged L-852A(L) LED In-Pavement Taxiway Centerline Light and Isolation Transformer on Existing Base Can with 1" Spacer Ring and New Bolts -- per each
Item L-852-4.3	Re-Install Salvaged L-852D(L) LED In-Pavement Taxiway Centerline Light and Isolation Transformer on Existing Base Can with New Bolts -- per each

Item L-852-4.4 New L-852A(L) LED In-Pavement Taxiway Centerline Light and Isolation Transformer on New L-868 Base Can (Retrofit in Existing Asphalt) -- per each

Item L-852-4.5 Re-Install Salvaged L-852B(L) LED In-Pavement Taxiway Centerline Light and Isolation Transformer on Existing Base Can with New Bolts -- per each

Item L-852-4.6 New L-852T(L) In-Pavement Taxiway Edge Light and Isolation Transformer on New Shallow L-868 Base Can (Retrofit in Existing Full Strength Concrete Pavement) -- per each

Item L-852-4.7 L-852T(L) In-Pavement Taxiway Edge Light and Isolation Transformer – Spares -- per each

Item L-852-4.8 L-852A(L) LED In-Pavement Taxiway Centerline Light and Isolation Transformer - Spares -- per each

REFERENCED PUBLICATIONS

852-6.1 FAA SPECIFICATIONS REFERENCED IN L-852.

AC 150/5345-7F	Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits
AC 150/5340-30J	Design and Installation Details for Airport Visual Aids
AC 150/5345-26D	Specification for L-823 Plug and Receptacle, Cable Connections (including Changes 1 and 2)
AC 150/5345-42H	Specification for Light Base and Transformer Housings, Junction Boxes and Accessories (including Change 1)
AC 150/5345-46E	Specification for Runway and Taxiway Light Fixtures
AC 150/5345-47C	Isolation Transformers for Airport Lighting Systems
AC 150/5345-53D	Airport Lighting Equipment Certification Program

END OF ITEM L-852

ITEM L-858(L) LED AIRPORT GUIDANCE LIGHTING SYSTEMS (SIGNAGE)

DESCRIPTION

858(L)-1.1 RELATED DOCUMENTS. The General Provisions of the Contract, including General and Special Conditions apply to work specified in this Item.

858(L)-1.2 GENERAL. This Item shall consist of internally lighted LED airport taxiway guidance signage furnished and installed in accordance with this specification, the referenced specifications, the manufacturer's recommendations, and the applicable codes, standards and Advisory Circulars. The signs shall be installed at the locations and in accordance with the dimensions, design, and details shown in the plans. This item shall include the furnishing of all equipment, materials, services, and incidentals necessary to place the systems in operation as completed units to the satisfaction of the RE, including concrete cast in place or precast sign bases with transformer enclosure, cover and gasket and an external sign grounding electrode system. This item shall also include the relocation of existing signs with new panels on new or existing concrete bases and installation of salvaged non-lit signs.

858(L)-1.3 FAA ADVISORY CIRCULARS AND STANDARDS.

a. Airfield signs and related materials covered by FAA specifications shall have the prior approval of the Federal Aviation Administration, Airports Service, Washington, DC 20591, and shall be certified by an approved laboratory such as ETL as conforming with applicable FAA standards and requirements, or shall be verified as exceeding FAA standards as required by these specifications.

b. All other equipment and material covered by other referenced specifications shall be subjected to acceptance through manufacturer's certification of compliance with the applicable specification. All electrical materials and equipment for which there is a nationally recognized standard shall bear the conformance labeling of the third party inspection authority, such as Underwriters Laboratories, Inc., Factory Mutual, ETL, or approved equal.

c. The following documents, of the issue in effect on date of application for qualification, are applicable to the extent specified:

Federal Aviation Administration (FAA) Advisory Circulars.

AC 150/5340-18F	Standards for Airport Sign Systems
AC 150/5340-30J	Design and Installation Details for Airport Visual Aids.
AC 150/5345-26D	Specification for L-823 Plug and Receptacle, Cable Connections (including Changes 1 & 2).

AC 150/5345-42H	Specification for Light Base and Transformer Housings, Junction Boxes and Accessories.
AC 150/5345-44K	Specification for Taxiway and Runway Signs.
AC 150/5345-47C	Isolation Transformers for Airport Lighting Systems.
AC 150/5345-53D	Airport Lighting Equipment Certification Program

Federal Specification

L-S-300	Sheeting and Tape -- Reflective; Non-exposed Lens, Adhesive Backing

Military Standard

MIL-STD-810	Environmental Test Methods

American Society for Testing and Materials (ASTM)

ASTM D 4956	Specification for Retro reflective Sheeting for Traffic Control

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code

(Copies of FAA Advisory Circulars may be obtained from the Department of Transportation, Publications Section, M-494.3, Washington, DC 20590).

(Copies of Federal Specifications may be obtained from General Services Administration offices in Washington, DC, Atlanta, Boston, Denver, Chicago, Kansas City, New York, San Francisco, and Seattle).

(Copies of Military Standards may be obtained from the Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, PA 19120, and Attention: Code CDS).

The signs shall meet or exceed FAA requirements when subjected to the qualification tests as described in the latest edition of AC 150/5345 – 44K.

The installation of Underground Cable for Airports, Airport Underground Electrical Duct, and Airport Lighting Systems that are not a part of this item are covered under the separate respective items of these specifications.

858(L)-1.4 SHOP DRAWINGS AND MATERIAL LISTS. Prior to the installation of any material and equipment and within 30 days of contract award, the Contractor shall submit to the Owner for approval six (6) copies of manufacturers' brochures or Electronic PDF containing complete dimensional and performance characteristics, installation and operation instructions, etc., for the following equipment: This list shall include the name of each item, the Federal

Aviation Administration specification number, the manufacture's name, the manufacturer's catalog number, and the size, type and/or rating of each item.

a) Shop drawings shall be submitted showing: installation requirements (i.e., foundation size, anchor bolt location, etc.); sign assembly, including all fabrication assembly and internal and external wiring diagrams; message layout for each sign; and tabulation of total volt-ampere (VA) for each sign at highest intensity step.

b) Catalog cuts shall be submitted showing: sign and sign base (features and accessories, installation details); results of tests performed by an independent laboratory testing source in accordance with AC 150/5345-44K addressing visual examination, wind load and frangibility load tests, photometric test results with luminance maps, environmental tests, production tests; load data for all brightness steps, as measured from the primary side of the isolation transformer, and power factor; lamp life.

c) Sign schedules including sign numbers and face panel descriptions.

d) Steel L-867 base and steel cover (sign base and transformer enclosure.)

e) Dimensioned and detailed pre-cast concrete bases.

f) Manufacturer's statement of warrantee (see Paragraph 858-2.8)

In addition to the above specific items, a materials list shall be submitted listing each specification paragraph number and stating whether the materials proposed are as specified or are substitutions. If the item is a substitute item, a complete submittal as described in the above paragraph shall be provided for that item.

The submittal shall be complete and made in one submission in booklet form with hardbound cover. Partial submissions will not be reviewed or considered.

858(L)-1.5 MATERIAL DELIVERY SCHEDULE AND REQUIREMENTS. All signs and associated materials, (transformers and connecting cables, transformer housings, anchor bolts, floor flanges, breakable couplings, and incidental mounting hardware), for the project shall be procured under this contract in accordance with the material delivery directed by the RE. The following material distinction is made to define the material to be delivered:

a. Mounting Hardware. Mounting hardware shall include detailed installation shop drawings as prepared by the sign supplier and approved by the RE, transformer housings, anchor bolts and floor flange templates, and sign markers (blank).

b. Sign. Signs shall include the actual sign to be installed, transformer and connecting cables, floor flanges, breakable couplings, tethers, and all other incidentals necessary to provide a complete and operable sign.

EQUIPMENT AND MATERIALS

858(L)-2.1 GENERAL. Taxiway guidance signs, hereinafter referred to as "Signs," shall be retro-reflective and shall be the internally illuminated, use a LED (light emitting diode) technology and shall be ETL certified, conforming to AC 150/5345-44K, other referenced publications, and to the requirements of this Section. In the event of conflict, the more stringent of these shall apply. The signs shall have a record of having operated successfully for a minimum period of one year at an airport located in the continental United States. The sign manufacturer shall have minimum five years experience in the manufacture of lighted airfield signs to FAA requirements.

Airport signage equipment and materials covered by FAA specifications shall have the prior approval of the Federal Aviation Administration, Airports Service, Washington, D.C. 20591, and shall be listed in Advisory Circular 150/5345-53D, Airport Lighting Equipment Certification Program.

All other equipment and materials covered by other referenced specifications shall be subject to acceptance through the manufacturer's certification of compliance with the applicable specifications and subject to Owner's approval.

Lists of the equipment and materials required for a particular system are contained in the applicable Advisory Circulars.

Match existing signs, new airport signs shall be curved face Lumacurve as manufactured by Standard Signs Inc., or approved equal, to match existing airfield signage. The Airport/Owner desires to achieve and maintain standardized airfield lighting equipment in order to reduce costs by minimizing replacement parts inventory and maintenance training.

858(L)-2.2 SIGN CLASSIFICATION. The classification of each sign shall be as shown on the Construction Drawings and as specified below:

a. Types. Signs of the following types are included:

(1) Type L-858R. Mandatory Instruction Sign. White Legend on a red background.

(2) Type L-858Y. Direction, Destination, and Boundary Sign. Black legend on a yellow background.

(3) Type L-858L. Taxiway Location Sign. Yellow legend and border on a black background.

b. Sizes. Signs of the following sizes are included:

(1) **Size 2.** 24-inch Sign Face with a 15-inch legend.

c. Styles. Signs of the following styles are included:

(a) Style 5. Powered from a fixed step 5.5A series lighting circuit.

d. Classes. Lighted signs of the following classes are included:

(1) **Class 1**. Operation for -4º degrees Fahrenheit (F) (-20º degrees Celsius (C)) to 131º degrees F (55 degrees C) environment.

A. Modes of Signs. Signs of the following modes are part of this specification:

(1) **Mode 2** – must withstand wind loads of 200 mph.

858(L)-2.3 EQUIPMENT TO BE SUPPLIED. The sign shall be complete in accordance with all specification requirements and shall include mounting legs and hardware, an electrical disconnect, any required series circuit adapter unit, and an instruction booklet.

858(L)-2.4 ENVIRONMENTAL REQUIREMENT. The signs, including all required components, shall be designed for continuous outdoor use under an ambient temperature range from -20 degrees C to +55 degrees C. The signs shall be capable of withstanding wind velocities up to 200 mph and exposure to driving rains.

858(L)-2.5 TAXIWAY GUIDNACE SIGN CONSTRUCTION FEATURES.

a. Sign Construction. Taxiway Guidance Signs shall be manufactured and furnished only by a supplier currently listed and approved under the FAA Airport lighting Equipment Certification Program

(1) Signs shall be constructed of lightweight, nonferrous materials, and shall be designed for installation on a concrete pad foundation. All required mounting hardware, except anchor bolts, shall be supplied with the sign. Loose parts shall be tethered to, or otherwise prevented from blowing away from, the installed sign enclosure. All screws or latches shall be the captive type, and shall be easy to open and close.

(2) Mounting legs for each sign shall have frangible points located 2 inches or less above the concrete pad foundation. The frangible points shall withstand wind loads due to jet blast of 200 mph, as simulated by an applied static load of 0.9 psi, but shall break before reaching an applied static load over the legend panel of 1.3 psi. Legend panels and panel supports shall withstand, at a minimum, the pressure at which the frangible points break.

(3) Taxiway guidance signs shall be of a modular design. Individual sign panel construction shall not exceed 42 inches in length. Sign panel shall be top load installed for maintenance efficiency.

(4) To insure reduced energy and maintenance requirements, the L-858 sign light source shall utilize an energy efficient, long life LED type lamp or engineer approved equal. Lamps shall be 4W with an estimated life of 25,000 hours. To facilitate quick lamp changes without the use of tools, lamps shall utilize a screw base socket. All sign configurations shall have a power factor of .92 or higher as measured on the primary of the L-830 isolation transformer. Sign systems must

operate on both medium intensity (4.8A – 6.6A) and high intensity (2.8A – 6.6A) circuits without internal modification to give the airport maximum flexibility in sign usage and minimize parts to be stocked. To maximize maintenance personnel safety, there shall be no more than 170Vdc at any point inside the sign. In addition, the power supply circuit shall output a regulated DC current of 0.29 amps maximum.

(5) Signs shall have legends on one or both sides, as required by the Drawings. The sign face shall comply with paragraph 858(L)-2.11. The sign face assembly shall have gasketing between the sign material and housing.

(6) The color of the sign enclosure shall be black.

(7) The sign shall be completely sealed against sand and dust so that all internal surfaces will remain bright and clean. The lamp(s) shall be easily changeable, and ballast and all electrical control equipment shall be easily accessible in enclosures mounted to the interior of the sign structure.

b) Tether. Each sign shall be supplied with a minimum of two tethers, with not less than two tethers per five sign legs, which can be secured to the sign enclosure. The tethers shall be installable such that each sign, when knocked down by a wind of greater than 200 mph, shall remain attached to the sign foundation. Tethers shall be 1/8" stainless steel aircraft cable and shall be secured to the sign enclosure and to a support leg base flange anchor bolt with lock nuts and large diameter washers.

c) Electrical Features.

(1) The signs shall be relampable without the use of tools. Loose parts shall be tethered to, or otherwise prevented from blowing away from, the installed sign enclosure. All screws and latches shall be the captive type.

(2) Power input from the lighting circuit shall be made through an isolation transformer conforming to AC 150/5345-47C.

(3) Power input leads shall be at least two feet in length and shall allow for lead termination in a Type 1, Class A, Style 9 receptacle conforming to AC 150/5345-26D.

(4) The L-858 sign light source shall utilize individual Light Emitting Diode (LED) lamps or Engineer approved equal.

(5) All wiring shall conform to the requirements of NFPA 70. All wiring shall be color-coded and shall be clearly labeled. There shall be no exposed wiring.

(6) All electrical materials and equipment for which there is a nationally recognized standard shall bear the conformance labeling of the third party inspection authority, such as Underwriters Laboratories, Inc., Factory Mutual, or ETL.

858(L)-2.6 REPLACEMENT PARTS POLICY. In order to maximize safe operations on the airfield, reduce risk of runway incursions and minimize inventory requirements, sign manufacturer shall provide the Owner an emergency replacement signs and parts service for the life of the signs. Orders for replacement parts and complete signs shall ship within 24 hours of order receipt. Manufacturer shall provide a history of providing such a service for a minimum of 5 years. The cost for this policy shall be considered incidental to each pay item for the signs.

858(L)-2.7 SPARES. In case of knock-downs or maintenance vehicle damage, new installations shall include 20- percent spare lamps/light sources for every sign supplied and 2 spare power supplies for every 10 signs supplied (minimum qty of 1). This will further protect the airport from premature component failure that occurs after the manufacturer's warranty expiration but prior to reaching the projected light sources full rated life.

858(L)-2.8 ELECTRICAL DISCONNECT.

a) All lighted signs must be equipped with a power input disconnect cable terminated with a Type II plug under the requirements of AC 150/5345-26.

b) The length of power disconnect cable must be at least 6 inches longer than required to permit the plug end to reach the top of the concrete pad on which the sign is mounted.

c) A cable clamp or similar restraining device must be provided in the sign to prevent strain on the cable terminal connections when the cable plug is pulled apart.

d) There must be no above ground power cable connections to signs. Power to a sign or sign array must be provided through breakaway cable connectors installed within the frangible point portion of the sign's mounting legs.

e) There must be no external above ground electrical connection between signs in a sign array.

f) The sign manufacturer must offer an optional ON/OFF power switch that is appropriate for the style of lighted signs. Signs for this project will be equipped with power switch and weatherproof cover.

858(L)-2.9 SIGN SIZES. The heights of the signs shall be in accordance with the dimensions as follows:

Size	Legend Height (Inches)	Legend Panel Height (Inches)	Overall Mounting Height (Inches)
2	15	24	36

The lengths of the signs shall be determined by the message to be conveyed, but shall not exceed the maximum length specified by Table 1 of AC 150/5345-44K.

858(L)-2.10 SIGN FACES

a. The signs shall be either single face (message only on one side) or double face (messages on two sides). The spacing, stroke, shape of legend characters, numerals, symbols, border for Type L-858L sign faces, and message dividers shall be in accordance with FAA AC 150/5345-44K.

b. The Contractor and Manufacturer shall provide a warranty for a minimum of three years against the delamination of the surface films from the face of the signs.

858(L)-2.11 PERFORMANCE REQUIREMENTS.

a. Sign Operation.

(1) Signs shall be energized and operated at any incoming current value of the series lighting circuit without flickering.

(2) The luminance level and uniformity of the sign shall be maintained across all series lighting circuit current values, as measured from the primary side of the isolation transformer.

(3) Power input from the series lighting circuit shall be made through isolation transformers, properly rated, and conforming to AC 150/5345-47C.

(4) Minimum rated operating lamp life, when sign is operated at the highest intensity step, shall not be less than 20,000 hours.

(5) The connection of multiple signs on a taxiway lighting circuit shall not adversely impact other circuit components, such as constant current regulator or isolation transformer.

b. Sign Luminance and Color.

(1) The internally illuminated background of the Type L-858Y sign and the legend of the Types L-858R and L858L signs shall have an average luminance from 10 to 30 foot-lamberts, with 16 to 30 foot-lamberts at the 2 highest intensity steps (white or yellow).

(2) Signs must be viewed from 800’ feet at night to determine if the luminance level is sufficient to make the Type L-858Y and L-858R background colors and Type L-858L legend and border colors readily discernible. Type L-858B, Runway Distance Remaining signs, must be viewed from 200’ feet at full brightness. Panel joints must not interfere with the legibility of the sign or leak light to create a color discontinuity across the joint. Signs must be evenly illuminated with no

dark areas or banding that interferes with legibility. Uniformity shall be kept as defined in FAA AC 150/5345-44K.

(3) The sign shall have a uniformity ratio no greater than 5:1 for luminance measured at any 3-inch grid on the sign for a specific color, and no more than 1.5:1 for luminance measured at any adjacent 3-inch grids.

(4) Manufacturer shall provide a three-year warranty on the retro reflective material lamination process.

858(L)-2.12 FINISH. External surfaces of the signs, excluding the mounting legs and face panel, shall be painted with a primer coat and a low luster, black finish coat. The surface color treatment of the nonmetallic surfaces shall be equal in quality to that obtained on metal surfaces.

858(L)-2.13 NAMEPLATE. Each sign shall have a nameplate giving the Sign Name as shown on the Construction Drawings, Type, Size, Style, Class, manufacturer's name, address, catalog number, and lamp data, including type and rating. The nameplate on Style 2, 3, and 5 signs shall give the total maximum volt-amp load and power factor as seen from the primary of the isolation transformer. The total maximum volt-amp load indicated shall reflect the highest possible volt-amp loading on the regulator and shall include loading due to a "worst case" isolation transformer, and any required ballast and/or adaptor units. The nameplate shall be mounted to the exterior of the sign enclosure at the topside of the sign.

858(L)-2.14 WORKMANSHIP. The equipment shall be fabricated in accordance with the highest quality workmanship. All wiring shall be neatly run and laced. All sharp edges and burrs shall be removed. Painted surfaces shall be free from runs, blotches, and scratches.

858(L)-2.15 INSTRUCTION BOOKLET. Two (2) copies of an instruction booklet shall be included with each order of signs, which shall include installation instructions, maintenance procedures (including operating voltage and point readings), and a complete parts list, including recommended spare parts list. It shall also describe the lamp wattage or current needed to maintain the luminance levels specified herein.

858(L)-2.16 SIGN COVER. Sign covers shall be capable of fully covering the sign and withstanding the weather conditions and jet blast to which it may be subjected during its installation. The material shall be sufficiently heavy (similar to canvas) to completely obscure the sign message so that it cannot be read.

858(L)-2.17 CONCRETE. Concrete for bases shall conform to the requirements of Item P-610 Structural Portland Cement Concrete. Precast concrete base shall be sized for four module signs.

858(L)-2.18 CONDUIT. Rigid steel and EMT conduit and fittings shall conform to the requirements of Fed. Spec. WW-C-581. PVC conduit and fittings shall conform to the requirements of Fed. Spec. W-C-1094.

858(L)-2.19 LIGHT BASE. Type L-867, galvanized steel, size B, one-piece, with steel cover plates meeting the requirements of FAA AC 150/5345-42H. Provide with grounding lug, grommeted conduit hubs and drainage holes as shown on the drawings.

858(L)-2.20 ISOLATING TRANSFORMER. An isolating transformer shall be provided with each signs and shall conform to the requirements of the applicable Advisory Circular. Provide with extended secondary connector cable kit. Transformers shall be minimum sized per manufacturer's requirements. Isolation transformer shall conform to the latest edition of FAA AC 150-5345-47C, Isolation Transformers for Airport Lighting Systems. The isolation transformer shall be an integrated unit, with power input leads at least 24 inches in length - one lead terminating in a Type I, Class A, Style 2 plug and the other lead in a Type I, Class A, Style 9 receptacle, conforming to the latest edition of FAA AC 150-5345-26D, Specification for L-823 Plug and Receptacle, Cable Connectors.

CONSTRUCTION METHODS

858(L)-3.1 GENERAL. The installation and testing details for the systems shall be as specified in the applicable Advisory Circulars.

858(L)-3.2 PHASING AND INTERRUPTIONS. The construction phasing and airfield operational requirements for this project may require that new signs are installed and covered until directed by the RE to activate the signs. Activating the signs will be done as directed by the RE or Operations.

858(L)-3.3 TEMPORARY UNLIGHTED SIGNS. If lighted signs are not available when required, temporary unlighted signs shall be provided and installed on the foundations for the associated permanent sign where required for aircraft operations. Sign legs with frangible points shall be fastened to the concrete foundation with drilled anchor bolts as required and as approved by the RE. When no longer required, signs shall be removed and any remaining holes in the concrete foundation shall be filled with grout. Temporary unlighted signs shall be salvaged when no longer required unless otherwise directed by the RE.

858(L)-3.4 LOCATION/ELEVATION. The signs shall be installed at the locations indicated in the plans. Guidance signs shall be located where indicated, offset 20'-35' from edge of full-strength pavement unless otherwise noted. Longitudinal tolerance is 1'-0". Foundation elevation shall be no more than 1 inch above finish grade as established on the civil grading and drainage drawings.

858(L)-3.5 TRANSFORMER. The transformer shall be installed in the L-867 base at location and position as indicated on the plans. The primary cable connections shall be made by use of the L-823 plug and receptacle cable connectors in accordance with plans and specifications.

858(L)-3.6 HARDWARE. All bolts, nuts, washers and lock washers shall be stainless steel. Install using high temperature anti-seize compound.

858(L)-3.7 CABLE, CONNECTOR, AND ISOLATION TRANSFORMERS. The primary and secondary cable leads of the transformers are supplied with factory-installed molded connectors. Visual inspection of these items during installation is very important. Minor cuts, bruises, or mishandling may result in progressive deterioration, which will eventually cause complete failure, but not until sometime after acceptance tests. During installation, these items shall be inspected for the following:

a. The mating surfaces of molded connectors are clean and dry when plugged together. If clean and dry inside, these high voltage connectors, with taping, form a connection equal or superior to a conventional high voltage splice. Conversely, if they are wet or dirty no amount of taping can produce a satisfactory connection. Two or three turns of tape should be used to hold the connector together and keep the parting line clean. Keeping the factory-installed caps in place until the final connection is made can ensure cleanliness of mating surfaces. The mating surfaces of uncapped connectors should not be laid down, touched, or breathed upon. If a connection must be broken, the connectors should be immediately capped.

b. The connectors are completely plugged together. After initial plugging, trapped air pressure may partially separate the plug and receptacle. If this happens, wait a few seconds and push them together again. Two or three turns of tape should be used to hold them in place.

c. The cables are not cut by shovels, kinked, and crushed by vehicle wheels bruised by rocks, or damaged in any way during handling and installation.

d. The cables do not directly cross each other and are separated by the specified distance.

e. The cables are not bent sharply where they enter (or leave) a conduit, and are supported properly by tamped ground so future settling will not cause sharp bends.

858(L)-3.8 IDENTIFICATION NUMBERS. Circuit identification shall be assigned to each sign in accordance with the drawings. The placing of the Circuit ID shall be accomplished by use of 2-inch diameter brass or bronze marker, with the numerals approximately 1/4-inch in height, engraved or stamped in, embedded in concrete next to transformer housing as detailed on the drawings, so each faces the taxiway or runway. Sign identification numbers shown on plans shall be engraved by Manufacturer furnish.

858(L)-3.9 FIELD TESTS AND INSPECTIONS.

a. Contractor shall provide the RE 10 working days' notice prior to test(s). All deficiencies found shall be corrected and tests repeated.

b. Operation. Upon completion of all the tests required under other sections, the Contractor shall show by in-service demonstration that all circuits, control equipment, and all lights covered by the contract are in good operating condition. The testing of each circuit shall be made using local control switches on the regulators in each lighting vault. Each switch shall be operated so that each switch position is engaged at least five times. During this process, all lights and associate equipment shall be observed to determine that each circuit operates properly. Telephone or radio communication between the operator and the observers shall be provided. The above tests shall be repeated from the alternate control station, from the remote control points, and also again from the local control switches on the regulators. Each lighting circuit shall be tested by operating the lighting circuits at each brightness step. Visual examination shall be made at the beginning and at the end of this test to determine that the correct signs are energized.

858(L)-3.10 ELECTRICAL TESTS ON CABLES. In addition to the cable tests required under other sections, the test described below shall be performed on the segment of primary series circuit cable connecting each sign to a light base. The test shall be performed for each sign prior to connecting the sign to the runway or taxiway lighting circuit. The test results shall be recorded and shall be submitted to the RE. The purpose of the test is to verify the good condition of new cable installed in conduit, prior to connecting to the existing lighting circuit.

a. Connect together the segments of primary cable from the sign base to the connecting light base. Include the sign isolation transformer in the loop. Support both leads so that there are gaps of several inches between bare conductors and ground. Make sure that the cable sheath is clean and dry for a distance of at least one foot from the end of the cable. Also make sure that exposed insulation at the end of the cable is clean and dry.

b. Apply a 500-volt test voltage with suitable meg-ohmmeter, such as model 1250 made by AEMC (manually operated), or approved equal. 500 Volts must be applied to the circuit. The insulation resistance to ground shall not be less than 200 meg-ohms to be acceptable. The contractor shall repair/replace any cable segment reading less than 200 meg-ohms and retest, at no additional cost to the airport. Only after acceptable readings are obtained shall the cable be connected to the series lighting circuit.

c. All the 500 and higher voltage tests on the airfield lighting circuits must be carefully monitored by the RE to ensure that excessive voltages are not applied to the circuits. The contractor shall coordinate all the tests with the RE prior to starting the tests.

d. The field test and the inspection of the system shall be incorporated into the signage pay items, with no separate payment made.

METHOD OF MEASUREMENT

858(L)-4.1 NEW L-858(L) LED SIZE 2 SIGNS ON NEW CONCRETE FOUNDATIONS. The quantity of each new sign shall include: Furnishing a new L-858(L) sign, LEDs, isolation transformers, L-867 transformer housing, hardware, conduits to sign with spare stubs and ground rod with ground conductor bonds to equipment installed and mounted to a new concrete foundation with new wiring and L-823 connectors installed as a complete unit, connected to

circuit, operating for a minimum of one week burn-in period, ready for operation, tested and accepted.

858(L)-4.2 EXISTING L-858(L) WITH NEW SIGN PANELS ON NEW FOUNDATIONS. The quantity of each shall include: Furnishing a new L-858(L) sign panels and face insert channels, L-867 transformer housing, hardware, conduits to sign with spare stubs and ground rod with ground conductor bonds to equipment installed and mounted to a new concrete foundation with new wiring and L-823 connectors installed as a complete unit, connected to circuit, operating for a minimum of one week burn-in period, ready for operation, tested and accepted.

858(L)-4.3 EXISTING L-858(L) WITH NEW SIGN PANELS. The quantity of each shall include: Furnishing a new L-858(L) sign panels and face insert channels installed as a complete unit, connected to circuit, operating for a minimum of one week burn-in period, ready for operation, tested and accepted.

858(L)-4.4 INSTALLATION OF EXISTING UNLIGHTED SIGNS. The quantity of each shall include: salvaged unlighted sign installed as a complete unit and accepted.

BASIS OF PAYMENT

858(L)-5.1 SYSTEM COMPONENT. Payment will be made at the contract unit price for each complete system component listed below installed in place by the Contractor, tested and accepted. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this Item.

Payment will be made under:

Item L-858(L)-5.1	New Size 2 Sign Panels and Face Insert Channels Installed in Existing Sign – per each
Item L-858(L)-5.2	Re-Install Salvaged L-858 Size 2, 3 Module Guidance Sign and Transformer With New Panels and Face Insert Channels on New Sign Base – per each
Item L-858(L)-5.3	New Size 2 L-858(L) LED 3-Module Guidance Sign and Isolation Transformer, on New Concrete Base – per each
Item L-858(L)-5.4	New Size 2 L-858(L) LED 3 Module Airfield Guidance Sign with New Shallow Transformer Housing (Retrofit in Existing Full Strength Concrete Pavement) – per each

Item L-858(L)-5.5 Re-Install Salvaged 3 Module Airfield Guidance Sign with New Shallow Transformer Housing (Retrofit in Existing Full Strength Concrete Pavement)– per each

Item L-858(L)-5.6 Re-Install Salvaged 3 Module Airfield Guidance Sign with New Sign Panels and Face Insert Channels on New Shallow Transformer Housing (Retrofit in Existing Full Strength Concrete Pavement) – per each

Item L-858(L)-5.7 Re-Install Unlit Sign - per each

REFERENCED PUBLICATIONS

858(L)-6.1 FEDERAL SPECIFICATIONS REFERENCED IN ITEM L-858(L).

Number	Title
WW-C-581	Conduit, Metal, Rigid; and Coupling, Elbow; and Nipple, Electrical Conduit: Zinc-Coated
W-C-1094	Conduit, Plastic-Type II Schedule 40

858(L)-6.2 FAA SPECIFICATION REFERENCED IN L-858.

AC 150/5340-18F	Standards for Airport Sign Systems.
AC 150/5345-26D	Specification for L-823 Plug and Receptacle, Cable Connections (including Changes 1 & 2).
AC 150/5345-42H	Specification for Light Base and Transformer Housings, Junction Boxes and Accessories (including Change 1).
AC 150/5345-44K	Specification for Taxiway and Runway Signs.
AC 150/5345-47C	Isolation Transformers for Airport Lighting Systems.

END OF ITEM L-858(L)

ITEM L-861T(L) ELEVATED MEDIUM INTENSITY LED TAXIWAY EDGE LIGHTS

DESCRIPTION

861T(L)-1.1 RELATED DOCUMENTS. The General Provisions of the Contract, including General and Special Conditions apply to work specified in this Item.

861T(L)-1.2 GENERAL. This Item shall consist of installing new LED omni-directional, medium-intensity elevated taxiway edge lights and salvaged LED medium intensity elevated taxiway edge lights in accordance with these specifications and at the locations shown on the plans.

This Item involves the following work:

a. Install all new conduit/duct system (per Item L-110).

b. Core drill pavement and install Type L-867 bases at indicated locations. Encase the L-867 bases with P-610 concrete grout according to detail shown on plans.

c. Pull new 5 kV lighting cable Type L-824C between adjacent light bases and splice at both ends to existing cable in the adjacent light bases (per Item L-108).

d. After paving and area grading have been completed, install and connect the new and salvaged Type L-861T elevated taxiway edge lights and test.

861T(L)-1.3 IDENTIFICATION NUMBERS. An identifying number shall be assigned to each light in accordance with the drawings. The placing of these numbers shall be accomplished by use of 2-inch x 1/16” thick aluminum tag, with the numerals approximately 3/16-inch in height, engraved, bolted to L-867 base as detailed on the drawings, so each faces the taxiway.

861T(L)-1.4 APPLICABLE DOCUMENTS. The publications listed at the end of this Item are incorporated herein by reference and form a part of this Item to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of this solicitation shall be applicable. In the text of this Item, such publications are referred to by basic designation only. Additional details and specifications pertaining to a specific system are contained in these documents and are to be considered to be a part of this Item. Perform all work in accordance with these documents except as specified herein. In the event of a conflict between contract documents and the referenced documents, the more stringent rule shall be applied.

861T(L)-1.5 SHOP DRAWINGS AND MATERIAL LISTS. Prior to the installation of any material and equipment and within 30 days of contract award, the Contractor shall submit to the Owner for approval six (6) copies of manufacturers' brochures containing complete dimensional

and performance characteristics, wiring diagrams, installation and operation instructions, etc., for the following equipment:

a. L-861T(L) LED Taxiway light fixtures, frangible couplings and stems
b. Fixture mounting base plates for L-867B base can with ground lug
c. L-830 Isolation transformers 10/15W
d. L-823 secondary cable connectors
e. Neoprene gaskets

861T(L)-1.6 LOCATION/ELEVATION. Lights shall be spaced on centers as indicated on the drawings. Longitudinal tolerance is +/- 6 inches.

Elevation of in-pavement bases shall be coordinated with the civil grading and drainage drawings. The base shall be set so that the light fixture base plate shall be within +1/2 inch of the finished pavement.

861T(L)-1.7 TESTING. Refer to Item L-100, Paragraph 100-3.8 for tests of applicable equipment.

MATERIALS

861T(L)-2.1 GENERAL. Airport lighting equipment and materials covered by FAA specifications shall have the prior approval of the Federal Aviation Administration, Airports Service, Washington, D.C. 20590.

861T(L)-2.2 MEDIUM-INTENSITY ELEVATED LIGHT FIXTURES. Type L-861T, omni-directional, meeting the requirements of FAA AC 150/5345-46D. Lights shall have blue optical system filters. Installed height to top of globe shall be 14 inches above base. Light source shall be Light Emitting Diode (LED), 6.6 amp input power as indicated in plans.

861T(L)-2.3 LIGHT BASE. Type L-867; size B, nominal 24 inch deep meeting the requirements of FAA AC 150/5345-42H. Refer to Item L-867/868 for base and base plate specifications. Provide with grounding lugs and ground rod (see drawings).

861T(L)-2.4 ISOLATION TRANSFORMER. Type L-830, 10/15 watts for LED fixtures, 60 hertz, meeting the requirements of FAA AC 150/5345-47C.

861T(L)-2.5 HARDWARE. All bolts, nuts, washers and lock washers shall be stainless steel per Item L-867. Install using high temperature anti-seize compound.

861T(L)-2.6 PLUG AND RECEPTACLE CABLE CONNECTORS. L-823, Type I, Class A, meeting the requirements of FAA AC 150/5345-26D as required to accommodate the extended length stem.

861T(L)-2.7 SEALANT. Shall meet the requirements of ASTM D 3405, Joint Sealants, hot poured for bituminous pavements, and applicable section(s) of FAA Specification Item P-605. Each lot or batch of sealing compound shall be delivered to the job site in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, and the safe heating temperature and shall be accompanied by the manufacturer's certification stating that the compound meets the requirements of this specification.

861T(L)-2.8 SPARES. New installations shall include a designated amount of spare L-861T(L) LED fixtures with stems and frangible couplings, which shall be furnished to airport maintenance.

METHOD OF MEASUREMENT

861T(L)-3.1 NEW TAXIWAY EDGE LIGHTS. The quantity to be measured shall be per each for the installation of each new LED elevated taxiway edge light fixtures and isolation transformers on new L-867 bases with connectors, secondary cables, ground rods, receptacle assemblies, including any other incidentals and testing in accordance with the plans and specifications and as accepted by the Owner.

861T(L)-3.2 NEW LED TAXIWAY EDGE LIGHTS (SPARES). The quantity to be measured shall be per each for the furnishing to the Airport new spare elevated LED taxiway edge light fixtures and isolation transformers including frangible couplings and stems in accordance with the plans and specifications and as accepted by the Owner.

BASIS OF PAYMENT

861T(L)-4.1 ELEVATED TAXIWAY EDGE LIGHTS. Payment for the installation of each new, LED elevated taxiway edge light shall be made at the contract unit price for installing each fixture. The unit price shall be full compensation for furnishing all materials and for all preparation, erection and installation of these materials to complete the item as accepted. The unit price of each of these items shall also include the Contractor's overhead, profit and markup.

861T(L)-4.2 NEW LED TAXIWAY EDGE LIGHTS (SPARES). Payment for the furnishing of each new spare elevated LED taxiway edge light and isolation transformer shall be made at the contract unit price for providing spare fixtures to the Owner. The unit price shall be full compensation for furnishing all materials to complete the item as accepted. The unit price of each of these items shall also include the Contractor's overhead, profit and markup.

Payment will be made under:

Item L-861T(L)-4.1 Re-Install Salvaged Elevated L-861T(L) Taxiway Edge Light and Isolation Transformer on New L-867 Base Can – per each

Item L-861T(L)-4.2 New Elevated L-861T(L) LED Taxiway Edge Light and Isolation Transformer on New L-867 Base Can – per each

Item L-861T(L)-4.3 Elevated L-861T(L) LED Taxiway Edge Light (with Stem and Frangible Coupling) and Isolation Transformer – Spares – per each

REFERENCED PUBLICATIONS

861T-5.1 FAA SPECIFICATIONS REFERENCED IN L-861T.

AC 150/5345-26D Specification for L-823 Plug and Receptacle, Cable Connections (including Changes 1 and 2)

AC 150/5345-42H Specification for Light Base and Transformer Housings, Junction Boxes and Accessories (including Change 1)

AC 150/5345-46E Specification for Runway and Taxiway Light Fixtures

AC 150/5345-47C Specification for Series to Series Isolation Transformers for Airport Lighting Systems

END OF ITEM L-861T

ITEM L-867/L-868 LIGHT BASE AND TRANSFORMER HOUSING

DESCRIPTION

867/868-1.1 RELATED DOCUMENTS. The General Provisions of the Contract, including General and Special Conditions apply to work specified in this Item.

867/868-1.2 GENERAL. This Item is also reference for in-pavement and elevated taxiway light bases, airfield guidance sign transformer housings and junction cans.

867/868-1.3 SHOP DRAWINGS AND MATERIAL LISTS. Prior to the installation of any material and equipment and within 30 days of contract award, the Contractor shall submit to the Owner for approval six (6) copies of manufacturers' brochures containing complete dimensional and performance characteristics, wiring diagrams, installation and operation instructions, etc., for the following equipment:

a. L-868B Galvanized Steel Base Cans – 24-hole top flange, 24” Deep
b. L-867B Galvanized Steel Base Cans; 24” Deep.
c. L-867E Galvanized Steel Base Cans; 24” Deep.
d. L-867B Galvanized Steel Base Cans; 12” Deep.
e. L-868 spacer rings – 1/8” to 1” thick, 24-hole
f. L-868 flange rings with 1 3/8” tall pavement dam rings for use with multi-hole adapter rings, 24-hole
g. L-868 Multi-hole adapter rings
h. Neoprene Gaskets, 12”
i. In-pavement fixture O-Rings, 12”
j. Grade 5, Fluoropolymer coated carbon steel bolts – 3/8”x2”
k. Stainless Steel Bolts
l. Grounding Clamps and Lugs
m. Rubber grommets for 2” conduits
n. ¾” thick, L-868 steel blank cover plates.
o. 3/8” thick L-867 transformer housing blank covers.
p. ½” thick L-867E cover plates
q. L-868B Mud Covers

867/868-1.4 LOCATION/ELEVATION. Lights shall be spaced on centers as indicated on the drawings. Longitudinal tolerance is +/- 6 inches.

L-867 bases for elevated taxiway edge light fixtures are located in a line parallel to the taxiway centerline not more than 10 ft. outward from the edge of the full strength pavement or in line with existing if less than 10’-0”. Elevation on elevated fixture bases shall be coordinated with the civil grading and drainage drawings. The +1 inch tolerance above finished grade for the finished surface of the shoulder pavement shall be considered when installing the base cans so that the light fixture flange may be placed within the above tolerance.

Elevation of in-pavement bases shall be coordinated with the civil paving, mill and overlay, grading and drainage drawings. The base shall be set so that, including extension rings, the top of light fixture flange / pavement dam ring shall be within +0/-1/16 inch of the finished pavement. The top of the in-pavement fixture or pavement dam ring edge (highest edge if fixture is not

exactly level and/or installed on a crowned pavement) must be between +0 inch and −1/16 inch from the pavement surface.

Bases retrofit in existing full strength concrete pavement shall be installed so that their nearest edge is at least 2 ft. (0.6 m) from any rigid pavement joint.

In the event of a conflict between any of the light fixtures and undesirable areas, such as rigid pavement joints, etc., the spacing should be varied per the tolerance specified for the lighting system being installed to resolve the conflict.

Transformer housings for sign foundations shall be as dimensioned in details on drawings.

867/868-1.5 LIGHT BASE AND LIGHT INSTALLATION ALIGNMENT TOOL. The tolerance requirements for location, elevation, and orientation of all light fixtures are of critical importance and must be maintained. In order to do so the light bases and lights shall be installed using an installation and alignment tool. This tool shall be capable of achieving the final alignment specified and shall be of sufficient strength to support the light base during placement and compaction of concrete around the base. The Contractor shall submit to the Engineer the proposed installation and alignment tool for approval. Upon approval, the Contractor shall procure a sufficient number of these tools to use in the installation process. No light base or light shall be installed without using an approved installation and alignment tool.

867/868-1.6 TEMPORARY BLANK COVER PLATES. Plywood covers are to be used to protect the bases during shipping, installation and construction. For all galvanized bases, a gasket shall be installed between the base and plywood cover to eliminate the bonding action of the plywood and zinc and to seal the inside of the base to protect during shipping and from construction materials. Plywood should be exterior grade ½ inch thick Bb/Cc or other material equal strength and weather resistance for Type L-867 and L-868 light bases.

867/868-1.7 IDENTIFICATION NUMBERS. Not Used.

MATERIALS

867/868-2.1 GENERAL. Airport lighting equipment and materials covered by FAA specifications shall have the prior approval of the Federal Aviation Administration, Airports Service Washington, D.C. 20590.

867/868-2.2 CONSTRUCTION. Construction of airport light bases, transformer housings and junction cans shall meet the requirements of latest version of AC 150/5345-42 Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories. Base cans shall be ordered with holes to accommodate the raceways indicated on the drawings. Provide nylon/rubber grommet at each hole as required on the drawings. Grommets shall be located at the depths shown on the drawings, and shall be sized per the conduit used. Conduit penetrating base cans shall be supplied with a bushing to prevent cable abrasion during installation.

a. Steel shall be used in the construction of L-867 and L-868 bases, extensions and accessories and shall meet the requirements of ASTM A-36. All welds shall be continuous to provide water tightness.

b. Construction of PVC or polyethylene plastic on other non-metallic materials for L-867 bases will not be accepted.

c. All L-867 and L-868 base cans shall be Class I, Size B, 24 inches in depth unless otherwise noted on plans. The top flange of L-868 bases shall be furnished with 24 threaded holes for mounting fixture rings and spacers as shown in Details.

d. The one or two-piece body (base and extension), including sides and bottom, shall be fabricated from one or more pieces. The dimensions of the base and/or extension shall be as shown on the plans. Two duct couplings or grommets shall be provided and installed near the bottom of the base as shown on the plans. The location and size, as shown on the plans, shall be considered standard. However, the location, number, type, and size of the duct connections can be altered to meet special conditions. Any sharp edges formed on the inside of the bases where duct couplings meet the inside surface of the housing shall be removed to prevent cutting of cable insulation at these points. The length of the body section as shown in the plans shall be considered standard, but the length may vary to meet special conditions. Extensions may vary in length as required to the closest 1/16 inch. Each base bottom shall be provided with ¾" diameter drain hole.

e. Shallow (12") L-868B cans for retrofit installation in existing rigid pavement shall have the duct openings in the approximate locations as shown on Plans. Contractor may be required to provide additional entries in field as required.

867/868-2.3 FLANGE RINGS, BEVEL RINGS AND SPACERS. All flange rings, bevel rings and spacers shall conform to the requirements of the most current AC 150/5345-42. A flange ring with mud dam shall be used on all in-pavement fixtures in accordance with the Plans.

Spacer rings are available in various designs depending on the application and are available in various thicknesses and diameters and are generally installed between the base flange and the light fixture or other accessory. Spacer rings shall be used for adjustment of fixture elevation.

To preserve the base integrity and proper bolt torque, a maximum of three spacer rings may be stacked together.

867/868-2.4 MULTI-HOLE ADAPTER RINGS. Multi-Hole adapter rings for L-868 bases shall conform to the requirements of the most current AC 150/5345-42. The multi-hole adapter rings shall be Class 1A, size B with six (6) 7/16" equally spaced, thru holes with 1" x 7/16" deep counter bore and eighteen (18) 3/8" – 16 tapped holes.

Multi-Hole adapter rings shall be installed for all COP in-pavement fixture bases between fixture and flange ring with pavement dam.

867/868-2.5 HARDWARE. Bolts and lock washers shall be supplied with each base and extension assembly. The bolts shall conform to dimensions specified in the AC - Manufacturer furnished fully threaded (tap bolts) 18-8 stainless steel, hex head 3/8" bolts or Grade 5

Fluoropolymer coated bolts per Plans and Engineering Brief 83, sufficiently long to provide full thread engagement into the mounting surface. All fixture mounting bolts must have at least 1/2 inch of thread engagement into the ring. Install Stainless Steel bolts only with high temperature anti-seize compound. Torque bolts to 25 FT LBS minimum or as recommended by Manufacturer for in-pavement light fixtures.

867/868-2.6 SHIPPING COVERS. Plywood covers are used to protect bases during shipping and installation and are to be installed on all base or base extension shipments.

- For all galvanized bases, a 3 mil (0.003 inch) polyethylene shipping gasket may be installed between the base and plywood cover or, as an alternative, the plywood cover should be waxed on the bottom surface to eliminate the bonding action of the plywood and zinc.
- The Type L-868 plywood cover should also be waxed on the OD edge to facilitate easy removal from any surrounding embedment material.
- Plywood should be exterior grade 1/2 inch thick Bb/Cc or other material of equal strength and weather resistance for Type L-867 light bases.

867/868-2.7 "MUD" COVERS. Mud covers may stand alone or may be used in conjunction with plywood covers on Type L-867 and Type L-868 bases to protect the base flange during construction, and to include surface marking to facilitate locating the center of the base when coring out to locate the base after pavement overlay. Mud covers are appropriately sized for the specific bases they are to protect.

867/868-2.8 BLANK COVERS. Blank covers are used to provide a cover for bases when no light fixture is to be installed.

For Type L-867B non-load bearing bases, the cover must be a minimum of 3/8 inches.

For Type L-867E non-load bearing bases, the cover must be a minimum of 1/2 inches.

For Type L-868B load bearing bases, the cover must be a minimum of 3/4 inches or equal in thickness to the light fixture and installed flush with pavement.

867/868-2.9 GROMMETS. Grommets supplied for duct entrances into bases shall be sized to provide a watertight connection and be made of a material suitable for direct earth burials or encasement by asphalt, Portland cement concrete, or epoxy sealers. The grommet material shall have a hardness of 50 ±5 as determined by a durometer (ASTM D-2240). Typical grommet details are shown on the plans.

867/868-2.10 GROUNDING LUGS. To provide maintenance personnel electrical safety, the manufacturer must install both an internal and external ground strap. The ground strap functions as a means to connect a ground lug that is connected to an earth ground or a safety ground conductor. For Class I bases, a metallic ground connector or strap must be welded to the interior and exterior wall of each base before applying surface protection. The details and location of the grounding lug are shown on the plans. The location of the lug may be varied to meet specified conditions. A three-hole copper or two stacked lay-in copper ground connector lugs shall be bolted to the steel lug by Contractor and should not be fastened to the ground connector or strap until after the base surface protection is applied.

NOTE: Under no circumstances should an exothermic weld be used to attach a ground or counterpoise connection to a galvanized light base because of the potential for heat damage to the galvanized coating. Under field conditions, repairs to the zinc coating after an exothermic weld are usually ineffective. If the galvanized coating is compromised, the corrosion of exposed light base steel will accelerate.

867/868-2.11 DRAINS. The conduit/base system should have drains installed in all the bases and at low points in the system to provide for drainage of water and deicing fluids away from the base and conduit system. If water and deicing fluids are allowed to pool for long periods of time in the light base, they will hasten corrosion of both the conduit and base system.

867/868-2.12 PROTECTIVE COATING. After fabrication, burrs and sharp edges shall be removed, and all metal parts shall be treated for corrosion protection. Prior to tapping operations, all parts of bases, junction boxes, spacer rings in excess of 1/4-inch in thickness, extensions, and conversion rings shall be hot-dip galvanized as specified in ASTM A-386, Class A, and applied in accordance with ASTM A-385. Base flanges, covers, and rings shall be wiped smooth to a flatness of +0.010 inch. Mud plates, grooved spacer rings, and other spacer rings 1/4-inch or less in thickness shall be plated with zinc in accordance with the requirements of Federal Specification QQ-Z-325, Type II, Class 1, or with cadmium in accordance with the requirements of Fed. Spec. QQ-P-416, Type II, Class 1. Tapped holes shall be protected with a polyurethane varnish or equivalent. A zinc dust primer meeting MIL-P-26915 (USAF) shall be permitted for touchup. The area covered by zinc dust primer shall not exceed 10 percent of the total treated area. Any case iron may be coated with a minimum of 2.0 mils of oxyplast powder in lieu of galvanizing.

867/868-2.13 QUALIFICATION TEST. Tests shall be in accordance with FAA AC 150/5345-42H.

CONSTRUCTION METHODS

867/868-3.1 LIGHT BASES. Light bases shall be installed at the locations shown on the plans. The bases shall be installed per the details shown on the plans. Before trenching or excavating, base can locations shall be surveyed and set within the tolerances as indicated on the contract documents. The Subcontractor will be held responsible for the correct layout, leveling, adjustment and orientation of all base cans installed. The standard base can configuration shall include two drilled openings toward the bottom of the base for the installation of the conduit grommets. The Contractor shall drill, in the appropriate location(s), any additional openings for additional conduit entries. Installation and connection of ground rods at each light base as detailed on the plans for the grounding system shall be incidental to the respective pay item.

Existing L-868 bases for taxiway centerline fixtures within limits of pavement mill and overlay shall have fixtures and flange / pavement dam rings and hardware removed and replaced with mud cover to protect during construction of new pavement. Survey shall be performed to collect and document existing light base locations. After pavement overlay, Contractor shall have survey provide points with offsets to core drill new asphalt for installation of new flanges with pavement dam rings, multi-hole adapter rings and fixtures. Contractor shall have on hand

spacer rings to adjust final installation height of new rings and hardware to +0 inch and −1/16 inch from the new overlay pavement surface.

867/868-3.2 CONDUIT CONNECTIONS. Prior to concrete encasement, conduit connections shall be made at the base hubs with rubber grommet to form a watertight connection as shown on the plans.

867/868-3.3 EXCAVATION AND BACKFILL. Each light base location shall be carefully excavated by widening the conduit trench to the outer dimension of the concrete encasement. After the casement form has set and conduits are connected to the base, 4000psi concrete may be placed and allowed to set. After concrete has sufficiently cured, the trench and base excavation shall be backfilled and compacted to the requirements of Item P-152. The cover-plates shall be visible and free of debris following completion of the backfill.

867/868-3.4 RETRO-FIT IN EXISTING ASPHALT. New light bases installed in areas existing asphalt pavement may be pre-cast and set within saw-cut and removed pavement sections or cored with 24" diameter cutter, suspended with steel strut or alignment jig and cast in place. 24" Sono-Tubes shall be utilized where required for cast in place bases. No square forms will be accepted. Restoration in kind of paved areas shall be considered incidental to the respective installation. No separate payment will be made.

867/868-3.5 ORIENTATION OF LIGHT BEAM FOR TAXIWAY CENTERLINE LIGHTS. Taxiway centerline lights must be oriented as follows, with a horizontal tolerance of ±1 degree.

On all straight portions of taxiway centerlines, the axis of the light beam must be parallel to the centerline of the taxiing path.

On curved portions (excluding acute-angled exits) with standard fillets. Orient the axes of the two beams of bidirectional lights parallel to the tangent of the nearest point of the curve designated as the true centerline of the taxiway path. Orient the axis of a unidirectional light beam so that it is "toed-in" to intersect the centerline at a point approximately equal to four times the spacing of lights on the curved portion.

Acute-angled exits. Orient the axis of a unidirectional light beam so that it is "toed-in" to intersect the centerline at a point approximately equal to four times the spacing of lights on the curved portion. Measure this chord spacing along the curve. Orient the axes of the two beams of bidirectional lights parallel to the tangent of the nearest point of the curve designated as the true centerline of the taxiing path.

867/868-3.6 L-867E JUNCTION CANS The quantity to be measured shall be per each for the provision and installation of each L-867E junction can with blank cover plates, gaskets, hardware, grounding, circuit identification markers and any other incidentals required to complete this item in accordance with the plans and specifications and as accepted by the Engineer.

METHOD OF MEASUREMENT

867/868-4.1 L-867 AND L-868 LIGHT BASES. Light bases for all other lights and signs shall be part of the measurement of the various types of lights installed. Contractor shall include cost of existing bolt removal, thread repair and new hardware and grounding lugs as part of the unit pricing for installation of new fixtures on existing light bases. Light bases for runway guard lights and transformer housings for signs shall be part of the measurement of the various types of lights and signs installed. No separate payment will be made for providing external ground rod, conductor or connections to new light bases and transformer housings.

867/868-4.2 L-867 JUNCTION CAN. The quantity to be measured shall be per each for the provision and installation of each L-867E junction can with gasket, blank cover and grounding in accordance with the plans and specifications and as accepted by the Owner. No separate payment will be made for providing external ground rod, conductor or connections to new junction cans.

BASIS OF PAYMENT

867/868-5.1 L-867 AND L-868 LIGHT BASES. Light bases for all other lights and transformer housings for signs shall be part of the measurement of the various types of lights installed.

867/868-5.2 JUNCTION CAN. Payment for the installation of each L-867 Size E junction can shall be made at the contract unit price for installing each junction can. The unit price shall be full compensation for furnishing all materials and for all preparation, erection and installation of these materials to complete the item accepted. The unit price of each of these items shall also include the Contractor's overhead, profit and markup.

Payments will be made under:

Item L-867/868-5.1	L-868 Spacer Rings / Base Can Extension Package (73 - 1", 37 - 1/2", 37 - 1/4", 37 - 1/8") – per Lump Sum
Item L-867/868-5.2	New L-867E (24" Dia) Junction Can with Blank Cover Installed– per each

REFERENCED PUBLICATIONS

867-7.1 FAA SPECIFICATIONS REFERENCED IN L-867/L-868.

Number	Title
AC 150/5345-42H	Specification for Light Base and Transformer Housing, Junction Boxes and Accessories.
AC 150/5345-53D	Airport Lighting Equipment Certification Program.

END OF ITEM L-867/868

PHX DVT GYR

CITY OF PHOENIX AVIATION DEPARTMENT

Construction Safety & Phasing Plan

May 4, 2018

Project Name: **Phoenix Goodyear Airport Taxiway A Rehab & Strengthening**
COP Project No.: AV41000075–1 FAA
FAA AIP No.: 3-04-0018-023-2018
ADOT No.: EXXXX

SCOPE OF WORK

Purpose: **Project AV41000075–1 FAA aims to achieve four goals:**

- **Goal 1:** This project includes the strengthening and rehabilitation of approximately 60,000 square yards of asphalt concrete on Taxiway A and bringing it up to ADG IV design standards with 30' paved shoulders. Taxiway A is 75 feet wide with gravel shoulders. The entire width of the pavement will be rehabilitated by milling 2 inches to remove the PFC (P–402) and paving back 3 inches (P–401) from STA 26+54 to STA 98+04, a distance of 7150 feet. This effort will bring the strength of the finished structural section up to a minimum PCN of 67. In addition to strengthening the taxiway, 30' paved shoulders will be constructed along both sides of Taxiway A. The shoulders shall be 4 inches of asphalt concrete (P–401) on 12.5 inches of aggregate base (P–209) on 6 inches of prepared subgrade.

- **Goal 2:** This project will also remove direct access to Runway 3/21 from the main ramp area by relocating a portion of Taxiway A3 and by remarking, resigning and relighting Connector Taxiway A2 at the apron area creating offsets in the connector taxiway alignments.

- **Goal 3:** The work at Taxiway A3 will also involve constructing fillets to meet Taxiway Design Group 5 standards. Thirty foot paved shoulders will also be added to these connector taxiways.

- **Goal 4:** Lastly, this project will improve safety at the airport by installing enhanced taxiway centerline markings, surface painted hold position markings at the connector taxiways as well as by enhancing the pole–mounted terminal area / ramp lighting.

Expires 9/30/2020

Phasing of the work, including temporary lighting measures, will be necessary in order to minimize impacts on airport operations during construction. The GYR priorities for phasing the work are shown in **Appendix E, Exhibits A, B, C, D, E and F.** Construction will be completed generally at night with a minimum of four rolling closures. One rolling closure is planned at the end of each phase. The rolling closures are intended to expedite the construction, enable efficient milling and paving of the taxiway, and reduce the number of transverse joints along the length of the taxiway. The typical nighttime closure hours are from 2100 hours to 0600 hours Sunday through Thursday. Rolling closures are discussed below under phasing, however, the Contractor should plan to complete most of the work associated with this project during the scheduled night time closures, Sunday through Thursday. For more information about each phase, see the **Operational Effects Table** in **Section 2.7**.

A. Taxiway A3/Ramp 3 Considerations:

Proposed Phase 1 of this project involves the relocation of a portion of Taxiway A3 between Taxiway A and the apron/terminal ramp area. The centerline of the taxiway will be relocated 190 feet north, creating an offset in Connector Taxiway A3. The new pavement section is designated as “Ramp 3”. Ramp 3 is shown on the GYR Airport draft Master Plan and satisfies FAA requirements to remove direct access between a runway and apron in order to reduce the opportunity for runway incursions.

Work shall be minimized at the tie–in location between Ramp 3 and the existing concrete apron. Only unsound panels and concrete patches that compromise the structural integrity of the new Ramp 3 tie–in shall be removed and replaced. Ramp 3 and apron reconstruction work may proceed even with an active runway since this area is outside of the Runway Safety Area (RSA).

B. Taxiway A2/Ramp 2 Considerations:

Proposed Phase 2 involves the relocation of the “apron” portion of Connector Taxiway A2 by remarking and resigning the connector taxiway. The relocated “through-way” pavement area is designated as “Ramp 2”.The work will include removal of existing pavement markings, removal and reinstallation of flush mounted taxiway edge lights, addition of new flush mounted edge lights, relocation of taxiway directional signs and marking the existing concrete pavement in accordance with FAA circulars. Work will also require the reconstruction of a 75-foot square section of Taxiway A in the Taxiway A2 alignment.

C. Strengthening Taxiway A Considerations:

The Taxiway A Strengthening and Rehabilitation portion of the project begins at the PCCP / AC joint on the south end of Taxiway A at Taxiway A9 and progresses north to Taxiway A2. (Approximate Stations 26+54 to 98+04 = 7,150 feet.) Work along Taxiway A includes the rehabilitation and strengthening of the taxiway asphalt pavement and construction of 30 foot shoulders along both sides of Taxiway A. Work will also include the adjustment of taxiway centerline lights, protection and adjustment of taxiway edge lights and minor drainage improvements. The installation of enhanced taxiway centerline markings and surface painted hold position markings at every connector taxiway are also part of the project.

A 120 calendar day construction contract period is estimated to complete the project work.

In order to reduce impacts to airport operations the Taxiway A3 and Taxiway A2 work are designated to take place as two separate phases only requiring runway closures when work takes place within the RSA. The Taxiway A shoulders will be constructed by working night shifts and reopening the taxiway each morning thus keeping the taxiway operational during daylight hours and on weekends.

Once the shoulders are complete, including the fillets and shoulders at Connector Taxiway A3, the project will shift to a mill and pave operation. This work will take place during two scheduled rolling closures to pave large sections of the taxiway and reduce the number of transverse joints along the length of Taxiway A.

Rolling closures will begin Sunday at 21:00 hours and extend through Wednesday at 06:00 hours — 57. If necessary the rolling closure might be stretched to end Thursday at 06:00 hours — 81 total hours. We are recommending that one rolling closure be scheduled for each phase. The length and timing of such closures are subject to discussion and approval of the GYR staff and the airport users.

D. Summary of Construction Issues:

1. Taxiway Shoulder Construction Options:
    a. Option A – Close portions of the affected taxiway system for night work leaving the runway operational. Normal nighttime work shifts will begin at 21:00 hours and end at 06:00 hours, Sunday through Thursday nights, leaving the site in a clean condition with no lips or drop-offs greater than 3" upon opening at 06:00 hours. **All taxiways will open promptly at 06:00 hours so all work needs to be complete prior to 05:30 hours providing 30 minutes for the contractor and airport personnel to conduct pre–opening inspections.**
    b. Option B – NOTAM portions of Taxiway A to ADG I aircraft (TSA = 49 feet) where shoulder widening is taking place allowing work to proceed around the clock, including during normal daylight hours. A NOTAM will notify pilots of aircraft larger then ADG -1 that they will be required to back–taxi on the runway to navigate around the construction area.
    c. Option C – Combination of Option A and Option B allowing work to proceed around the clock. Closures will need to be routinely scheduled and allowed to happen on an as–needed basis.

2. Steps shall be taken to minimize the impacts to the users at the South T-Hangars. Users may have limited access to their aircraft during short periods of time when work is proceeding near their ramp access to Taxiway A. Tenants may be able to relocate their aircraft to alternate locations on the airfield prior to construction blocking access between the runway and the South T-Hangar apron.

3. The Taxiway A "mill and fill" operation will take place during two rolling closures. The milling operation will begin first, followed closely by brooming, and final shoulder trimming. A 3-inch lift of P-401 asphalt concrete shall be placed the entire width of the taxiway and feathered from 3 inches at the edge of the taxiway to 2 inches at the edge of 30' shoulders. The shoulders are designed with a 4-inch P-401 section and will be paved with an initial 2 inch lift of P-401 leaving a 2 inch lip until final taxiway milling and paving operations take place. The final taxiway structural section will bring Taxiway A up to full strength with a PCN strength of 66.

4. Measures may be necessary to limit construction activity in the period leading up to and after the Phoenix NASCAR event scheduled for November 9 –11, 2018 so that Goodyear Airport can accommodate the increased air traffic associated with the event.

Runway 3/21 will be closed when working in the Runway Safety Area. And Taxiways will be closed when work takes place within the Taxiway Safety Areas. Only night work will be permitted from 2100 hours to 0600 hours Sunday thru Thursday, unless another work schedule is agreed upon by the Contractor, Engineer, Aviation Department Project Manager and GYR Operations. Proposed work will require partial closures of Taxiway A and complete Runway closures when work takes place within the RSA.

In addition, FAA AC 150/5370-2G Operational Safety on Airports during Construction specifically precludes the following in the RSA while the Runway is open:

- **Open excavations**
- **Slopes that do not satisfy RSA minimums, typically 1% minimum and 3% maximum**
- **Barricades are typically not permitted within the RSA of an active runway. Barricades placed in an RSA to identify hazardous conditions or limits of construction shall be removed before opening a runway for aircraft operations**
- **The CSPP requires that the Runway shall be closed for any work or disturbance in the RSA (excavations, trenching, placing of millings, paving, etc.)**

Any provision of the CSPP or Contractor prepared Safety Plan Compliance Document (SPCD) in conflict with the above prohibitions shall immediately be called to the attention of Airport Operations Personnel and Engineer so that corrective measured can be taken.

The Airport Operations personnel will provide "Lighted X's" to mark all runway closures in accordance with the provisions of the CSPP and the Construction Contract Documents.

TENTATIVE DATES FOR START OF WORK AND COMPLETION:

START: **October, 2018**
COMPLETION: **January, 2019**

TABLE OF CONTENTS

CONSTRUCTION SAFETY & PHASING PLAN
PHOENIX GOODYEAR AIRPORT RUNWAY SHIFT

Page

SCOPE OF WORK 1

A. Taxiway A3/Ramp 3 Considerations: 2

B. Taxiway A2/Ramp 2 Considerations: 2

C. Strengthening Taxiway A Considerations: 2

D. Summary of Construction Issues: 3

SECTION 1: BASIC CONSIDERATIONS 3

2.1 OVERVIEW ***3***

2.2 RESPONSIBILITIES ***3***

A. Emergency Communications 3

B. Airport Operator (The City of Phoenix Aviation Department) 4

C. NOTAM Issuance 4

2.3 SUBMITTALS ***4***

A. Filing of 7460-1 4

B. Submittal of a Safety Plan Compliance Document (SPCD) 4

C. The SPCD Must Communicate the Following 4

2.4 CSPP REQUIREMENTS ***5***

A. SPCD 5

B. Accidents 5

SECTION 2: PLAN REQUIREMENTS 6

2.5 COORDINATION ***6***

A. Pre-Construction Meeting 6

B. Weekly Progress Meetings 6

C. Contractor Safety Meetings 6

D. Meeting Agenda Topics 7

2.6 CONSTRUCTION PHASING ***7***

A. Phase 1: Taxiway A3/Ramp 3: 7

B. Phase 2 Taxiway A2/Ramp 2: 8

C. Phase 3 Taxiway A – 2,467 Linear Feet: 8

D. Phase 4 Taxiway A – 2,934 Linear Feet: 9
E. Summary of Construction Issues: 9
2.7 AREAS AND OPERATIONS AFFECTED BY CONSTRUCTION ACTIVITY 10
A. Identification of Affected Areas 10
B. Operational Effects and Mitigation Measures 11
2.8 PROTECTION OF NAVIGATIONAL AIDS (NAVAIDS) 15
2.9 CONTRACTOR ACCESS 15
A. Location and Storage of Stockpiled Construction Materials 15
B. Vehicle and Pedestrian Operations 16
1) Construction Site Parking Requirements 16
2) Equipment Storage Areas Identified 16
3) Access and Haul Roads 17
4) Flaggers, Spotters and Observers Controlling Equipment Crossings of Movement Areas 17
5) Vehicle Operator Requirements 18
6) Vehicle Identification 18
7) Proper Vehicle Operations 18
(1) **Day Construction (VFR Conditions)** 18
(2) **Night Construction (and IFR Conditions)** 18
(3) **No Vehicle Shall Be Operated In Any Portion of the AOA** 18
(4) **Use of Roadways** 18
(5) **Operating Speeds** 19
(6) **Runway and Taxiway Safety Area Access** 19
8) Radio Communications 19
9) Security Violations 19
10) Methods of Separating Vehicle and Pedestrian Traffic from the AOA and Airport Movement Areas 19
2.10 WILDLIFE MANAGEMENT 20
2.11 FOREIGN OBJECT DEBRIS (FOD) MANAGEMENT 20
2.12 HAZARDOUS MATERIAL (HAZMAT) MANAGEMENT 20
A. Material Release 21
B. Regulated Substances 21
C. Reporting Procedures 21
2.13 NOTIFICATION OF CONSTRUCTION ACTIVITIES 21

A. NOTAM Issuance 21
B. Communication With Responsible Parties 22
D. Notification of Key Personnel 22
2.14 INSPECTION REQUIREMENTS 22
2.15 PROTECTION OF UNDERGROUND UTILITIES AND FACILITIES 23
2.16 PENALTIES FOR NONCOMPLIANCE WITH AIRPORT RULES 23
A. Severe Violation 24
2.17 SPECIAL CONDITIONS 24
2.18 RUNWAY AND TAXIWAY VISUAL AIDS 24
A. Temporary Lighting (AC 150/5340-24) 24
B. Airport Specific Standards 24
C. Temporary Signage Plan Approved by FAA (150/5345-53) 25
D. Use of Temporary Visual Aids 25
E. Affected Areas and Operations, Including Possible Safety Problems 25
2.19 MARKING AND SIGNS FOR ACCESS ROUTES 26
2.20 HAZARD MARKING, LIGHTING AND SIGNING 26
A. Barricade Requirements 26
B. Traffic Cones Shall Not Be Used At Any Time on The AOA 26
C. Maintenance 26
D. Exhibit of Barricade Materials Depicted 27
E. Lighting and Marking Requirements 27
2.21 WORK ZONE LIGHTING FOR NIGHTTIME CONSTRUCTION 28
2.22 PROTECTION OF RUNWAY AND TAXIWAY SAFETY AREAS 28
A. Definitions and Abbreviations 29
B. Excavations in Runway and Taxiway Safety Areas 30
C. Erosion Control 31
2.23 OTHER LIMITATIONS ON CONSTRUCTION 31
A. Prohibitions 31

LIST OF APPENDICES:

- **APPENDIX A** – AIRPORT IMPROVEMENT PROGRAM SAFETY/PHASING PLAN CHECKLIST
- **APPENDIX B** – FAA AC 150/5370-2G, OPERATIONAL SAFETY ON AIRPORTS DURING CONSTRUCTION
- **APPENDIX C** – NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION, FAA FORM 7460-1 AND STRATEGIC EVENT SUBMISSION FORM
- **APPENDIX D** – AIRPORT SUBSURFACE INVESTIGATION, EXCAVATION, SAW CUTTING, POT HOLING, DRILLING CONSTRUCTION ACTIVITY NOTIFICATION PERMIT
- **APPENDIX E** – CONSTRUCTION SAFETY (BARRICADING) & PHASING PLAN DRAWINGS

SECTION 1: BASIC CONSIDERATIONS

2.1 OVERVIEW

Aviation safety is the primary consideration at airports, especially during construction projects. Hazardous practices and marginal conditions created by construction activities can decrease or jeopardize operational safety on airports. To minimize disruption of normal aircraft operations and to avoid situations that could compromise the airport's safety, the Phoenix Goodyear Airport Staff must carefully plan, schedule and coordinate construction activities. The intent of this document is to clearly communicate the airfield safety and security requirements, and expectations for the Contractor throughout the duration of the above stated Project.

This Construction Safety & Phasing Plan (CSPP) has been developed by the City of Phoenix Aviation Department in compliance with FAA AC 150/5370-2G Operational Safety on Airports during Construction. In *Appendix A* of the CSPP is the filled in *Safety and Phasing Plan Checklist* showing the coordination between this CSPP and AC150/5370-2G. The construction Contractor is responsible for complying with the CSPP and a contractor prepared Safety Plan Compliance Document (SPCD) describing how they will comply with the requirements of the CSPP and supplying any details that could not be determined before contract award. *See **Appendix A** – Airport Improvement Program Safety/Phasing Checklist.* FAA AC 150/5370-2G is incorporated by reference in **Appendix B**.

2.2 RESPONSIBILITIES

Operational safety on the airport remains the airport operator's responsibility at all times. The airport operator must develop, certify, and submit for FAA approval each CSPP. It is also the airport operator's responsibility to apply the requirements of the FAA approved CSPP. The airport operator must revise the CSPP when conditions warrant changes and must submit the revised CSPP to the FAA for approval. The airport operator must also require and approve a SPCD from the project contractor.

A. Emergency Communications

Emergency Telephone Number

911

For

POLICE FIRE RESCUE

For emergencies involving safety (injuries, fires, accidents, etc.) the Contractor will immediately call **911**, followed by contacting, as soon as possible during Airport Operational hours, the GYR Aviation Supervisor on duty at (623) 932-4550. At all other times, contact the Communications Center at Sky Harbor Airport at (602) 273-3302 to be connected to the On-Call Aviation Supervisor for the Goodyear Airport. The Sky Harbor Emergency Communications Line is 602-273-3311.

Goodyear Airport Air Traffic Control Tower Operational hours are: **05:30-21:30 Daily.**

B. Airport Operator (The City of Phoenix Aviation Department)

Phoenix Goodyear Airport (GYR) is tasked with ensuring federal regulations and standards are enforced and complied with. In addition to these federal requirements, GYR has established rules and regulations backed by Civil Code, which are enforced to ensure safe and secure operations at GYR. Airside Operations staff, authorized with enforcement of these rules and regulations, must be strictly obeyed at all times while working at GYR. All Contractors operating on the airfield must recognize and abide by this authority.

C. NOTAM Issuance

The GYR Aviation Supervisor will issue all required NOTAMs. All proposed construction work, including runway and taxiway closures, will require a NOTAM and must be communicated to the Aviation Supervisor at least 72 hours in advance.

2.3 SUBMITTALS

A. Filing of 7460-1

The Contractor must coordinate with the airport to allow 45-days notification by GYR to FAA of construction activities affecting Part 77 navigable airspace and construction activities requiring a runway closure for longer than 24 hours or 4 hours for consecutive days. City of Phoenix (COP) personnel will complete the paperwork and filing will be accomplished through FAA form 7460-1 and the Airport Sponsor Strategic Event Coordination (SEC) form.

The form 7460-1 shall describe construction activities taking place in the Air Operations Area (AOA). The use of cranes shall also be addressed. See **Appendix C** for Form 7460-1.

The SEC form shall describe the project scope, provide project duration and list the facilities that will be affected by the event.

B. Submittal of a Safety Plan Compliance Document (SPCD)

The contractor must submit the SPCD to the GYR Airside Operations Superintendent for approval prior to the Notice to Proceed.

C. The SPCD Must Communicate the Following

- A complete contact list for all Contractor personnel and their responsibilities. Including 24/7 contacts.
- Any stipulations to the Airport's "CSPP".

Appendix A of the Contractor's SPCD must communicate:

- The construction limits for this project;
- All haul routes must be clearly communicated;
- Storage areas for equipment and materials;
- Staging areas for equipment and materials;
- AOA access routes, and work area access routes;
- Work areas necessary for the scope of work for this project;
- Location of flag person operations must be depicted;

- Details for any needed access across or within an aircraft movement area;
- Taxiway and Runway Safety Areas;
- Phasing and Sequence of Work.

Appendix B of the Contractor's SPCD must communicate:

- All parking areas for construction vehicles and equipment for this project including, if appropriate, a barricade plan for these areas;
- A complete Barricade Plan for all areas within the AOA;
- Aircraft crossing points for aircraft movement through and around work areas;
- Depiction of all associated taxiway and runway safety areas;
- Depiction of all associated NAVAID Critical Areas and plans for protection.

Appendix C of the Contractor's SPCD must communicate:

- Material stockpile locations;
- Employee parking locations for this project;
- Details regarding any temporary airfield signage, marking or lighting needed;
- Taxiway and Runway Safety Areas;
- Airfield Drivers Permit needs.

Appendix D of the Contractor's SPCD must communicate:

- A detailed temporary marking, signage, and lighting plan;
- Areas of all planned excavation;
- A list of equipment planned for use which may exceed the maximum height such as cranes, excavators, drill rigs, or backhoes;
- Details for any Temporary Visual Aids for Pilots;
- Taxiway and Runway Safety Areas;
- A copy of the contractor's HAZCOM program.

2.4 CSPP REQUIREMENTS

To the extent possible, the CSPP addresses the elements outlined in Chapter 3, Guidelines for Writing a CSPP. (See also Section 2.4 in AC 150/5370–2G for outline of elements.) Details that cannot be determined at this stage are to be included in the SPCD.

A. SPCD

The Safety Plan Compliance Document (SPCD) should include a general statement by the construction contractor that they have read and will abide by the CSPP. In addition the SPCD must include all supplemental information that could not be included in this CSPP prior to contract award. The SPCD should not duplicate information in the CSPP.

B. Accidents

The driver of any motor vehicle involved in an accident while on the Airport, which results in injury or death to any person or damage to any property, must report the accident by calling during Airport Operational hours (6am to 9pm), the GYR Aviation Supervisor on Duty at (623) 932-4550. At all other times, call the Communications Center of Sky Harbor Airport at (602) 273-3302 to be connected to the On-Call Aviation Supervisor at GYR. In the event of injury, the driver will render assistance as needed until emergency vehicles arrive. All persons involved in any accident occurring on the Airport will make a full report thereof to the Airport as soon after the accident as possible and before leaving the Airport.

SECTION 2: PLAN REQUIREMENTS

This CSPP will take precedence over all field decisions and should be complied with at all times. Any desire to deviate from any part of this CSPP must be coordinated in writing with Airport Operations.

2.5 COORDINATION

Airport Sponsor certifies that this attached safety plan was developed in accordance with AC 150/5370-2G

Certified by _____ and submitted to FAA on_____
Airport Sponsor ***Date***

FAA Accepted Signature

FAA Project Manager	Date	FAA Airport Certification Safety Inspector	Date

Coordination:

In compliance with the GYR Operations Plan, prior to the award of the construction contract, GYR and Aviation Department personnel held several airport stakeholder and pre-design meetings where Airside Safety and construction scope and phasing were addressed. In addition, a Pre-Bid meeting will be scheduled to discuss construction scope, scheduling, work quality, and Airside Safety.

A. Pre-Construction Meeting

A Preconstruction meeting will be held at least two (2) weeks prior to start of work. Besides discussing the scope of work, construction schedule, means and methods, and quality, **Airside Safety** will be addressed to the satisfaction of GYR Operations personnel. Local FAA Air Traffic Control (ATCT) representatives, including the Air Traffic Control Tower Manager and Tech Ops SSC Manager must be invited to attend these meetings.

B. Weekly Progress Meetings

Weekly progress meetings attended by the Aviation Department Project Manager, GYR Operations personnel, Engineer-of-Record personnel, Contractor and Subcontractor supervisory personnel, ATCT representatives, including the Air Traffic Control Tower Manager and Tech Ops SSC Manager and GYR Stakeholders will be held to discuss construction progress, work schedule and quality, and Airside Safety. Weekly meetings will be chaired by the Aviation Department Project Manager. The Contractor will prepare meeting agendas and minutes.

C. Contractor Safety Meetings

All project Foremen and Superintendents are responsible for conducting weekly safety

meetings and daily pre-task plan meetings on the job. **These meetings should include Airside Operations personnel assigned to ensure oversight of the work and, if appropriate, the designated FAA ATCT point of contact.**

D. Meeting Agenda Topics

Operational Safety must be a standing agenda topic for all construction meetings and conferences. All safety issues identified in these meetings and any identified mitigations must be forwarded in a written report to the Airport's Safety Committee. The Airport Safety Committee will determine whether the issues identified should rise to the Airport's Standards Committee for a formal Safety Management Assessment and decision.

2.6 CONSTRUCTION PHASING

The Project Manager will include Airside Operations in the development and approval of the CSPP. Operational safety and efficiency will be a strong consideration throughout the development of the phasing plan. Diagrams communicating the construction limits and phasing for this project can be found in **Appendix E** of this CSPP. Any stipulations to this CSPP must be included in the SPCD.

Phasing of the work will be necessary to minimize impacts on airport operations during construction. The GYR priorities for phasing of the work are shown in **Appendix E, Exhibits A, B, C, D, E and F.** Construction will be completed generally at night with two rolling closures to enable efficient milling and paving of the taxiway reducing the number of transverse joints and paving operations. The hours of closure are from 2100 hours to 0600 hours Sunday thru Thursday nights. Rolling closures will be investigated as a possible way to expedite portions of the construction; the Contractor should plan to complete this project during the night time closures, Sunday through Thursday. See the **Operational Effects Table** in **Section 2.7**.

A. Phase 1: Taxiway A3/Ramp 3:

Phase 1 work will involve relocating existing electrical duct banks, constructing new fillets, installing taxiway edge lights, constructing 30' asphalt shoulders and constructing a new pavement section between Taxiway A and the ramp area. The new pavement section will be designated as Ramp 3. The work will also involve milling and overlaying Taxiway A3 and Taxiway A within the Phase 1 construction limits shown in **Appendix E, Exhibits B and C.**

a. Phase 1 construction is expected to take 45 days.

b. Nightly work will take place in an active **Airport Operations Area** until paving operations begin. Paving operations and taxiway marking will take place during a 57 hour rolling closure with the Runway and Taxiways closed.

c. Taxiway A shoulders between Taxiways A2 and A3 will be constructed during Phases 1 and 2. The limits of each are shown on Exhibits C and D in Appendix E.

d. Work will require a complete closure of Taxiway A3. Existing Ramp 3 will remain open for daytime operations during most of Phase 1. Taxiway A will be re-opened for normal daytime operations each morning.

    i. Runway will be closed when work takes place within the RSA.

e. At the completion of the rolling closure, Taxiway A3 and Ramp 3 will marked with temporary markings, properly signed and opened for normal aircraft operations.

f. At least 30 days after the completion of the final phase of paving operations, the asphalt pavement will need to be re-striped with the final pavement markings. Pavement markings include: edge, hold position markings, surface painted hold position markings and enhanced centerline markings.

B. Phase 2 Taxiway A2/Ramp 2:

Phase 2 work will involve relocating designated electrical items, constructing new fillets, installing taxiway edge lights, constructing 30' shoulders and marking a shifted pavement section between Taxiway A and the ramp area. This pavement section will be designated as Ramp 2. The work will also involve milling and overlaying Taxiway A within the Phase 2 construction limits shown in **Appendix E, Exhibits B and D.**

a. Phase 2 construction is expected to take 28 days.

b. Nighttime or daytime work may take place during Phase 2. No work shall take place within the Runway Safety Area (RSA) unless the runway is closed too.

c. Taxiway A shoulders between Taxiways A2 and A3 will be constructed during Phases 1 and 2. The limits of each are shown on Exhibits C and D in Appendix E.

d. Taxiway A north of Ramp 2 and south of Taxiway A1, Taxiway A2 and Ramp 2 will remain closed for the duration of Phase 2.

e. From time–to–time nightly closures of portions of TW A outside of Phase 2 will be permitted provided that all such closed sections shall be re-opened for normal daytime operations.

f. Ramp 2 will be open and have the proper markings, signs, and lights when Phase 2 is opened.

g. At least 30 days after the completion of the final phase of paving operations Taxiway A1 and A2 will have enhanced centerline markings, edge markings and surface painted hold signs placed.

C. Phase 3 Taxiway A – 2,467 Linear Feet:

Phase 3 work will involve the following: 1) Constructing the first 2 – inch asphalt pavement lift for the Taxiway A shoulders during night time work; 2) Milling and overlaying 2,467 linear feet of Taxiway A pavement and paving the final lift for the shoulders during a 57 hour rolling closure.

a. Phase 3 work is expected to take 24 days.

b. Nightly work will take place on the 30' shoulders until milling and final paving operations.

i. Runway will remain open for the duration of Phase 3 work unless contractor needs to complete work within the RSA, which may include millings placement in the infield areas.

c. TW A will be re-opened every morning after nightly closures for shoulder construction.

d. Final milling and paving operations will take place over a 57 hour rolling closure (Sunday Night to Wednesday morning)

   During the rolling closure:

   i. Two (2) inches of AC pavement will be milled from the taxiway surface and 3 inches of new P-401 will be paved the full width of the taxiway and tapered to 2 inches at the edges of asphalt shoulders.

   ii. The taxiway will receive temporary edge and centerline markings

e. Final markings will be placed at least 30 days after the final phase of paving operations take place.

D. Phase 4 Taxiway A – 2,934 Linear Feet:

Phase 4 work will involve the following: 1) Constructing the first 2–inch pavement lift for the Taxiway A shoulders during night time work: 2) Milling and overlaying 2,934 linear feet of Taxiway A pavement and paving the final lift for the shoulders during a 57 hour rolling closure.

a. Phase 4 construction is expected to take 24 days.

b. Nightly work will take place on the 30' shoulders until milling and final paving operations.

   i. Runway will remain open for the duration of Phase 4 work unless contractor needs to complete work within the RSA which includes placing millings in the infield areas.

c. TW A will be re-opened every morning after nightly closures for shoulder construction.

d. Final paving operations will take place over a 57 hour rolling closure (Sunday Night to Wednesday morning).

   During the rolling closure:

   i. Two (2) inches of AC pavement will be milled from the taxiway surface and 3 inches of new P-401 will be paved the full width of the taxiway and tapered to 2 inches at the edges of asphalt shoulders.

   ii. The taxiway will receive temporary edge and centerline markings.

e. At least 30 days following final paving operations, final taxiway centerline, edge markings and surface painted hold signs shall be placed.

E. Summary of Construction Issues:

1. Taxiway Shoulder Construction Options:

a. Option A – Close portions of the affected taxiway system for night work leaving the runway operational. Normal nighttime work shifts will begin at 21:00 hours and end at 06:00 hours, Sunday through Thursday nights, leaving the site in a clean condition with no lips or drop-offs greater than 3" upon opening at 06:00 hours. **All taxiways will open promptly at 06:00 hours so all work needs to be complete prior to 05:30 hours providing 30 minutes for the contractor and airport personnel to conduct pre–opening inspections.**
b. Option B – NOTAM portions of Taxiway A to ADG I aircraft (TSA = 49 feet) where shoulder widening is taking place allowing work to proceed around the clock, including during normal daylight hours. A NOTAM will notify pilots of aircraft larger then ADG -1 that they will be required to back–taxiing on the runway to navigate around the construction area.
c. Option C – Combination of Option A and Option B allowing work to proceed around the clock. Closures will need to be routinely scheduled and allowed to happen on an as–needed basis.

2. Steps shall be taken to minimize the impacts to the users at the South T-Hangars. Users may have limited access to their aircraft during short periods of time when work is proceeding near their ramp access to Taxiway A. Tenants may be able to relocate their aircraft to alternate locations on the airfield prior to construction blocking access between the runway and the South T-Hangar apron.

3. The Taxiway A "mill and fill" operation will take place during two rolling closures. The milling operation will begin first, followed closely by brooming, and final shoulder trimming. A 3-inch lift of P-401 asphalt concrete shall be placed the entire width of the taxiway and feathered from 3 inches at the edge of the taxiway to 2 inches at the edge of 30' shoulder. The shoulders are designed with a 4-inch P-401 section and will be paved with an initial 2 inch lift of P-401 leaving a 2 inch lip until final taxiway milling and paving operations take place. The final taxiway structural section will bring Taxiway A up to full strength with a PCN strength of 66.

Runway 3/21 will be closed when working in the Runway Safety Area. And Taxiways will be closed when work takes place within the Taxiway Safety Areas. Only night work will be permitted from 2100 hours to 0600 hours Sunday thru Thursday, unless another work schedule is agreed upon by the Contractor, Engineer, Aviation Department Project Manager and GYR Operations. Proposed work will require partial closures of Taxiway A and complete Runway closures when work takes place within the RSA.

The Airport Operations personnel will provide "Lighted X's" to mark all runway closures in accordance with the provisions of the CSPP and the Construction Contract Documents.

The Contractor shall address phasing of project and sequence of work in **Appendix A** of the SPCD.

2.7 AREAS AND OPERATIONS AFFECTED BY CONSTRUCTION ACTIVITY

A. Identification of Affected Areas

1) **Closing, or partial closing, of runways, taxiways, and aprons:**
   See **Appendix E** for the affected areas.
2) **Closing of Aircraft Rescue and Fire Fighting access routes:**
   No ARFF facility exists at GYR.
3) **Closing of access routes used by airport and airline support vehicles:**
   See **Section 2.13** for details on establishing detour routes for airport vehicles.
4) **Interruption of utilities, including water supplies for firefighting:**
   No domestic water, electrical, sewer, telephone, or other associated lines exist in the work area. See also **Section 2.15**.
5) **Approach/departure surfaces affected by height of objects:**
   No fixed objects will be placed that will penetrate approach/departure surfaces. Tall equipment will only be used by the Contractor when a 7460-1 determination letter has been issued for such equipment. See **Section 2.23**.
6) **Construction areas, storage areas, and access routes near runways, taxiways, and aprons:**
   See **Appendix E** for the affected areas.

B. Operational Effects and Mitigation Measures

The **Operational Effects Table** details the temporary changes to runway and taxiway operations as well as temporary changes to air traffic control and air traffic procedures, as coordinated with the ATO. See **Section 2.13** for details on determining vehicle detour routes and **Section 2.15** for maintenance of underground utilities.

Operational Effects Table

Phase 1	**Taxiway A3 and Ramp 3**
Description	Within the construction limits of Phase 1 the Contractor will rehabilitate and strengthen Taxiway A; Add 30-foot paved shoulders both sides of Taxiway A; Remove direct apron access to Runway 3/21 by relocating that portion of Taxiway A3 between apron and Taxiway A approximately 190 feet to the north; Add AC fillets and 30-foot paved shoulders to Taxiway A3 bringing it up to TDG 5 standards; Add enhanced taxiway centerline striping and surface painted hold position markings to Taxiway A and connector taxiways.
Runway Length	8500 feet.
Operational Requirements	**Existing**
Aircraft Operations	Runway will remain open during normal nighttime work periods. Portions of the taxiway system will be closed. See **Appendix E, Exhibit C** for closures and barricade plan. Runway will be closed during paving operations conducted during rolling closure.
RW 3-21 ARC	ADG – IV
RW 3 Approach Minimums	1-Mile
RW 21 Approach Minimums	Visual
RW 3 Approach Procedure	RNAV – GPS; Circling
RW 21 Approach Procedure	Visual - Circling
RW 3 NAVAIDS	4-Box PAPI
RW 21 NAVAIDS	4-Box PAPI

Runway Closures	Runway 3-21 is to remain open during the Phase 1 except when work needs to take place inside the RSA. Normal night shifts will be 21:00 hours through 06:00 hours, Sunday through Thursday. The runway and airport will be closed for one 57-hour rolling closure to complete the paving operations associated with Phase 1 including Taxiway A3 and Taxiway A mill and overlay and 30' paved shoulders; Taxiway A3 paved fillets and shoulders; Ramp 3 paving and paved shoulders. **NO WORK IN THE RSA WILL OCCUR WHEN RUNWAY 3-21 IS OPEN.**
Taxiway Closures	The following nightly taxiway closures will be a part of Phase 1: Taxiway A will be closed nightly at a point just north of Connector Taxiway A5 to a point south of Connector Taxiway A2. The ramp area will also be closed as shown on **Appendix E, Exhibit C.** Taxiway A3 will be closed for the duration of Phase 1. Connector Taxiways A4 and A3 will also be closed at the Runway. Each morning the Taxiway A and A4 will be opened up for operations necessitating separate low level barricade plans for night time periods and for daytime operations. **See Appendix E, Exhibit C for the barricade plan for night time work periods and the barricade plan for daytime operations.** Aircraft will need to back-taxi on Runway 3/21 at night to access the primary ramp at GYR. These operational effects will be NOTAM'ed. **NO WORK IN THE TSA WILL OCCUR WHEN THE TAXIWAY IN QUESTION IS OPEN UNLESS STEPS ARE TAKEN TO COMPLY WITH PARAGRAPH 2.22.3.4 OF FAA 150/5370–2G — *OPERATIONAL SAFETY ON AIRPORTS DURING CONSTRUCTION TO ALLOW PASSAGE OF AIRCRAFT*.**
ATC Procedure Changes	No ATC Procedure Changes are expected. Construction will require modified taxi routes as shown in Appendix E, Exhibits B through F
Phase 2	**Taxiway A2 and Ramp 2**
Description	Within the construction limits of Phase 2 the Contractor will rehabilitate and strengthen Taxiway A; Add 30-foot paved shoulders to both sides of Taxiway A; Remove direct apron access to Runway 3/21 by relocating the portion of Taxiway A2 between the apron and Taxiway A, approximately 325 feet to the north; Add enhanced taxiway centerline striping and surface painted hold position markings to Taxiway A and connector Taxiways A1 and A2.
Runway Length	8500 feet.
Operational Requirements	**Existing**
Aircraft Operations	Runway will remain open during normal nighttime work periods. Portions of the taxiway system will be closed. See **Appendix E, Exhibit D** for closures and barricade plan. Runway will be closed during paving operations only if work occurs in the RSA.
RW 3-21 ARC	ADG – IV
RW 3 Approach Minimums	1-Mile
RW 21 Approach Minimums	Visual
RW 3 Approach Procedure	RNAV – GPS; Circling
RW 21 Approach Procedure	Visual - Circling
RW 3 NAVAIDS	4-Box PAPI
RW 21 NAVAIDS	4-Box PAPI

Runway Closures	Runway 3-21 is to remain open during Phase 2 except when work needs to take place inside the RSA. Normal night shifts will be 21:00 hours through 06:00 hours, Sunday through Thursday to complete the paving operations associated with Phase 2 including Taxiway A mill and overlay and 30' paved shoulders; Ramp 2 new signage, lighting and marking. **NO WORK IN THE RSA WILL OCCUR WHEN RUNWAY 3-21 IS OPEN.**
Taxiway Closures	Taxiway A will be closed for the duration of Phase 2 from a point immediately south of Taxiway A1 to a point just north of new Ramp 3. Taxiway A2 and the apron area at new Ramp 2 will also be closed for the duration of Phase 2. See closed areas as shown on **Appendix E, Exhibit D. See Appendix E, Exhibit D for the barricade plan for night time work periods and the barricade plan for daytime operations.** During Phase 2 aircraft will need to back-taxi on Runway 3/21 around Taxiway A2 to access the primary ramp at GYR. These operational effects will be NOTAM'ed. **NO WORK IN THE TSA WILL OCCUR WHEN THE TAXIWAY IN QUESTION IS OPEN UNLESS STEPS ARE TAKEN TO COMPLY WITH PARAGRAPH 2.22.3.4 OF FAA 150/5370–2G — *OPERATIONAL SAFETY ON AIRPORTS DURING CONSTRUCTION TO ALLOW PASSAGE OF AIRCRAFT*.**
ATC Procedure Changes	No ATC Procedure Changes are expected. Construction will require modified taxi routes as shown in Appendix E, Exhibits B through F
Phase 3	**Taxiway A Rehab & Strengthening**
Description	Within the construction limits of Phase 3 the Contractor will rehabilitate and strengthen Taxiway A; Add 30-foot paved shoulders both sides of Taxiway: Add enhanced taxiway centerline striping and surface painted hold position markings to Taxiway A and connector taxiways A10, A9, A8 and A7.
Runway Length	8500 feet.
Operational Requirements	**Existing**
Aircraft Operations	Runway will remain open during normal nighttime work periods while the Contractor constructs the 30–foot shoulders. The associated taxiway system will be closed. See **Appendix E, Exhibit E** for closures and barricade plan. Runway will be closed during paving operations conducted during rolling closure.
RW 3-21 ARC	ADG – IV
RW 3 Approach Minimums	1-Mile
RW 21 Approach Minimums	Visual
RW 3 Approach Procedure	RNAV – GPS; Circling
RW 21 Approach Procedure	Visual - Circling
RW 3 NAVAIDS	4-Box PAPI
RW 21 NAVAIDS	4-Box PAPI
Runway Closures	Runway 3-21 is to remain open during the Phase 3 except when work needs to take place inside the RSA. Normal night shifts will be 21:00 hours through 06:00 hours, Sunday through Thursday. The runway and airport will be closed for one 57-hour rolling closure to complete the paving operations associated with Phase 3 including Taxiway A mill and overlay and paving of 30 shoulders. **NO WORK IN THE RSA WILL OCCUR WHEN RUNWAY 3-21 IS OPEN.**

Taxiway Closures	The following nightly taxiway closures will be a part of Phase 3: Taxiway A will be closed nightly from Taxiway A10 to a point between Connector Taxiways A7 and A6. See **Appendix E, Exhibit E.** The taxiways will be opened up for operations each morning. These operational effects will be NOTAM'ed. **NO WORK IN THE TSA WILL OCCUR WHEN THE TAXIWAY IN QUESTION IS OPEN UNLESS STEPS ARE TAKEN TO COMPLY WITH PARAGRAPH 2.22.3.4 OF FAA 150/5370–2G — *OPERATIONAL SAFETY ON AIRPORTS DURING CONSTRUCTION TO ALLOW PASSAGE OF AIRCRAFT*.**
ATC Procedure Changes	No ATC Procedure Changes are expected. Construction will require modified taxi routes as shown in Appendix E, Exhibits B through F
Phase 4	**Taxiway A Rehab & Strengthening**
Description	Within the construction limits of Phase 4 the Contractor will rehabilitate and strengthen Taxiway A; Add 30-foot paved shoulders both sides of Taxiway: Add enhanced taxiway centerline striping and surface painted hold position markings to Taxiway A and connector taxiways A6, A5 and A4.
Runway Length	8500 feet.
Operational Requirements	**Existing**
Aircraft Operations	Runway will remain open during normal nighttime work periods while the Contractor constructs the 30–foot shoulders. The associated taxiway system will be closed. See **Appendix E, Exhibit F** for closures and barricade plan. Runway will be closed during paving operations conducted during rolling closure.
RW 3-21 ARC	ADG – IV
RW 3 Approach Minimums	1-Mile
RW 21 Approach Minimums	Visual
RW 3 Approach Procedure	RNAV – GPS; Circling
RW 21 Approach Procedure	Visual - Circling
RW 3 NAVAIDS	4-Box PAPI
RW 21 NAVAIDS	4-Box PAPI
Runway Closures	Runway 3-21 is to remain open during the Phase 4 except when work needs to take place inside the RSA. Normal night shifts will be 21:00 hours through 06:00 hours, Sunday through Thursday. The runway and airport will be closed for one 57-hour rolling closure to complete the paving operations associated with Phase 4 including Taxiway A mill and overlay and paving of 30 shoulders. **NO WORK IN THE RSA WILL OCCUR WHEN RUNWAY 3-21 IS OPEN.**
Taxiway Closures	The following nightly taxiway closures will be a part of Phase 4: Taxiway A will be closed nightly from a point just north of Ramp 8 to a point just south of Taxiway A3. Connector Taxiways A4, A5, A6 and A7 will be closed each night and reopened each morning. See **Appendix E, Exhibit F.** The taxiways will be opened up for operations each morning. These operational effects will be NOTAM'ed. **NO WORK IN THE TSA WILL OCCUR WHEN THE TAXIWAY IN QUESTION IS OPEN UNLESS STEPS ARE TAKEN TO COMPLY WITH PARAGRAPH 2.22.3.4 OF FAA 150/5370–2G — *OPERATIONAL SAFETY ON AIRPORTS DURING CONSTRUCTION TO ALLOW PASSAGE OF AIRCRAFT*.**

ATC Procedure Changes	No ATC Procedure Changes are expected. Construction will require modified taxi routes as shown in Appendix E, Exhibits B through F

2.8 PROTECTION OF NAVIGATIONAL AIDS (NAVAIDS)

ALL AFFECTED NAVAID CRITICAL AREAS DEPICTED

NAVAID critical areas are depicted on **Exhibit B** of **Appendix E** for contractor reference. Also included on **Exhibit B** is the distance and direction from each NAVAID to construction activity locations. There are no changes to airport NAVAIDS anticipated with this project.

Construction materials and equipment shall not be placed or parked where they may interfere with the line-of-sight of the GYR Air Traffic Control Tower (ATCT) and navigational aids in operation. Airport Operations shall determine if any materials or equipment will cause any type of interference. If it is determined that construction could affect FAA NAVAIDS, coordination with Airside Operations and local FAA Airways Facilities personnel must be accomplished before the construction project proceeds. If agreed that a construction impact is likely, the systems will be deactivated or the runway will be closed, and a NOTAM will be issued advising pilots of the system outage.

Parking of vehicles or equipment near electronic NAVAID's require special consideration since they may interfere with signals essential to air navigation. Pay particular attention to stockpiling material, as well as to movement and parking of equipment that may interfere with line of sight from the GYR ATCT or with electronic emissions. Interference from construction may require NAVAID shutdown. This condition requires that a NOTAM be filed. Construction activities and materials/equipment storage near a NAVAID may also obstruct access to the equipment and instruments for maintenance. Before commencing construction activity, parking vehicles, or storing construction equipment and materials near a NAVAID, consult with the GYR Airside Operations if the project anticipates any impact so proper coordination with FAA Tech Ops and ATCT can take place. Any details regarding work within NAVAID Critical Areas should be included in the Contractor's SPCD.

2.9 CONTRACTOR ACCESS

A. Location and Storage of Stockpiled Construction Materials

Stockpiled materials and equipment storage are only permitted in areas designated on the Construction Safety Drawings in **Appendix E** with the approval of Airport Operations. Stockpiled materials and equipment storage are never permitted within the RSA and OFZ of an operational runway or the TSA and TOFA of an operational taxiway. In coordination with GYR, the Contractor will ensure that stockpiled materials and equipment adjacent to these areas are prominently marked and lighted during hours of restricted visibility or darkness. This includes determining and verifying that materials are stored at an approved location to prevent foreign object damage and attraction of wildlife.

Stockpiled material or equipment should not be stored near aircraft turning areas or operational movement areas, aprons, or excavations and trenches. Stockpiled materials shall not be stored near NAVAIDs, visual or approach aids, nor shall they obstruct the GYR ATCT's line of sight to any runway or taxiway.

At the conclusion of each phase, the stockpiles and equipment storage areas shall be removed and relocated, as necessary, to the next phase or to the primary contractor

staging area. Contractor staging areas and stockpiles shall not be permitted inside the active runway ROFA.

B. Vehicle and Pedestrian Operations

GYR Airport Operations must provide proper coordination and management oversight throughout all phases of the project to address construction equipment access to the movement area.

Only the Airport has the authority to open or close airport movement areas (runways, taxiways, and other areas of an airport that are used for taxiing or hover taxiing, air taxiing, takeoff, and landing of aircraft). The Contractor will request all needed movement area closures and openings through the GYR Aviation Supervisor. The Aviation Supervisor will collaborate with the GYR ATCT and will be responsible for orchestrating all closures and re-openings of movement areas.

Prior to entering any work site within the AOA, the Contractor will physically meet with airport staff daily to discuss the intended activities. The Contractor must also arrange a physical inspection of the work area with Airport staff prior to leaving any area that has been closed for work or that has been used for a crossing point or haul route by the Contractor. Contractor shall place all barricades and hazard lights as necessary and shall be responsible for maintaining hazard equipment throughout the duration of Construction. Barricade locations must be approved by GYR Operations.

Access to the AOA and the project site will be through Entry Gate # 2, accessed from the Goodyear Parkway. The Contractor shall use the existing asphalt perimeter road and an existing gravel haul road to access his fenced storage yard and staging area. Exact location of haul routes, stockpile areas and fenced staging areas will be established during the Pre-construction conference.

Appendix A of the Contractor's SPCD must communicate the Airport–approved Haul Routes for this project.

Appendix C of the Contractor's SPCD must communicate the Airport–approved Material stockpile locations and equipment staging, and employee parking locations for this project.

1) Construction Site Parking Requirements

All parking of construction vehicles and equipment for this project will be limited to areas designated by Airport Operations. There shall be no equipment or material storage in the active Runway Safety Area (RSA) or Active Taxiway Safety areas (TSA) or in the runway or taxiway infield areas. The Contractor shall remove all equipment from the runway and taxiway Object Free Areas (OFA), including the infields before the areas are reopened to aircraft operations. Staging on apron areas will be allowed with prior approval from Airport Operations and the Engineer of Record.

2) Equipment Storage Areas Identified

Equipment storage is only permitted in areas designated by the Airport Operations in collaboration with the Engineer of Record. Equipment storage is never permitted within the RSA and Obstacle Free Zone (OFZ) of an operational runway or within the TSA and Taxiway Object Free Area (TOFA) of an operational taxiway. Equipment is allowed temporarily within the Runway Object Free Area (ROFA) however, shall be removed from the ROFA when not in use. In coordination with GYR the Contractor will

ensure that stockpiled materials and equipment adjacent to these areas are prominently marked and lighted during hours of restricted visibility or darkness. This includes determining and verifying that equipment is stored at an approved location in a manner to prevent the leaking of fuels, oils, fluids in to storm drains or soils. The contractor will be responsible for cleaning any spills coming from the equipment.

3) Access and Haul Roads

The Contractor shall access the construction work area only at locations and by haul routes identified on the Construction Safety Drawings in **Appendix E**. The Contractor shall not use any access or haul roads other than those approved by Airport Operations. The Contractor must take care to maintain security during construction when access points are created in the security fencing to permit the passage of construction vehicles and personal. Temporary gates should be equipped so they can be securely closed and locked to prevent access by animals and unauthorized people. Procedures should be in place to ensure that only authorized persons and vehicles have access to the AOA.

The Contractor shall ensure that no personnel or equipment enters into the active movement areas or their associated Object Free Areas without the appropriate Airport Operations escort. **Access into movement areas or Safety Areas without an Airport Operations escort is prohibited!**

All access into movement areas must be coordinated and approved by the on duty **GYR Airside Operations Supervisor**. All communications with Air Traffic Control Tower (GYR ATCT) will be the responsibility of GYR Airport Operations. No access into movement areas will be authorized without a trained and certified Airport Operations escort.

When operating within an active RSA or TSA, clearance must be obtained from GYR Airport Operations and GYR ATCT prior to entering the area. Failure to receive proper clearance will result in extreme consequences. Once Airport Operations and GYR ATCT clearance has been received and you are escorted into these areas, all instructions from the GYR ATCT and the Airport Operations Escort must be strictly obeyed.

4) Flaggers, Spotters and Observers Controlling Equipment Crossings of Movement Areas

At such a pre-approved taxi-lane, taxiway or runway crossing point, the Contractor shall have a flag person stationed on each side of the crossing point to monitor aircraft movement and to direct construction traffic. The flag persons shall be equipped with handheld signs or flags to assist in directing construction traffic. For nighttime construction operations, the flag person shall also be equipped with lighted wands and light plants on each side of the active, taxi-lane, taxiway or runway. In addition, one vacuum sweeper and one water truck shall be dedicated to and stationed full time at each active taxi-lane, taxiway or runway crossing to maintain the surface free from construction traffic debris. Mud and other material tracked onto taxi-lane, taxiway or runway surfaces shall be removed by hand if necessary to achieve its complete removal. Location of flag person operations must be depicted on **Appendix A** of the Contractor's SPCD.

5) Vehicle Operator Requirements

The Contractor will be responsible for ensuring compliance with all airport rules and regulations. Contractors will impress upon their workers, suppliers, and subcontractors that compliance is mandatory and noncompliance will not be tolerated.

All operators shall be trained and approved by GYR staff prior to being allowed access to the construction project.

6) Vehicle Identification

Vehicles on site during construction shall be marked and lighted in accorcance with AC 150/5210-5 *Painting, Marking, & Lighting of Vehicles on an Airport.* Temporary construction equipment must be marked and lighted in accordance with the latest approved version of AC 71/7460-1, Obstruction Marking and Lighting. All construction related traffic is restricted to designated service and haul routes and work areas depicted in the Contract Documents, CSPP and approved SPCD.

7) Proper Vehicle Operations

(1) **Day Construction (VFR Conditions)**

a. All vehicles will have appropriate logos on both sides of the vehicle.
b. All vehicles will have either a flashing amber beacon or a construction flag. The standard for construction flags is 3' X 3' with 1 sq. ft. alternating white and orange checkers.
c. All heavy equipment (loaders, cranes, earth movers, dump trucks, backhoes, cement trucks, pavers, etc.) will have a construction flag – no exceptions.
d. Cranes and other tall vehicles must have a construction flag and a red obstruction light illuminated at the highest point on the vehicle.
e. Vehicles not meeting these requirements must be escorted by a vehicle that meets the requirements.

(2) **Night Construction (and IFR Conditions)**

a. All vehicles will have appropriate logos on both sides of the vehicle.
b. All vehicles will have a flashing amber beacon.
c. All vehicles will have working headlights/marker lights where applicable.
d. Cranes and other tall vehicles must have a red obstruction light illuminated at the highest point on the vehicle.

(3) **No Vehicle Shall Be Operated In Any Portion of the AOA**

a. In a careless or negligent manner.
b. In disregard of the right and safety of others.
c. Without due caution or at a speed or manner which could endanger persons or property.
d. While the driver is impaired or under the influence of an intoxicating liquor or any narcotic habit-forming drug.
e. If it is hazardously equipped or loaded in a manner which could endanger persons or property.

(4) **Use of Roadways**

a. All vehicles will drive within the marked vehicle/tug roadways to reach their destination. Never drive on the runway or taxiway.
b. Construction may require the deployment of temporary service routes or haul routes. Establishment of these routes must require prior coordination with the Engineer of Record and Airport Operations.

(5) **Operating Speeds**

a. The maximum speed for all vehicles and equipment, with the exception of authorized emergency vehicles during emergency functions operated within the vehicle/tug roadways, is 25 miles per hour.
b. Vehicles and equipment operated in all other apron and terminal service areas must not exceed 15 miles per hour, with the exception of authorized emergency vehicles during emergency functions.
c. The maximum speed for vehicles operated around hangars is 5 miles per hour.
d. The maximum speed for all motor vehicles and ground support equipment operated in aircraft safety areas, such as runways and taxiways, will be determined by the operator in accordance with operational necessity and safe operating practices.
e. The maximum speed for construction vehicles will be determined by Airport Operations and will be based on the construction site location and operational necessity.

(6) **Runway and Taxiway Safety Area Access**

a. No individual will be allowed into the runway and taxiway safety areas unless they are escorted by an individual that has the proper certification and has the permission of the on-duty Airside Operations Supervisor.

8) Radio Communications

All communications with FAA Air Traffic Control Tower (GYR ATCT) must be coordinated through Airport Operations. Construction workers needing access onto runways or taxiways must be under escort by an Airport Operations person certified for access into movement areas. All access into movement areas must be coordinated and approved by the on-duty Airside Operations Supervisor. All communications with the GYR ATCT will be the responsibility of Airport Operations.

The control of vehicular activity within the airport's movement areas is of the highest importance. This requires coordination with airport users and ATCT. The Contractor shall have no direct contact with ATCT Ground Control. All communications with ATCT shall be coordinated through Airport Operations. However, the Contractor must properly train his/her personnel, particularly flag persons, on the proper procedures for monitoring radio frequencies and, if the need arises, to make emergency communications to ATCT.

Details for any needed access across or within an aircraft movement area and the plans for the use of flag persons must be communicated in Appendix A of the Contractor's SPCD.

9) Security Violations

At GYR, safety and security is our top priority. GYR has an operations staff which is responsible for safety and security in the Air Operations Area. GYR Operation staff encourages contractor personnel to keep their eyes out for suspicious activity and to report to an Airport employee anything that seems out of place.

10) Methods of Separating Vehicle and Pedestrian Traffic from the AOA and Airport Movement Areas

All vehicles associated with this project must drive within the marked vehicle/tug roadways until they are directly abeam their ramp destination. Never drive on or near a runway or taxiway. Airport Operations personnel continuously monitor and enforce

airport rules and regulations pertaining to the safe operations of vehicles on the AOA. The Contractor will be responsible for ensuring compliance with all airport rules and regulations. Contractors will impress upon their workers that compliance is mandatory and noncompliance will not be tolerated.

If the need arises, all requests for escorts into movement areas must be made through the on-duty GYR Aviation Supervisor at (623) 932-4550. Airport staff will monitor all construction activity to ensure proper separation between construction activity and aircraft movement. Airport staff shall coordinate construction activity with the control tower during their normal hours: 0600-2100 hrs.

2.10 WILDLIFE MANAGEMENT

Interaction of wildlife with air traffic can be dangerous. Because wildlife will likely move through the AOA to get to or leave the work areas, it is critical that all reasonable efforts be made to reduce the potential for attraction of wildlife to the construction areas. This includes proper housekeeping techniques to remove any scrap food, structures or piles of materials that might attract wildlife, including birds.

GYR's security fence aids in the protection of the AOA from unwanted wildlife. The Contractor shall monitor and ensure all access gates close securely following any movement of personnel into or out of the airport property.

2.11 FOREIGN OBJECT DEBRIS (FOD) MANAGEMENT

The Contractor will have a minimum of one vacuum sweeper, one water truck, and dedicated operators on site full time throughout this project to respond as needed or as directed by the Engineer or Airport staff to remove FOD. Special attention will be given at each active taxiway, runway, or taxilane crossing to maintain the surface free from construction traffic debris. Mud and other material tracked into the paths of aircraft will be removed by hand if necessary to achieve its complete removal. GYR Airport staff will be on site throughout this project to ensure that any FOD hazards are quickly mitigated. Prior to the opening of closed airport movement areas, the Contractor shall visually inspect the movement areas for FOD.

Closed pavements will be swept clean prior to reopening to aircraft traffic. Exposed earth in excavation areas within 75 feet of the centerline, immediately adjacent to active taxiways, will be covered to prevent dust from jet blast. Cover material will be weighted to prevent movement from jet blast.

2.12 HAZARDOUS MATERIAL (HAZMAT) MANAGEMENT

Contract shall provide HAZCOM (Hazard Communication) and MSDS (Material Safety & Data Sheets) plans and documents to ensure their availability on site for employees to review. Contractor shall:

- Review MSDS and use recommendations for handling, storage, and emergency situations.
- When a new product comes on site, review MSDS with crew.
- Maintain all labels on containers.
- Submit Contractor Health & Safety Plan to Airport for review and compliance with HAZCOM program provisions.

A. Material Release

A release is defined as any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, placing, leaching, dumping, or disposing into or on any land in a manner that fuels and other regulated substances, pollutants, or storm-water may come to be located in a public storm drain system.

B. Regulated Substances

Regulated substances include without limitation, any substance, materials or wastes that are or become regulated under, or that are classified as hazardous or toxic under any environmental law, including petroleum.

C. Reporting Procedures

The Contractor will immediately report any Material Releases to the GYR Aviation Supervisor On-Duty using the Emergency Notification in **Section 2.14**. Airport staff and Goodyear Fire Personnel will respond to all spills and/or Hazardous Material situations and will manage the event/situation following Aviation Department Rules and Regulations and Goodyear Fire Department procedures. (See also the contact numbers in Section 102.)

2.13 NOTIFICATION OF CONSTRUCTION ACTIVITIES

To ensure notification of all airport tenants and users of the airport of construction projects that may affect their daily routine, GYR shall utilize the NOTAM (Notice to Airmen) system through the FAA Flight Service System (FSS), and email notifications through the Aviation Department's Pardon Our Dust program.

Construction activities may interfere with airport vehicle routes. Detoured routes will be established during the Pre-Construction Conference and approved by GYR Airport Operations.

GYR will coordinate with the City of Goodyear to ensure water availability for fire protection is maintained throughout the project, and will coordinate and designate the fire hydrant to be used for construction water. Emergency response access and routing coordination will be accomplished before and during construction activities on the Air Operations Area (AOA).

All AOA projects at GYR will have design, pre-bid and pre-construction conferences in which GYR Operations staff will outline GYR safety and security rules and regulations that apply to the project.

GYR requires Contractors to hold weekly construction meetings to communicate and collaborate on issues relating to the project. GYR staff will attend these meetings and address issues of safety and security on the AOA.

The Contractor will be responsible for disseminating instructions regarding safety and security to all personnel involved in work relating to this project.

A. NOTAM Issuance

The GYR Aviation Supervisor will issue all required NOTAMs. Work requiring a NOTAM must be communicated to the Aviation Supervisor at least 72 hours in advance.

B. Communication With Responsible Parties

The Aviation Department Project Manager, in collaboration with Goodyear staff and other Aviation Department Divisions, will act as liaison between the Contractor and other Goodyear Airport stakeholders including GYR ATCT, FAA, and GYR Tech Ops. The Contractor will communicate all needs for outside contact through the Project Manager. If the need for communications is urgent, the GYR Aviation Supervisor may be contacted to act as the airport's liaison for FAA communication with GYR ATCT

D. Notification of Key Personnel

The Contractor shall provide the phone numbers for all responsible personnel, including project superintendent, project manager, project principal or sponsor, and the responsible personnel from each of the key subcontractors' firms, each of whom may be contacted in case of an emergency. The Contractor's list of key personnel shall be provided to COP prior to beginning construction. Personnel will be on-call 24-hours per day to maintain construction hazard lighting and barricades. The Contractor will designate a person responsible to maintain and service all barricade/traffic control equipment. In the event there are changes to the contact list, new names and numbers shall be provided within 24 hours of the change.

GYR and Engineer of Record Key Personnel include:

Name	Title	Representing	Contact No.
Bradley Hagen	Airport Manager	GYR Airport	602-683-3630
Kenneth Brock	Aviation Supervisor	GYR Airport	623-932-4550
On-Duty GYR Aviation Supervisor	Aviation Supervisor	GYR Airport	623-932-4550
Dan Moss	Tower Manager	GYR ATCT	602-379-6565
Alfonso Sanchez	Project Manager	COP/Aviation	602-683-3827
Jay Dupont	Electrical Foreman	COP/Aviation	602-821-4277
Sky Harbor Communications Center	Operator on Duty	COP/Aviation	602-273-3302
Carmen Parks	Project Manager	Morrison-Maierle, Inc.	480-319-4252
Keith Belden	Senior Engineer	Morrison-Maierle, Inc.	602-908-4840

POLICE **911**
FIRE **911**
RESCUE **911**
AIRPORT During Airport Operational hours, contact the GYR Aviation Supervisor on Duty at (623) 932-4550; at all other times contact the Communications Center at Sky Harbor Airport at (602) 273-3302 to be connected to the On-Call Aviation Supervisor for the Goodyear Airport

2.14 INSPECTION REQUIREMENTS

Operational safety and security monitoring will be conducted continuously throughout all phases of construction within the AOA. Inspector duties are the responsibility of assigned GYR staff as well as Contractor supervisory personnel, COP Project Inspectors and Engineer of Record personnel. In addition, the Contractor shall be responsible for developing and implementing a

Contractor Quality Control program including inspections necessary to assure compliance with the requirements of the CSPP and other provisions of the Construction Contract Documents. The Contractor shall also inspect for FOD during each shift AND at the end of each shift prior to the opening of closed movement areas.

2.15 PROTECTION OF UNDERGROUND UTILITIES AND FACILITIES

Prior to opening an excavation, effort will be made to determine whether underground installation (including sewer, telephone, water, fuel, electric lines, etc.) will be encountered, and if so, where such underground installations are located. Use of Blue Stake and as-built research is always required. GYR also requires the submission of "Airport Subsurface Investigation, Excavation, Saw Cutting, Pot Holing, Drilling, and Construction Activity Permits Checklist" prior to any excavation procedure. (See **Appendix D** for Permit forms.)

Additional sources of information include:

- Aviation Department Design and Construction Services (as-built drawings)
- Facilities and Services (electrical)
- Aviation Department GIS (as-built drawings)
- Aviation Department Planning and Environmental (environmental facilities monitoring wells, lead paint removal, contaminated soil testing & removal)
- Federal Aviation Administration (fiber optics, communications, & power)
- COP Information Technology (communications)
- Goodyear Fire Department (water, fire protection)

In the event a utility line is damaged, the Contractor shall contact GYR Operations personnel, Aviation Department Project Manager and the Engineer immediately. Contractor shall develop proposed remediation solution for approval by the Engineer, Aviation Department Project Manager and Goodyear Airport Operations.

During Construction, the Contractor shall remove equipment and personnel from locations requiring underground utility and infrastructure maintenance. Equipment and personnel shall not be allowed into the maintenance area until clearance has been provided by the ATCT, GYR Operations or other Authority responsible for the underground utility / infrastructure.

2.16 PENALTIES FOR NONCOMPLIANCE WITH AIRPORT RULES

Due to the safety and security precautions necessary at Goodyear Airport, failure of the Contractor to adhere to the prescribed requirements/regulations has consequences that may jeopardize the health, welfare and lives of the customers and employees at GYR, as well as the Contractor's own employees. Therefore, if the Contractor is found to be in noncompliance, the Goodyear staff will issue a Notice of Violation (NOV).

A NOV will be issued for observed violations of any rules, regulations, local, state, and federal laws governing the airport. The NOV will be issued by and monitored by GYR Airport staff personnel. A copy of the NOV will be given to the individual involved.

When issuing an NOV, designated GYR staff personnel will advise the responsible individual of the violation and provide them, as well as the Contractor's Superintendent, with a copy of the NOV. The individual to whom the NOV was issued is responsible for coordinating a hearing with

the Goodyear Airport Manager within three (3) calendar days from the date of the infraction. Failure to coordinate the hearing may result in suspension of work. Participants at the hearing will include the individual to whom the NOV was issued, his or her immediate supervisor, and GYR personnel.

A. Severe Violation

Any violation of a severe nature (i.e., a violation resulting in property damages, injury, runway incursions or surface incidents) as determined by the Goodyear Airport Manager (or designee) will warrant immediate suspension of the work and the employee's permit/badge.

Some examples of severe violations are:

- Failure to yield to an aircraft.
- Entering movement areas without ATC clearance.
- Compromising airport security (security breach).
- Reckless endangerment of life or property.

Throughout the duration of the job, any practice or situation that GYR Airport staff or the Engineer of Record determines to be unsafe or a hindrance to regular airport operations will be immediately rectified.

2.17 SPECIAL CONDITIONS

Emergencies and operating conditions may necessitate sudden changes, both in airport operations and in the operations of the Contractor. Aircraft operations will always have priority over all construction operations. Should runways or taxiways be required for the use of aircraft and should GYR Airport staff deem construction activity to be too close to active runways or taxiways, the Contractor will suspend their operations, remove their personnel, plant, equipment, and materials to a safe distance and stand by until the runways and taxiways are no longer required for use by aircraft.

Any violation of the safety requirements contained in this document, the Contract Documents, or the SPCD shall be considered a violation of the Contract itself and will be sufficient cause for halting the work without extending the time limit of the job.

2.18 RUNWAY AND TAXIWAY VISUAL AIDS

A. Temporary Lighting (AC 150/5340-24)

Placement of construction area lighting for nighttime construction must be coordinated with Airport Operations to ensure no adverse impacts to ATCT or pilot visibility. All Temporary Airfield lighting must be approved by Airside Operations. Airside Operations will be responsible for ensuring that any temporary lighting is compliant with the most current Advisory circular. Temporary lighting and signs must be frangible below 3 inches from the ground and be tethered in a manner approved by Airside Operations.

B. Airport Specific Standards

Airport Operations has airport specific standards for the deployment of temporary runway and taxiway lighting and signs. The contractor must ensure that all temporary lighting and signage is designed and placed in accordance with these standards. A field inspection of all temporary airfield lighting and signs must be completed prior to their use.

C. Temporary Signage Plan Approved by FAA (150/5345-53)

All plans for temporary airfield signage must be approved by Airport Operations. Airport Operations will be responsible for forwarding the airport's approved sign plan to the FAA for approval. Details regarding any temporary airfield signage or lighting needed for this project must be included in **Appendix D.** of the Contractor's SPCD.

D. Use of Temporary Visual Aids

Temporary visual aids will only be used as directed by the Engineer of Record in collaboration with Airport Operations and FAA Air Traffic. Details regarding the use of any temporary visual aids must be included in the Contractor's SPCD **Appendix D.**

E. Affected Areas and Operations, Including Possible Safety Problems

Prior to entering any work site within the AOA, the Contractor will physically meet with Airport Operations to discuss the intended activities. The Contractor must also arrange a physical inspection of the work area with Airport Operations prior to leaving any area that has been closed for work, or that has been used for a crossing point or haul route by the Contractor. Crossing points and Haul routes must be clearly communicated in the Contractor's SPCD **Appendix A.**

F. Temporary Lighting, Sign, and Marking Requirements

Temporary airfield markings and signs will only be used at the direction of the Engineer of Record after approval by the Airport. All temporary marking must comply with Advisory Circular 150/5340-1L Standards for Airport Marking (or the then current edition of AC 150/5340-1 if updated).

All temporary airfield lighting and signage must be clearly visible to pilots, not misleading, confusing or deceptive. They must be properly secured in place to prevent movement by prop wash, jet blast, wind vortices or other wind currents. They also must be constructed of materials that would minimize damage to an aircraft in the event of inadvertent contact and shall be approved by the Airport. The Airport will be responsible for forwarding the Airport's approved plan to the FAA for approval.

The following current edition of Advisory Circulars and standards are applicable:

AC 150/5340-18F – 08/16/2010 Standards for Airport Sign Systems
AC 150/5340-30J – 07/21/2014 Design and Installation Details for Airport Visual Aids
AC 150/5345-44K – 09/29/2010 Specification for Runway and Taxiway Signs
AC 150/5345-50B – 09/20/2007 Specification for Portable Runway and Taxiway Lights
AC 150/5345-53D – 09/26/2012 Airport Lighting Certification Program
AC 150/5345-55A – 06/27/2007 Specification for L-893, Lighted Visual Aid to Indicate Temporary Runway Closure

Placement of construction area lighting for night time construction must be coordinated with the Airport to ensure no adverse impacts to GYR ATAC or pilot visibility.

See **Appendix E: Exhibits** "**A**" through "**F**" for proposed barricades, temporary marking and striping.

2.19 MARKING AND SIGNS FOR ACCESS ROUTES

Pavement markings and signs intended for the use of construction personnel shall confirm AC 150/5340-18, and to the extent practicable, the Manual for Uniform Traffic Control Devises (MUTCD) and the Cities of Phoenix and Goodyear Traffic Barricade Regulations.

2.20 HAZARD MARKING, LIGHTING AND SIGNING

A. Barricade Requirements

Hazard-marking barricades, flashers, etc., shall be spaced such that a breach is physically prevented barring a deliberate act and will be used:

- To identify and define the limits of construction making them visible to aircraft, personnel or vehicles.
- To identify hazards such as open manholes, small areas under repair, stockpiled material, waste areas, etc.
- To identify OFA to construction personnel.
- To prevent aircraft from taxiing onto a closed runway for takeoff; and to identify FAA, airport, and National Weather Service facilities and utilities, instrument landing systems (ILS) critical areas, as well as other sensitive areas to prevent damage, interference, and facility shutdown.
- Lighted "X's" will be used to identify closed runways to approaching aircraft. GYR shall provide and place Lighted X's to designate runway closures. *See* Civil Technical Specification M-003 Airport Safety and Security.

B. Traffic Cones Shall Not Be Used At Any Time on The AOA

Hazardous areas, in which aircraft may not enter, should be indicated by the use of low level barricades marked with diagonal, alternating orange and white reflective stripes. An OFA, adjacent to construction activity, should be delineated using vertical panel barricades to ensure that no construction related activity passes into the OFA without prior coordination. During reduced visibility or night hours, the barricades will be supplemented with flashing red lights. The red flashing warning lights shall meet the luminance requirements of the Arizona Department of Transportation. Interval spacing for barricades and lights required will be determined by GYR Aviation Supervisor and may vary depending on the location of the work. The intensity of the lights and spacing for barricades, flags, and lights will be adequate to delineate the hazardous area without ambiguity. Adequacy of the barricading will be at the sole discretion of GYR Aviation Supervisor. Barricades are not permitted in any active safety area. All barricades must pose the least danger to aircraft and be sturdy enough to withstand typical winds, prop wash and jet blast.

C. Maintenance

The Contractor will have a designated person on-call 24 hours a day for emergency maintenance of airport hazard lighting and barricades.

D. Exhibit of Barricade Materials Depicted

Approved Types of Barricades

- ***Low level water filled*** barricades shall be no higher than 18 inches off the ground, and be used for the following lighting situation:
  - When delineating a closed area or identifying a construction hazard each barricade should be configured with at least one flashing red light. The flashing red lights must meet the luminance requirements of the State Highway Department.
  -
  - Barricades shall be placed such that no more than 5 feet apart.
- ***Vertical Panel*** type barricades with heavy rubber base and one flashing red light will be used to delineate RSA's and TSA's from construction areas.

Note: *Only barricades located outside of the OFA may be supplemented with sandbags for added support.*

See **Appendix E** for the Barricade Location Plan.

E. Lighting and Marking Requirements

Low profile lights, retro-reflective taxiway edge markers, low level barricades with red flashing burning warning lights shall be provided and erected by the Contractor as shown on the plans or as directed by the Airport and Engineer of Record. All construction areas, including closed runways and taxiways, should be clearly and visibly separated from active AOA's. Lighted "X's" shall be provided, placed and removed by GYR Operations personnel.

In addition to barricades, Taxiway closures will also be marked with vinyl yellow X's in accordance with Civil Technical Specification M-003 Airport Safety and Security. Closure X's shall be properly secured using sand bags or other approved method.

Hazard areas, facilities, cables, and power lines should also be clearly identified using approved barricades. The Contractor is responsible for maintaining the condition and visibility of all barricades identifying above-mentioned areas and, for making sure the marking and lighting aids remain in place. Appropriate barriers, lights, signs and marking should be used as necessary, to clearly separate all construction/maintenance areas from other parts of the AOA. All barricades, temporary markers, and other objects in the movement areas must be less than 3 inches above the ground level, of low mass, easily collapsible upon contact with an aircraft or any of its components, weighted down or sturdily attached to the surface to prevent displacement from prop-wash, jet blast, wing vortex, or other surface wind currents and, if affixed to the surface, frangible at ground level.

Contractor is required to have a representative on call 24 hours a day for emergency maintenance of airport hazard lighting and barricades.

See **Appendix E: Exhibits** "**A**" through "**F**" for proposed barricades, temporary marking and striping.

2.21 WORK ZONE LIGHTING FOR NIGHTTIME CONSTRUCTION

Lighting equipment must adequately illuminate the work area if the construction is to be performed during nighttime hours. Refer to AC 150/5370-10 for minimum illumination levels for nighttime paving projects. Additionally, it is recommended that all support equipment, except haul trucks, be equipped with artificial illumination to safely illuminate the area immediately surrounding their work areas. The lights should be positioned to provide the most natural color illumination and contrast with a minimum of shadows. The spacing must be determined by trial. Light towers should be positioned and adjusted to aim away from ATCT cabs and active runways to prevent blinding effects. Shielding may be necessary. Light towers should be removed from the construction site when the area is reopened to aircraft operations. Construction lighting units should be identified and generally located on the construction phasing plans in relationship to the ATCT and active runways and taxiways.

2.22 PROTECTION OF RUNWAY AND TAXIWAY SAFETY AREAS

The Contractor will ensure that no personnel or equipment enters into the active movement area or their associated Safety Areas without the appropriate GYR Operations escort. **Access into movement areas or Safety Areas without a GYR Operations escort is prohibited!**

All access into movement areas must be coordinated and approved by the on duty GYR Aviation Supervisor. All communications with Air Traffic Control Tower (GYR ATCT) will be the responsibility of GYR staff. No access into movement areas will be authorized without a trained and certified Goodyear Airport staff escort.

When operating within runway and taxiway safety areas, clearance must be obtained from the GYR Aviation Supervisor and GYR ATCT and a NOTAM of runway or taxiway closure must be issued prior to entering the area. Failure to receive proper clearance will result in extreme consequences. Once GYR Aviation Supervisor and GYR ATCT clearance has been received, the NOTAM is issued and personnel are escorted into these areas, all instructions from the ATCT and the GYR Airport Operations escort must be strictly obeyed.

No construction may occur within a runway or taxiway safety area while the associated runway or taxiway is open for aircraft operations.

During construction operations near active taxiways or runways, the Contractor will furnish and maintain vertical panel barricades equipped with red warning lights along the edges of the runway safety areas and taxiway safety areas. This is to warn construction equipment to stay clear of the active airfield pavement as well as to warn pilots of areas having construction hazards. Low level barricades equipped with red and blue lights acceptable to GYR Aviation Supervisor are used to delineate a taxiway edge adjacent to construction. The Contractor will maintain low level barricades with red warning lights around all equipment, stockpiles and/or other areas as directed by the Engineer of Record and GYR Aviation Supervisor.

AC 150/5300-13A establishes and defines the standard areas for protection as defined below. Any construction activity in or near these established areas must be closely coordinated with GYR. Any unauthorized or unescorted entry into one of these areas or zones will result in regulatory action by the Airport against the Contractor. For reference, all protected areas are depicted on **Exhibit B** of **Appendix E** of this document. The contractor shall provide GYR Airport

Operations with a notice at least 72 hours in advanced if work shall be conducted within these protected areas.

A. Definitions and Abbreviations

Runway Safety Area (RSA) - The defined surface surrounding the runway over which an aircraft in dry weather is able to cross at normal operating speeds without incurring significant damage. The Runway 3-21 RSA is 500 feet wide centered on the runway centerline and 1000 feet from the runway ends. Work closer than these limits must be performed with the runway closed. Adjustments to the RSA dimension will be coordinated between the airport operator, the local ATCT, and the appropriate FAA Airports District Office with the issuance of a local NOTAM.

Runway Object Free Area (ROFA) – An area on the ground centered on the runway, centerline provided to enhance the safety of aircraft operations by having the area free of objects. The ROFA is 800 feet wide, centered on the runway centerline. Construction, including excavations, may be permitted in the ROFA. However, equipment must be removed from the ROFA when not in use, and material should not be stockpiled in the ROFA if not necessary.

Taxiway Object Free Area (TOFA) – An area on the ground centered on the taxiway centerline provided to enhance the safety of aircraft operations by having the area free of objects. The Taxiway OFA at GYR is 259 feet centered on the centerline at Taxiway Alpha.

- **The taxiway object free area dimensions** may be temporarily adjusted if the taxiway is restricted to aircraft operations requiring a taxiway object free area that is equal to the taxiway object free area width available.
- **Offset taxiway pavement markings** may be used as a temporary measure to provide the required taxiway object free area. Where offset taxiway pavement markings are provided, centerline lighting or reflectors are required.
- **Construction activity may be accomplished** without adjusting the width of the taxiway object free area, subject to the following restrictions:
    (1) Appropriate NOTAMs are issued
    (2) Marking and lighting meeting the provisions of paragraphs 2.19, 2.20 and 2.21 below are implemented.
    (3) Five-foot clearance is maintained between equipment and materials and any part of an aircraft. In this situation, flaggers must be used to direct construction equipment and wing walkers will be necessary to guide aircraft. If a five-foot clearance cannot be maintained, then it will be necessary to move personnel and equipment for the passage of aircraft.
    (4) Work may only take place within the TOFA of an active Taxiway with the prior approval of GYR Operations.

Obstacle Free Zone (OFZ) – The OFZ is the airspace below 150 feet above the established airport elevation along the runway and extended runway centerline that is required to be clear of all objects. The Runway 3-21 OFZ is 400 feet centered on the runway centerline. In general, personnel, material and/or equipment may not penetration the OFZ while the runway is open for aircraft operations. If a penetration to the OFZ is necessary, it may be possible to continue aircraft operations through operational restrictions. The Contractor shall notify the Engineer of Record and GYR Airport Operations so that such restrictions and NOTAMs can be issued.

Runway Approach/Departure Areas and Clearways – All personnel, materials and/or equipment must remain clear of the applicable threshold siting surfaces. Objects that do not penetrate these surfaces may still be obstructions to air navigation and may affect standard instrument approach procedures.

Taxiway Safety Area (TSA) – A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an airplane that unintentionally departs the pavement. The TSA at GYR is 171 feet centered on the taxiway centerline. Adjustments to the TSA dimension will be coordinated between the airport operator, the local ATCT, and the appropriate FAA Airports District Office with the issuance of a local NOTAM. No construction may occur within the TSA while the taxiway is open for aircraft operations.

Threshold Siting Surface (TSS) – The TSS is utilized to locate runway threshold in order to meet approach obstacle clearance requirements. The dimensions of the TSS vary with the type of aircraft operations, the approach visibility minimums and the types of navigations instrumentation. The Runway 3-21 TSS is 800' x 3,800' x 10,000', sloping at a rate of 20:1 from each threshold. No personnel, material, or equipment may penetrate the TSS while the Runway is open for aircraft operations

Personnel, material and/or equipment must not penetrate the OFZ, TSS or runway approach/departure areas and clearways while Runway 3-21 is open for aircraft operations. In the event work must take place within these restricted areas, GYR Airport Operations and ATCT shall coordinate with the FAA district office.

B. Excavations in Runway and Taxiway Safety Areas

This project will require trenching for the installation of new and relocation of existing electrical fixtures.

The City of Phoenix requires that all trenching or excavation within the AOA require prior coordination with Airport Operations. Open trenching and excavation may be permitted outside the Runway Safety Area (RSA) of the active runway and outside the Taxiway Safety Area (TSA) of an open taxiway. These open trenches outside of the RSA and TSA are only allowed with proper coordination and approval from Airport Operations. Adequate signs, lights, and markings must be visible in order to properly identify the open trench construction areas. Adequate marking of open trenches and excavations includes, but is not limited to, red or orange flags and red lights during hours of restricted visibility or darkness, as approved by GYR Airport Operations. Trenching and excavation activity inside the RSA (250 feet of the runway centerline) or inside the TSA (85.5 feet from a taxiway centerline) requires the affected runway or taxiway to be closed.

In the event a trench or excavation in the RSA or TSA cannot be backfilled prior to re-opening the runway or taxiway for aircraft operations, an appropriate cover must be placed over the trench or excavation. The covering for open trenches or excavations shall be of sufficient strength to support the weight of the heaviest aircraft operating on the runway, Boeing 767. Trenches or excavations less than 3 inches in depth are permitted in the RSA.

Graphics showing areas of all planned excavation must be communicated in **Appendix D** of the contractor's SPCD. The Contractor is also responsible for developing a Barricade Location Plan.

All open trenches & excavations shall be predominately marked whether or not they are located within a protective surface/area on the airfield.

C. Erosion Control

Throughout the course of construction, soil erosion must be controlled to maintain RSA and TSA standards ensure the areas are clear and graded with no potentially hazardous ruts, humps, depressions or other surface variations and are capable, under dry conditions, of supporting aircraft rescue and firefighting equipment, and the occasional passage of aircraft without causing structural damage to the aircraft. Details regarding grading and soil erosion control can be found in the project's Storm Water Pollution Prevention Plan (SWPPP).

2.23 OTHER LIMITATIONS ON CONSTRUCTION

Constant diligence must be maintained to ensure that personnel and equipment are protected from the hazards of jet blast from aircraft operations. Jet Blast hazard areas will be communicated to all construction personnel.

A. Prohibitions

1) No Use of Tall Equipment

The maximum height of equipment not on normal haul roads is 20 feet. Any crane erections will be coordinated with the GYR Aviation Supervisor during every shift. All cranes must have at their highest point either a red light for night operations, or a 3' x 3' orange and white checkerboard flag for daylight only operations. Cranes will be boomed down when not in use. A 72-hour notice must be provided to the Airport to allow appropriate NOTAM issuance. Construction equipment shall not penetrate the Approach/Departure Surfaces of an active Runway. If the Contractor expects to use construction equipment with a height greater than 20 feet, he shall provide notification as soon as possible so that the proper clearances can be obtained. The Contractor shall not as a result of their activities affect the approach and departure surfaces with their equipment or operations.

FAR Part 77, "Objects Affecting Navigable Airspace," Current Edition: establishes the standards for determining obstructions to navigable airspace. Civil airport imaginary surfaces are defined in the publication. It also sets forth requirements for notice of certain proposed construction or alteration. Notice of construction provides a basis for recommendations for identifying the construction or alteration in accordance with Advisory Circular (AC) 70/7460-1, "Obstruction Marking and Lighting," Current Edition. Any vehicles exceeding Part 77 surfaces and/or operating on movement areas must be appropriately marked and lighted in accordance with the latest approved version of AC 150/5210-5, "Painting, Marking and Lighting of Vehicles Used on an Airport." All high profile equipment such as cranes must be lowered when not in use.

2) No Use of Flame Welding or Torches

The use of open flame welding or torches is prohibited unless adequate fire safety precautions are provided and the GYR Airport Operations approves their used.

3) No Use of Electrical Blasting Caps or Flare Pots

The use of flare pots within the AOA is strictly prohibited along with the used of electrical blasting caps on or within 1,000 feet of the airport property. Should the

Contractor's construction operations require blasting, procedures for ensuring adequate distance for protection shall be included in the SPCD.

B. Restrictions

See section 2.6 for proposed Runway and Taxiway closures during construction.

Appendix A

FAA AC No.: 150/5370-2G Operational Safety on Airports During Construction

Safety and Phasing Plan Checklist

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APPENDIX C. SAFETY AND PHASING PLAN CHECKLIST

This appendix is keyed to Chapter 2. In the electronic version of this AC, clicking on the paragraph designation in the Reference column will access the applicable paragraph. There may be instances where the CSPP requires provisions that are not covered by the list in this appendix.

This checklist is intended as an aid, not a required submittal.

Table C-1. CSPP Checklist

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
General Considerations					
Requirements for predesign, prebid, and preconstruction conferences to introduce the subject of airport operational safety during construction are specified.	2.5	Yes			CSPP 2.5
Operational safety is a standing agenda item for construction progress meetings.	2.5	Yes			CSPP 2.5D
Scheduling of the construction phases is properly addressed.	2.6	Yes			CSPP 2.6 A-E
Any formal agreements are established.	2.5.3			NA	
Areas and Operations Affected by Construction Activity					
Drawings showing affected areas are included.	2.7.1	Yes			Appendix E
Closed or partially closed runways, taxiways, and aprons are depicted on drawings.	2.7.1.1	Yes			Appendix E
Access routes used by ARFF vehicles affected by the project are addressed.	2.7.1.2		No		No AARF at GYR
Access routes used by airport and airline support vehicles affected by the project are addressed.	2.7.1.3	Yes			CSPP 2.7A.2 2.7A.3
Underground utilities, including water supplies for firefighting and drainage.	2.7.1.4	Yes			CSPP 2.7A.4

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Approach/departure surfaces affected by heights of temporary objects are addressed.	2.7.1.5	Yes			CSPP 2.7A.5
Construction areas, storage areas, and access routes near runways, taxiways, aprons, or helipads are properly depicted on drawings.	2.7.1	Yes			Appendix E
Temporary changes to taxi operations are addressed.	2.7.2.1	Yes			CSPP 2.7B
Detours for ARFF and other airport vehicles are identified.	2.7.2.2	Yes			CSPP 2.13
Maintenance of essential utilities and underground infrastructure is addressed.	2.7.2.3	Yes			CSPP 2.7A.4 2.15
Temporary changes to air traffic control procedures are addressed.	2.7.2.4	Yes			CSPP 2.7B
NAVAIDs					
Critical areas for NAVAIDs are depicted on drawings.	2.8	Yes			Appendix E
Effects of construction activity on the performance of NAVAIDS, including unanticipated power outages, are addressed.	2.8	Yes			CSPP 2.8
Protection of NAVAID facilities is addressed.	2.8	Yes			CSPP 2.8
The required distance and direction from each NAVAID to any construction activity is depicted on drawings.	2.8	Yes			Appendix E
Procedures for coordination with FAA ATO/Technical Operations, including identification of points of contact, are included.	2.8, 2.13.1, 2.13.5.3.1, 2.18.1	Yes			CSPP 2.13 and 2.2
Contractor Access					
The CSPP addresses areas to which contractor will have access and how	2.9	Yes			CSPP 2.9B.3

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
the areas will be accessed.					
The application of 49 CFR Part 1542 Airport Security, where appropriate, is addressed.	2.9	Yes			CSPP 2.9B.9
The location of stockpiled construction materials is depicted on drawings.	2.9.1	Yes			Appendix E
The requirement for stockpiles in the ROFA to be approved by FAA is included.	2.9.1	Yes			Stockpiles not permitted in ROFA
Requirements for proper stockpiling of materials are included.	2.9.1	Yes			CSPP 2.9A
Construction site parking is addressed.	2.9.2.1	Yes			CSPP 2.9B.1
Construction equipment parking is addressed.	2.9.2.2	Yes			CSPP 2.9B.1
Access and haul roads are addressed.	2.9.2.3	Yes			CSPP 2.9B.3
A requirement for marking and lighting of vehicles to comply with AC 150/5210-5, *Painting, Marking and Lighting of Vehicles Used on an Airport,* is included.	2.9.2.4	Yes			CSPP 2.9B.6
Proper vehicle operations, including requirements for escorts, are described.	2.9.2.5, 2.9.2.6	Yes			CSPP 2.9B.7
Training requirements for vehicle drivers are addressed.	2.9.2.7	Yes			CSPP 2.9B.5
Two-way radio communications procedures are described.	2.9.2.9	Yes			CSPP 2.9B.8
Maintenance of the secured area of the airport is addressed.	2.9.2.10	Yes			CSPP 2.9B.3
Wildlife Management					
The airport operator's wildlife management procedures are addressed.	2.10	Yes			CSPP 2.10

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Foreign Object Debris Management					
The airport operator's FOD management procedures are addressed.	2.11	Yes			CSPP 2.11
Hazardous Materials Management					
The airport operator's hazardous materials management procedures are addressed.	2.12	Yes			CSPP 2.12
Notification of Construction Activities					
Procedures for the immediate notification of airport user and local FAA of any conditions adversely affecting the operational safety of the airport are detailed.	2.13	Yes			CSPP 2.13
Maintenance of a list by the airport operator of the responsible representatives/points of contact for all involved parties and procedures for contacting them 24 hours a day, seven days a week is specified.	2.13.1	Yes			CSPP 2.13D
A list of local ATO/Technical Operations personnel is included.	2.13.1			NA	
A list of ATCT managers on duty is included.	2.13.1	Yes			CSPP 2.13D
A list of authorized representatives to the OCC is included.	2.13.2			NA	
Procedures for coordinating, issuing, maintaining and cancelling by the airport operator of NOTAMS about airport conditions resulting from construction are included.	2.8, 2.13.2, 2.18.3.3.9	Yes			CSPP 2.13A
Provision of information on closed or hazardous conditions on airport movement areas by the airport operator to the OCC is specified.	2.13.2			NA	
Emergency notification procedures for medical, fire fighting, and police	2.13.3	Yes			CSPP 2.13D

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
response are addressed.					
Coordination with ARFF personnel for non-emergency issues is addressed.	2.13.4			NA	NO ARFF at GYR
Notification to the FAA under 14 CFR parts 77 and 157 is addressed.	2.13.5			NA	No FAA owned NAVAIDS
Reimbursable agreements for flight checks and/or design and construction for FAA owned NAVAIDs are addressed.	2.13.5.3.2			NA	
Inspection Requirements					
Daily and interim inspections by both the airport operator and contractor are specified.	2.14.1, 2.14.2	Yes			CSPP 2.14
Final inspections at certificated airports are specified when required.	2.14.3			NA	
Underground Utilities					
Procedures for protecting existing underground facilities in excavation areas are described.	2.15	Yes			CSPP 2.15
Penalties					
Penalty provisions for noncompliance with airport rules and regulations and the safety plans are detailed.	2.16	Yes			CSPP 2.16
Special Conditions					
Any special conditions that affect the operation of the airport or require the activation of any special procedures are addressed.	2.17	Yes			CSPP 2.17
Runway and Taxiway Visual Aids - Marking, Lighting, Signs, and Visual NAVAIDs					
The proper securing of temporary airport markings, lighting, signs, and visual NAVAIDs is addressed.	2.18.1	Yes			CSPP 2.18, 2.19 2.20
Frangibility of airport markings, lighting, signs, and visual NAVAIDs is specified.	2.18.1, 2.18.3, 2.18.4.2, 2.20.2.4	Yes			CSPP 2.18, 2.19 2.20

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
The requirement for markings to be in compliance with AC 150/5340-1, *Standards for Airport Markings*, is specified.	2.18.2	Yes			CSPP 2.18F
Detailed specifications for materials and methods for temporary markings are provided.	2.18.2	Yes			CSPP 2.18F
The requirement for lighting to conform to AC 150/5340-30, *Design and Installation Details for Airport Visual Aids;* AC 150/5345-50, *Specification for Portable Runway and Taxiway Lights;* and AC 150/5345-53, *Airport Lighting Certification Program*, is specified.	2.18.3	Yes			CSPP 2.18F
The use of a lighted X is specified where appropriate.	2.18.2.1.2, 2.18.3.2	Yes			CSPP 2.20A
The requirement for signs to conform to AC 150/5345-44, *Specification for Runway and Taxiway Signs;* AC 50/5340-18, *Standards for Airport Sign Systems;* and AC 150/5345-53, *Airport Lighting Certification Program*, is specified.	2.18.4	Yes			CSPP 2.18F
Marking and Signs For Access Routes					
The CSPP specifies that pavement markings and signs intended for construction personnel should conform to AC 150/5340-18 and, to the extent practicable, with the MUTCD and/or State highway specifications.	2.18.4.2	Yes			CSPP 2.19
Hazard Marking and Lighting					
Prominent, comprehensible warning indicators for any area affected by construction that is normally accessible to aircraft, personnel, or vehicles are specified.	2.20.1	Yes			CSPP 2.20

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Hazard marking and lighting are specified to identify open manholes, small areas under repair, stockpiled material, and waste areas.	2.20.1	Yes			CSPP 2.20A
The CSPP considers less obvious construction-related hazards.	2.20.1	Yes			CSPP 2.20
Equipment that poses the least danger to aircraft but is sturdy enough to remain in place when subjected to typical winds, prop wash and jet blast is specified.	2.20.2.1		No		Equipment will not be allowed in active ROFA /TOFA areas
The spacing of barricades is specified such that a breach is physically prevented barring a deliberate act.	2.20.2.1	Yes			CSPP 2.20D Appendix E
Red lights meeting the luminance requirements of the State Highway Department are specified.	2.20.2.2	Yes			CSPP 2.20D
Barricades, temporary markers, and other objects placed and left in areas adjacent to any open runway, taxiway, taxi lane, or apron are specified to be as low as possible to the ground, and no more than 18 inch high.	2.20.2.3	Yes			CSPP 2.20D
Barricades are specified to indicate construction locations in which no part of an aircraft may enter.	2.20.2.3	Yes			CSPP 2.20A
Highly reflective barriers with lights are specified to barricade taxiways leading to closed runways.	2.20.2.5			NA	
Markings for temporary closures are specified.	2.20.2.5	Yes			CSPP 2.20E Appendix E
The provision of a contractor's representative on call 24 hours a day for emergency maintenance of airport hazard lighting and barricades is specified.	2.20.2.7	Yes			CSPP 2.20E

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Work Zone Lighting for Nighttime Construction					
If work is to be conducted at night, the CSPP identifies construction lighting units and their general locations and aiming in relationship to the ATCT and active runways and taxiways.	2.21	Yes			CSPP 2.21
Protection of Runway and Taxiway Safety Areas					
The CSPP clearly states that no construction may occur within a safety area while the associated runway or taxiway is open for aircraft operations.	2.22.1.1, 2.22.3.1	Yes			CSPP 2.22
The CSPP specifies that the airport operator coordinates the adjustment of RSA or TSA dimensions with the ATCT and the appropriate FAA Airports Regional or District Office and issues a local NOTAM.	2.22.1.2, 2.22.3.2	Yes			CSPP 2.22A
Procedures for ensuring adequate distance for protection from blasting operations, if required by operational considerations, are detailed.	2.22.3.3			NA	This project does not require blasting
The CSPP specifies that open trenches or excavations are not permitted within a safety area while the associated runway or taxiway is open, subject to approved exceptions.	2.22.1.4	Yes			CSPP 2.22B
Appropriate covering of excavations in the RSA or TSA that cannot be backfilled before the associated runway or taxiway is open is detailed.	2.22.1.4	Yes			CSPP 2.22B
The CSPP includes provisions for prominent marking of open trenches and excavations at the construction site.	2.22.1.4	Yes			CSPP 2.22A
Grading and soil erosion control to maintain RSA/TSA standards are	2.22.3.5	Yes			CSPP 2.22C

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
addressed.					
The CSPP specifies that equipment is to be removed from the ROFA when not in use.	2.22.2	Yes			CSPP 2.9B.2
The CSPP clearly states that no construction may occur within a taxiway safety area while the taxiway is open for aircraft operations.	2.22.3	Yes			CSPP 2.22A
Appropriate details are specified for any construction work to be accomplished in a taxiway object free area.	2.22.4	Yes			CSPP 2.22A
Measures to ensure that personnel, material, and/or equipment do not penetrate the OFZ or threshold siting surfaces while the runway is open for aircraft operations are included.	2.22.4.3.6	Yes			CSPP 2.22A
Provisions for protection of runway approach/departure areas and clearways are included.	2.22.6	Yes			CSPP 2.22A
Other Limitations on Construction					
The CSPP prohibits the use of open flame welding or torches unless adequate fire safety precautions are provided and the airport operator has approved their use.	2.23.1.2	Yes			CSPP 2.23A
The CSPP prohibits the use of electrical blasting caps on or within 1,000 ft (300 m) of the airport property.	2.23.1.3	Yes			CSPP 2.23A

APPENDIX D. CONSTRUCTION PROJECT DAILY SAFETY INSPECTION CHECKLIST

The situations identified below are potentially hazardous conditions that may occur during airport construction projects. Safety area encroachments, unauthorized and improper ground vehicle operations, and unmarked or uncovered holes and trenches near aircraft operating surfaces pose the most prevalent threats to airport operational safety during airport construction projects. The list below is one tool that the airport operator or contractor may use to aid in identifying and correcting potentially hazardous conditions. It should be customized as appropriate for each project including information such as the date, time and name of the person conducting the inspection.

Table D-1. Potentially Hazardous Conditions

Item	Action Required (Describe)	No Action Required (Check)
Excavation adjacent to runways, taxiways, and aprons improperly backfilled.		
Mounds of earth, construction materials, temporary structures, and other obstacles near any open runway, taxiway, or taxi lane; in the related Object Free area and aircraft approach or departure areas/zones; or obstructing any sign or marking.		
Runway resurfacing projects resulting in lips exceeding 3 inch (7.6 cm) from pavement edges and ends.		
Heavy equipment (stationary or mobile) operating or idle near AOA, in runway approaches and departures areas, or in OFZ.		
Equipment or material near NAVAIDs that may degrade or impair radiated signals and/or the monitoring of navigation and visual aids. Unauthorized or improper vehicle operations in localizer or glide slope critical areas, resulting in electronic interference and/or facility shutdown.		
Tall and especially relatively low visibility units (that is, equipment with slim profiles) — cranes, drills, and similar objects — located in critical areas, such as OFZ and		

Item	Action Required (Describe)	No Action Required (Check)
approach zones.		
Improperly positioned or malfunctioning lights or unlighted airport hazards, such as holes or excavations, on any apron, open taxiway, or open taxi lane or in a related safety, approach, or departure area.		
Obstacles, loose pavement, trash, and other debris on or near AOA. Construction debris (gravel, sand, mud, paving materials) on airport pavements may result in aircraft propeller, turbine engine, or tire damage. Also, loose materials may blow about, potentially causing personal injury or equipment damage.		
Inappropriate or poorly maintained fencing during construction intended to deter human and animal intrusions into the AOA. Fencing and other markings that are inadequate to separate construction areas from open AOA create aviation hazards.		
Improper or inadequate marking or lighting of runways (especially thresholds that have been displaced or runways that have been closed) and taxiways that could cause pilot confusion and provide a potential for a runway incursion. Inadequate or improper methods of marking, barricading, and lighting of temporarily closed portions of AOA create aviation hazards.		
Wildlife attractants — such as trash (food scraps not collected from construction personnel activity), grass seeds, tall grass, or standing water — on or near airports.		
Obliterated or faded temporary markings on active operational areas.		
Misleading or malfunctioning obstruction lights. Unlighted or unmarked obstructions in the approach to any open runway pose aviation hazards.		

Item	Action Required (Describe)	No Action Required (Check)
Failure to issue, update, or cancel NOTAMs about airport or runway closures or other construction related airport conditions.		
Failure to mark and identify utilities or power cables. Damage to utilities and power cables during construction activity can result in the loss of runway / taxiway lighting; loss of navigation, visual, or approach aids; disruption of weather reporting services; and/or loss of communications.		
Restrictions on ARFF access from fire stations to the runway / taxiway system or airport buildings.		
Lack of radio communications with construction vehicles in airport movement areas.		
Objects, regardless of whether they are marked or flagged, or activities anywhere on or near an airport that could be distracting, confusing, or alarming to pilots during aircraft operations.		
Water, snow, dirt, debris, or other contaminants that temporarily obscure or derogate the visibility of runway/taxiway marking, lighting, and pavement edges. Any condition or factor that obscures or diminishes the visibility of areas under construction.		
Spillage from vehicles (gasoline, diesel fuel, oil) on active pavement areas, such as runways, taxiways, aprons, and airport roadways.		
Failure to maintain drainage system integrity during construction (for example, no temporary drainage provided when working on a drainage system).		

Item	Action Required (Describe)	No Action Required (Check)
Failure to provide for proper electrical lockout and tagging procedures. At larger airports with multiple maintenance shifts/workers, construction contractors should make provisions for coordinating work on circuits.		
Failure to control dust. Consider limiting the amount of area from which the contractor is allowed to strip turf.		
Exposed wiring that creates an electrocution or fire ignition hazard. Identify and secure wiring, and place it in conduit or bury it.		
Site burning, which can cause possible obscuration.		
Construction work taking place outside of designated work areas and out of phase.		

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Appendix B

FAA AC 150/5370-2G, *Operational Safety on Airports during Construction*

The FAA Advisory Circular is part of the Construction Safety and Phasing Plan and shall be downloaded by plan users from the following FAA website:

https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.information/documentNumber/150_5370-2G

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Appendix C

Notice of Proposed Construction or Alteration, FAA Form 7460-1

Strategic Event Coordination (SEC) Form

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Please Type or Print on This Form

Form Approved OMB No.2120-0001
Expiration Date: 8/31/2014

U.S. Department of Transportation
Federal Aviation Administration

Failure To Provide All Requested Information May Delay Processing of Your Notice

Notice of Proposed Construction or Alteration

FOR FAA USE ONLY

Aeronautical Study Number

1. Sponsor *(person, company, etc. proposing this action):*

Attn. of:

Name:

Address:

City: State: Zip:

Telephone: Fax:

2. Sponsor's Representative *(if other than #1):*

Attn. of:

Name:

Address:

City: State: Zip:

Telephone: Fax:

3. Notice of: ☑ New Construction ☐ Alteration ☐ Existing

4. Duration: ☐ Permanent ☑ Temporary (5 months, ____days)

5. Work Schedule: Beginning 10/2018 End 02/2019

6. Type: ☐ Antenna Tower ☐ Crane ☐ Building ☐ Power Line ☐ Landfill ☐ Water Tank ☑ Other Construction Equipment

7. Marking/Painting and/or Lighting Preferred:

☐ Red Lights and Paint ☐ Dual - Red and Medium Intensity
☐ White-Medium Intensity ☐ Dual - Red and high Intensity
☐ White -High Intensity ☑ Other

8. FCC Antenna Structure Registration Number *(if applicable)*:

N/A

9. Latitude: 32 0 25 , 20 , 40 "

10. Longitude: 112 0 22 , 24 , 82

11. Datum: ☑ NAD 83 ☐ NAD 27 ☐ Other

12. Nearest: City: Goodyear State AZ

13. Nearest *Public-use* *(not private-use)* or Military Airport or Heliport:

Phoenix Goodyear Airport (GYR)

14. Distance from #13. to Structure: N/A - Equipment will be on the Airport

15. Direction from #13. to Structure: Equipment will be on the Airport

16. Site Elevation *(AMSL)*: 968 ft.

17. Total Structure Height *(AGL)*: 15 ft.

18. Overall Height (#16 + #17) *(AMSL)*: 983 ft.

19. Previous FAA Aeronautical Study Number *(if applicable)*:

N/A -OE

20. Description of Location: *(Attach a USGS 7.5 minute Quadrangle Map with the precise site marked and any certified survey)*

Project work will take place along Taxiway A between Connector Taxiways A9 and A1. No work will take place on the physical Runway 3/21 except for work at the intersection of Connector Taxiway A3.

21. Complete Description of Proposal:

This Phoenix Goodyear Airport (GYR) project includes the strengthening and rehabilitation of approximately 60,000 square yards of asphalt concrete on Taxiway A. In addition to strengthening the taxiway, 30' paved shoulders will be constructed along both sides of Taxiway A bringing it up to ADG IV design standards. Taxiway A is 75 feet wide with gravel shoulders. This project will also remove direct access to Runway 3/21 from the terminal ramp area by relocating a portion of Connector Taxiway A3 (Ramp 3) and by remarking, resigning and relighting a portion of Connector Taxiway A2 (Ramp 2) creating offsets in the connector taxiway alignments. Additionally new fillets will be constructed at Connector Taxiway A3 to meet Taxiway Design Group (TDG) 5 standards, and 30-foot asphalt paved shoulders will be constructed. Safety will be improved at the airport by installing enhanced taxiway centerline markings and surface painted hold position markings at the connector taxiways.

Frequency/Power (kW)	

Notice is required by 14 Code of Federal Regulations, part 77 pursuant to 49 U.S.C., Section 44718. Persons who knowingly and willingly violate the notice requirements of part 77 are subject to a civil penalty of $1,000 per day until the notice is received, pursuant to 49 U.S.C., Section 46301(a)

I hereby certify that all of the above statements made by me are true, complete, and correct to the best of my knowledge. In addition, I agree to mark and/or light the structure in accordance with established marking & lighting standards as necessary.

Date	Typed or Printed Name and Title of Person Filing Notice	Signature

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National NAS Strategic Interruptions Service Level Agreement

WESTERN SERVICE AREA
AIRPORT SPONSOR STRATEGIC EVENT SUBMISSION FORM

Submit this form preferably 45 days prior to the event to the Federal Aviation Administration, Air Traffic Organization, Planning and Requirements Group, Western Service Area

Please email the completed form to 9-AJV-SEC-WSA@faa.gov

AIRPORT NAME _____ **LOCATION ID** _____

CITY, STATE _____

Referenced **NRA NUMBER** _____

PROJECT SCOPE (Example: Reconstruct Runway 18/36)

_____

PROJECT PHASE (Example: Phase 1 of 3) _____

EVENT (Example: Runway 18/36 closure) _____

DURATION Start Date: _____ End Date: _____

Hours 24 hrs a day ☐ - or - from: _____ to: _____ daily

Other Hours of Operation Specify: _____

FACILITIES IMPACTED

Are any facilities impacted? Yes ☐ No ☐ If yes, list impacted facilities below along with the duration of the impacts if different than duration of the event (these facilities may be found on the NRA determination letter).

Facility (e.g., RWY 18 localizer): _____ Start Date: _____ End Date: _____ Hours: Start/End Time _____	Facility: _____ Start Date: _____ End Date: _____ Hours: Start/End Time _____
Facility: _____ Start Date: _____ End Date: _____ Hours: Start/End Time _____	Facility: _____ Start Date: _____ End Date: _____ Hours: Start/End Time _____
Facility: _____ Start Date: _____ End Date: _____ Hours: Start/End Time _____	Facility: _____ Start Date: _____ End Date: _____ Hours: Start/End Time _____

Submitted by Sponsor Representative

Print Name _____
Title _____
Signature _____ Date _____

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Appendix D

Airport Subsurface Investigation, Excavation, Saw Cutting, Pot Holing, Drilling Construction Activity Notification Permit

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PHX DVT GYR

CITY OF PHOENIX AVIATION DEPARTMENT

AIRPORT SUBSURFACE INVESTIGATION, EXCAVATION, SAW CUTTING, POT HOLING, DRILLING CONSTRUCTION ACTIVITY NOTIFICATION PERMIT

(Minimum 72 Hour Notice Required*)

[This form is valid up to a maximum of a 30 day duration – if duration exceeds 30 days, a second form is to be processed.]

TO: _____ DATE:
(Aviation Department Project Manager, Special Projects Administrator, Program Manager or Designated Proxy)

FROM: CIP No.:
TI No.:

PROJECT NAME: JOA No.:

TYPE: (Subsurface Investigation, Excavation, Saw Cutting, Pot Holing or Drilling Construction Activity)

AREA(S) AFFECTED: (Terminals, Parking, RCC, Roads, Sidewalks, Tunnels, Taxiway, Runway, Roof, Walls)

DATE(S), TIME(S) AND DURATION OF ACTIVITY:

AIRPORT DIVISION(S), STAKEHOLDER(S), TENANT(S) AFFECTED: **(Facilities and Services, Airlines, Restaurant or Retail)**

REASON FOR CONSTRUCTION ACTIVITY:

CONTRACTOR REPRESENTATIVE:

Phone: ( ) After Hours Phone: ( )

DCS INSPECTOR:

Phone: ( ) After Hours Phone: ( )

PROJECT MANAGER:

Phone: ( ) After Hours Phone: ( )

PROJECT MANAGER APPROVAL:
(Aviation Department Project Manager, Special Projects Administrator, Program Manager or Designated Proxy)
Date:
Time:

THE PSM2 POD IS RESPONSIBLE FOR DISTRIBUTION TO THE FOLLOWING PARTIES: Facilities and Services, Operations, Technology, Communications Center, Fire Department, Risk Management, Business and Properties, Tenants, Adjacent Construction Projects, FAA.
DISTRIBUTED BY: DATE: TIME:

***NOTE: Project Manager's approval must be received prior to start of any Construction Activity. The 72-Hour clock begins at the time of submission for approval. If this form is submitted by noon on Friday, weekend time counts as 24 hours, i.e., outage may occur at noon on the following Tuesday. If this form is submitted after noon on Friday, the weekend will not be counted towards the 72 hours.**

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PHX DVT GYR

CITY OF PHOENIX AVIATION DEPARTMENT

AIRPORT SUBSURFACE INVESTIGATION, EXCAVATION, SAW CUTTING, POT HOLING, DRILLING CONSTRUCTION ACTIVITY PERMIT FIELD CHECKLIST

Project Name: _____ **Airport:** PHX ☐ GYR ☐ DVT ☐ **Project Type:** Capital ☐ JOA ☐ TI ☐

Date: _____

Time: _____

Prime Contractor Representative present?	(Name): _____	Y ☐	N ☐
Aviation Project Manager present?	(Name): _____	Y ☐	N ☐
Aviation Inspector present?	(Name): _____	Y ☐	N ☐

Verify the work location is per design documents.	Y ☐	N ☐
Verify "Blue-Stake" or GPR been performed.	Y ☐	N ☐
Verify the PSM² email Notice was sent for this work.	Y ☐	N ☐
Verify Equipment is as specified in the Permit Work Plan.	Y ☐	N ☐
Verify Emergency Procedure is in place.	Y ☐	N ☐
If applicable, has the Airside Operations Supervisor been notified?	Y ☐	N ☐
If applicable, has the Landside Operations Supervisor been notified?	Y ☐	N ☐
If applicable, has the Terminal Operations Supervisor been notified?	Y ☐	N ☐
If applicable, has the Ground Transportation Operations Supervisor been notified?	Y ☐	N ☐
If applicable, has the Parking Operations Supervisor been notified?	Y ☐	N ☐
Has required FAA coordination taken place on Construction Activities?	Y ☐	N ☐

Comments/Notes:

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Appendix E

Construction Safety (Barricading) and Phasing Plan Drawings

List of Exhibits:

Exhibit A – Low Level Barricades, Lighted X and Temporary Taxiway Surface Marking
Exhibit B – Overall Phasing Plan
Exhibit C – Phase 1
Exhibit D – Phase 2
Exhibit E – Phase 3
Exhibit F – Phase 4

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LOW LEVEL BARRICADE EXAMPLES

BARRICADE DIMENSIONS: 10"H x 96"L x 10"W

CLOSED AREA *
LOW LEVEL BARRICADES
(TWO FLASHING RED LIGHTS)

BARRICADE DIMENSIONS: 10"H x 96"L x 10"W

CONSTRUCTION STAGING *
LOW LEVEL BARRICADES
(ONE FLASHING RED LIGHT)

*Barricades shall be spaced at a minimum 5' apart.
Contractor to provide & maintain barricades
throughout project

RUNWAY LIGHTED X EXAMPLES

DAYTIME LIGHTED X

NIGHTTIME LIGHTED X

PATTERN	SYMBOL TYPE / DIMENSION	A	B	C	D	E	F	G
A	CLOSED RUNWAY	10' [3M]*	25' [7.5M]	60' [18M]	-	-	-	-
B	CLOSED RUNWAY (ALTERNATE)	-	-	-	48' [14.4M]	120' [36M]	6' [1.8M]	129.25' [39M]
C	CLOSED TAXIWAY	5' [1.5M]**	12.5' [3.8M]	30' [9M]	-	-	-	-
D	CLOSED TAXIWAY (ALTERNATE)	-	-	-	24' [7.2M]	60' [18M]	3' [.09M]	64.6' [20M]

* FOR TEMPORARY SYMBOL THIS DIMENSION MAY BE CHANGED TO 8' [2.4M]

** FOR TEMPORARY SYMBOL THIS DIMENSION MAY BE CHANGED TO 4' [1.2M]

ALL DIMENSIONS ARE IN FEET AND METERS (M)

NOTE: BOTH SYMBOLS ARE ALWAYS PAINTED YELLOW.

GENERAL NOTES

1. CLOSURES, VEHICLE MARKING, COMMUNICATIONS AND OTHER SAFETY REQUIREMENTS SHALL BE IN CONFORMANCE WITH THE CONTRACTOR'S SAFETY PLAN COMPLIANCE DOCUMENT, WHICH IS SPECIFIED IN THE CONTRACT. THE SAFETY PLAN COMPLIANCE DOCUMENT SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW PRIOR TO NOTICE-TO-PROCEED BEING ISSUED. THE SAFETY PLAN COMPLIANCE DOCUMENT WILL BE DISCUSSED AT THE PRE-CONSTRUCTION CONFERENCE. THE SAFETY PLAN COMPLIANCE DOCUMENT AND/OR THE WORK PHASING SHOWN HEREON MAY BE MODIFIED AT ANY TIME BY THE AIRPORT MANAGER, OR THE GYR AVIATION SUPERVISOR.

2. THE AIRPORT CONTACT FOR THIS PROJECT IS THE AIRPORT MANAGER, BRADLEY HAGAN, (602) 683-3630. ALL NOTAMS REQUIRED DURING CONSTRUCTION SHALL BE FILED BY THE GYR AVIATION SUPERVISOR OR HIS AUTHORIZED AGENT.

3. THE ENGINEER FOR THIS PROJECT IS MORRISON-MAIERLE, INC. THE PROJECT MANAGER FOR MORRISON-MAIERLE, INC. IS CARMEN PARKS, 480-319-5744.

4. THE CONTRACTOR SHALL NOTIFY THE GYR AVIATION SUPERVISOR AND THE ENGINEER A MINIMUM OF 72 HOURS BEFORE COMMENCING ANY CONSTRUCTION THAT WILL HAVE DIRECT OR INDIRECT IMPACT TO AIRCRAFT OPERATIONS OR INVOLVE MOVEMENT OF MEN AND EQUIPMENT IN AIR OPERATIONS AREAS (AOA). AT NO TIME SHALL THE CONTRACTOR PENETRATE THE RUNWAY OBSTACLE FREE ZONE (ROFZ), RUNWAY OBJECT FREE AREA (ROFA), RUNWAY SAFETY AREA (RSA), TAXIWAY OBJECT FREE AREA (TOFA) OR THE TAXIWAY SAFETY AREA (TSA) WITHOUT PRIOR APPROVAL FROM THE ENGINEER OR GYR AVIATION SUPERVISOR. THIS PROJECT WILL REQUIRE PARTIAL AND/OR COMPLETE RUNWAY CLOSURES. REFER TO SHEET G-102 FOR CONSTRUCTION INFORMATION, INCLUDING HAUL ROADS, STAGING AREA, AND LOCATIONS FOR PLACEMENT OF MILLINGS.

5. EQUIPMENT MAINTENANCE, FUEL STORAGE AND OTHER ACTIVITIES OF THE CONTRACTOR CONDUCTED ON AIRPORT PROPERTY WHICH MAY DIRECTLY OR INDIRECTLY IMPACT AIR OPERATIONS OR SAFETY SHALL BE SUBJECT TO REVIEW BY THE AIRPORT MANAGER OR THE AVIATION SUPERVISOR. THE AIRPORT MANAGER AND THE AVIATION SUPERVISOR SHALL HAVE THE AUTHORITY TO REQUIRE THE CONTRACTOR TO TAKE REASONABLE PRECAUTIONS TO PROTECT THE INTERESTS OF THE TOWN OF GOODYEAR, THE CITY OF PHOENIX AND THE USERS OF PHOENIX-GOODYEAR AIRPORT.

6. TEMPORARILY STOCKPILED MATERIALS AND CONSTRUCTION EQUIPMENT SHALL BE PROMINENTLY MARKED AND LIGHTED DURING HOURS OF RESTRICTED VISIBILITY OR DARKNESS. STOCKPILES SHALL BE REMOVED ON A DAILY BASIS, OR PRIOR TO OPENING THE RUNWAY FOR NORMAL AIRCRAFT OPERATIONS.

7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR IDENTIFYING ONSITE UTILITIES AND OWNERSHIP OF UTILITIES PRIOR TO COMMENCING CONSTRUCTION. THE CONTRACTOR IS RESPONSIBLE FOR DETAILED UTILITY LOCATIONS IN ALL WORK AREAS.

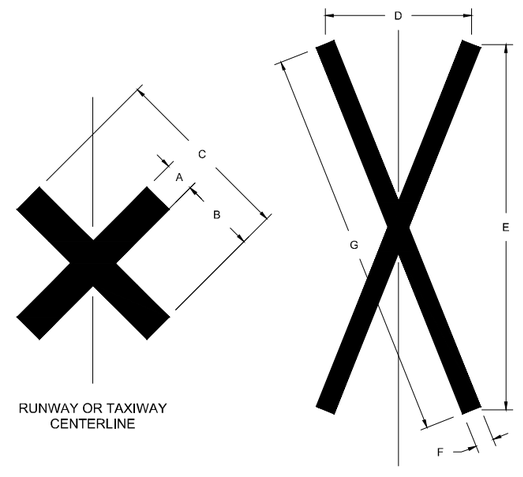
8. CONTRACTOR STAGING AREA AND FIELD OFFICES/TRAILERS SHALL BE LOCATED AS DEPICTED ON SHEET G-102. THE LOCATIONS ARE SUBJECT TO APPROVAL BY THE AIRPORT MANAGER AND WILL BE FINALIZED AT THE PRE-CONSTRUCTION CONFERENCE.

9. ACCESS TO THE AIRPORT BY THE CONTRACTOR, SUBCONTRACTORS AND SUPPLIERS IS LIMITED TO THE LOCATION SHOWN ON SHEET G-102 AND IS SUBJECT TO APPROVAL BY THE AIRPORT MANAGER. THE CONTRACTOR SHALL ENSURE ALL ACCESS GATES ARE CLOSED AND SECURE AFTER ENTERING OR EXITING THE AIRPORT. CONTRACTOR, SUBCONTRACTORS, AND SUPPLIERS SHALL ADHERE TO THE HAUL ROUTE(S) IDENTIFIED ON THE DRAWINGS. THE IDENTIFIED ROUTES ARE SUBJECT TO THE AIRPORT MANAGER'S APPROVAL. ACCESS ACROSS THE APRON AREAS, TAXIWAYS OR RUNWAY IS STRICTLY PROHIBITED. THE CONTRACTOR SHALL CONTACT THE AIRPORT MANAGER OR ENGINEER IF THERE IS NEED TO CROSS ACTIVE AIRFIELD PAVEMENT.

10. THE CONTRACTOR SHALL LIMIT OPERATIONS TO THE CONSTRUCTION AREAS AND PHASING IDENTIFIED IN THE PLANS. ALL OTHER AREAS OF THE AIRPORT ARE RESTRICTED. DURING CONSTRUCTION, THE CONTRACTOR SHALL BE AWARE OF NAVAID LOCATIONS AND SHALL BE RESPONSIBLE FOR PROTECTING ALL EXISTING NAVAID FACILITIES. THE CONTRACTOR SHALL RECEIVE PERMISSION FROM THE AIRPORT MANAGER OR HIS AUTHORIZED AGENT PRIOR TO WORKING OR TRAVELING IN UNAUTHORIZED AREAS OF THE AIRPORT.

11. ALL WORK AND MATERIALS NECESSARY TO MEET THE REQUIREMENTS OF THE CONSTRUCTION SAFETY AND PHASING PLAN ARE SUMMARIZED IN ITEM M-003-8.1 AIRPORT SAFETY AND SECURITY.

TEMPORARY CLOSED SURFACE MARKING



RUNWAY OR TAXIWAY CENTERLINE

RUNWAY OR TAXIWAY CENTERLINE

ALTERNATE

ISSUED FOR BID

Registered Professional Engineer (Civil) CERTIFICATE NO. 57132 CARMEN M. PARKS Date Signed 09/28/2018

Expires 9/30/2020

Morrison Maierle
engineers ● surveyors ● planners ● scientists
3200 East Camelback Drive
Phoenix, AZ 85018
602.273.2900
www.mmi.net
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NO.	REVISIONS / SUBMISSIONS	DATE
	.	

PHX DVT CITY OF PHOENIX AVIATION DEPARTMENT

GYR AIRPORT TW A REHAB & STRENGTHENING

AV41000075-IFAA

Designed by: CMP
Drawn by: TGJ
Checked by: JM
Date: 05/2018
Dwg scale: N.T.S.
MMI Proj. No.: 8131.022

GYR AIRPORT TW A REHAB & STRENGTHENING

CSPP EXHIBIT A - GENERAL NOTES AND DETAILS

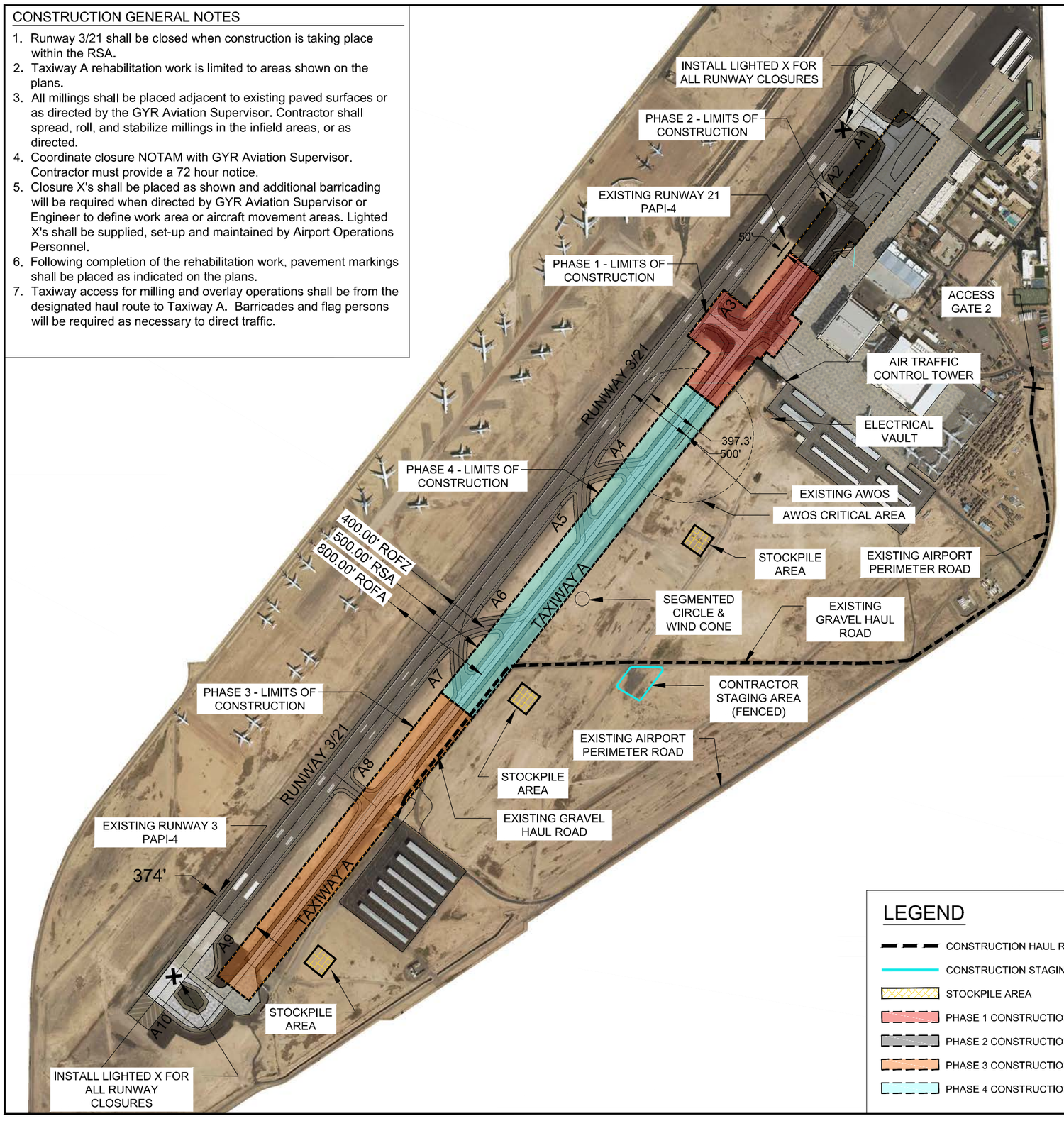
Sheet Reference Number:

G-101

Sheet 06 of 66

CONSTRUCTION GENERAL NOTES

1. Runway 3/21 shall be closed when construction is taking place within the RSA.
2. Taxiway A rehabilitation work is limited to areas shown on the plans.
3. All millings shall be placed adjacent to existing paved surfaces or as directed by the GYR Aviation Supervisor. Contractor shall spread, roll, and stabilize millings in the infield areas, or as directed.
4. Coordinate closure NOTAM with GYR Aviation Supervisor. Contractor must provide a 72 hour notice.
5. Closure X's shall be placed as shown and additional barricading will be required when directed by GYR Aviation Supervisor or Engineer to define work area or aircraft movement areas. Lighted X's shall be supplied, set-up and maintained by Airport Operations Personnel.
6. Following completion of the rehabilitation work, pavement markings shall be placed as indicated on the plans.
7. Taxiway access for milling and overlay operations shall be from the designated haul route to Taxiway A. Barricades and flag persons will be required as necessary to direct traffic.



LEGEND

- CONSTRUCTION HAUL ROUTE
- CONSTRUCTION STAGING AREA
- STOCKPILE AREA
- PHASE 1 CONSTRUCTION AREA
- PHASE 2 CONSTRUCTION AREA
- PHASE 3 CONSTRUCTION AREA
- PHASE 4 CONSTRUCTION AREA

N

0 400' 800'

SCALE:1"=400'

GENERAL NOTES

1. RUNWAY 3/21 GROUP IV EXISTING CRITICAL AREAS:
   a. Runway Safety Area (RSA) 250' from Runway Centerline
   b. Runway Object Free Area (ROFA) 400' fromRunway Centerline
   c. Runway Obstacle Free Zone (ROFZ) 200' fromRunway Centerline

2. TAXIWAY A GROUP IV EXISTING CRITICAL AREAS:
   a. Taxiway Safety Area (TSA) 85.5' from Taxiway Centerline
   b. Taxiway Object Free Area (TOFA) 129.5' from Taxiway Centerline

3. RUNWAY 3/21 AND TAXIWAY CLOSURES:
   a. Runway and taxiway closures will be necessary when working within the RSA and/or TSA. Taxiway A closures typically allowed only at night from 2100 hrs to 0600 hrs, Sunday through Thursday, and as longer duration rolling closures as specified in 3b below.
   b. The project schedule anticipates three separate rolling closures to complete the Taxiway A rehabilitation project:
      i. Phase 1 will require one 57-hour rolling closure that includes a runway closure starting at 2100 Sunday night & reopening at 0600 on Wednesday morning.
      ii. Phase 2 will not require a runway closure. No work will take place within the RSA.
      iii. Phases 3 & 4 will each require a 57-hour rolling closure of Taxiway A while the runway remains open starting at 2100 Sunday night & reopening at 0600 on Wednesday morning.

4. TAXIWAY REHABILITATION CONSTRUCTION NOTES:
   a. Taxiway A pavement will be rehabilitated from existing edge of PCCP at STA 26+54 to the existing edge of PCCP at STA 98+04, a total of 7,150 LF by 75 FT wide plus the construction of 30-foot shoulders. Additionally, a 75' square concrete section along Taxiway A within the Taxiway A2 alignment will be reconstructed.
   b. From the south, the four phase sections of Taxiway A to be rehabilitated are:
      i. Phase 3 - STA 26+54 to STA 51+21 for a total of 2,467 LF.
      ii. Phase 4 - STA 51+21 to STA 80+55 for a total of 2,934 LF.
      iii. Phase 1 - STA 80+55 to STA 93+00 for a total of 1,245 LF.
      iv. Phase 2 - STA 93+00 to STA 98+79 for a total of 579 LF.
   c. 2" of PFC on Taxiway A shall be milled and replaced with 3" of P-401 asphalt concrete. Taxiway A and connector taxiway grades shall be transitioned as shown on the plans.
   d. Temporary striping shall be placed on the new AC pavement at the conclusion of each rolling closure period. Permanent striping will be placed 30 days following the completion of Phase 4.
   e. All phases will involve some electrical work as outlined on the subsequent sheets.

ISSUED FOR BID

Registered Professional Engineer (Civil) CERTIFICATE NO. 57132 CARMEN M. PARKS Date Signed 09/06/19

Expires 9/30/2020

Morrison Maierle
engineers ▪ surveyors ▪ planners ▪ scientists
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NO.	REVISIONS / SUBMISSIONS	DATE
	.	

PHX DVT CITY OF PHOENIX AVIATION DEPARTMENT

GYR AIRPORT TW A REHAB & STRENGTHENING

AV41000075-IFAA

Designed by: CMP
Drawn by: TGJ
Checked by: JM
Date: 05/2018
Dwg scale: 1" = 400'
MMI Proj. No.: 8131.022

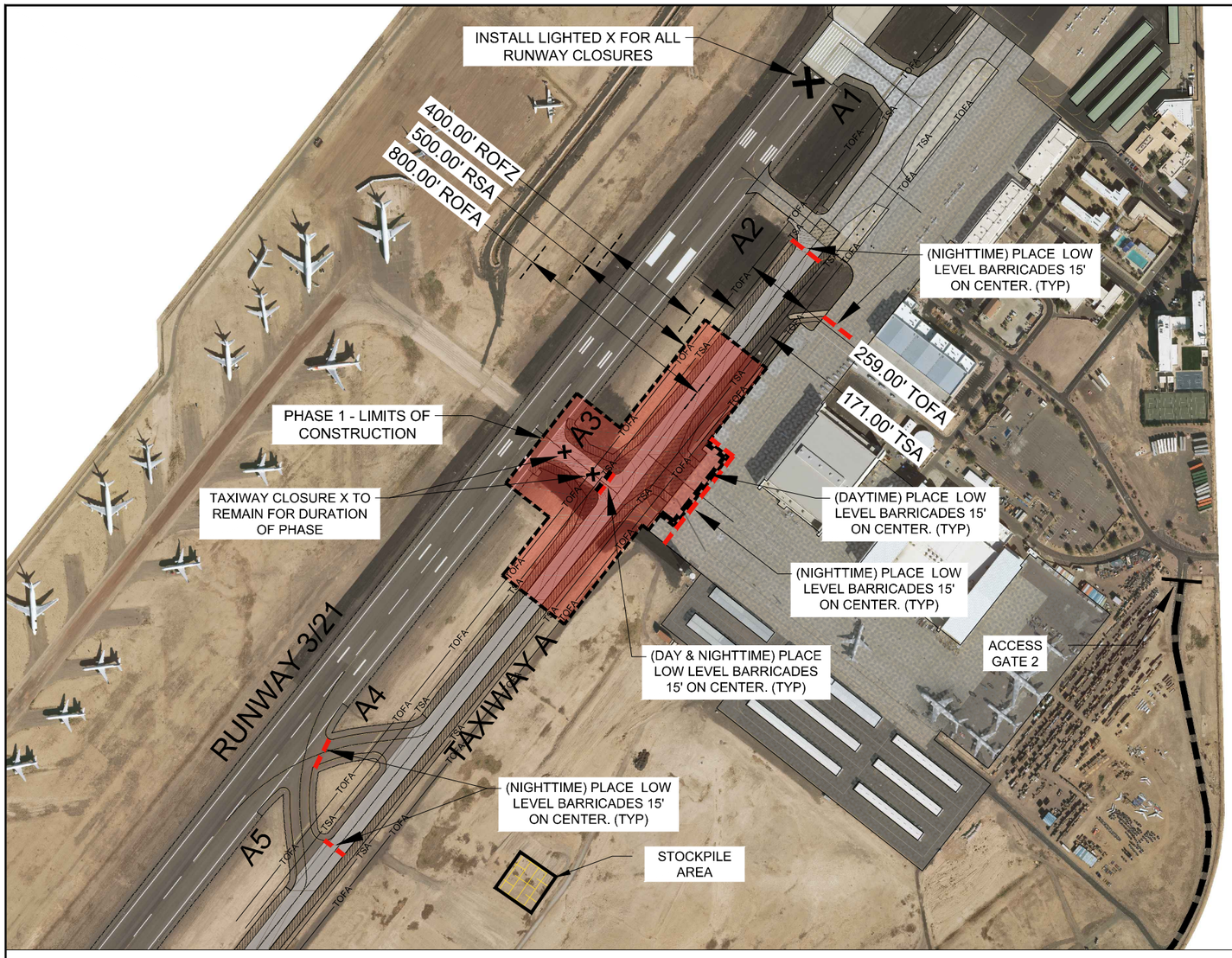
GYR AIRPORT TW A REHAB & STRENGTHENING

CSPP EXHIBIT B - OVERALL PHASING PLAN

Sheet Reference Number:

G-102

Sheet 07 of 66



LEGEND

- CONSTRUCTION HAUL ROUTE
- LOW LEVEL BARRICADES (DAY-TIME CLOSURES)
- LOW LEVEL BARRICADES (NIGHT-TIME CLOSURES)
- TAXIWAY CLOSURE X's
- RUNWAY CLOSURE LIGHTED X's
- STOCKPILE AREA
- PHASE 1 CONSTRUCTION AREA

PHASE 1 GENERAL NOTES

1. Phase 1 work on Taxiway A, A3, and Ramp 3 must be completed in its entirety prior to beginning Phase 2 work.
2. Runway shall remain open for normal operations except when work is taking place within the RSA.
3. Taxiway A, A3, and Ramp 3 shall be constructed as indicated on the plans and specifications.
4. All stockpiled material must be located outside of the Runway and Taxiway A Object Free Area as shown and removed from the site as required by the GYR Aviation Supervisor or Engineer.
5. A portion of Taxiway A and A3 shall be closed and barricaded as shown each night while work is being conducted.
6. Taxiway A shall re-open every morning for normal aircraft operations. Taxiway A3 & new Ramp 3 shall remain closed for the duration of Phase 1.
7. Existing Ramp 3 may be utilized only for daytime operations prior to its demolition.
8. Work on Taxiway A3 within RSA will require a full runway.
9. During the 57-hour rolling closure (runway closed), closure barricades and closure X's shall be placed as shown and additional barricading will be required when directed by GYR Aviation Supervisor or Engineer to define work area or aircraft movement areas.

BARRICADE NOTES

1. During normal nightly closure, low level barricades shall be placed as shown to restrict taxiway and ramp access to Phase 1 work areas.
2. In closed areas, taxiway centerline lights, edge lights and signs shall be covered, or temporarily made inoperable during nightly taxiway closures when the runway is open.
3. Barricades shall be relocated as shown each morning to open up Taxiway A and all lighting and signage operable.
4. Taxiway A3 must remain closed for the duration of Phase 1, low level barricades shall be placed at Runway 03/21 and Taxiway A, signs must be covered, and lights made inoperable.

PHASE 1 - SCOPE OF WORK

Taxiway A3 - Relocate existing electrical duct banks, construct new fillets, install taxiway edge lights, construct 30' asphalt shoulders and relocate pavement section between Taxiway A and the ramp area (Ramp 3), and mill and overlay that portion of Taxiway A within Phase 1 (STA 80+55 to STA 93+00).

1. Phase 1 construction is expected to take 45 days to complete.
2. Nightly work will take place until milling and paving operations commence. Milling operations, paving operations, and taxiway marking will take place during a 57-hour rolling closure. The 57 hour rolling closure will require a runway closure.
3. All work inside the RSA (250' from the Runway Centerline) will require nightly runway closures.
4. Work will require a complete closure of Taxiway A3 and new Ramp 3 for the duration of Phase 1. Taxiway A and existing Ramp 3 (apron access) shall be closed nightly and reopened each morning for daytime operations.
   3a. Runway will be open during normal nightly work periods, except when work takes place within the RSA.
5. At the completion of the rolling closure, Taxiway A3 and Ramp 3 will receive temporary centerline and edge markings.
6. 30 days following the completion of Phase 4, the asphalt pavement will need to be re-striped with the final pavement markings. Pavement markings include: edge, hold position markings, surface painted hold signs and enhanced centerline markings.

N

0 250' 500'

SCALE:1"=250'

ISSUED FOR BID

Registered Professional Engineer (Civil) CERTIFICATE NO. 57132 CARMEN M. PARKS Date Signed ARIZONA, U.S.A.

Expires 9/30/2020

Morrison Maierle
engineers • surveyors • planners • scientists
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602.273.2900
www.mmi.net
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NO.	REVISIONS / SUBMISSIONS	DATE

PHX DVT GYR
CITY OF PHOENIX AVIATION DEPARTMENT

GYR AIRPORT TW A REHAB & STRENGTHENING

AV41000075-IFAA

Designed by: CMP
Drawn by: TGJ
Checked by: JM
Date: 05/2018
Dwg scale: 1" = 250'
MMI Proj. No.: 8131.022

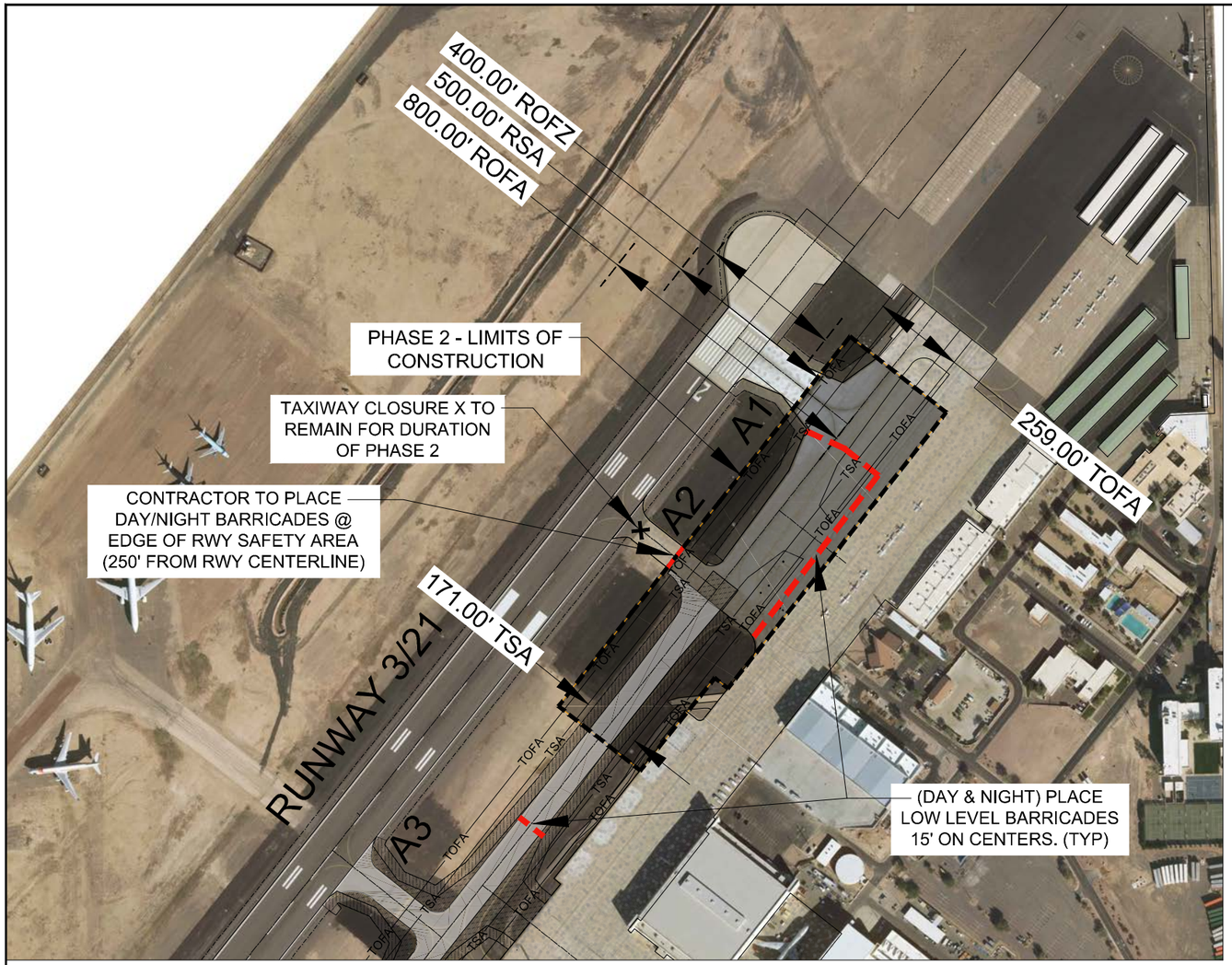
GYR AIRPORT TW A REHAB & STRENGTHENING

CSPP EXHIBIT C - PHASE 1

Sheet Reference Number:

G-103

Sheet 08 of 66



LEGEND

- CONSTRUCTION HAUL ROUTE
- LOW LEVEL BARRICADES (DAY & NIGHT - WHOLE PHASE)
- TAXIWAY CLOSURE X's
- RUNWAY CLOSURE LIGHTED X's
- PHASE 2 CONSTRUCTION AREA

PHASE 2 GENERAL NOTES

1. Phase 1 work must be completed in its entirety prior to beginning Phase 2 work. Phases 3 and 4 will commence upon the completion of Phase 2.
2. Runway shall remain open for normal operations for the duration of Phase 2.
3. Taxiway A improvements and Ramp 2 shall be constructed as indicated on the plans and specifications.
4. All stockpiled material must be located outside of the Runway Object Free Area as shown and removed from the site as required by the GYR Aviation Supervisor or Engineer.
5. Taxiway A and Ramp 2 shall be closed and properly barricaded as shown for the duration of Phase 2. Aircraft shall use ramp taxilane to bypass the construction area.
6. Taxiway A2 and Ramp 2 shall remain closed for the duration of Phase 2.
7. Contractor shall coordinate partial Taxiway A closure NOTAM with GYR Aviation Supervisor. Contractor must provide a 72-hour notice.

BARRICADE NOTES

1. For all of Phase 2, low level barricades shall be placed as shown to restrict taxiway and ramp access to Phase 2 work areas.
2. In closed areas, taxiway centerline lights, edge lights and signs shall be covered, or temporarily made inoperable.

PHASE 2 - SCOPE OF WORK

Taxiway A2 - Relocate designated electrical items, install taxiway edge lights, reconstruct 75-foot square concrete section of Taxiway A, and restripe pavement section between Taxiway A and the ramp area (Ramp 2).

1. Phase 2 construction is expected to take 28 days.
2. Nighttime or daytime work may take place for Phase 2. No work will take place within the Runway Safety Area (RSA).
3. Taxiway A shoulders and Taxiway A milling and paving between Sta 93+00 and Sta 98+00 will be constructed during Phase 2.
4. Taxiway A (north of Ramp 2 and south of Taxiway A1), Taxiway A2, and Ramp 2 will remain closed for the duration of Phase 2.
5. Ramp 2 will be open and have the proper markings, signs, and lights at the end of Phase 2.
6. Taxiway A1 and A2 will have enhanced centerline markings and surface painted hold signs placed at least 30 days following the final phase paving operations.
7. Taxiway A between Ramp 2 and Taxiway A1 will be reopened at the conclusion of Phase 2.

N

0 200' 400'

SCALE:1"=200'

ISSUED FOR BID

Registered Professional Engineer (Civil) CERTIFICATE NO. 57132 CARMEN M. PARKS Date Signed ARIZONA U.S.A.

Expires 9/30/2020

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CITY OF PHOENIX AVIATION DEPARTMENT

GYR AIRPORT TW A REHAB & STRENGTHENING

AV41000075-IFAA

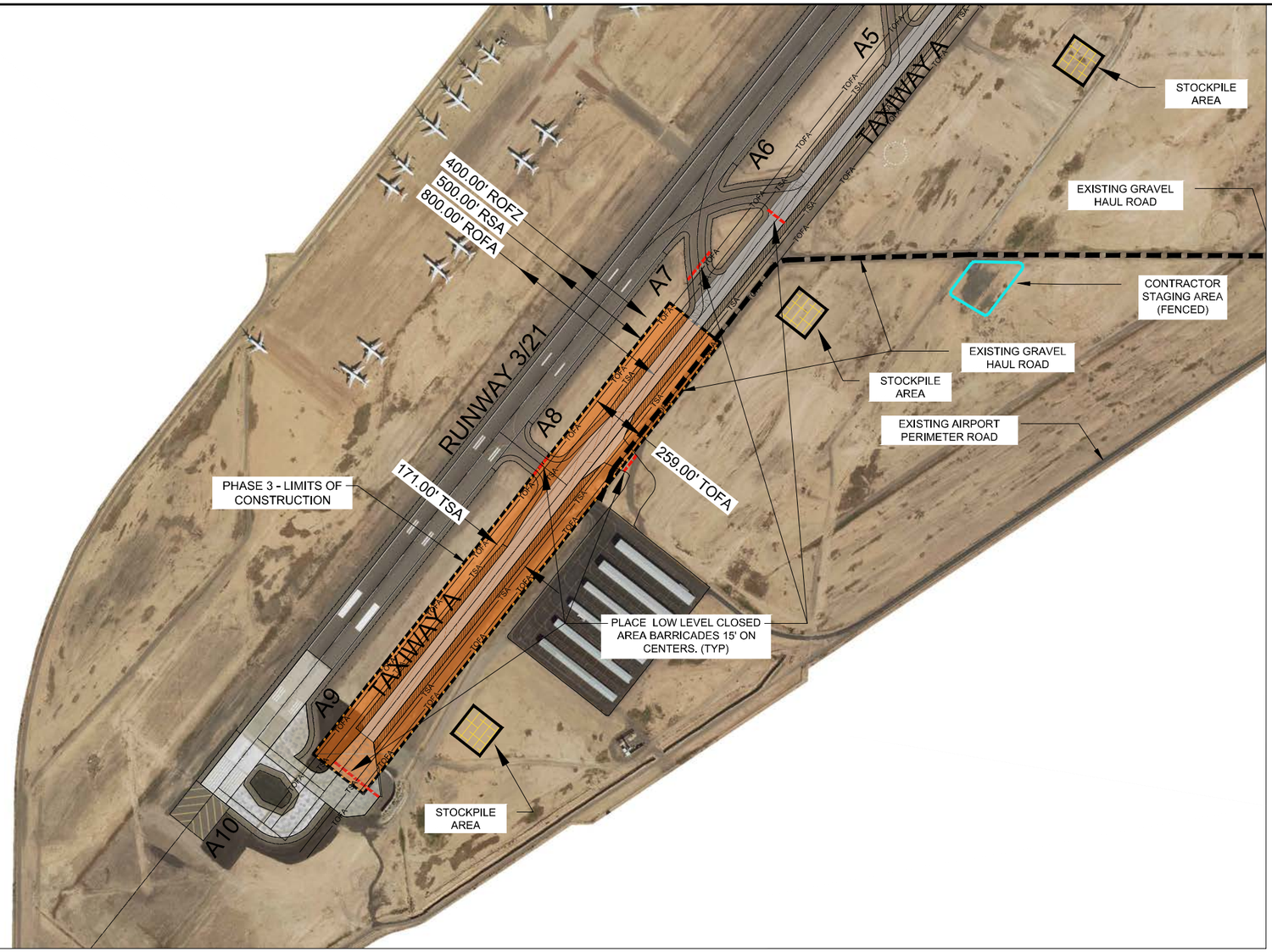
Designed by: CMP
Drawn by: TJ
Checked by: JM
Date: 05/2018
Dwg scale: 1" = 200'
MMI Proj. No.: 8131.022

GYR AIRPORT TW A REHAB & STRENGTHENING

CSPP EXHIBIT D - PHASE 2

Sheet Reference Number:

G-104



LEGEND

- CONSTRUCTION HAUL ROUTE
- CONSTRUCTION STAGING AREA
- LOW LEVEL BARRICADES
- STOCKPILE AREAS
- PHASE 3 CONSTRUCTION AREA

PHASE 3 GENERAL NOTES

1. Phase 2 work on Taxiway A2 and Ramp 2 must be completed in its entirety prior to beginning Phase 3 work.
2. Runway shall remain open for normal operations except when work is taking place within the RSA.
3. Taxiway A shoulders shall be constructed as indicated on the plans and specifications.
4. All stockpiled material must be located outside of the Runway and Taxiway Object Free Area as shown and removed from the site as required by the GYR Aviation Supervisor or Engineer.
5. Taxiway A, A7, A8, A9, A10, and Ramp 8 shall be closed and barricaded as shown each night while work is being conducted. Aircraft landing on RW 21 shall back-taxi on the runway to bypass the construction area.
6. Taxiway A, A7, A8, A9, A10, and Ramp 8 shall re-open every morning for normal aircraft operations.
7. Contractor shall coordinate closure NOTAM with GYR Aviation Supervisor. Contractor must provide a 72-hour notice.
8. GYR Aviation Supervisor and Contractor shall coordinate with South T-Hanger tenants prior to closing Ramp 8 access to hangers for 57-hour rolling closure to allow tenants to relocate their aircraft.
9. During the 57-hour rolling closure, closure barricades and closure X's shall be placed as shown and additional barricading will be required when directed by GYR Aviation Supervisor or Engineer to define work area or aircraft movement areas.

BARRICADE NOTES

1. During normal nightly closure, low level barricades shall be placed as shown to restrict taxiway and ramp access to Phase 3 work areas.
2. In closed areas, taxiway centerline lights, edge lights and signs shall be covered, or temporarily made inoperable during nightly taxiway closures when the runway is open.

PHASE 3 - SCOPE OF WORK

Mill and overlay 2,467 linear feet of Taxiway A. Construct 30' paved shoulders, paint enhanced centerline markings & surface painted hold signs for Taxiway A7 through Taxiway A10.

1. Phase 3 work is expected to take 24 days.
2. Nightly work will take place on the 30' shoulders until milling and final paving operations.
   a. Runway will remain open during entire Phase 3 work unless contractor needs to complete work within the RSA, which includes millings placement in the infield areas.
3. Taxiway A, A7, A8, A9, and A10 will be re-opened every morning after nightly closures.
4. Final paving operations will take place over a 57-hour rolling closure (Sunday Night to Wednesday morning).
   a. At least 30-days following final phase paving operations, surface painted hold signs and enhanced taxiway centerline markings will be painted on Taxiways A7, A8, A9, and A10.
   b. Taxiway A will receive temporary edge and centerline markings.
   c. Taxiway A final markings will be placed at least 30-days after the completion of the final phase paving operations.

N

0 300' 600'

SCALE:1"=300'

ISSUED FOR BID

Registered Professional Engineer (Civil) CERTIFICATE NO. 57132 CARMEN M. PARKS Date Signed 9/30/2020 ARIZONA U.S.A.

Expires 9/30/2020

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CITY OF PHOENIX AVIATION DEPARTMENT

GYR AIRPORT TW A REHAB & STRENGTHENING

AV41000075-IFAA

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Drawn by: TGJ
Checked by: JM
Date: 05/2018
Dwg scale: 1" = 300'
MMI Proj. No.: 8131.022

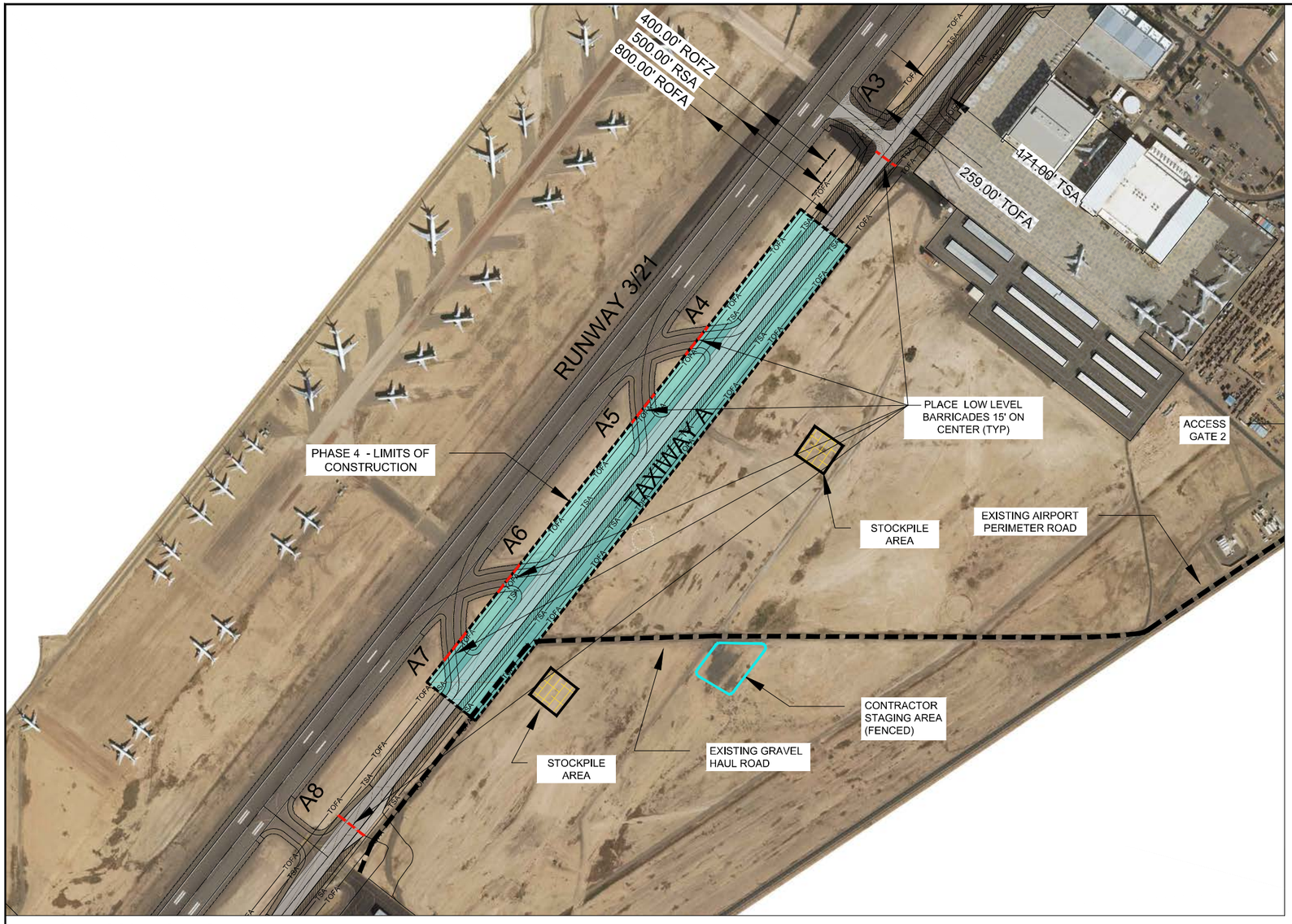
GYR AIRPORT TW A REHAB & STRENGTHENING

CSPP EXHIBIT E - PHASE 3

Sheet Reference Number:

G-105

Sheet 10 of 66



LEGEND

- CONSTRUCTION HAUL ROUTE
- CONSTRUCTION STAGING AREA
- LOW LEVEL BARRICADES
- STOCKPILE AREA
- PHASE 4 CONSTRUCTION AREA

PHASE 4 GENERAL NOTES

1. Phase 3 work on Taxiway A must be completed in its entirety prior to beginning Phase 4 work.
2. Runway shall remain open for normal operations except when work is taking place within the RSA.
3. Taxiway A shoulders shall be constructed as indicated on the plans and specifications.
4. All stockpiled material must be located outside of the Runway and Taxiway Object Free Area as shown and removed from the site as required by the GYR Aviation Supervisor or Engineer.
5. Taxiway A, A4, A5, A6, and A7 shall be closed and barricaded as shown each night while work is being conducted. Aircraft shall taxi on the runway to bypass the construction area.
6. Taxiway A, A4, A5, A6, and A7 shall re-open every morning for normal aircraft operations.
7. Coordinate closure NOTAM with GYR Aviation Supervisor. Contractor must provide a 72-hour notice.
8. During the 57-hour rolling closure, closure barricades and closure X's shall be placed as shown and additional barricading will be required when directed by GYR Aviation Supervisor or Engineer to define work area or aircraft movement areas.

BARRICADE NOTES

1. During normal nightly closure, low level barricades shall be placed as shown to restrict taxiway and ramp access to Phase 4 work areas.
2. In closed areas, taxiway centerline lights, edge lights and signs shall be covered, or temporarily made inoperable during nightly taxiway closures when the runway is open.

PHASE 4 - SCOPE OF WORK

Mill and overlay 2,934 linear feet of TW A. Construct 30' paved shoulders. Paint enhanced centerline markings & surface painted hold signs for Taxiway A4 through Taxiway A6.

1. Phase 4 work is expected to take 24 days.
   a. Runway will remain open during entire Phase 4 work unless contractor needs to complete work within the RSA, which includes placing millings placement in the field.
2. Nightly work will take place on the 30' shoulders until milling and final paving operations.
   a. Taxiway A (from a point beyond A3 thru A7), A4, A5, A6, and A7 will be re-open every morning after nightly closures.
3. Final paving operations will take place over a 57-hour rolling closure (Sunday Night to Wednesday morning).
   a. At least 30-days following final phase paving operations, surface painted hold signs and enhanced taxiway centerline markings will be painted on Taxiway A4, A5, and A6.
   b. Taxiway A will receive temporary edge and centerline markings.
   c. Taxiway A final markings will be placed at least 30-days after the completion of the final phase paving operations.

N

0 300' 600'

SCALE:1"=300'

ISSUED FOR BID

Registered Professional Engineer (Civil) CERTIFICATE NO. 57132 CARMEN M. PARKS Date Signed ARIZONA U.S.A.

Expires 9/30/2020

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GYR AIRPORT TW A REHAB & STRENGTHENING

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Date: 05/2018
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MMI Proj. No.: 8131.022

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CSPP EXHIBIT F - PHASE 4

Sheet Reference Number:

G-106

Geotechnical Evaluation

Phoenix-Goodyear Airport Taxiway A Rehabilitation
1658 South Litchfield Road
Goodyear, Arizona

Morrison-Maierle

3202 East Harbour Road | Phoenix, Arizona 85034

May 1, 2018 | Project No. 605605001

Geotechnical | Environmental | Construction Inspection & Testing | Forensic Engineering & Expert Witness

Geophysics | Engineering Geology | Laboratory Testing | Industrial Hygiene | Occupational Safety | Air Quality | GIS

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

May 1, 2018
Project No. 605605001

Ms. Carmen Parks
Morrison-Maierle
3202 East Harbour Drive
Phoenix, Arizona 85034

Subject: Geotechnical Evaluation
Phoenix-Goodyear Airport Taxiway A Rehabilitation
1658 South Litchfield Road
Goodyear, Arizona

Dear Ms. Parks:

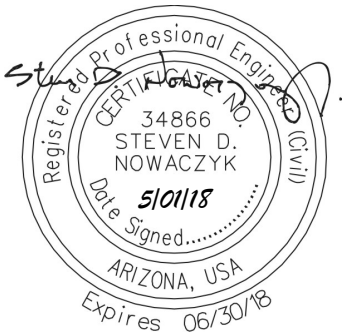
In accordance with your authorization, Ninyo & Moore is pleased to submit this geotechnical evaluation report, for the above-referenced site. The attached report presents our methodology, findings, conclusions, and recommendations regarding the geotechnical conditions at the project sites.

Ninyo & Moore appreciates the opportunity to be of service to you on this project.

Respectfully submitted,
NINYO & MOORE

Farhad Rahimi
Project Engineer

Steven D. Nowaczyk, PE
Managing Principal Engineer



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CONTENTS

1	INTRODUCTION	1
2	SCOPE OF SERVICES	1
3	SITE DESCRIPTION	2
4	PROPOSED CONSTRUCTION	2
5	FIELD EXPLORATION AND LABORATORY TESTING	3
6	GEOLOGY AND SUBSURFACE CONDITIONS	3
6.1	Geologic Setting	3
6.2	Subsurface Conditions	4
6.2.1	Asphalt Concrete over Base Material	4
6.2.2	Alluvium	4
6.2.3	Groundwater	4
7	GEOLOGIC HAZARDS	4
7.1	Perched Ground Water	5
7.2	Land Subsidence and Earth Fissures	5
7.3	Faulting and Seismicity	5
7.4	Liquefaction	6
8	CONCLUSIONS	6
9	RECOMMENDATIONS	7
9.1	Pre-Construction Survey	7
9.2	Earthwork	7
9.2.1	Site Preparation	8
9.2.2	Excavations	8
9.2.3	Grading, Fill Placement, and Compaction	9
9.2.4	Bottom Stability	10
9.2.5	Construction Dewatering	10
9.2.6	Imported Fill	10
9.2.7	Earthwork and Ground Compaction Factor	11
9.3	Pavement Design	11
9.4	Corrosion	15
9.5	Concrete	16

9.6 Site Drainage and Storm Water 16
9.7 Pre-Construction Conference 16
9.8 Construction Observation and Testing 17
10 LIMITATIONS 17
11 REFERENCES 19

TABLES

1 – Seismic Design Parameters 6

FIGURES

1 – Site Location
2 – Boring Locations
3 – 6 Pavement Section
7 – Subgrade Acceptance Chart

APPENDICES

A – Boring Logs
B – Laboratory Testing
C – Findings on Coring at Taxiway A3
D – Photographs

1 INTRODUCTION

In accordance with your authorization, we have performed a geotechnical evaluation for the Phoenix-Goodyear Airport Taxiway A Rehabilitation project located in Goodyear, Arizona. The purpose of our evaluation was to assess the subsurface conditions at the project site in order to formulate geotechnical recommendations for design and construction. According to City of Phoenix request and approval on February 13, 2018, we conducted two cores and soil hand sampling on Taxiway A3 to explore the thickness of asphalt and aggregate base. The detail of this exploration is in Appendix C of this report. This report presents the results of our evaluation and our geotechnical conclusions and recommendations regarding the proposed construction.

2 SCOPE OF SERVICES

The scope of our services for this project generally included:

- Reviewing readily available published and in-house geotechnical reports, topographic information, soil surveys, aerial photographs and published geologic literature, including maps and reports pertaining to the project sites and vicinity.
- Obtaining right of entry permission from the Goodyear Airport.
- Conducting a visual survey of the existing pavement surface and marking out our proposed exploration locations.
- Notifying Arizona 811 and Goodyear Airport personnel of the boring locations prior to drilling.
- Evaluating the presence of underground utilities at our exploration locations prior to field activities using geophysical techniques.
- Coring of the existing asphalt pavement at 22 exploration locations using an electronic core machine.
- Drilling 22 hollow-stem auger borings (within each of the aforementioned cored holes) using a truck-mounted drill rig to depths of up to 10 feet below ground surface (bgs). The borings were logged in general accordance with industry standard methods and samples were obtained for laboratory testing. The boring logs are presented in Appendix A.
- Performing laboratory tests on selected samples obtained from the borings to evaluate in-situ moisture content and density, gradation, Atterberg limits, Proctor, California Bearing Ratio (CBR), consolidation, and corrosivity characteristics. The results of the laboratory testing are presented on the boring logs and/or in Appendix B.
- Preparing this report presenting our findings, conclusions, and recommendations regarding the design and construction of the project.

Our scope of services did not include environmental consulting services such as hazardous waste sampling or analytical testing at the site. A detailed scope of services and estimated fee for such services can be provided upon request.

3 SITE DESCRIPTION

The project site is located at the intersection of Goodyear Parkway and Litchfield Road in Goodyear, Arizona, and lies within Sections 4, 5, and 8 of Township 2 North, Range 1 West. The approximate location of the site is depicted on Figure 1 of this report. Access to the Goodyear Airport was via Litchfield Road and Goodyear Parkway. Taxiway A was situated on the east side of the main runway and extended from southwest to northeast. The existing pavement was asphaltic concrete (AC).

According to the Phoenix South, Arizona-Maricopa Co., 7.5-Minute United States Geological Survey (USGS) Topographic Quadrangle Map (1979), the site is at an approximate elevation of 965 feet relative to mean sea level. Based on the information from this topographic map, the project site slopes gently from the north down to the south, towards the Gila River.

Several aerial photographs from Maricopa County were reviewed for this project. A 1937 photograph depicted the site as undeveloped desert land dissected by washes that traversed in the northeast-southwest direction. The railway embankment was observed in this photograph. The Phoenix-Goodyear Municipal Airport to the west of the site was not depicted in this photograph and Maricopa County 85 was depicted as an unpaved roadway. A 1949 photograph depicted the site as being similar to its current condition with the exception of a northeast-southwest drainage feature near the northwest corner of the site. The Phoenix-Goodyear Municipal Airport was depicted in this photograph, and Maricopa County 85 was depicted as a paved roadway. Aerial photographs from 1959, 1969 and 1979 depicted the northern portion of the site as being graded. Available aerial photographs from 1999 to 2010 depicted the site as being similar to its current condition. The drainage feature noted in the 1949 aerial photograph was not apparent in the photographs dating back to 1999.

4 PROPOSED CONSTRUCTION

The proposed improvements will generally include the rehabilitation of Taxiway A, shoulder widening, new pavement on Taxiway A3 and Ramp 3, and new pavement Portland cement concrete pavement (PCCP) on Taxiway A2 widening. It is our understanding that the new overlay pavements along the Taxiway A will consist of AC surface layer, the new shoulder and new pavement on Taxiway A3 and Ramp 3 will consist of AC, and Taxiway A2 widening will

consist of PCCP. The project may also include some additional improvements; however, this report addresses the rehabilitation and new pavement improvements.

5 FIELD EXPLORATION AND LABORATORY TESTING

On January 15, 16 and 17, 2018, Ninyo & Moore conducted subsurface explorations in order to evaluate the existing subsurface conditions and to collect soil samples for laboratory testing. Our evaluation consisted of pavement coring, soil drilling, logging, and sampling of 22 small-diameter borings, denoted as B-1 through B-22. Borings were advanced to depths of approximately 10 feet bgs. Bulk and relatively undisturbed soil samples were collected at selected intervals. Detailed descriptions of the soils encountered are presented on the logs in Appendix A. The general locations of the borings are depicted on Figure 2.

The soil samples collected from our drilling activities were transported to the Ninyo & Moore laboratory in Phoenix, Arizona for geotechnical laboratory analysis. The analysis included in-situ moisture content and density, gradation, Atterberg limits, Proctor density, CBR, consolidation, and corrosivity characteristics. A description of each laboratory test method and the remainder of the test results are presented in Appendix B.

6 GEOLOGY AND SUBSURFACE CONDITIONS

The geology and subsurface conditions at the site are described in the following sections.

6.1 Geologic Setting

The project site is located in the Basin and Range physiographic provinces. The Basin and Range physiographic province is typified by broad alluvial valleys separated by steep, discontinuous, and subparallel mountain ranges. The mountain ranges generally trend north-south and northwest-southeast. The basin floors consist of alluvium with thickness extending to several thousands of feet. The basins and surrounding mountains were formed approximately 10 to 13 million years ago during the mid- to late-Tertiary. Extensional tectonics resulted in the formation of horsts (mountains) and grabens (basins) with vertical displacement along high-angle normal faults. Intermittent volcanic activity also occurred during this time. The surrounding basins filled with alluvium from the erosion of the surrounding mountains, as well as, from river deposition. Coarser-grained alluvial material was deposited at the margins of the basins near the mountains.

The surface geology of the locations of the borings is described mostly as Holocene (<10,000 years) well-sorted deposits of sand, silt, and gravels with stage I to stage II calcic horizons developed within argillic soils (Demsey, 1989).

6.2 Subsurface Conditions

Our knowledge of the subsurface conditions at the project site is based on our field exploration and laboratory testing, and our understanding of the general geology of the area. The following paragraph provides a generalized description of the materials encountered. More detailed descriptions are presented on the logs in Appendix A.

6.2.1 Asphalt Concrete over Base Material

AC over base material was encountered at the surface of our borings. The thickness of the existing AC pavement structure varied between 7.5 and 9.8 inches in our borings, while the base thickness varied between 3.0 to 30.0 inches in our borings.

6.2.2 Alluvium

Alluvium was encountered below the base material in our borings and extended to the total explored depths. In our borings, the alluvium generally consisted of clayey sand (SC), lean clay (CL), silty clayey sand (SC-SM), silty sand (SM), and silty clay (CL-ML). Varying amounts of sand, gravel and scattered caliche nodules were observed in our borings.

6.2.3 Groundwater

Groundwater was not encountered in our borings. Based on well data provided by the Arizona Department of Water Resources, historical groundwater depths have been encountered as shallow as 35 feet bgs or deeper. Groundwater levels can fluctuate due to seasonal variations, irrigation, groundwater withdrawal or injection, and various other factors. In general groundwater is not expected to be a constraint to the construction of this project. It should be noted that groundwater and soil moisture conditions within the area will vary depending on rainfall and/or runoff conditions not apparent at the time of our field study.

7 GEOLOGIC HAZARDS

The following section provides a discussion regarding potential geologic hazards such as faulting and seismicity.

7.1 Perched Ground Water

Perched ground was not encountered during the field investigations. However, perched ground water conditions can be encountered during construction. Uncontrolled ingress of moisture during and after construction can lead to construction delays and premature deterioration of embankment fills and pavement distress. The presence and potential impact should be investigated during construction.

7.2 Land Subsidence and Earth Fissures

Groundwater depletion, due to groundwater pumping, has caused land subsidence and earth fissures in numerous alluvial basins in southern Arizona. It has been estimated that subsidence has affected more than 3,000 square miles and has caused damage to a variety of engineered structures and agricultural land (Schumann and Genualdi, 1986). From 1948 to 1983, excessive groundwater withdrawal has been documented in several alluvial valleys where groundwater levels have been reportedly lowered by up to 500 feet. With such large depletions of groundwater, the alluvium has undergone consolidation resulting in large areas of land subsidence.

In some areas of Arizona, earth fissures are associated with land subsidence and pose an on-going geologic hazard. Earth fissures generally form near the margins of geomorphic basins where significant amounts of groundwater depletion have occurred. Reportedly, earth fissures have also formed due to tensional stress caused by differential subsidence of the unconsolidated alluvial materials over buried bedrock ridges and irregular bedrock surfaces (Schumann and Genualdi, 1986).

Groundwater levels have lowered approximately as low as 100 feet at the location of the site. Based on our field reconnaissance and review of the referenced material, there are no known earth fissures underlying or near the subject site. The closest documented earth fissure to the site is approximately 10 miles to the north and, therefore, earth fissures are not expected to be a constraint to the project.

7.3 Faulting and Seismicity

The site lies within the Sonoran zone, which is a relatively stable tectonic region located in southwestern Arizona, southeastern California, southern Nevada, and northern Mexico (Euge et al., 1992). This zone is characterized by sparse seismicity and few Quaternary faults. Based on our field observations, review of pertinent geologic data, and analysis of aerial photographs, faults are not located on or adjacent to the property. The closest fault to the site

with documented Quaternary age movement is the 6.8 mile-long northwest striking Carefree fault zone, located approximately 40 miles to the northeast of the site (Pearthree, 1998). Approximately 2 meters of displacement has occurred along this fault within middle Pleistocene deposits (<750,000 years), but the upper Pleistocene and Holocene deposits (<250,000 years) are not displaced.

Based on a Probabilistic Seismic Hazard Assessment for the Western United States, issued by the USGS (1999), the site is located in a zone where the peak ground accelerations that have a 10 percent, 5 percent, and 2 percent probability of being exceeded in 50 years are 0.05g, 0.07g and 0.10g, respectively. Seismic design parameters according to the 2012/2015 International Building Code (IBC) and 2009 American Association of State Highway Transportation Officials (AASHTO) Specifications for Load Resistance Factor Design Bridge Design are presented in Table 1:

Table 1 – Seismic Design Parameters

Seismic Design Factors (2012/2015 IBC)	Value
Site Class	D
Site Coefficient, F_a	1.6
Site Coefficient, F_v	2.4
Mapped Spectral Acceleration at 0.2-second Period, S_s	0.159 g
Mapped Spectral Acceleration at 1.0-second Period, S_1	0.054 g
Spectral Acceleration at 0.2-second Period Adjusted for Site Class, S_{MS}	0.254 g
Spectral Acceleration at 1.0-second Period Adjusted for Site Class, S_{M1}	0.129 g
Design Spectral Response Acceleration at 0.2-second Period, S_{DS}	0.170 g
Design Spectral Response Acceleration at 1.0-second Period, S_{D1}	0.086 g

7.4 Liquefaction

Based on the Standard Penetration Test values at the site, the lack of near surface water, and the low ground motion hazard (relatively low ground accelerations), the likelihood or potential for liquefaction at the project site is not a design consideration.

8 CONCLUSIONS

Based on the results of our subsurface evaluation, laboratory testing, and data analysis, it is our opinion that the proposed construction is feasible from a geotechnical standpoint, provided that the recommendations of this report are incorporated into the design and construction of the proposed project, as appropriate. Site specific geotechnical considerations include the following:

- The surface soils encountered at in our borings are considered to be rippable with earth moving or excavation equipment in good working condition.

- Differing subsurface conditions may be encountered during construction in areas that are between or away from the boring locations.
- Imported and on-site soils that exhibit a relatively low plasticity index and a very low to low expansive potential can generally be used for engineered fill.
- New pavements should be supported on a zone of moisture-conditioned, compacted, acceptable in-situ soils, engineered or imported fill.
- An earthwork (shrinkage) factor of 14 percent is estimated for this project.
- Groundwater was not observed in our borings. Based on nearby well data, the approximate depth to regional groundwater varies and may be as shallow as 35 feet bgs in the site vicinity.
- The subgrade materials are corrosive to ferrous metals, while the sulfate content of the soils present a negligible sulfate exposure for concrete.

9 RECOMMENDATIONS

The following sections present our geotechnical recommendations for the proposed construction. If the proposed construction is changed from that discussed in this report, Ninyo & Moore should be contacted for additional recommendations.

9.1 Pre-Construction Survey

Prior to construction activities, it may be desirable to recognize the condition of the existing utilities, structures, or other features that are near the planned construction, and to survey or document (e.g., photographs, video, official documentation, etc.) their pre-construction condition. The findings of the survey could be used to document any damage that might result from this project.

9.2 Earthwork

The following sections provide our earthwork recommendations. The earthwork specifications recommended by the United States Department of Transportation Federal Aviation Administration (FAA) Circulars 150/5320-6F and 150/5370-10G, Maricopa Association of Governments, and any City of Phoenix guidelines/supplements, are expected to apply, except as noted.

9.2.1 Site Preparation

Construction areas should be cleared of deleterious materials. Vegetation and debris from the clearing operation should be removed from the site in accordance with the project Specifications. Demolition debris and obstructions that extend below finish grade, if present, should be removed from the site in accordance with the project Specifications.

After rough grade has been achieved and prior to placement of fill, the exposed subgrade should be visually observed for the presence of debris, organic matter and other unsuitable materials. If unsuitable subgrade soils are encountered during the earthwork operations, these soils should be removed and be replaced with engineered fill as recommended in this report, and as approved by the Engineer.

9.2.2 Excavations

Our evaluation of the excavation characteristics of the on-site materials is based on the results of 22 exploratory borings, site observations, and our experience with similar materials. In our opinion, excavation of the surface on-site materials can generally be accomplished with heavy-duty earth moving or excavation equipment in good operating condition. Some dense and caliche cemented materials were found in our borings and should be anticipated. These soils could slow the rate of excavation. Contractors should make their own evaluations of rippability and plan in accordance with their evaluation as well as with the project specifications. Because of the widely spaced nature of our borings, soils encountered during construction may differ from the soils encountered in our borings.

If needed, the contractor should provide safely sloped excavations or an adequately constructed and braced shoring system in compliance with Occupational Safety and Health Administration (OSHA) regulations for employees working in an excavation that may expose them to the danger of moving ground. Based on the soil conditions at the site, OSHA Soil "Type C" should be used. This corresponds to a temporary slope of 1.5H:1V (Horizontal to Vertical [H:V]) for excavations that are less than 20 feet deep. If material is stored or equipment is operated near an excavation, additional shoring should be used to resist the extra pressure due to superimposed loads.

Temporary excavations that encounter groundwater seepage or surface runoff may also require shoring or stabilization by placing sandbags or gravel along the base of the seepage zone. Excavations encountering groundwater seepage should be evaluated on a case-by-case basis.

9.2.3 Grading, Fill Placement, and Compaction

On-site and imported soils that are used as engineered fill that exhibit relatively low plasticity indices (PI) and very low to low expansive potential are generally suitable for re-use as select, engineered fill. Relatively low PI is defined as a PI value of 15, or less, as evaluated by ASTM D4318. Very low to low expansive potential soils are defined as having an expansion index (per ASTM D4829) of 50 or less. Based on laboratory test results, the PI values at this site could range from Non-Plastic (zero) to 22. As such, some of the on-site soils may be suitable for re-use as engineered fill. Additional field sampling and laboratory testing should be conducted by the contractor prior to and/or during construction to better evaluate the limits of these unsuitable materials.

Engineered fill should also not include construction debris, or other non-soil fill materials. Clay lumps and rock particles should not be larger than 4 inches in dimension. Obstructions that extend below finish grade should be removed and the resulting holes filled with compacted soil. Unsuitable fill material should be disposed of offsite or in non-structural areas. Furthermore, we recommend that engineered fill used to support new pavements have an R-value of 30 or more and a CBR Value of 10 or more.

Soils exhibiting an organic content of more than 4 percent in accordance with AASHTO T 267, or significant roots and other organic matter or vegetation, should not be used as engineered fill and should be removed from below settlement-sensitive structures, if any are planned. This material should be disposed of offsite or may be used in non-structural areas or as topsoil, if it meets those requirements.

In order to provide a relatively consistent subgrade base for construction for areas to receive new pavements, it is recommended that the existing subgrade soils be overexcavated to a depth of 12 inches or more. This overexcavated zone should extend laterally 1 foot or more beyond the pavement footprint.

Following the overexcavation described above, and prior to the placement of any new fill, the resulting exposed surface should be proofrolled and carefully evaluated by Ninyo & Moore. Based on this evaluation, additional remediation may be needed. This could include additional scarification of the exposed surface. This additional remediation, if needed, should be addressed by Ninyo & Moore during the earthwork operations.

Engineered fill materials associated with this project should be placed in lifts not exceeding 8 inches loose thickness and compacted to 95 percent relative compaction as evaluated by ASTM D1557 in accordance with the Specifications, at moisture content between 2 percent below to 2 percent above the laboratory optimum.

Engineered fill material in trenches (if needed) should be mechanically compacted to a relative compaction of 95 percent as evaluated by ASTM D1557 at moisture content between 2 percent below to 2 percent above the laboratory optimum. Lift thickness for backfill will be dependent upon the type of compaction equipment utilized, but should generally be placed in lifts not exceeding 8 inches in loose thickness.

9.2.4 Bottom Stability

The proposed excavations are not anticipated to encounter significant groundwater (with the possible exception of surface run-off or perched zones) or soft materials at their base. Therefore, excavation and trench excavation bottom stability problems during construction are not anticipated on this site.

9.2.5 Construction Dewatering

No significant groundwater seepage from the regional groundwater table is anticipated on the site during construction. However, perched groundwater may be encountered where the new improvements are to be constructed.

Given the relatively low probability of encountering significant seepage on the site, we anticipate that the excavations that do encounter seepage or surface run-off could be dewatered by sumping the water from the bottom of the excavation. However, heavily saturated units or perched groundwater zones, if encountered, may call for more aggressive means of dewatering and consultation with a qualified expert. Discharge of water from the excavations to natural drainage channels may entail securing a special permit.

9.2.6 Imported Fill

Imported fill, if utilized, it should consist of clean, granular material with a relatively low PI (i.e., 15 or less). Imported material in contact with ferrous metals should preferably have low corrosion potential (minimum resistivity of 2,000 ohm-cm and chloride content less than 25 parts per million [ppm]). In lieu of this, corrosion protection techniques (e.g., cathodic protection, pipe wrapping, etc.) can be implemented. A corrosion specialist should be consulted for recommendations. Imported material in contact with concrete should have a

soluble sulfate content of less than 0.1 percent. We recommend that imported fill used to support new pavements (if needed) have an R-value of 30 or more and a CBR Value of 10 or more. The geotechnical consultant should evaluate such materials and details of their placement prior to importation.

If borrow material is needed for this project, it should comply with the requirements of the project Specifications. The on-site geotechnical representative should evaluate the potential borrow material before it is brought to the site.

9.2.7 Earthwork and Ground Compaction Factor

An earthwork (shrinkage) factor of 14 percent is estimated. This shrinkage factor represents an average of the materials encountered and assumes that materials excavated from the site will be placed as fill. Potential bidders should consider this in preparing estimates and should review the available data to make their own conclusions regarding excavation conditions.

We recommend that a ground compaction factor of 0.20 feet be used for this project. The ground compaction factor should be compensated for when constructing embankment fill sections outside the existing roadway prism.

9.3 Pavement Design

We understand that the new pavement will be reconstructed with AC and PCCP materials. The following sections present our design assumptions and recommendations for new pavement sections for the proposed improvements.

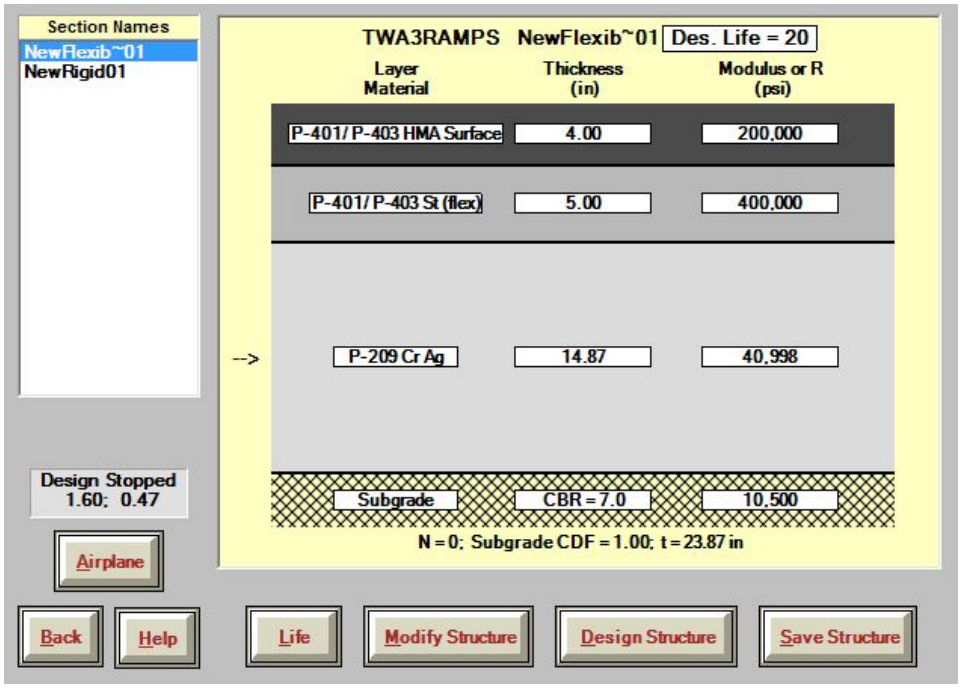
The design parameters we assumed for the pavement section includes a 20-year design life and maximum Gross Aircraft Weight up to 413,000 pounds for the design loading. This design also assumes that periodic pavement maintenance will be needed. Federal Aviation Authority Rigid and Flexible Iterative Elastic Layered Design (FAARFIELD) 1.42, the Federal Aviation Authority standard for airfield pavement design, was utilized to analyze the recommended pavement structural section below. FAARFIELD incorporates three dimensional (3D) finite element responses to aircraft loads (for both new pavements and pavement overlays) utilizing CBR for subgrade support, material modulus for pavement layers and aircraft weight. The pavement design calculations are presented in this report.

Based on the laboratory testing performed and for conservatism, a design CBR Value of 7 was used. This recommended value assumes the soil conditions encountered in borings B-1 through

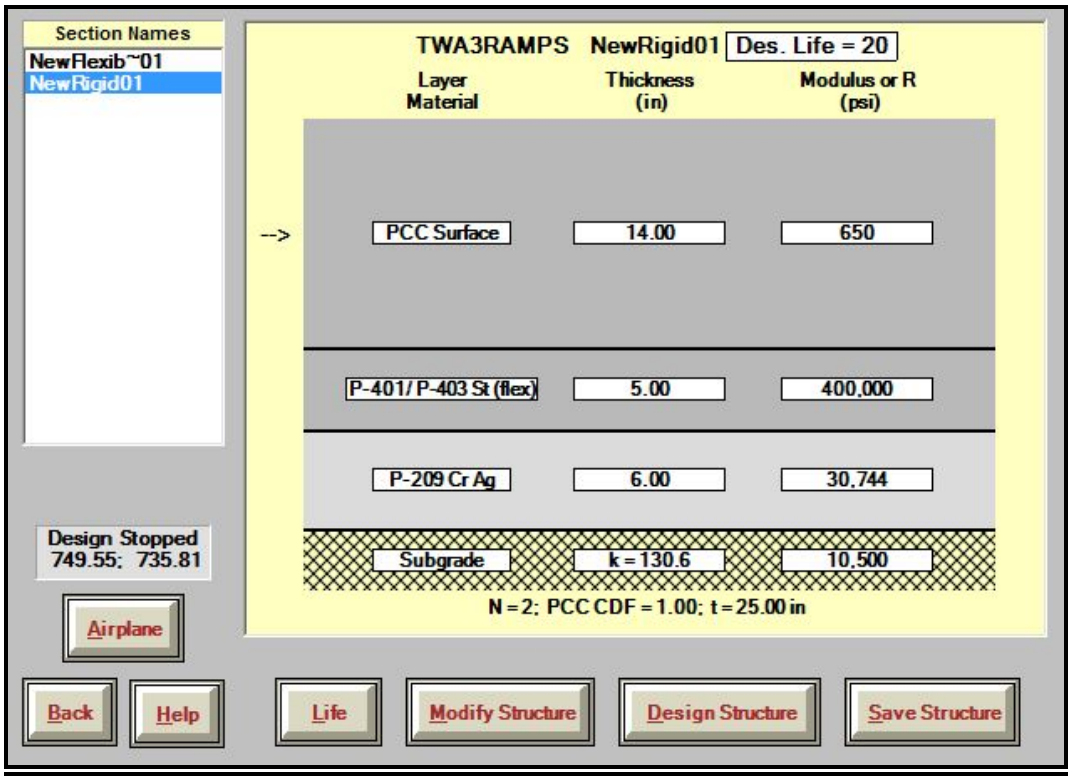
B-22 are representative of the soil conditions within the proposed pavement areas. If during construction, the subgrade is found to vary significantly from the expected soil conditions, we should be contacted so we may re-evaluate our design CBR value. For purposes of design, evaluation of the existing pavement, and new construction, it is assumed that soils within 3 feet of the finished roadway subgrade will exhibit an R-value of 30 or more and a CBR Value of 10 or more. We recommend that any new engineered fill used within 3 feet of the finished roadway subgrade also have an R-value of 30 or more and a CBR Value of 10 or more. If the project calls for import fill from an offsite source, we recommend that the soils used for pavement subgrade support have an R-value of 30 or more and a CBR Value of 10 or more. Please refer to Figure 7, Subgrade Acceptance Chart for guidance during construction.

For the pavement reconstruction, various alternatives for different sections of the project areas were considered. These alternatives are presented below.

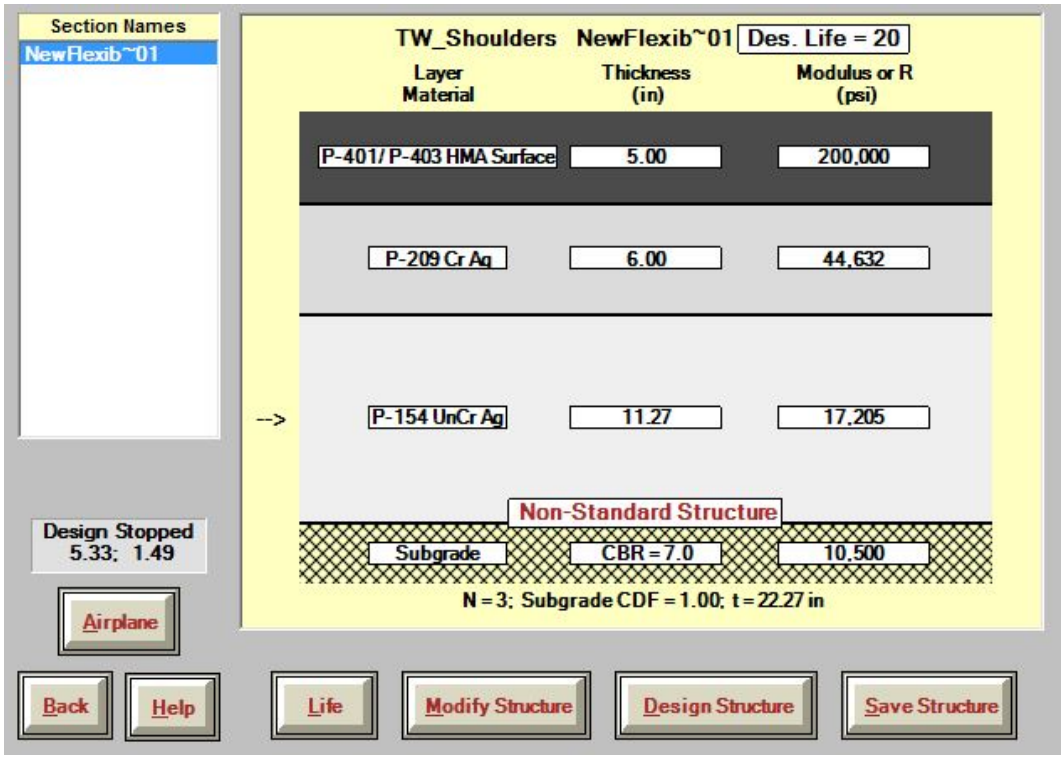
Section 1 – Taxiway A3 and Ramp 3 (New AC Pavement): Section 1 utilizes the existing aircraft fleet mix with a CBR value of 7. This pavement structural section applies to the Taxiway A3 and Ramp 3 reconstruction area. The CBR value of 7 was conservatively chosen due to the anticipated poor subgrade conditions located under the existing pavement. The recommended pavement structural for this section is 4 inches of P-401 AC and 5 inches of P-403 Stabilized Base AC on 15 inches of P-209 aggregate base course placed on 12 inches of prepared compacted subgrade. The pavement structural section reflects the minimum design pavement thickness allowed by the FAA. The output results from FAARFIELD are as follows:



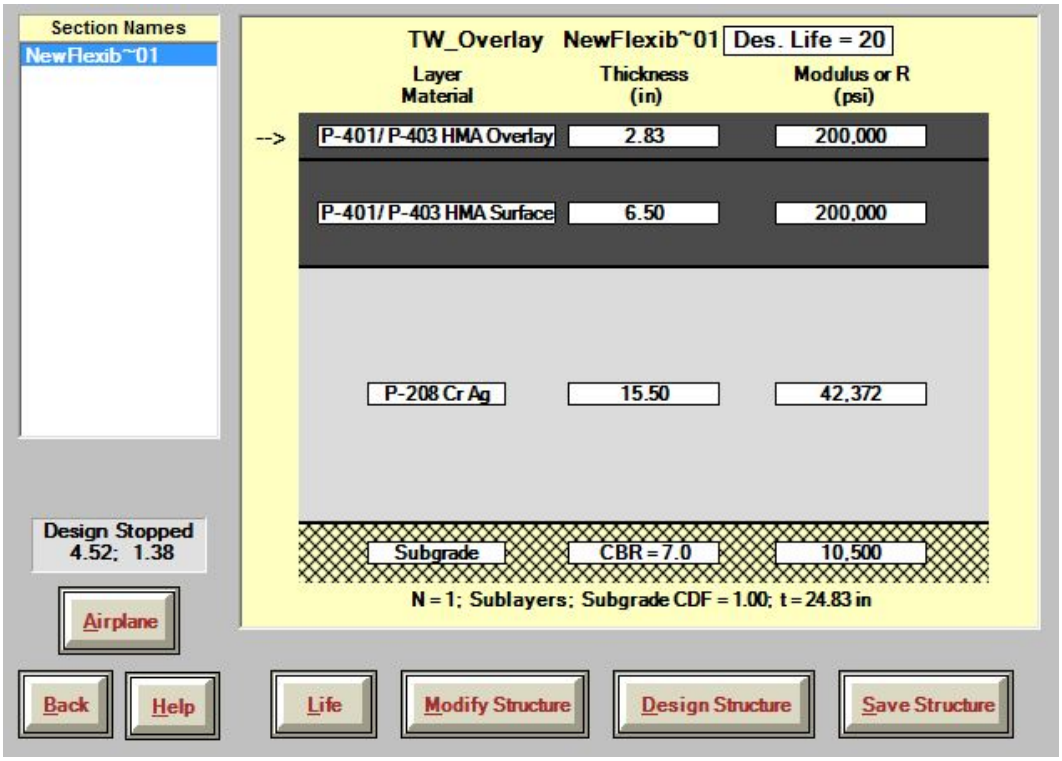
Section 2 – Taxiway A2 Widening (New PCCP Pavement): The following pavement structural section apply to the widening the existing taxiway A2. Section 2 utilizes the existing aircraft fleet mix with a k-value of 130.6 pond per cubic inch. As noted at the bottom of the output screen, the pavement structural section reflects the minimum design pavement thickness allowed by the FAA. The recommended pavement structure for section 2 is 14 inches of new P-501 PCCP on 5 inches of P-403 stabilized base and 6 inches of P-209 aggregate base placed on 12 inches of prepared compacted subgrade. The output results from FAARFIELD are as follows:



Section 3 – Taxiway A Shoulders (New AC Pavement): The recommended pavement structural for this section is 5 inches of P-401 AC and 6 inches of P-209 aggregate base on 11 inches of P-154 subbase placed on 12 inches of prepared compacted subgrade. The pavement structural section reflects the minimum design pavement thickness allowed by the FAA. The output results from FAARFIELD are as follows:



Section 4 – Taxiway A Overlay - The recommended pavement structural for this section is 2 inches of mill and 3 inches of new P-401 AC overlay. The pavement structural section reflects the minimum design pavement thickness allowed by the FAA. The output results from FAARFIELD are as follows:



9.4 Corrosion

From the chemical testing performed, the corrosion potential of the site soils was evaluated to determine the potential effect on concrete and ferrous materials.

Laboratory testing consisted of pH, minimum electrical resistivity, and soluble sulfate and chloride contents. The pH and minimum electrical resistivity tests were performed in general accordance with Arizona Test Method 236c, while sulfate and chloride tests were performed in accordance with Arizona Test Methods 733 and 736, respectively. The results of the corrosivity tests are presented in Appendix B.

The soil pH value of the selected samples from our borings ranged from 8.8 to 9.9, which is considered to be alkaline. The electrical resistivity values measured in the laboratory ranged from 375 to 2968 ohm-cm, which is considered corrosive to ferrous materials. The chloride content of the samples tested ranged from 5 ppm to 58 ppm, which is also considered to represent a corrosive environment to ferrous materials. The soluble sulfate content of the soil

samples tested ranged from 0.001 percent to 0.055 percent, which is considered to represent negligible sulfate exposure for concrete.

The results of the laboratory testing indicate that the on-site materials are potentially corrosive to ferrous metals. Special consideration may be given to the use of heavy-gauge, corrosion-protected, underground steel pipes or culverts, if any are planned. As an alternative, plastic pipe or reinforced concrete pipe may be considered. A corrosion specialist may be consulted.

9.5 Concrete

Laboratory chemical tests performed on soil samples indicated sulfate content of the soil samples tested ranged from 0.001 percent to 0.055 percent. Based on guidelines from the American Concrete Institute, the on-site soils should be considered to have a negligible sulfate exposure to concrete.

Notwithstanding the sulfate test results and due to the limited number of chemical tests performed, as well as our experience with similar soil conditions and regional practice, we recommend that Type II cement be used for the construction of concrete structures at this site. Due to potential uncertainties as to the use of reclaimed irrigation water, or topsoil that may contain higher sulfate contents, pozzolan or admixtures designed to increase sulfate resistance may be considered.

The concrete should have a water-cementitious materials ratio no more than 0.50 by weight for normal weight aggregate concrete. However, higher strength concrete may be selected for increased durability and resistance to shrinkage cracking. The structural engineer should ultimately select the concrete design strength based on the project-specific loading conditions.

9.6 Site Drainage and Storm Water

Surface drainage should be provided to divert water away from paved surfaces. Surface water should not be permitted to drain towards or to pond adjacent to pavement areas. Positive drainage for this project is defined as a slope of 2 or more percent for a distance of 5 or more feet away from the pavement.

9.7 Pre-Construction Conference

We recommend that a pre-construction conference be held. Representatives of the owner, civil engineer, Ninyo & Moore, and the contractor should be in attendance to discuss the project plans and schedule. Our office should be notified if the project description included herein is incorrect, or if the project characteristics are significantly changed.

9.8 Construction Observation and Testing

During construction operations, we recommend that Ninyo & Moore perform observation and testing services for the project. These services should be performed to evaluate exposed subgrade conditions, including the extent and depth of overexcavation, to evaluate the suitability of proposed borrow materials for use as fill and to observe placement, and test compaction of fill soils. If another geotechnical consultant is selected to perform observation and testing services for the project, we request that the selected consultant provide a letter to the owner, with a copy to Ninyo & Moore, indicating that they fully understand our recommendations and that they are in full agreement with the recommendations contained in this report. Qualified subcontractors utilizing appropriate techniques and construction materials should perform construction of the proposed improvements.

10 LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

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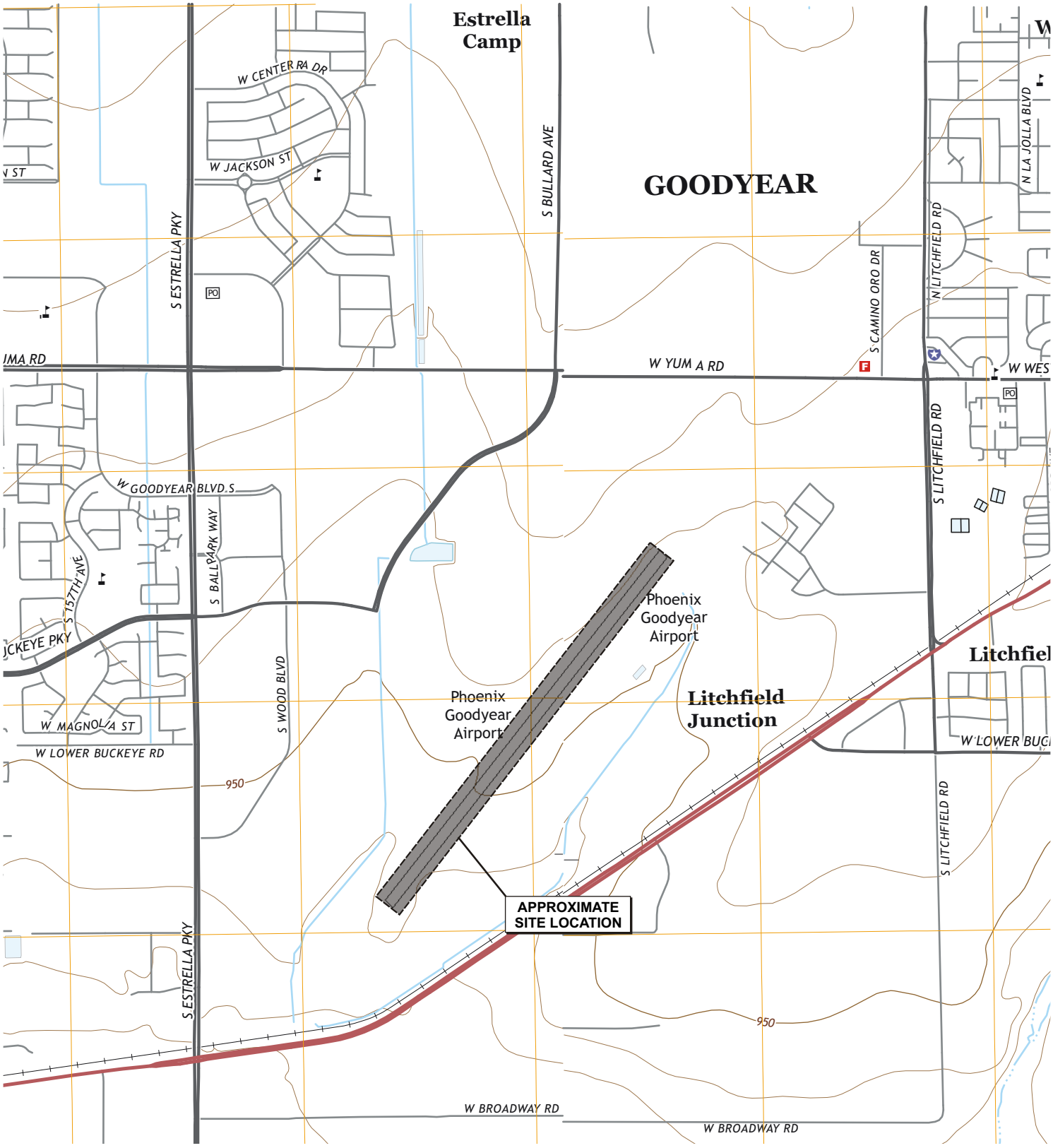
FIGURES



Source: US Geological Survey 7.5-minute topographic map, Tolleson & Perryville, Arizona, 2014.

N

0 2000

Approximate Scale in Feet

Note: Dimensions, directions and locations are approximate.

FIGURE 1

SITE LOCATION

PHOENIX-GOODYEAR TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

605605001 | 5/18

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

bsm file no: 5605vmap0318

Source: NAVTEQ, 10/04/16.

0 580
Approximate Scale in Feet

Note: Dimensions, directions and locations are approximate.

bsm file no: 5605blm0318

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FIGURE 2

BORING LOCATIONS

PHOENIX-GOODYEAR TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

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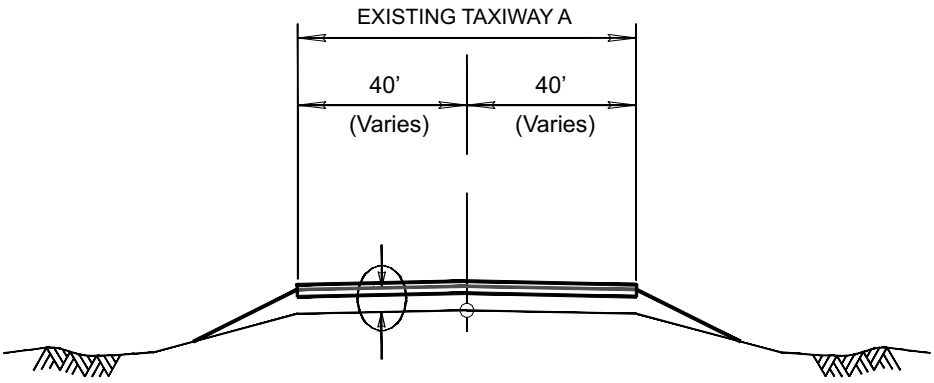

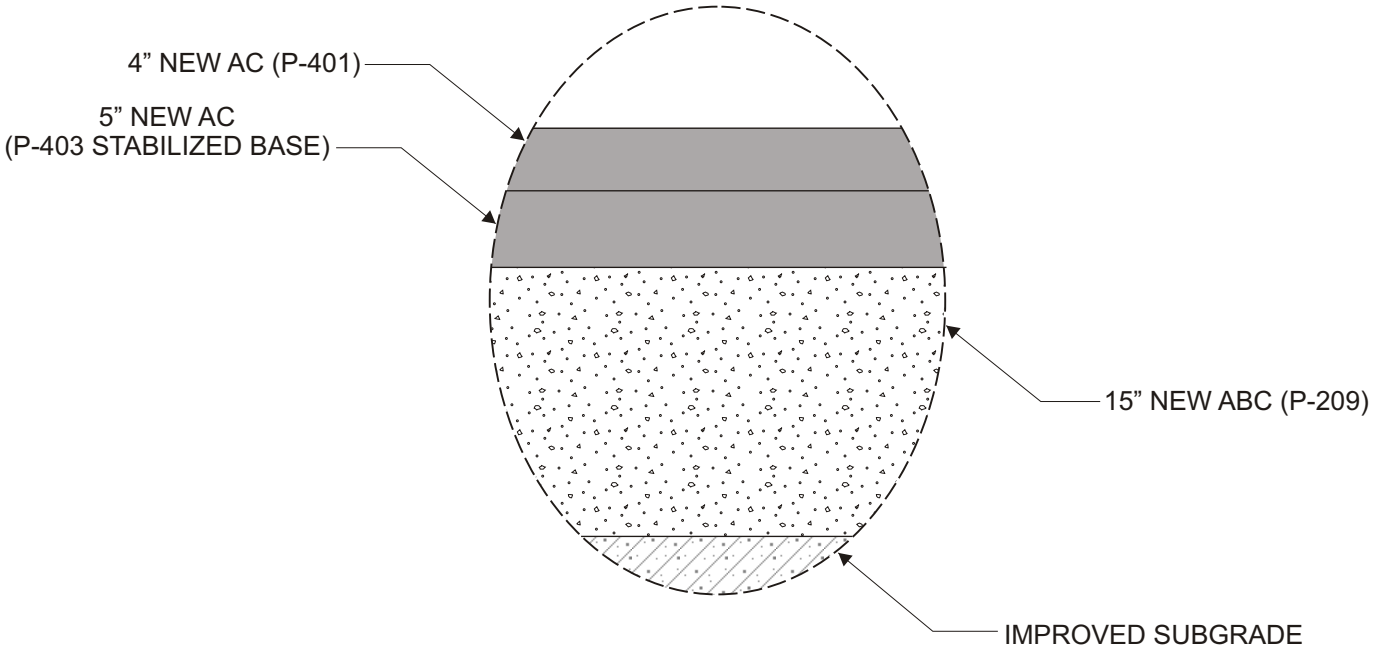

PHASE 1
TAXIWAY A3 AND RAMP 3*

* SEE PLANS FOR LOCATIONS AND APPLICATIONS

FIGURE 3

PAVEMENT SECTION

PHOENIX-GOODYEAR TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

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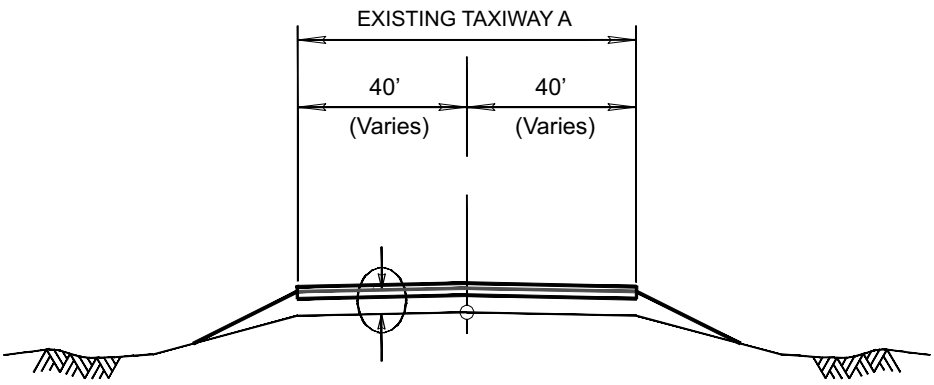
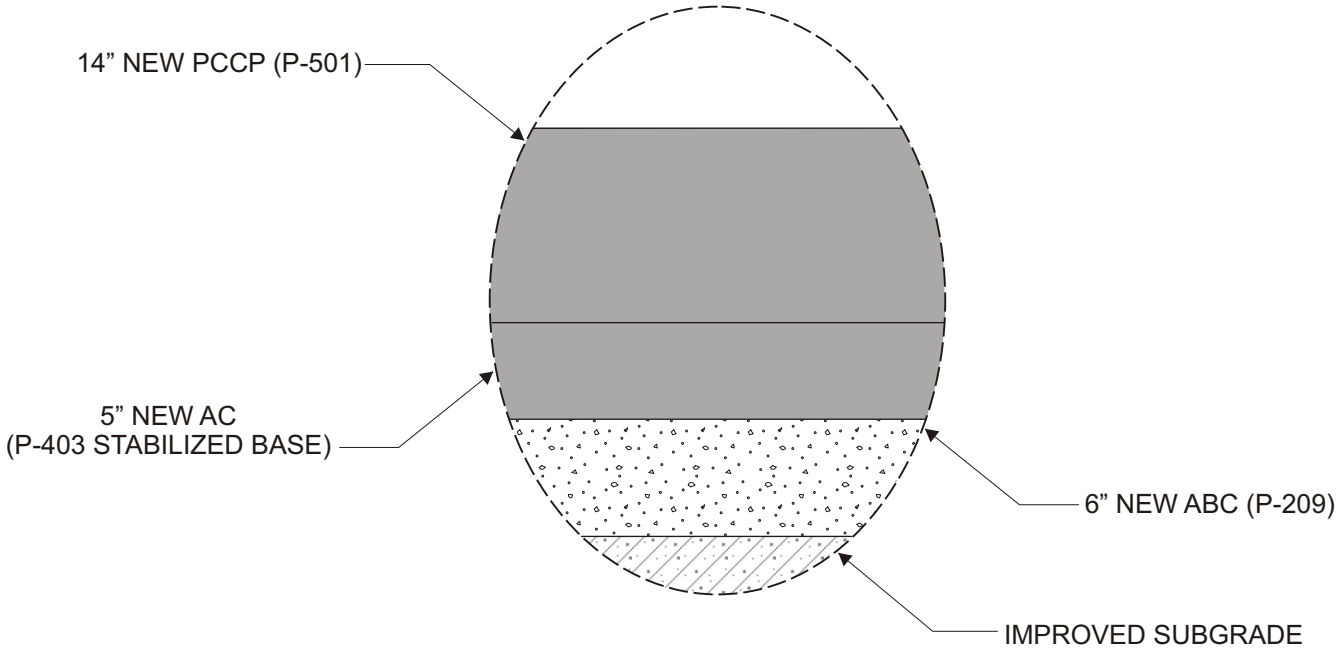
bsm file no: 5605sec0318a





PHASE 2
TAXIWAY A2 WIDENING *

* SEE PLANS FOR LOCATIONS AND APPLICATIONS

FIGURE 4

PAVEMENT SECTION

PHOENIX-GOODYEAR TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

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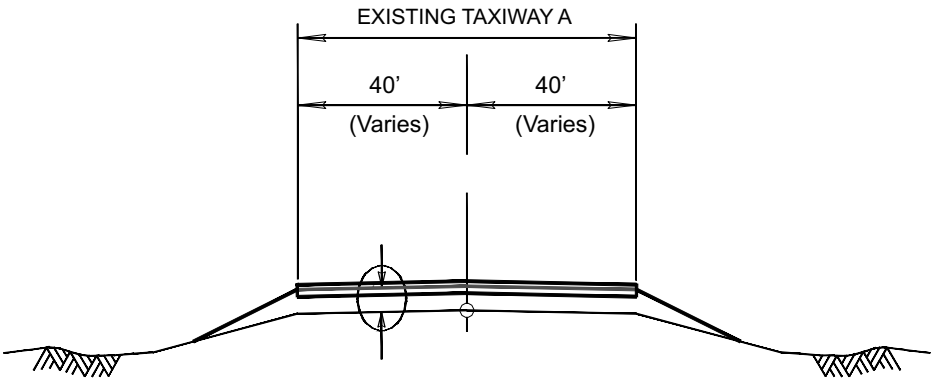
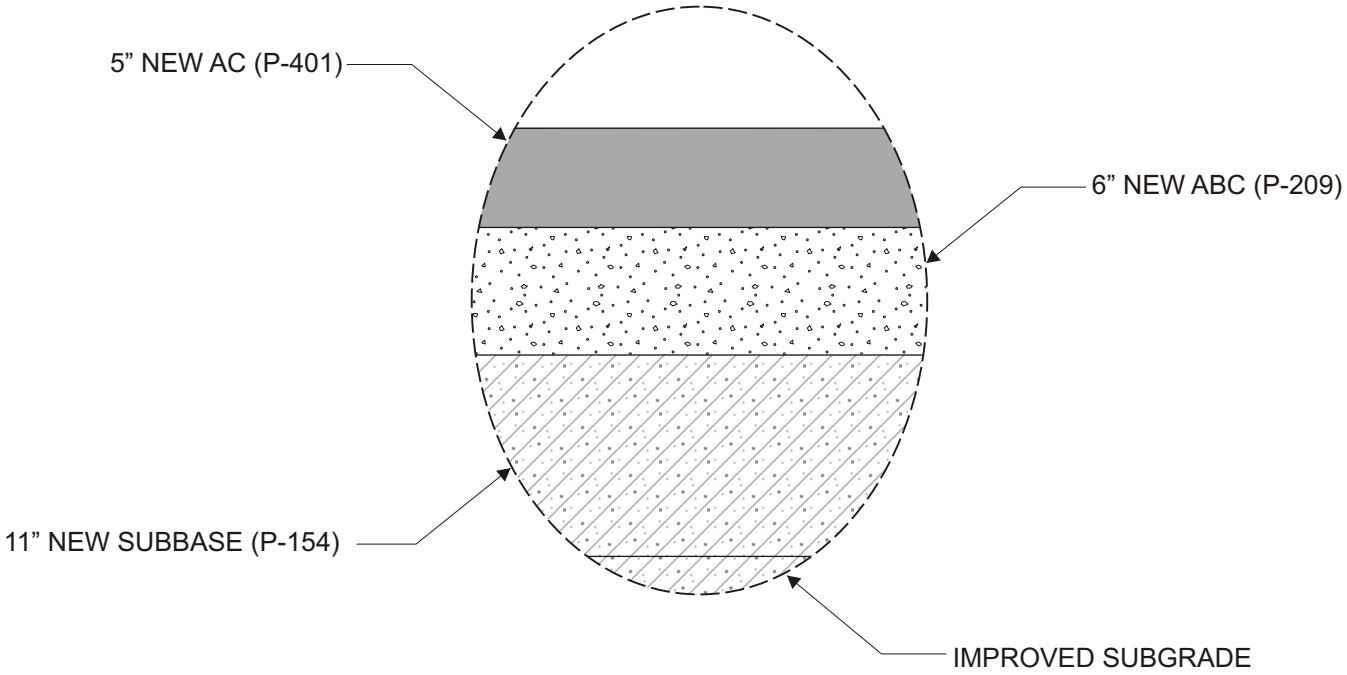
bsm file no: 5605sec0318b





TAXIWAY SHOULDERS*

* SEE PLANS FOR LOCATIONS AND APPLICATIONS

FIGURE 5

PAVEMENT SECTION

PHOENIX-GOODYEAR TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

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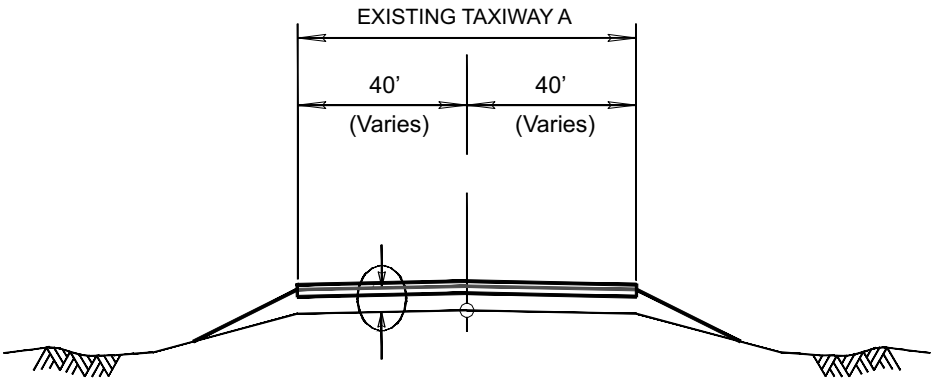
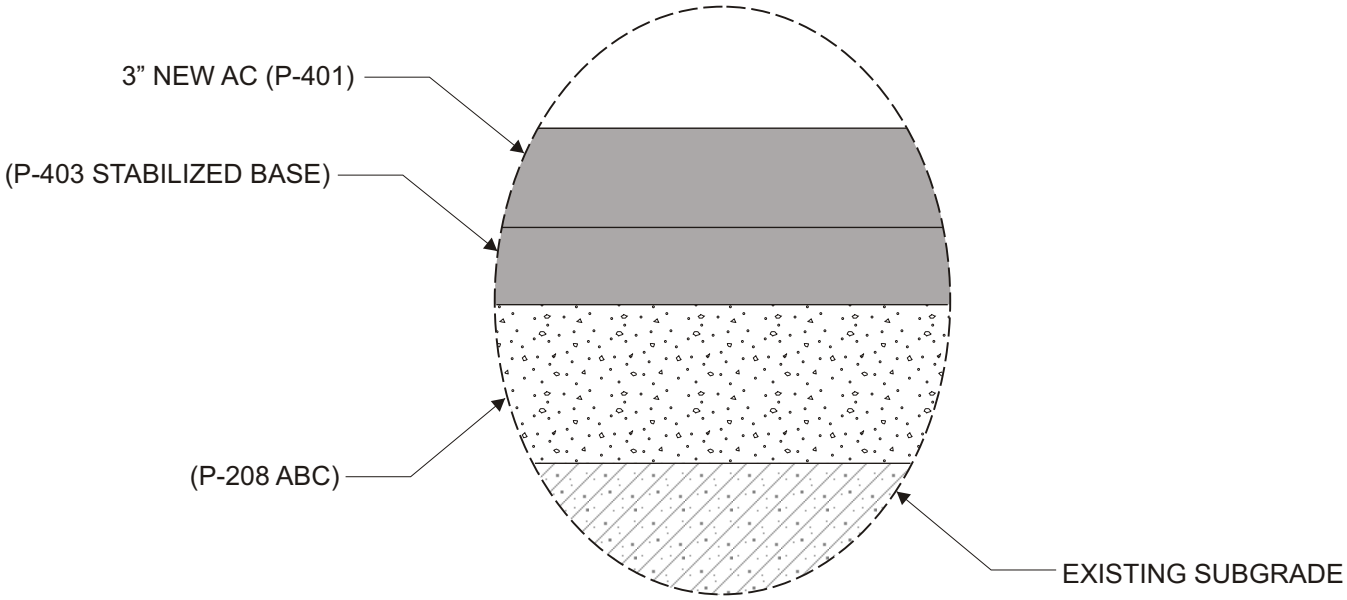




TAXIWAY OVERLAY*

* SEE PLANS FOR LOCATIONS AND APPLICATIONS

FIGURE 6

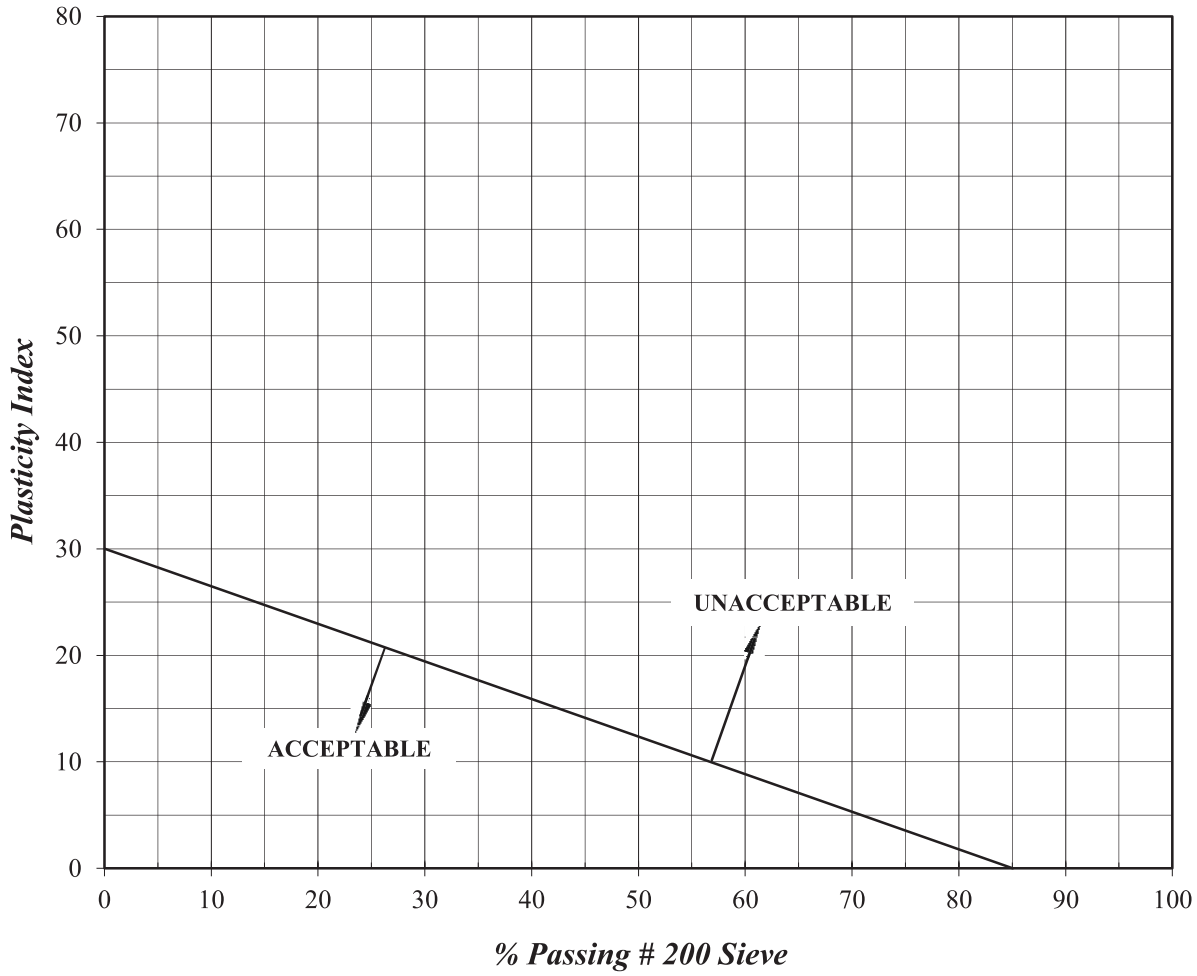
PAVEMENT SECTION

PHOENIX-GOODYEAR TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

bsm file no: 5605sec0318d

TYPICAL SECTION



DESIGN R-VALUE: 30

FIGURE 7

SUBGRADE ACCEPTANCE CHART

PHOENIX-GOODYEAR TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

bsm file no: 5605cht0318

APPENDIX A

Boring Logs

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples

Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples

Bulk samples of representative earth materials were obtained from the exploratory borings and test pits. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Sampler

Disturbed drive samples of earth materials were obtained by means of a SPT sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1-3/8 inches. The sampler was driven into the ground 12 to 18 inches with a 140-pound hammer falling freely from a height of 30 inches in general accordance with ASTM D1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the sampler, bagged, sealed and transported to the laboratory for testing.

Field Procedure for the Collection of Relatively Undisturbed Samples

Relatively undisturbed soil samples were obtained in the field using the following methods.

The Modified Split-Barrel Drive Sampler

The sampler, with an external diameter of 3.0 inches, was lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sample barrel was driven into the ground with the weight of a hammer or the kelly bar of the drill rig in general accordance with ASTM D1586. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer or bar, and the number of blows per foot of driving are presented on the boring logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

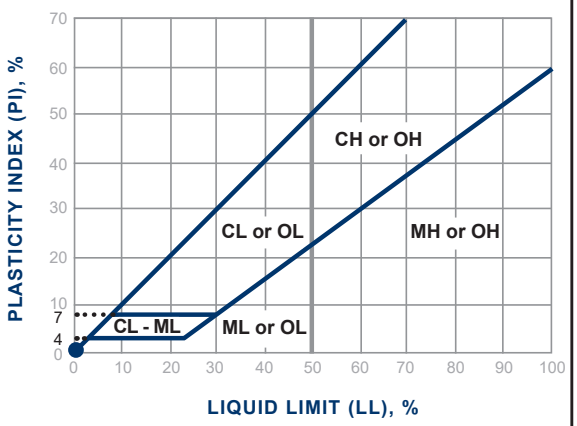
Soil Classification Chart Per ASTM D 2488

Primary Divisions			Secondary Divisions	
			Group Symbol	Group Name
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	**GRAVEL** more than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVEL less than 5% fines	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL with DUAL CLASSIFICATIONS 5% to 12% fines	GW-GM	well-graded GRAVEL with silt
			GP-GM	poorly graded GRAVEL with silt
			GW-GC	well-graded GRAVEL with clay
			GP-GC	poorly graded GRAVEL with
		GRAVEL with FINES more than 12% fines	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND 50% or more of coarse fraction passes No. 4 sieve	CLEAN SAND less than 5% fines	SW	well-graded SAND
			SP	poorly graded SAND
		SAND with DUAL CLASSIFICATIONS 5% to 12% fines	SW-SM	well-graded SAND with silt
			SP-SM	poorly graded SAND with silt
			SW-SC	well-graded SAND with clay
			SP-SC	poorly graded SAND with clay
		SAND with FINES more than 12% fines	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	**SILT and CLAY** liquid limit less than 50%	INORGANIC	CL	lean CLAY
			ML	SILT
			CL-ML	silty CLAY
		ORGANIC	OL (PI > 4)	organic CLAY
			OL (PI < 4)	organic SILT
	SILT and CLAY liquid limit 50% or more	INORGANIC	CH	fat CLAY
			MH	elastic SILT
		ORGANIC	OH (plots on or above "A"-line)	organic CLAY
			OH (plots below "A"-line)	organic SILT
	Highly Organic Soils		PT	Peat

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		> 12"	> 12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock-salt-sized to pea-sized
	Medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	< 0.0029"	Flour-sized and smaller

Plasticity Chart



Apparent Density - Coarse-Grained Soil

Apparent Density	Spooling Cable or Cathead		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	Modified Split Barrel (blows/foot)
Very Loose	≤ 4	≤ 8	≤ 3	≤ 5
Loose	5 - 10	9 - 21	4 - 7	6 - 14
Medium Dense	11 - 30	22 - 63	8 - 20	15 - 42
Dense	31 - 50	64 - 105	21 - 33	43 - 70
Very Dense	> 50	> 105	> 33	> 70

Consistency - Fine-Grained Soil

Consis-tency	Spooling Cable or Cathead		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	Modified Split Barrel (blows/foot)
Very Soft	< 2	< 3	< 1	< 2
Soft	2 - 4	3 - 5	1 - 3	2 - 3
Firm	5 - 8	6 - 10	4 - 5	4 - 6
Stiff	9 - 15	11 - 20	6 - 10	7 - 13
Very Stiff	16 - 30	21 - 39	11 - 20	14 - 26
Hard	> 30	> 39	> 20	> 26

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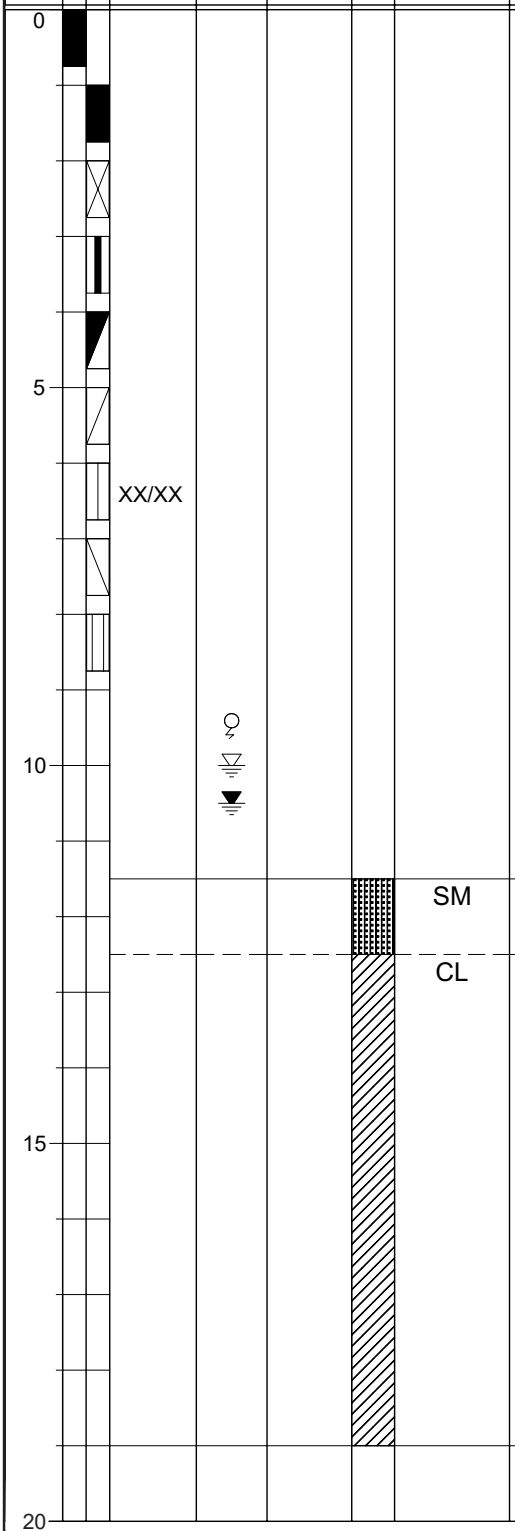
USCS METHOD OF SOIL CLASSIFICATION

BORING LOG EXPLANATION SHEET



Bulk sample.

Modified split-barrel drive sampler.

No recovery with modified split-barrel drive sampler.

Sample retained by others.

Standard Penetration Test (SPT).

No recovery with a SPT.

Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.

No recovery with Shelby tube sampler.

Continuous Push Sample.

Seepage.

Groundwater encountered during drilling.

Groundwater measured after drilling.

MAJOR MATERIAL TYPE (SOIL):

Solid line denotes unit change.

Dashed line denotes material change.

Attitudes: Strike/Dip
b: Bedding
c: Contact
j: Joint
f: Fracture
F: Fault
cs: Clay Seam
s: Shear
bss: Basal Slide Surface
sf: Shear Fracture
sz: Shear Zone
sbs: Shear Bedding Surface

The total depth line is a solid line that is drawn at the bottom of the boring.

DATE DRILLED 1/15/18 BORING NO. B-1

GROUND ELEVATION 937' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 8.4-inches thick
		50/5"	8.0	110.5		GC-GM	BASE MATERIAL: Brown, dry, dense, silty clayey GRAVEL.
5		23				SC	ALLUVIUM: Brown, dry, dense, clayey SAND.
		12	15.2	105.9			Loose.
		11					Medium dense.
10							Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/15/18 shortly after completion of drilling.
15							Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20							

DATE DRILLED 1/15/18 BORING NO. B-2

GROUND ELEVATION 941' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 9.8-inches thick
			32				SC-SM	BASE MATERIAL: Brown, dry, dense, silty clayey SAND.
			24	10.3	119.2		SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND.
5			3					Loose.
			9	11.5	102.3			
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled and non-shrink grout patched on 1/15/18 shortly after completion of drilling.
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
15								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20								

DATE DRILLED 1/15/18 BORING NO. B-3

GROUND ELEVATION 943' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8.5-inches thick
		X	62				GC-GM	BASE MATERIAL: Brown, dry, dense, silty clayey GRAVEL. No ring recovery; bagged two rings.
			8				CL	ALLUVIUM: Brown, moist, firm, lean CLAY.
5			26	20.2	73.7			
			45					Very dense; few gravel.
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/15/18 shortly after completion of drilling.
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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FIGURE A- 3

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PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

DATE DRILLED 1/15/18 BORING NO. B-4

GROUND ELEVATION 943' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8.6-inches thick
			25				SC-SM	BASE MATERIAL: Brown, dry, dense, silty clayey SAND.
			20	11.2	110.2		SC	ALLUVIUM: Brown, dry, dense, clayey SAND.
5			14					Medium dense; scattered caliche nodules.
			20	16.1	93.1			
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/15/18 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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DATE DRILLED 1/15/18 BORING NO. B-5

GROUND ELEVATION 943' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8.8-inches thick
							GC-GM	BASE MATERIAL: Brown, dry, medium dense, silty clayey GRAVEL.
			27	15.6	104.5		SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND; scattered caliche nodules.
5			28					
			32	13.1	109.4			
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/15/18 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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DATE DRILLED 1/15/18 BORING NO. B-6

GROUND ELEVATION 946' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 9.1-inches thick
			29				SP-SM	BASE MATERIAL: Brown, dry, medium dense, poorly graded SAND with silt.
			33	20.3	102.2		SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND; scattered caliche nodules.
5			30					Dense.
			32	24.1	98.5			Medium dense.
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/15/18 shortly after completion of drilling.
15								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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DATE DRILLED 1/16/18 BORING NO. B-7

GROUND ELEVATION 946' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 9.7-inches thick
		■	50/3"	6.9	100.6		GC-GM	BASE MATERIAL: Brown, dry, very dense, silty clayey GRAVEL.
		■	20				SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND; numerous caliche nodules.
5		■	26	13.6	99.1			
		■	26					Dense.
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/16/18 shortly after completion of drilling.
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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DATE DRILLED 1/16/18 BORING NO. B-8

GROUND ELEVATION 951' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8.2-inches thick
			43				SM	BASE MATERIAL: Brown, dry, dense, silty SAND.
			53	9.5	117.4		SC	ALLUVIUM: Brown, dry, dense, clayey SAND.
5			21					Scattered caliche nodules.
			35	15.5	109.7			Medium dense.
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/16/18 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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DATE DRILLED 1/16/18 BORING NO. B-9

GROUND ELEVATION 952' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 8.6-inches thick
		50/5"	7.0	106.7		GC-GM	BASE MATERIAL: Brown, dry, very dense, silty clayey GRAVEL.
5		14				SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND.
		8	11.3	109.0			Loose.
10		11					Medium dense.
							Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/16/18 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
15							
20							

DATE DRILLED 1/16/18 BORING NO. B-10

GROUND ELEVATION 952' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8.2-inches thick
							GP	BASE MATERIAL: Brown, dry, very dense, poorly graded GRAVEL.
			39				SC-SM	ALLUVIUM: Brown, dry, medium dense, silty clayey SAND; scattered caliche nodules.
			30	9.3	109.8			
5								
			25					Dense.
			21	14.8	100.1			Medium dense.
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/16/18 shortly after completion of drilling.
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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FIGURE A- 10

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PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

DATE DRILLED 1/16/18 BORING NO. B-11

GROUND ELEVATION 953' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 9.0-inches thick
		■	50/5"	7.4	108.6		GC-GM	BASE MATERIAL: Brown, dry, very dense, silty clayey GRAVEL.
5		■	10				SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND; scattered caliche nodules.
		■	23	12.9	105.4			
10		■	17					Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/16/18 shortly after completion of drilling.
15								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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FIGURE A- 11

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

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DATE DRILLED 1/16/18 BORING NO. B-12

GROUND ELEVATION 953' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 7.5-inches thick
			50/4"				SW-SM	BASE MATERIAL: Brown, dry, very dense, well graded SAND with silt.
			31	10.8	110.7		SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND; scattered caliche nodules.
5			12					
			56	11.6	108.1			Dense.
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/16/18 shortly after completion of drilling.
15								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20								

DATE DRILLED 1/16/18 BORING NO. B-13

GROUND ELEVATION 954' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8.6-inches thick
							GC-GM	BASE MATERIAL: Brown, dry, medium dense, silty clayey GRAVEL.
			32	7.5	118.1		SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND; scattered caliche nodules.
			15					
5								
			44					Dense.
			25	15.0	96.1			
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/16/18 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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20								

FIGURE A- 13

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PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

DATE DRILLED 1/16/18 BORING NO. B-14

GROUND ELEVATION 955' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 9.3-inches thick
						GC-GM	BASE MATERIAL: Brown, dry, dense, silty clayey GRAVEL.
		28				CL	ALLUVIUM: Brown, moist, stiff, lean CLAY.
5		31	10.5	118.7			Medium dense.
		5					Loose.
10		33	14.5	106.0			Medium dense; scattered caliche nodules.
							Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/16/18 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
15							
20							

DATE DRILLED 1/16/18 BORING NO. B-15

GROUND ELEVATION 953' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 9.8-inches thick
		31	7.5	117.2		GC-GM	BASE MATERIAL: Brown, dry, medium dense, silty clayey GRAVEL.
5		8				SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND; trace gravel.
		30	11.1	114.2			
10		4					Moist; trace gravel.
							Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/16/18 shortly after completion of drilling.
15							Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
							The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20							

DATE DRILLED 1/16/18 BORING NO. B-16

GROUND ELEVATION 953' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 9.1-inches thick
							GC-GM	BASE MATERIAL: Brown, dry, dense, silty clayey GRAVEL.
			24				SC	ALLUVIUM: Brown, dry, dense, clayey SAND.
5			38	14.2	110.7			Medium dense; trace gravel.
			10					
			17	11.7	101.5			Scattered caliche nodules.
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/16/18 shortly after completion of drilling.
15								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20								

DATE DRILLED 1/17/18 BORING NO. B-17

GROUND ELEVATION 955' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8.4-inches thick
							GC-GM	BASE MATERIAL: Brown, dry, medium dense, silty clayey GRAVEL.
			29	6.3	111.2		SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND.
			13					
5							SM	Brown, dry, loose, silty SAND; trace clay.
			8	11.7	104.9			
							SC	Brown, moist, medium dense, clayey SAND.
			16					
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/17/18 shortly after completion of drilling.
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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DATE DRILLED 1/17/18 BORING NO. B-18

GROUND ELEVATION 955' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 8.5-inches thick
						GC-GM	BASE MATERIAL: Brown, dry, medium dense, silty clayey GRAVEL.
		17				CL	ALLUVIUM: Brown, moist, firm, lean CLAY.
5		36	12.9	111.9			
		4					Loose.
		26	14.0	107.4			Medium dense.
10							Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/17/18 shortly after completion of drilling.
							Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
							The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
15							
20							

DATE DRILLED 1/17/18 BORING NO. B-19

GROUND ELEVATION 955' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 9.6-inches thick
		☒	50/4"				GC-GM	BASE MATERIAL: Brown, dry, dense, silty clayey GRAVEL. No ring recovery; bagged amount of two rings.
			17				SM	ALLUVIUM: Brown, dry, medium dense, silty SAND.
5			10	12.5	103.8			Loose.
			4					
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/17/18 shortly after completion of drilling.
15								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20								

DATE DRILLED 1/17/18 BORING NO. B-20

GROUND ELEVATION 956' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8.6-inches thick
							GC-GM	BASE MATERIAL: Brown, dry, dense, silty clayey GRAVEL.
			29				CL-ML	ALLUVIUM: Brown, moist, stiff, silty CLAY.
			27	10.9	118.0			Medium dense.
5							SM	Brown, moist, loose, silty SAND; trace gravel.
			5					
							SC	Brown, moist, medium dense, clayey SAND.
			38	10.5	116.6			
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/17/18 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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DATE DRILLED 1/17/18 BORING NO. B-21

GROUND ELEVATION 956' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8.4-inches thick
		■	35	6.4	123.0		GC-GM	BASE MATERIAL: Brown, dry, medium dense, silty clayey GRAVEL.
		■	16				CL	ALLUVIUM: Brown, moist, firm, lean CLAY.
5		■	18	13.9	107.8			
		■	10					
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/17/18 shortly after completion of drilling.
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
15								
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DATE DRILLED 1/17/18 BORING NO. B-22

GROUND ELEVATION 957' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (Wildcat Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 9.3-inches thick
			19				SM	BASE MATERIAL: Brown, dry, medium dense, silty SAND.
			32				SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND; scattered caliche nodules. No recovery; possible large gravel down.
5			13					
			51	11.1	108.0			Dense.
10								Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 1/17/18 shortly after completion of drilling.
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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APPENDIX B

Laboratory Testing

APPENDIX B

LABORATORY TESTING

Classification
Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D2488. Soil classifications are indicated on the logs of the exploratory borings in Appendix A.

In-Place Moisture and Density Tests
The moisture content and dry density of relatively undisturbed samples obtained from the exploratory borings were evaluated in general accordance with ASTM D2937. The test results are presented on the logs of the exploratory borings in Appendix A.

Gradation Analysis
Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D422. The grain-size distribution curves are shown on Figures B-1 through B-15. These test results were utilized in evaluating the soil classifications in accordance with the USCS.

Atterberg Limits
Tests were performed on selected representative fine-grained soil samples to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D4318. These test results were utilized to evaluate the soil classification in accordance with the USCS. The test results and classifications are shown on Figures B-16 and B-17.

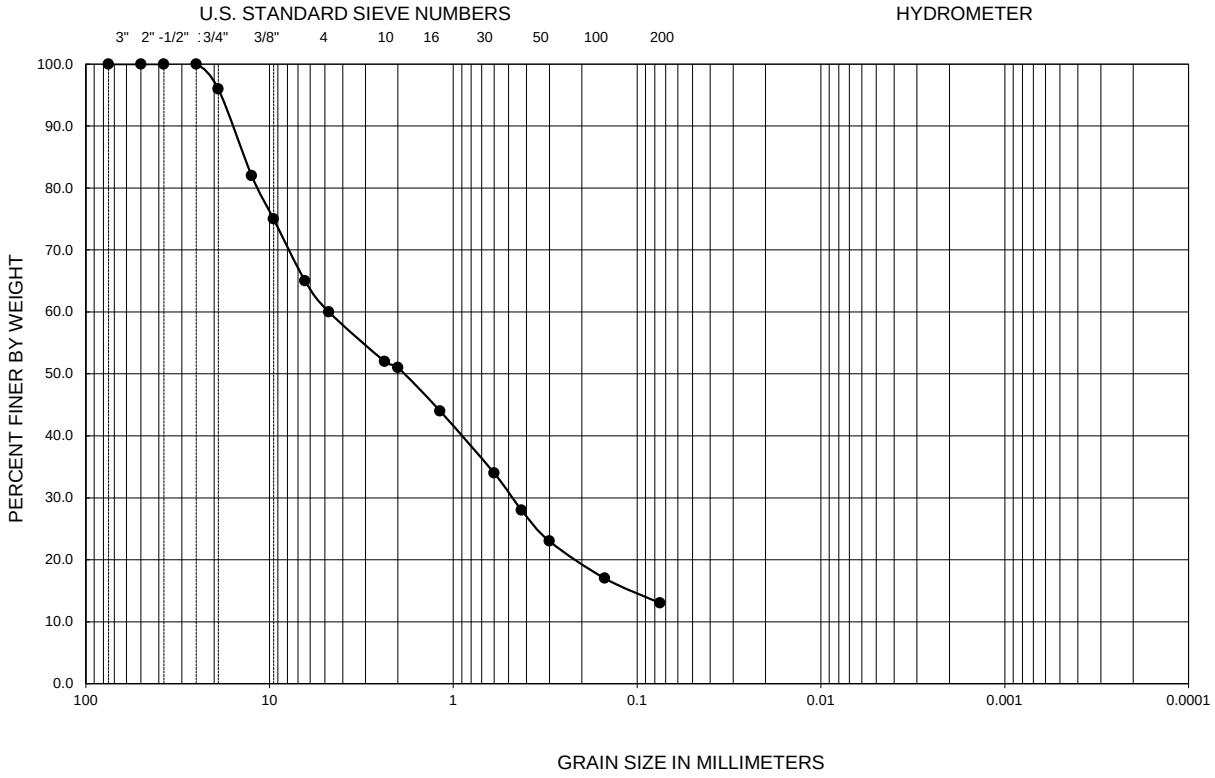
Consolidation Tests
Consolidation tests were performed on selected relatively undisturbed soil samples in general accordance with ASTM D2435. The samples were inundated during testing to represent adverse field conditions. The percent of consolidation for each load cycle was recorded as a ratio of the amount of vertical compression to the original height of the sample. The results of the tests are summarized on Figures B-18 through B-21.

Maximum Dry Density and Optimum Moisture Content Tests
The maximum dry density and optimum moisture content of selected representative soil samples were evaluated in general accordance with ASTM D1557. The results of these tests are summarized on Figure B-22.

California Bearing Ratio (CBR) Tests
The California Bearing Ratio (CBR) of selected representative soil samples were evaluated in general accordance with ASTM D 1883. The results of these tests are summarized on Figure B-23.

Soil Corrosivity Tests
Soil pH, and resistivity tests were performed on representative samples in general accordance with Arizona Test Method 236c. The soluble sulfate and chloride content of a selected sample were evaluated in general accordance with Arizona Test Method 733 and Arizona Test Method 736, respectively. The test results are presented on Figure B-24.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B2	1-2.5	24	20	4	--	0.478	4.83	--	--	13.0	SC-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

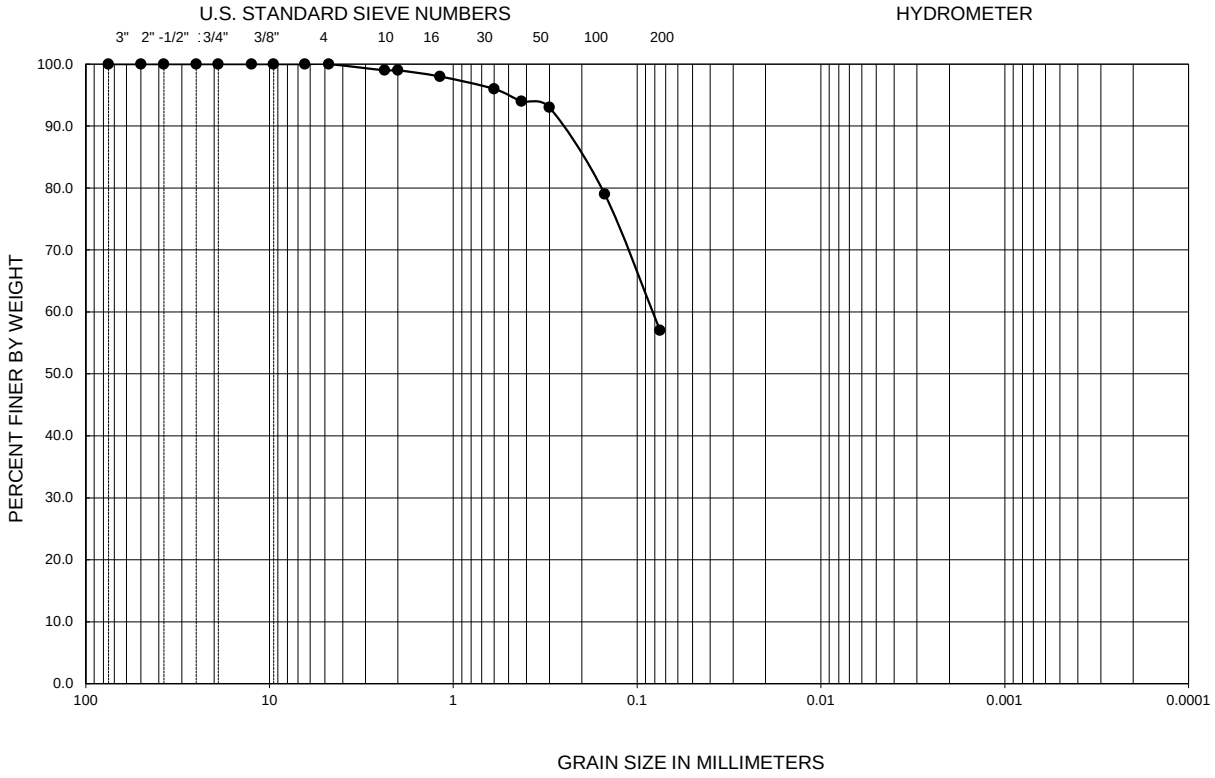
FIGURE B-1

GRADATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B3	6-7.5	42	20	22	--	--	0.08	--	--	57.0	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

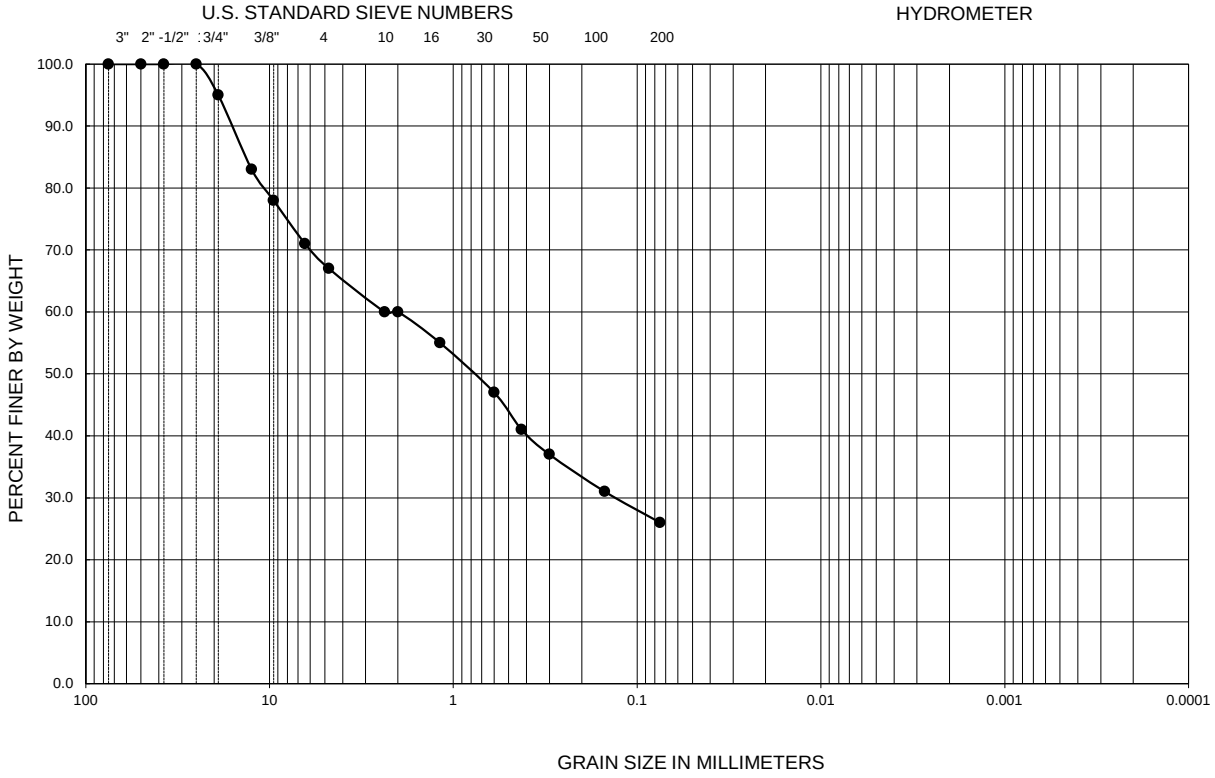
FIGURE B-2

GRADATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B4	1-2.5	28	21	7	--	0.130	2.39	--	--	26.0	SC-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

FIGURE B-3

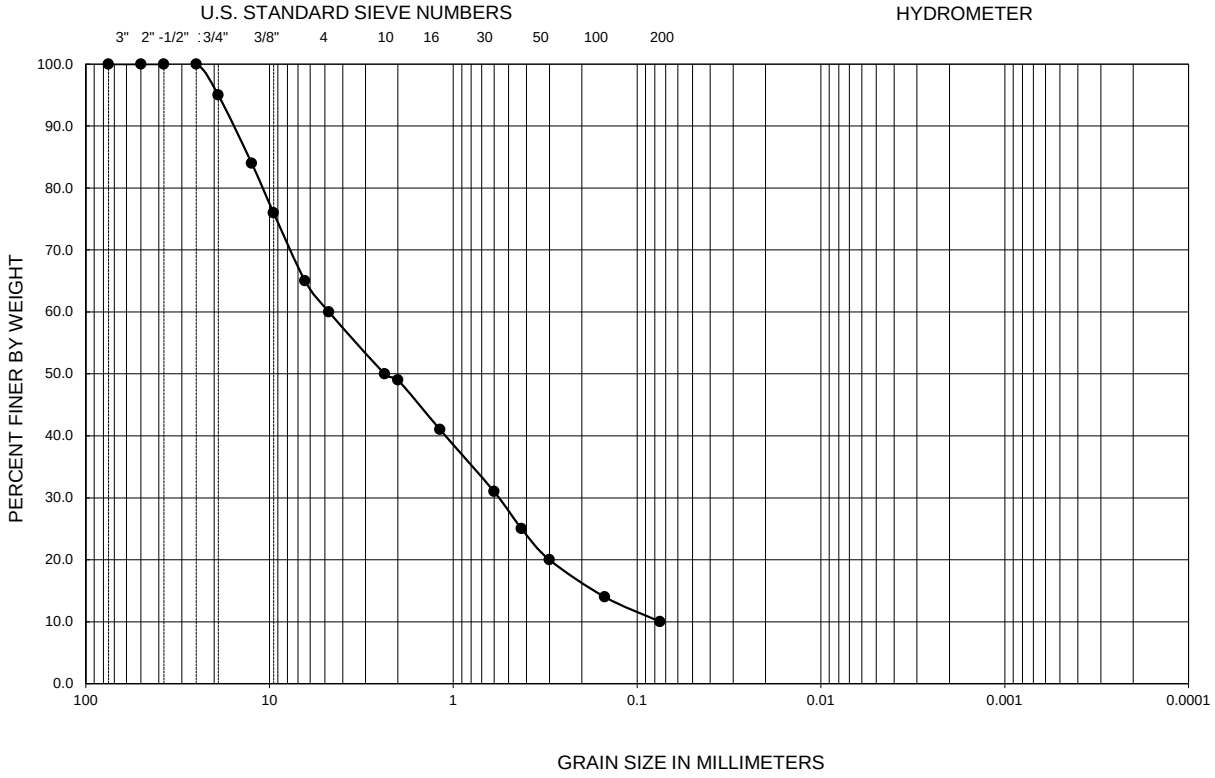
GRADATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B6	1-2.5	28	26	2	0.074	0.555	4.83	65.2	0.9	10.0	SP-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

FIGURE B-4

GRADATION TEST RESULTS

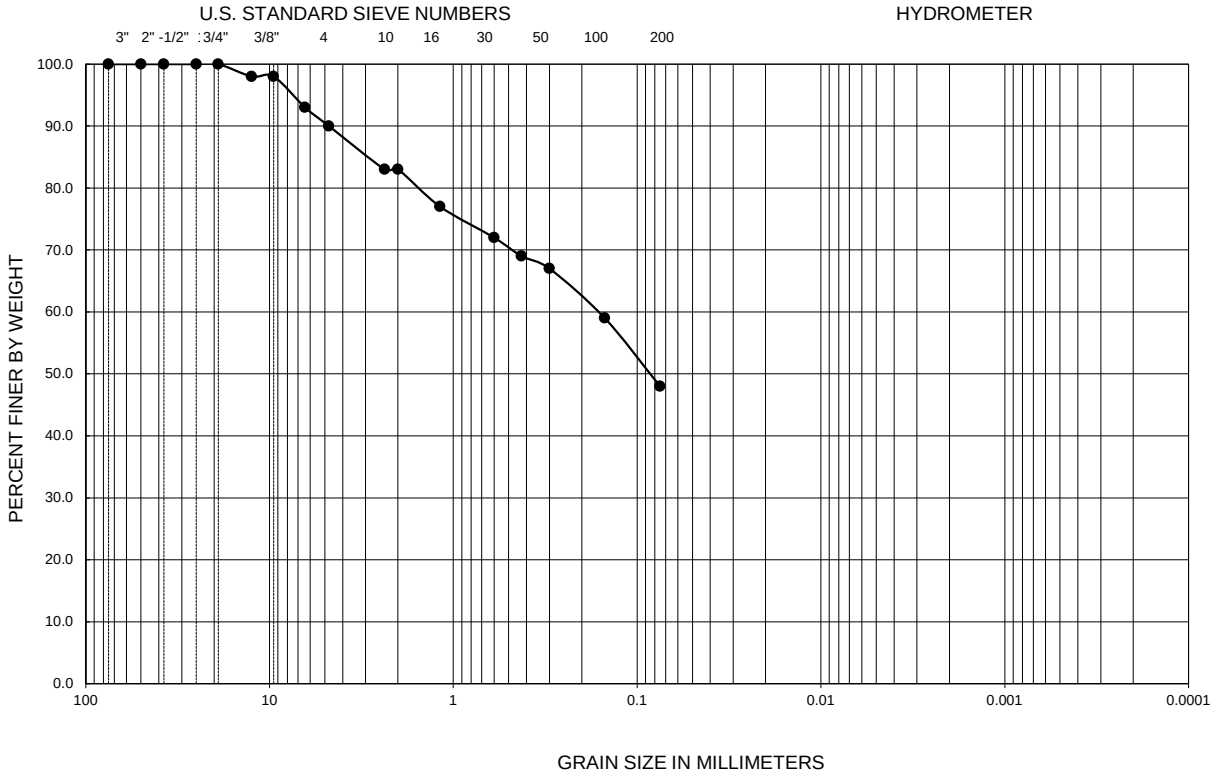
PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B7	6-7.5	39	19	20	--	--	0.16	--	--	48.0	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

FIGURE B-5

GRADATION TEST RESULTS

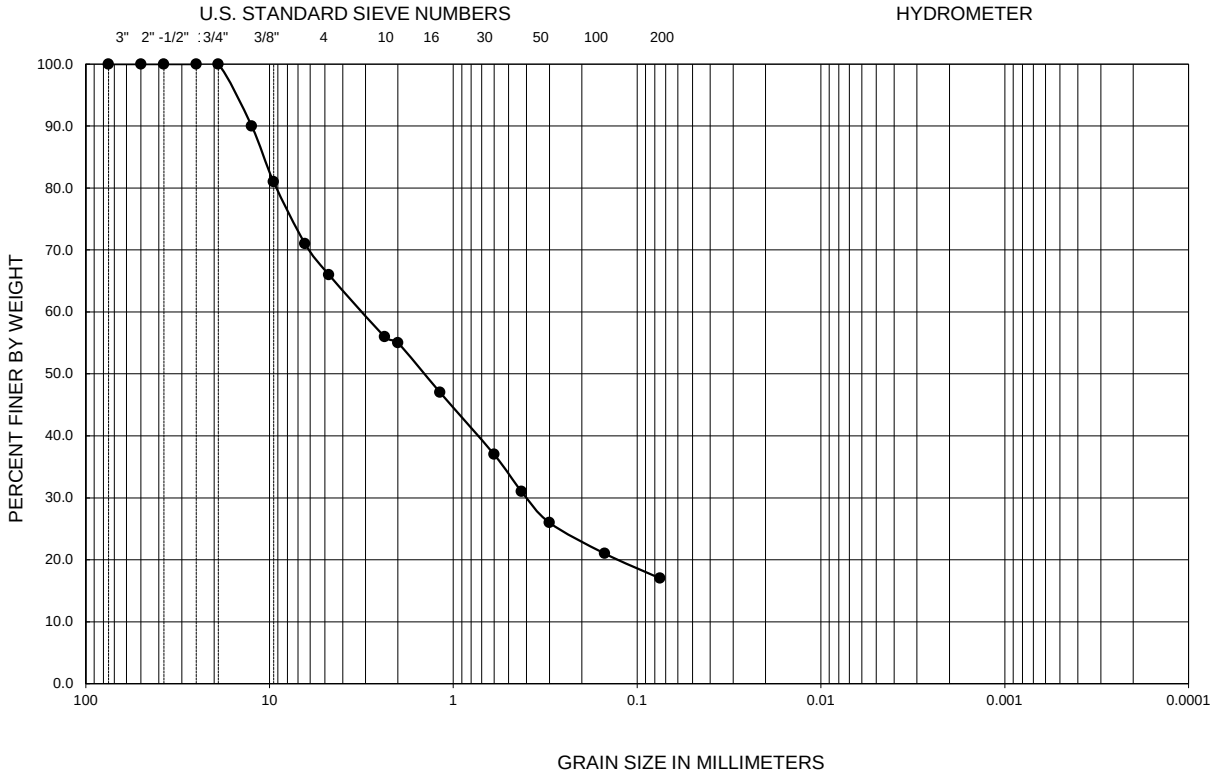
PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B8	1-2.5	26	22	4	--	0.403	3.16	--	--	17.0	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

FIGURE B-6

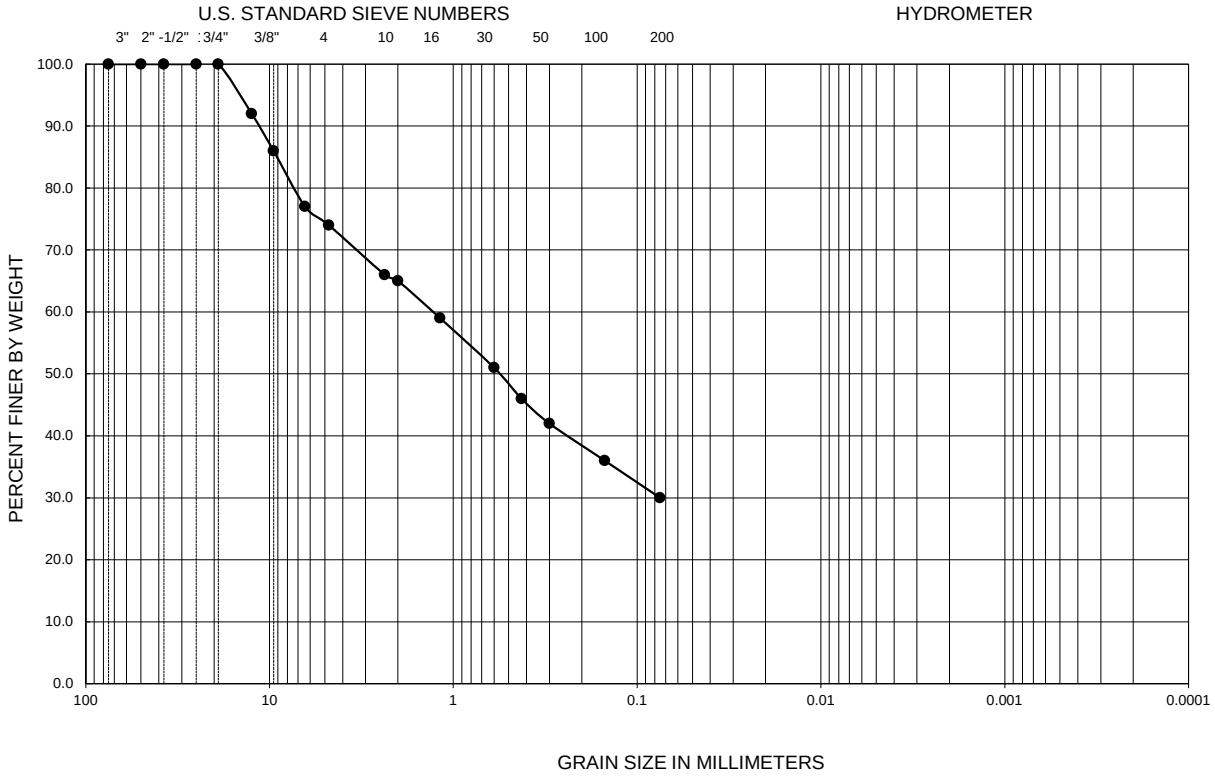
GRADATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B10	1-2.5	25	19	6	--	0.074	1.30	--	--	30.0	SC-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

FIGURE B-7

GRADATION TEST RESULTS

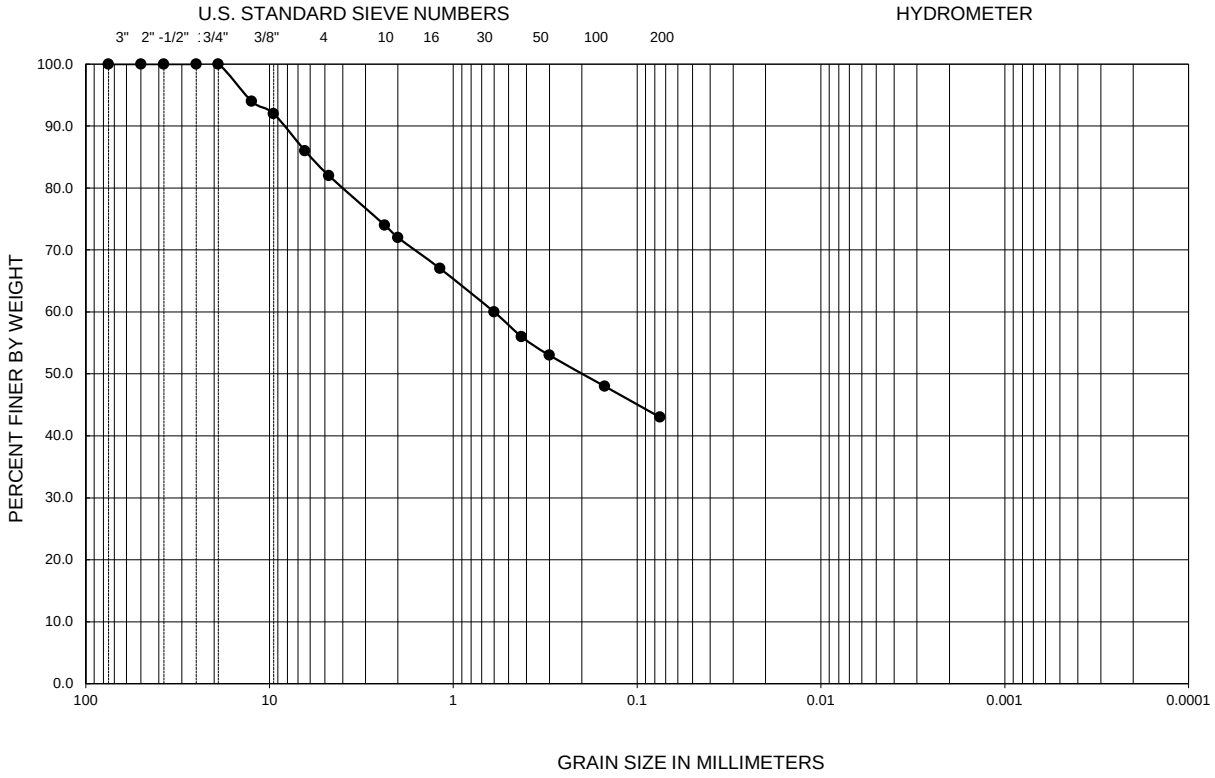
PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B11	6-7.5	34	17	17	--	--	0.58	--	--	43.0	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

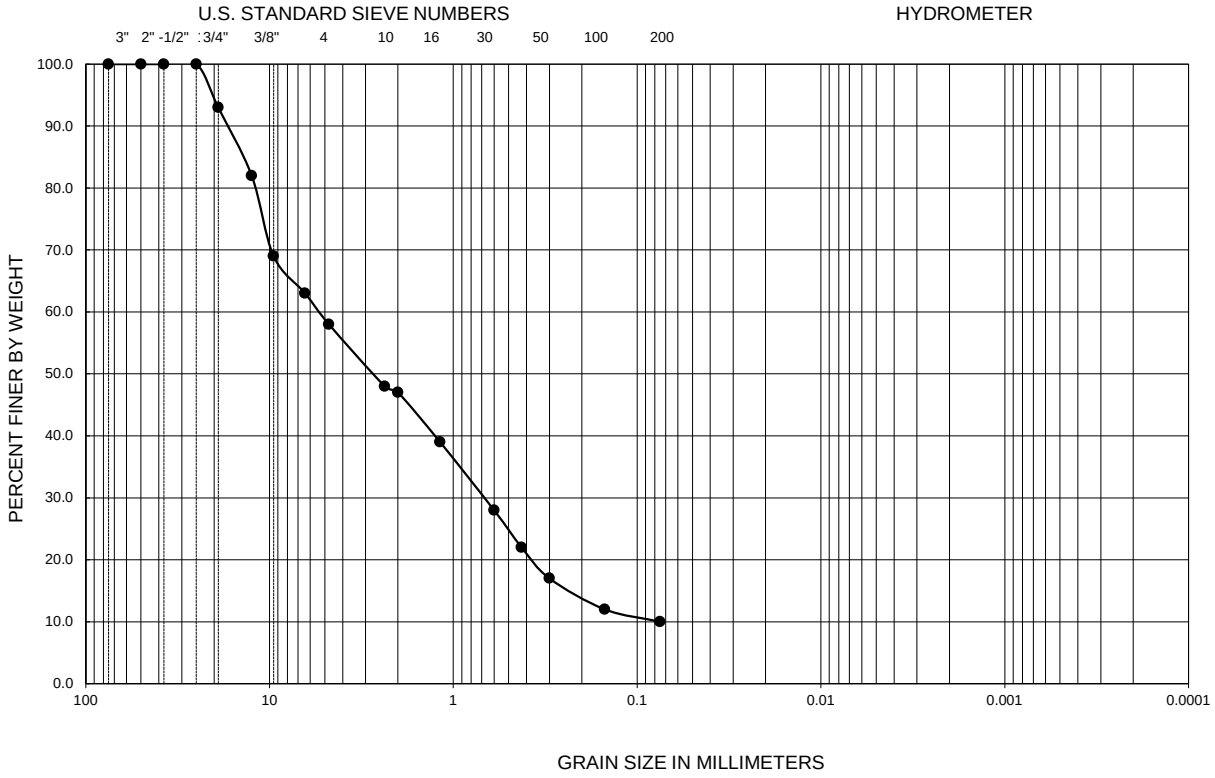
FIGURE B-8

GRADATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B12	1-1.3	--	--	NP	0.074	0.665	5.39	72.8	1.1	10.0	SW-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

FIGURE B-9

GRADATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

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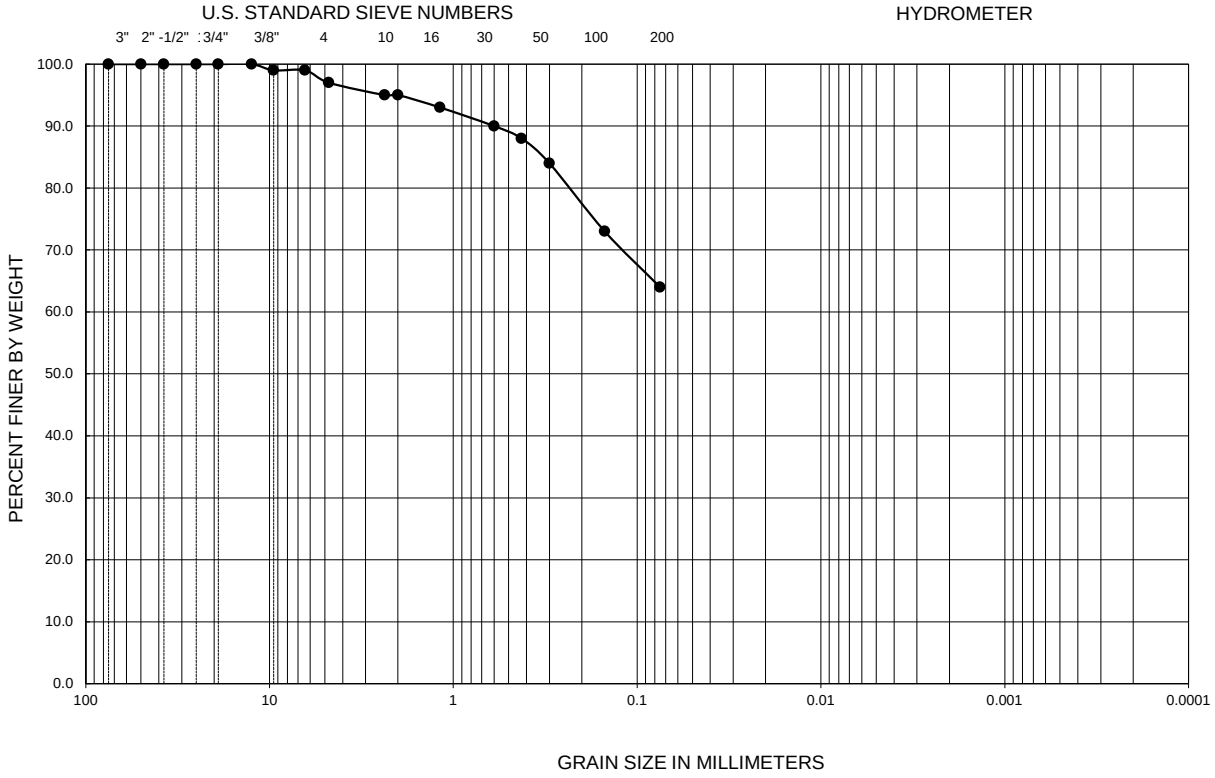
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-14	1-2.5	24	16	8	--	--	--	--	--	64.0	CL

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FIGURE B-10

GRADATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION
GOODYEAR, ARIZONA

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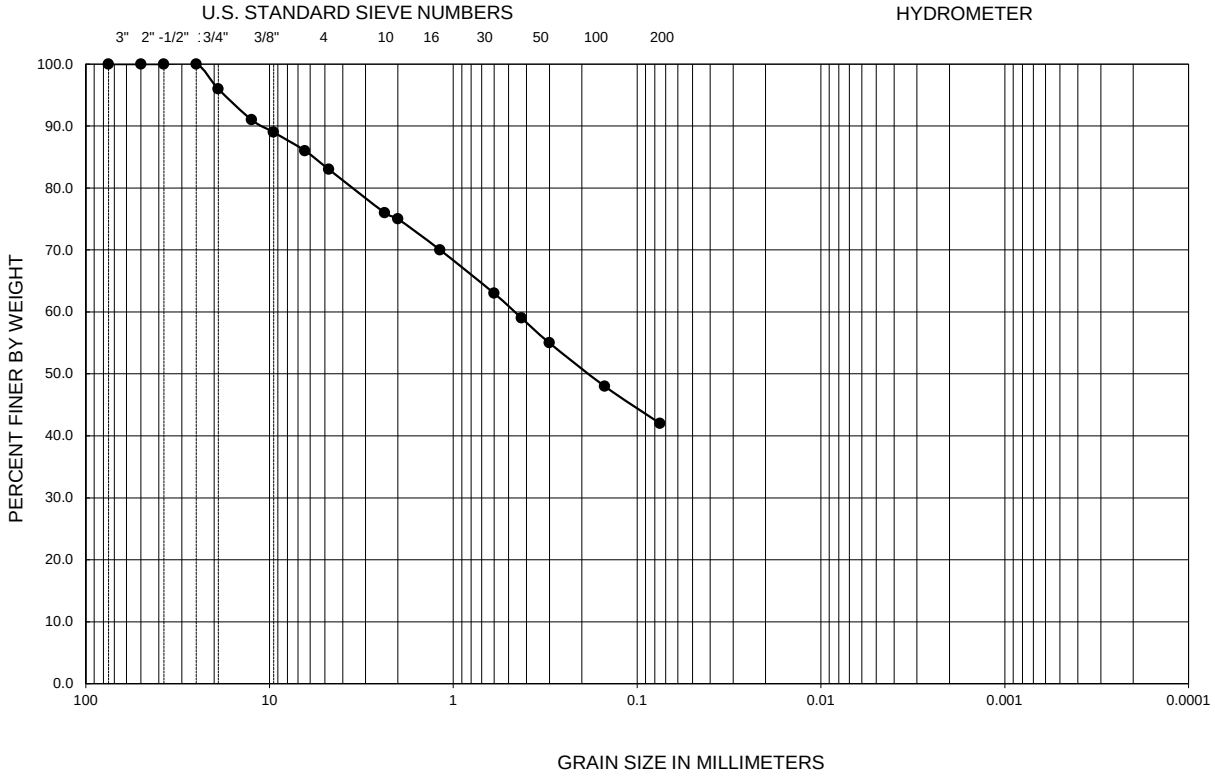
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B16	1-2.5	34	19	15	--	--	0.47	--	--	42.0	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

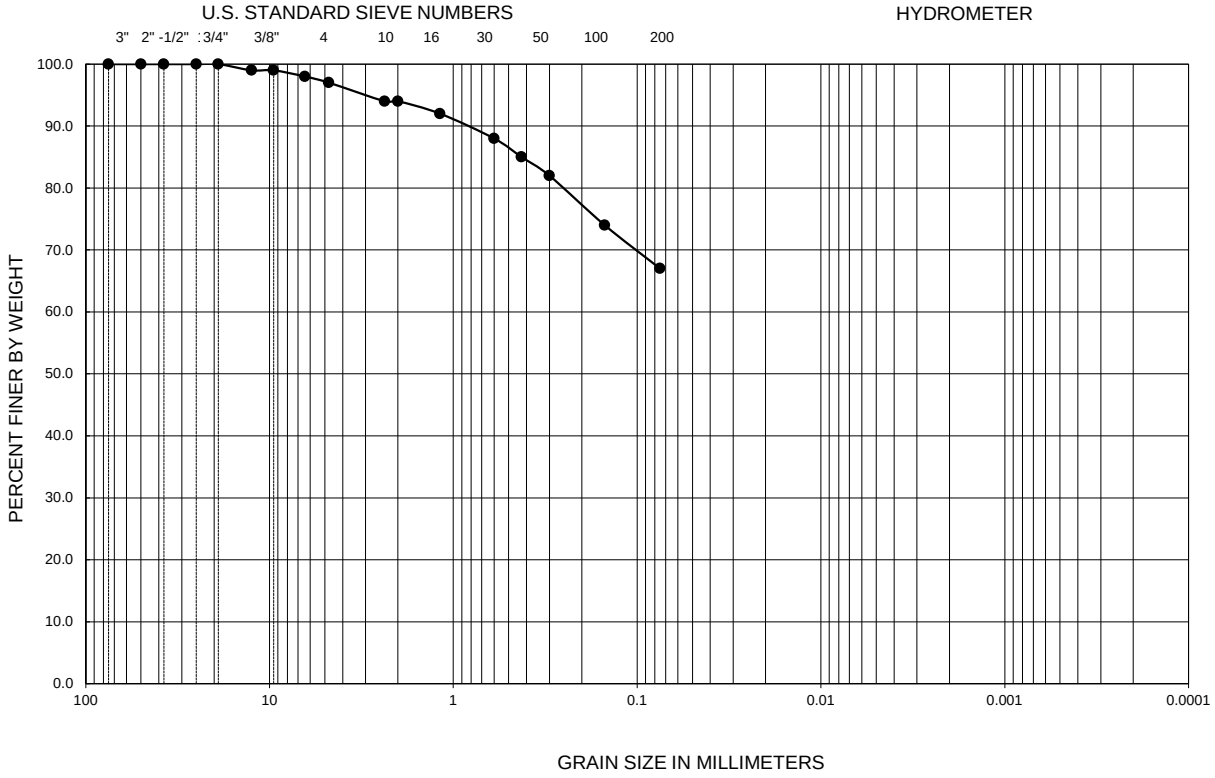
FIGURE B-11

GRADATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B18	1-2.5	29	16	13	--	--	--	--	--	67.0	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

FIGURE B-12

GRADATION TEST RESULTS

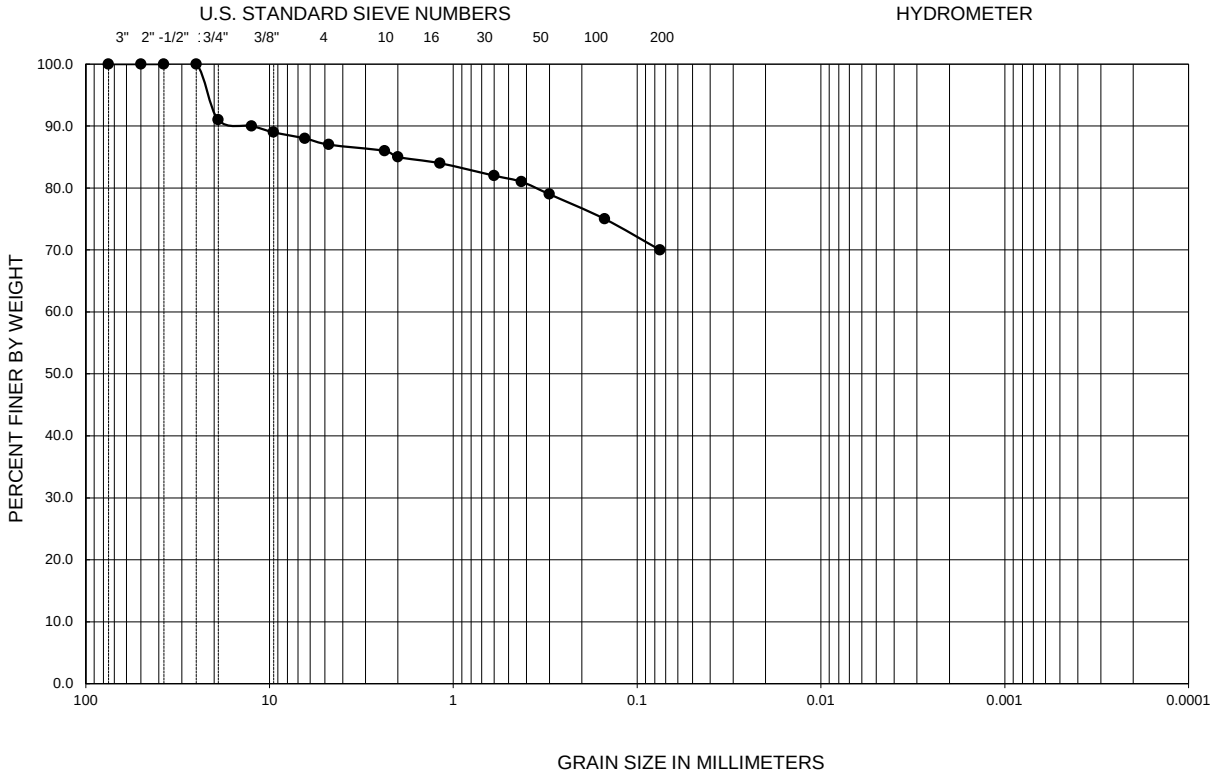
PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B20	1-2.5	23	16	7	--	--	--	--	--	70.0	CL-ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

FIGURE B-13

GRADATION TEST RESULTS

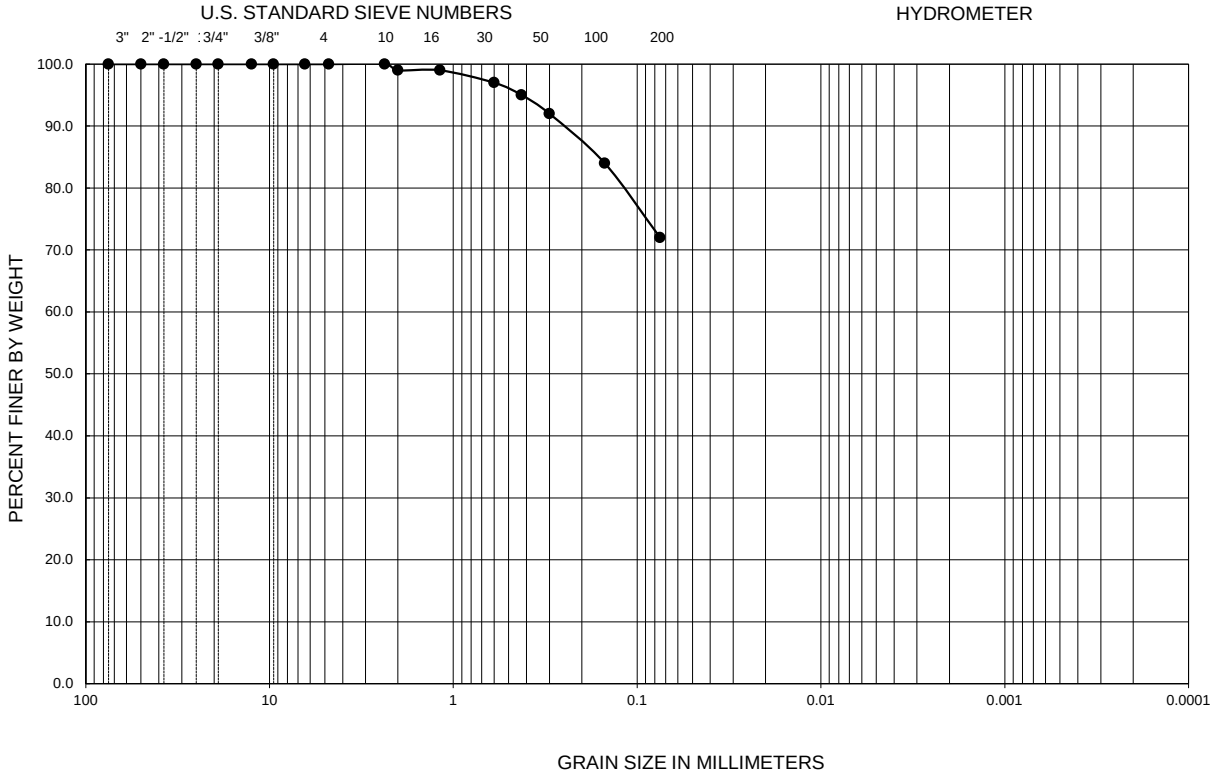
PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B21	6-7.5	30	16	14	--	--	--	--	--	72.0	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

FIGURE B-14

GRADATION TEST RESULTS

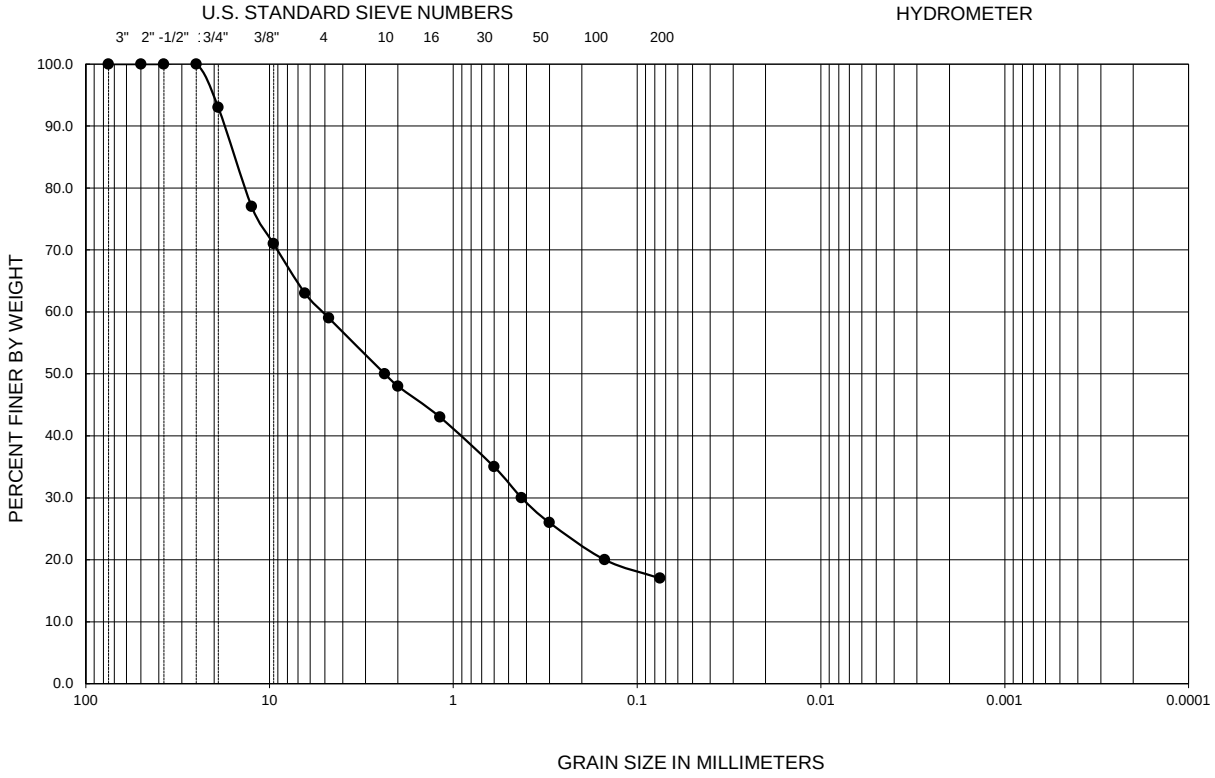
PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B22	1-2.5	--	--	NP	--	0.432	5.17	--	--	17.0	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM C136 / D422

FIGURE B-15

GRADATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

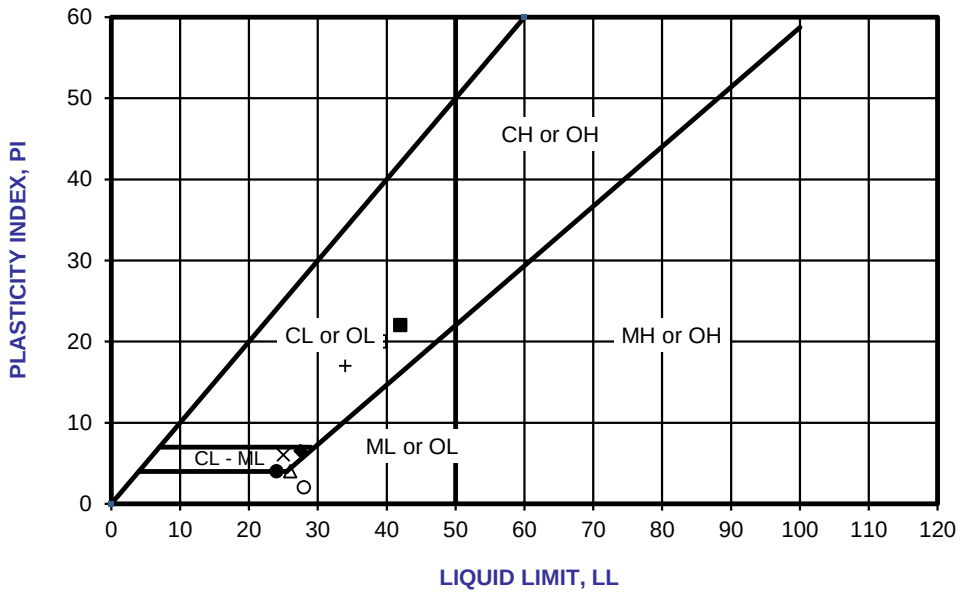
GOODYEAR, ARIZONA

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

SYMBOL	LOCATION	DEPTH (ft)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS
●	B2	1-2.5	24	20	4	CL-ML	SC-SM
■	B3	6-7.5	42	20	22	CL	CL
◆	B4	1-2.5	28	21	7	CL-ML	SC-SM
○	B6	1-2.5	28	26	2	ML	SP-SM
□	B7	6-7.5	39	19	20	CL	SC
△	B8	1-2.5	26	22	4	ML	SM
X	B10	1-2.5	25	19	6	CL-ML	SC-SM
+	B11	6-7.5	34	17	17	CL	SC

NP - INDICATES NON-PLASTIC



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

FIGURE B-16

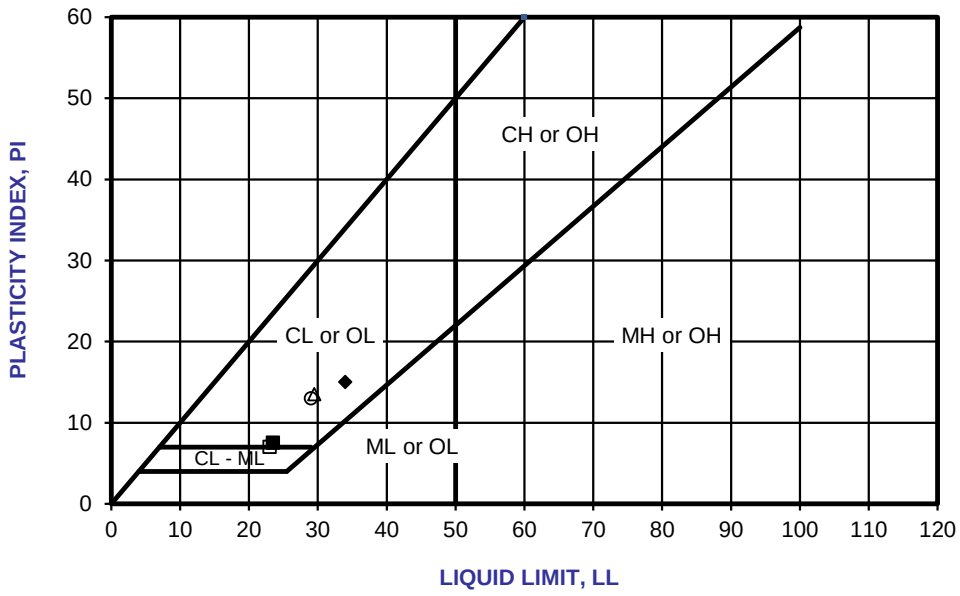
ATTERBERG TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

SYMBOL	LOCATION	DEPTH (ft)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS
●	B12	1-1.3	--	--	NP	ML	SW-SM
■	B14	1-2.5	24	16	8	CL	CL
◆	B16	1-2.5	34	19	15	CL	SC
○	B18	1-2.5	29	16	13	CL	CL
□	B20	1-2.5	23	16	7	CL-ML	CL-ML
△	B21	6-7.5	30	16	14	CL	CL
X	B22	1.25	--	--	NP	ML	SM

NP - INDICATES NON-PLASTIC



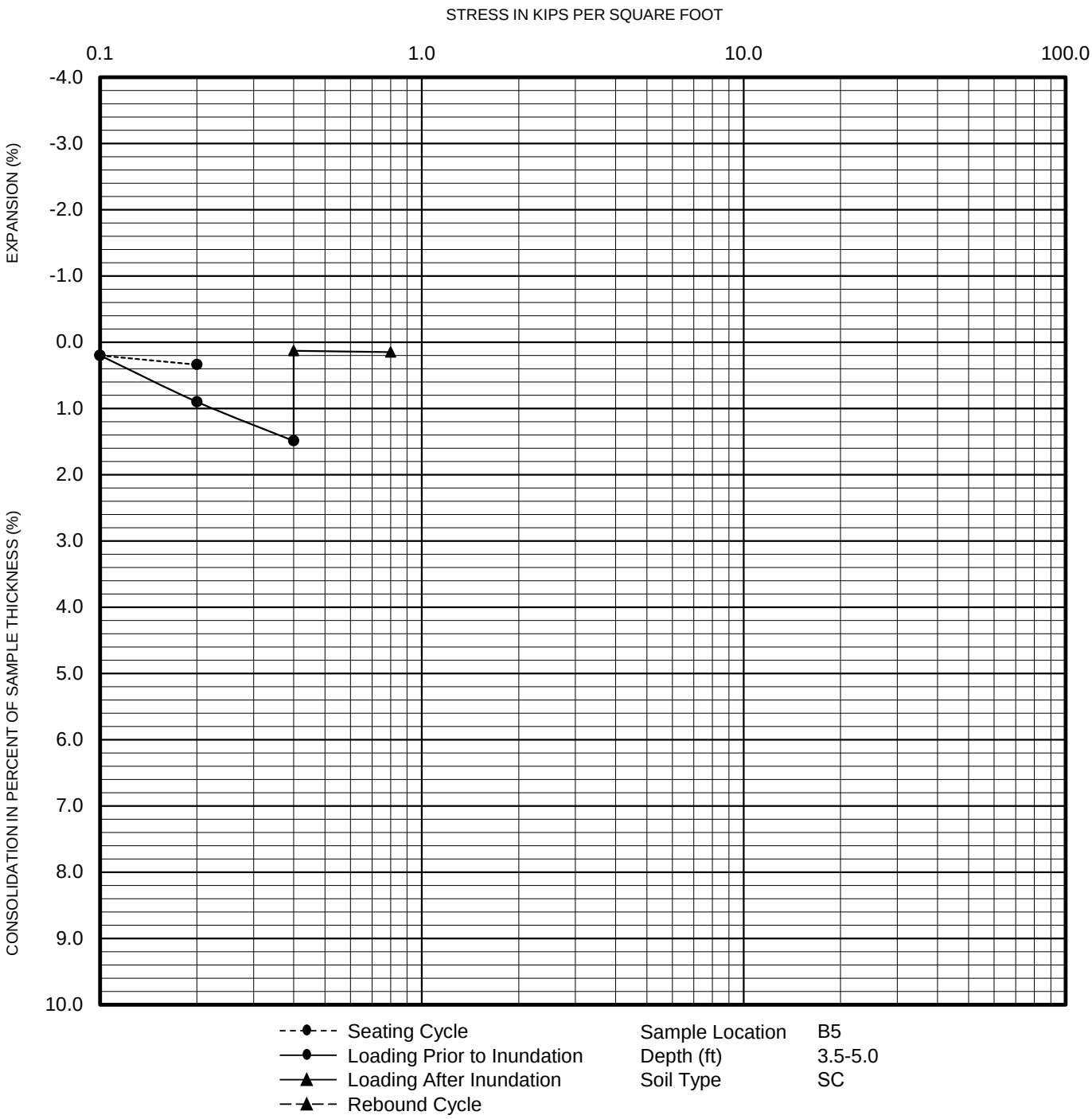
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

FIGURE B-17

ATTERBERG TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

FIGURE B-18

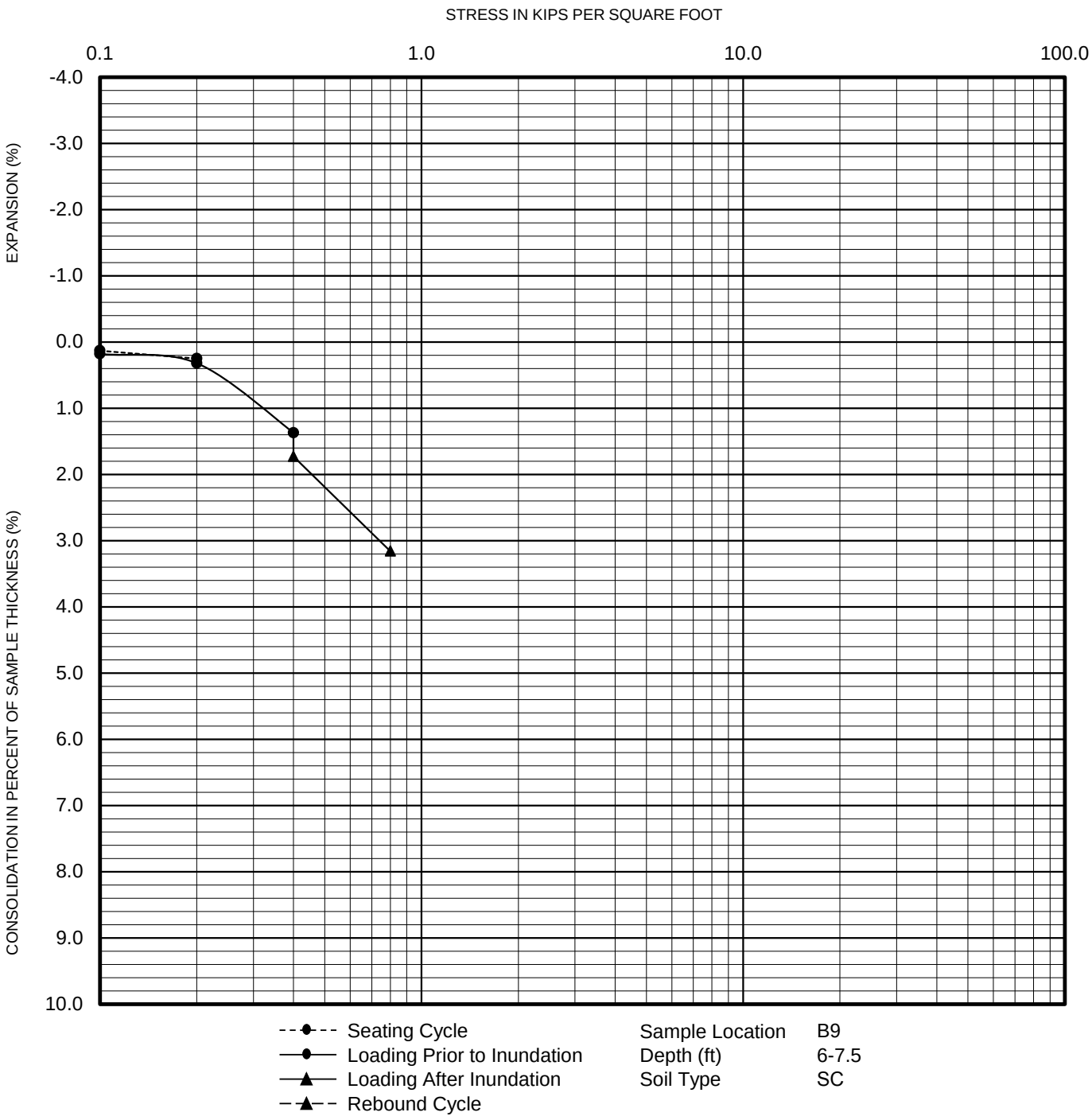
CONSOLIDATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

FIGURE B-19

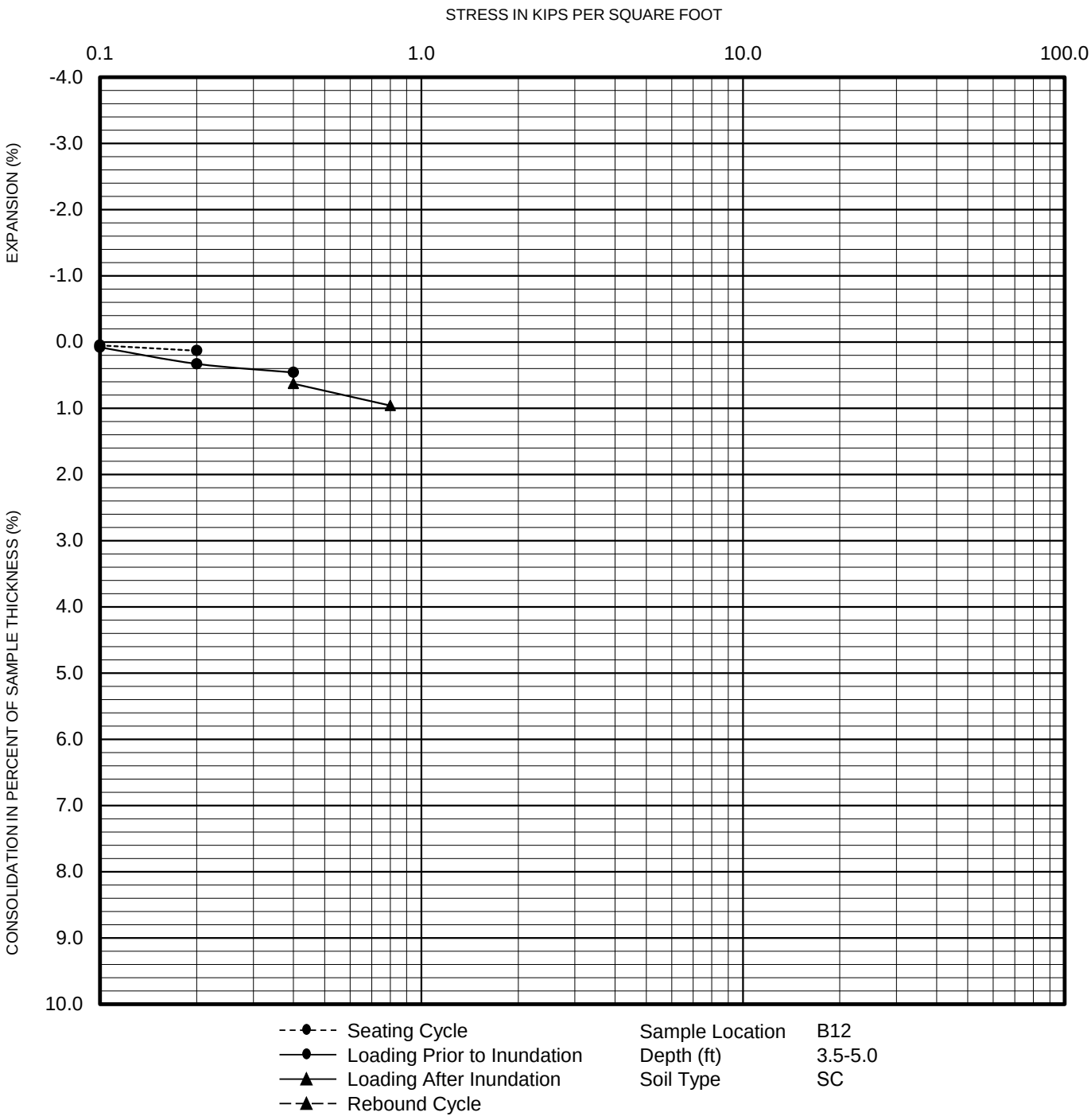
CONSOLIDATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

FIGURE B-20

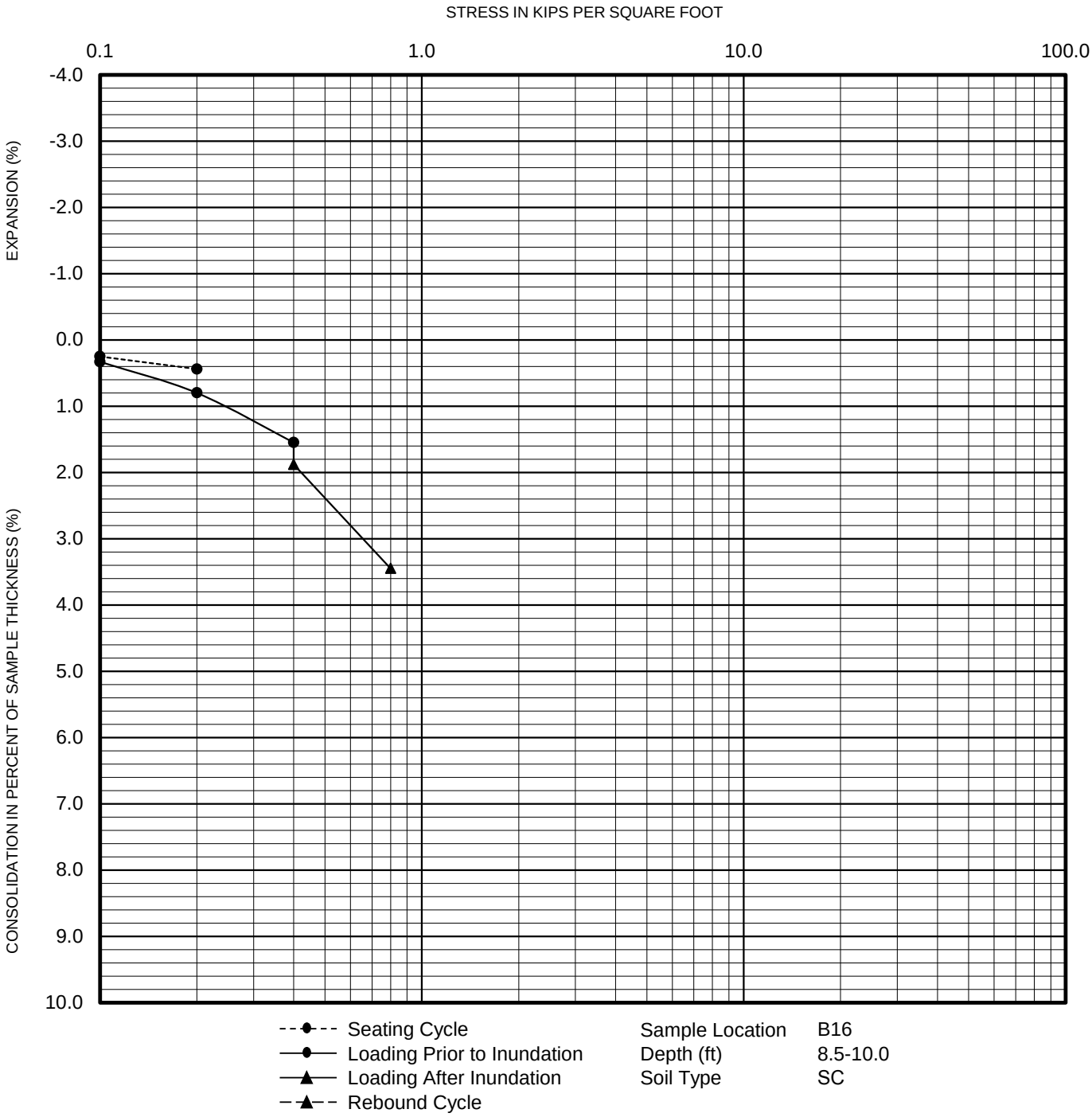
CONSOLIDATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

FIGURE B-21

CONSOLIDATION TEST RESULTS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A REHABILITATION

GOODYEAR, ARIZONA

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

SAMPLE LOCATION	DEPTH (FT)	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (PERCENT)
B-1	1.0-5.0	131.1	9.9
B-3	5.0-10.0	116.5	15.8
B-7	5.0-10.0	116.9	15.6
B-9	1.0-5.0	131.6	9.9
B-11	1.0-5.0	129.9	9.7
B-13	5.0-10.0	110.4	19.0
B-17	5.0-10.0	120.8	13.4
B-19	1.0-5.0	125.3	12.0

PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD D 1557

SAMPLE LOCATION	SAMPLE DEPTH (ft)	CBR AT 0.1" PENETRATION *
B-1	1.0-5.0	45
B-3	5.0-10.0	6
B-7	5.0-10.0	12
B-9	1.0-5.0	37
B-11	1.0-5.0	26
B-13	5.0-10.0	3
B-17	5.0-10.0	18
B-19	1.0-5.0	18

* PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 1883

SAMPLE LOCATION	SAMPLE DEPTH (ft)	pH [1]	RESISTIVITY [1] (Ohm-cm)	SULFATE CONTENT [2] (ppm)	(%)	CHLORIDE CONTENT [3] (ppm)
B1	1.0-5.0	9.5	2,968	8	0.001	<5
B7	5.0-10.0	8.8	375	553	0.055	41
B13	5.0-10.0	9.3	1,055	23	0.002	<5
B21	5.0-10.0	9.9	568	157	0.016	58

[1] PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 236c
[2] PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 733
[3] PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 736

APPENDIX C

Findings on Coring at Taxiway A3

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

February 21, 2018
Project No. 605334006

Mr. Jon Loehrke, Materials Supervisor
City of Phoenix
2485 East Buckeye Road
Phoenix, Arizona 85034

Subject: Findings on Coring at Taxiway A3
Phoenix-Goodyear Airport Taxiway A Rehabilitation
1658 South Litchfield Road
Goodyear, Arizona

Dear Mr. Loehrke:

In accordance with your request and authorization, Ninyo & Moore has performed two pavement cores at the above-referenced site. The purpose of our evaluation was to assess the thickness of asphalt pavement and underlying base materials at the core locations. We have prepared this letter to present our findings.

SITE / PROJECT DESCRIPTION

This project site is located at the Phoenix-Goodyear Airport at 1658 South Litchfield Road, Goodyear, Arizona. We understand that a new project which consists of the design of pavement rehabilitation and strengthening for Taxiway A, that is west of the existing South Apron in currently planned. Taxiway A, which is used to taxi aircraft on the airfield, is to be rehabilitated as the pavement life has expired. Additionally the project involves the construction of new shoulders along the full length of Taxiway A, widening of Taxiway A2, and new asphalt section in Taxiway A3 and Ramp 3. To better evaluate the current pavement thickness associated with Taxiway A, we were asked to perform two cores at key locations. The location of the cores, that are denoted as C-1 and C-2, are shown on Figure 1.

THICKNESS OF ASPHALT AND BASE MATERIAL

Our knowledge on the thickness of asphalt and base material at the project site is based on our field exploration. The following sections provide a generalized description of the materials encountered. More detailed descriptions are presented on the core logs in Attachment A.

Asphalt Concrete and Base Material

Asphalt concrete (AC) was encountered at the surface of our cores and ranged from approximately 13 to 16 inches thick. Base material was observed below the AC pavements at one of the core location, C-1 and was approximately 11 inches in thickness. In our second core location, C-2, unknown concrete were encountered below the AC.

LIMITATIONS

Our opinions and recommendations are provided in accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding our opinions and conclusions.

Ninyo & Moore appreciates the opportunity to provide services on this project.

Respectfully submitted,
NINYO & MOORE

Farhad Rahimi
Project Engineer

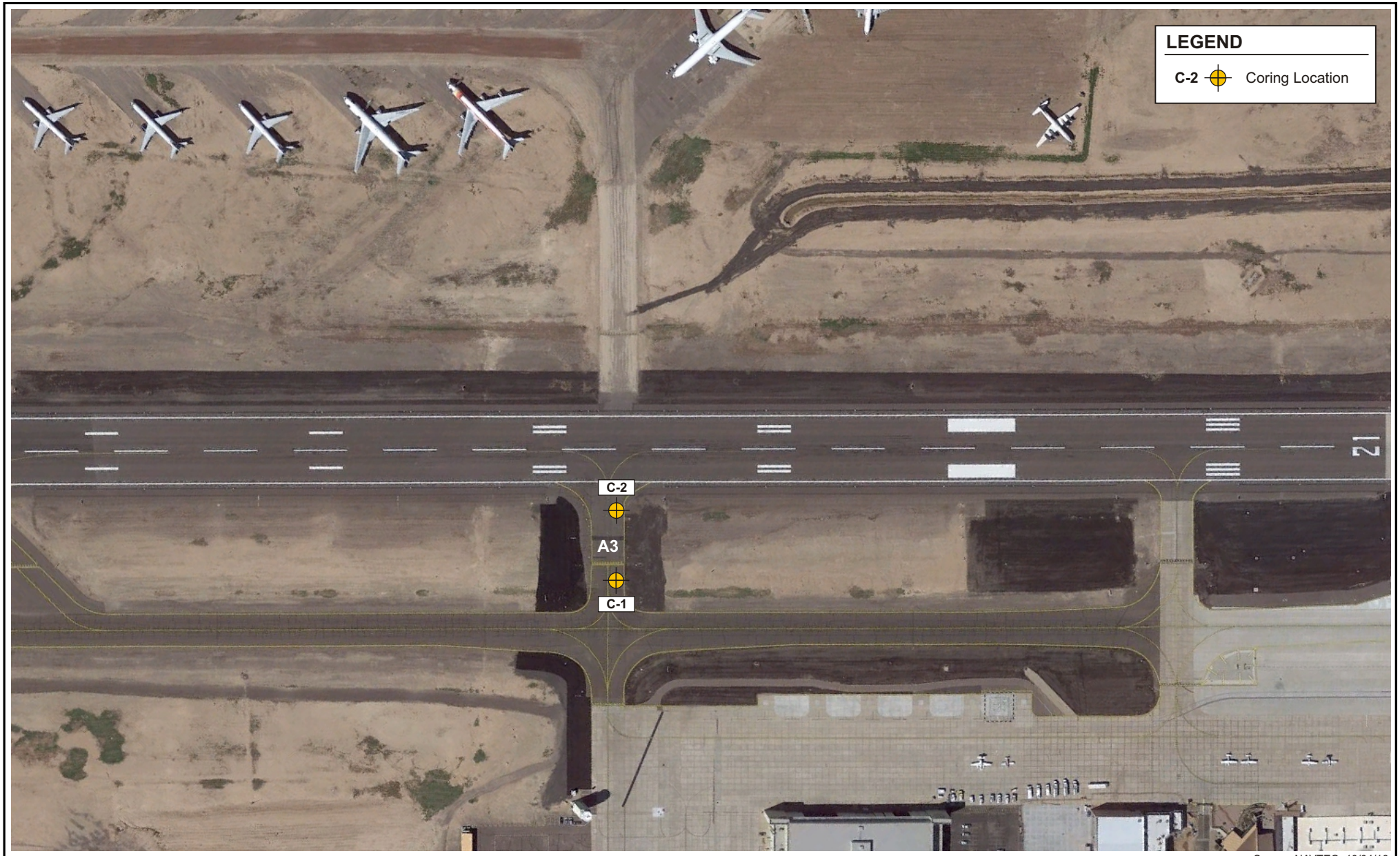
Steven D. Nowaczyk, PE
Managing Principal Engineer

FAR/SDN/hmf

Attachments: Figure 1 – Core Locations
Attachment A – Coring Log

Distribution: (1) Addressee (via e-mail)

FIGURE



Source: NAVTEQ, 10/04/16.

N

0 100

Approximate Scale in Feet

Note: Dimensions, directions and locations are approximate.

bsm file no: 5334blm0218

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

FIGURE 1

CORING LOCATIONS

PHOENIX-GOODYEAR AIRPORT TAXIWAY A3 IMPROVEMENTS

GOODYEAR, ARIZONA

605334006 | 2/18

ATTACHMENT A

Coring Log

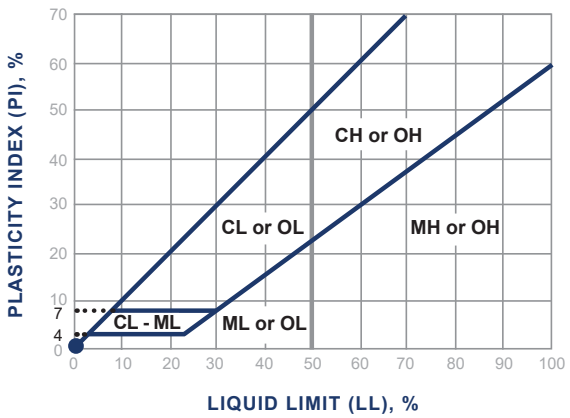
Soil Classification Chart Per ASTM D 2488

Primary Divisions			Secondary Divisions	
			Group Symbol	Group Name
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	**GRAVEL** more than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVEL less than 5% fines	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL with DUAL CLASSIFICATIONS 5% to 12% fines	GW-GM	well-graded GRAVEL with silt
			GP-GM	poorly graded GRAVEL with silt
			GW-GC	well-graded GRAVEL with clay
			GP-GC	poorly graded GRAVEL with
		GRAVEL with FINES more than 12% fines	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND 50% or more of coarse fraction passes No. 4 sieve	CLEAN SAND less than 5% fines	SW	well-graded SAND
			SP	poorly graded SAND
		SAND with DUAL CLASSIFICATIONS 5% to 12% fines	SW-SM	well-graded SAND with silt
			SP-SM	poorly graded SAND with silt
			SW-SC	well-graded SAND with clay
			SP-SC	poorly graded SAND with clay
		SAND with FINES more than 12% fines	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	**SILT and CLAY** liquid limit less than 50%	INORGANIC	CL	lean CLAY
			ML	SILT
			CL-ML	silty CLAY
		ORGANIC	OL (PI > 4)	organic CLAY
			OL (PI < 4)	organic SILT
	SILT and CLAY liquid limit 50% or more	INORGANIC	CH	fat CLAY
			MH	elastic SILT
		ORGANIC	OH (plots on or above "A"-line)	organic CLAY
			OH (plots below "A"-line)	organic SILT
	Highly Organic Soils		PT	Peat

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		> 12"	> 12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock-salt-sized to pea-sized
	Medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	< 0.0029"	Flour-sized and smaller

Plasticity Chart



Apparent Density - Coarse-Grained Soil

Apparent Density	Spooling Cable or Cathead		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	Modified Split Barrel (blows/foot)
Very Loose	≤ 4	≤ 8	≤ 3	≤ 5
Loose	5 - 10	9 - 21	4 - 7	6 - 14
Medium Dense	11 - 30	22 - 63	8 - 20	15 - 42
Dense	31 - 50	64 - 105	21 - 33	43 - 70
Very Dense	> 50	> 105	> 33	> 70

Consistency - Fine-Grained Soil

Consis-tency	Spooling Cable or Cathead		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	Modified Split Barrel (blows/foot)
Very Soft	< 2	< 3	< 1	< 2
Soft	2 - 4	3 - 5	1 - 3	2 - 3
Firm	5 - 8	6 - 10	4 - 5	4 - 6
Stiff	9 - 15	11 - 20	6 - 10	7 - 13
Very Stiff	16 - 30	21 - 39	11 - 20	14 - 26
Hard	> 30	> 39	> 20	> 26

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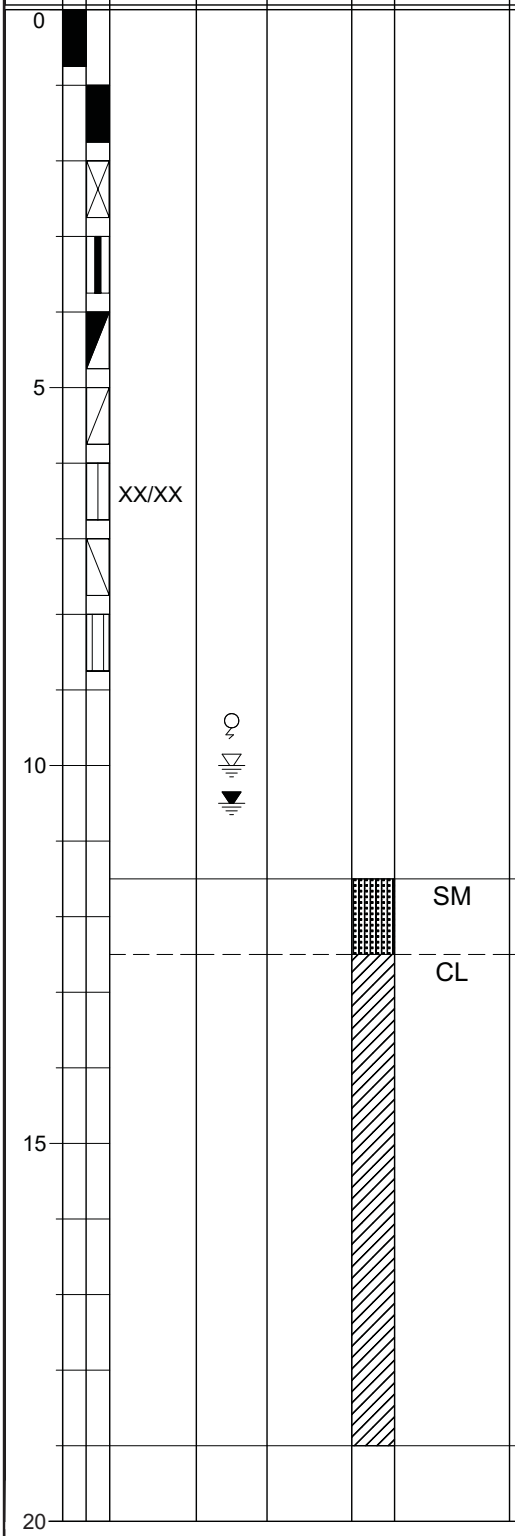
Geotechnical & Environmental Sciences Consultants

USCS METHOD OF SOIL CLASSIFICATION

BORING LOG EXPLANATION SHEET



Bulk sample.

Modified split-barrel drive sampler.

No recovery with modified split-barrel drive sampler.

Sample retained by others.

Standard Penetration Test (SPT).

No recovery with a SPT.

Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.

No recovery with Shelby tube sampler.

Continuous Push Sample.

Seepage.

Groundwater encountered during drilling.

Groundwater measured after drilling.

SM

MAJOR MATERIAL TYPE (SOIL):

Solid line denotes unit change.

CL

Dashed line denotes material change.

Attitudes: Strike/Dip
b: Bedding
c: Contact
j: Joint
f: Fracture
F: Fault
cs: Clay Seam
s: Shear
bss: Basal Slide Surface
sf: Shear Fracture
sz: Shear Zone
sbs: Shear Bedding Surface

The total depth line is a solid line that is drawn at the bottom of the boring.

DATE DRILLED 2/13/18 BORING NO. C-1

GROUND ELEVATION 956' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING Hand Auger

DRIVE WEIGHT N/A DROP N/A

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 13-inches thick.
							GP	BASE MATERIAL: Brown, dry, medium dense, poorly graded GRAVEL with sand.
								Total Depth = 2 feet. Groundwater not encountered during drilling. Backfilled with non-shrink grout on 2/13/18 shortly after completion of drilling.
5								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								
15								
20								

FIGURE A- 1

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Geotechnical & Environmental Sciences Consultants

PHOENIX-GOODYEAR AIRPORT TAXIWAY A3 IMPROVEMENTS
GOODYEAR, ARIZONA
605334006 | 2/18

DATE DRILLED 2/13/18 BORING NO. C-2

GROUND ELEVATION 957' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING Hand Auger

DRIVE WEIGHT N/A DROP N/A

SAMPLED BY DM LOGGED BY DM REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 16-inches thick.
								Unknown concrete.
								Total Depth = 1.3 feet.
								Groundwater not encountered during drilling.
								Backfilled with non-shrink grout on 2/13/18 shortly after completion of drilling.
								Notes:
								Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
5								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								
15								
20								

APPENDIX D

Photographs

Photograph 1: **B-1 – Estimated four layers of asphalt.**

Photograph 2: **B-2 – Estimated four layers of asphalt.**

Photograph 3: **B-3 – Estimated four layers of asphalt.**

Photograph 4: **B-4 – Estimated four layers of asphalt.**

Photograph 5: **B-5 – Estimated four layers of asphalt.**

Photograph 6: **B-6 – Estimated four layers of asphalt.**

Photograph 7: **B-7 – Estimated four layers of asphalt.**

Photograph 8: **B-8 – Estimated four layers of asphalt.**

Photograph 9: **B-9 – Estimated four layers of asphalt.**

Photograph 10: **B-10 – Estimated four layers of asphalt.**

Photograph 11: **B-11 – Estimated four layers of asphalt.**

Photograph 12: **B-12 – Estimated four layers of asphalt.**

Photograph 13: **B-13 – Estimated four layers of asphalt.**

Photograph 14: **B-14 – Estimated four layers of asphalt.**

Photograph 15: **B-15 – Estimated four layers of asphalt.**

Photograph 16: **B-16 – Estimated four layers of asphalt.**

Photograph 17: **B-17 – Estimated four layers of asphalt.**

Photograph 18: **B-18 – Estimated four layers of asphalt.**

Photograph 19: **B-19 – Estimated four layers of asphalt.**

Photograph 20: **B-20 – Estimated four layers of asphalt.**

Photograph 21: **B-21 – Estimated four layers of asphalt.**

Photograph 22: **B-22 – Estimated four layers of asphalt.**

Photograph 23:

Ninyo & Moore

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3202 East Harbour Drive | Phoenix, Arizona 85034 | p. 602.243.1600

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