

TECHNICAL SPECIFICATIONS – CIVIL  
AND  
CONSTRUCTION SAFETY AND PHASING PLAN



P I N A L ♦ C O U N T Y

*Wide open opportunity*

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## TECHNICAL SPECIFICATIONS - CIVIL

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## ITEM P-100 CONTRACTOR QUALITY CONTROL PROGRAM

### DESCRIPTION

**100-1.1GENERAL.** This item shall consist of all work necessary to ensure quality control of the Contractor's work during Construction in accordance with applicable requirements.

The Contractor shall be responsible to conduct all quality control testing and inspections as indicated in the technical specifications, as well as any other test or inspection not specifically listed but necessary to adequately control the work to the satisfaction of the Owner. The Owner will be responsible for acceptance testing at their discretion. The Owner's quality acceptance test results will be made available to the Contractor upon request. The Contractor shall not depend on the Owner's quality acceptance for the Contractor's quality control. Although guidelines are established and certain minimum requirements are specified herein and elsewhere in the contract technical provisions, the Contractor shall assume full responsibility for accomplishing the stated purpose.

The Contractor shall be prepared to discuss and present, at the Preconstruction Conference, his understanding of the project's quality control requirements, specifically identifying all requirements for each material introduced by this project. The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the Quality Control Program (QCP) has been approved by the Owner. No partial payment will be made for materials subject to specific quality control requirements until the QCP has been approved.

The Contractor shall be responsible to conduct all quality control testing and inspections and for each pay item that is shown in the bid, as well as any other test or inspection not specifically listed but necessary to adequately control the work to the satisfaction of the Owner. The Contractor shall not depend on any Engineer's Quality Acceptance testing that may be performed during the course of the project for the Contractor's Quality Control Program.

The Contractor shall submit his QCP to the Owner **at least five (5) working days prior to the Pre-Construction Conference** for the review and approval. The QCP 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;
- e. Quality control testing plan (test type, standard, and frequency);
- f. Documentation of quality control activities; and
- g. Requirements for corrective action when QC or QA criteria are not met.



The Contractor is encouraged to add any additional elements to the QCP that he deems necessary to adequately control all production and/or construction processes required by this contract

The QCP shall include, at a minimum, a quality control plan, all required quality control testing and inspections to be performed by the Contractor, and a list of personnel including their resumes showing adequate accreditation and experience, a Quality Control Manager (a minimum of 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). The QCP shall include a comprehensive schedule correlating material submittals, construction activities, and the associated QC tests and required inspections. The QCP will also include at a minimum the following elements:

1. Designation of a Quality Control Manager, a Contractor's representative responsible for implementing and monitoring the QCP for the duration of the project.
2. Identification of individual/subcontractor responsibilities for conducting quality control tests and inspections in a manner and frequency to adequately control operations, and submitting reports on the following items (as a minimum):
  - a. Compaction testing, in accordance with ASTM D 698, of subgrade per Technical Specification P-152 at a rate of not less than one test per specified lot of graded section, (moisture contents, densities, etc.).
  - b. Compaction, in accordance with ASTM D 698, thickness, and unit weight testing of Aggregate Base Course per Technical Specification P-208, with a minimum of one test per specified lot, each lift.
  - c. Asphalt Concrete testing per P-405, at a rate of not less than:
    - i. Mineral aggregate quality on sieve analysis per 600 tons of production.
    - ii. Asphalt Concrete one sample per 250 tons.
    - iii. Density & Thickness one each per specified lot, each lift.
  - d. Bituminous Tack Coat per P-603.
    - i. Samples of the bituminous material that the Contractor proposes to use, together with a statement as to its source and character, must be submitted and approved before use of such material begins.
    - ii. The Contractor shall furnish the vendor's certified test reports for each load bituminous material shipped to the project. The tests reports shall contain all the data identified in MAG 329.
  - e. Structural Portland Cement Concrete per Technical Provision P-610.
    - i. Compressive Strength Tests shall be performed in accordance with ASTM C 31, ASTM C 39, and ASTM C 172
  - f. Pavement Markings per Technical Provision P-620.
3. Procedure for providing test result information in a timely manner to the Owner, and provisions for corrective work and re-tests if required due to failed test samples.
4. A schedule that correlates construction activities, required materials testing, and all testing procedures. This schedule shall be updated weekly by the Contractor and discussed with the Owner at each weekly construction meeting.



The Contractor shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations on a form acceptable to the Owner. 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 Owner shall be provided at least one copy of each daily inspection report on the work day following the day of record.

#### **METHOD OF MEASUREMENT**

**100-2.1 GENERAL.** Measurement for Contractor Quality Control to be paid for will be determined by the lump sum amount provided in the bid.

**100-2.2 COMPUTATIONS FOR CONTRACTOR MONTHLY PAY APPLICATIONS.** Monthly progress payments will be calculated by dividing the lump sum amount by the performance period in months.

**100-2.3 SCHEDULE OF VALUES.** Contractor must submit a schedule of values to the Engineer detailing a cost breakdown for each quality control requirement.

#### **BASIS OF PAYMENT**

**100-3.1** Contractor Quality Control will be paid for at the lump sum price provided in the bid based on work effort as outlined in the Contractor Quality Control 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:

- Item P-100-3.1 Contractor's Quality Control (Base Bid) – per Lump Sum
- Item P-100-3.2 Contractor's Quality Control (Add Alt No. 1) – per Lump Sum
- Item P-100-3.3 Contractor's Quality Control (Add Alt No. 2) – per Lump Sum

#### **END OF ITEM P-100**



## ITEM P-101 MOBILIZATION

### DESCRIPTION

**101-1.1 GENERAL.** Mobilization shall consist of preparatory work and operations, including but not limited to, installation of the Contractor's Staging and Storage area temporary utilities, temporary fencing and access gates, staging area track-out pad(s), the movement of personnel, equipment, materials, supplies and incidentals to the project site, and for transportation of buildings, laboratory field testing storage facilities, equipment and tools, haul roads and other facilities necessary to complete the work on the project including providing one or more staging areas with security fence and gate(s) if desired by the Contractor to secure staging areas or if required by the plans. This item is also for the Contractor's operations and material storage for the project and 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, fencing and access gates, and track-out pad to the staging area(s), removal of materials laboratories (if any), demobilization of equipment, and the clean-up and restoration of the construction staging and storage area(s) to a condition acceptable to San Manuel Airport and Pinal County. Demobilization costs shall be considered incidental to the Mobilization payment line item provided.

### CONSTRUCTION METHODS

**101-2.1 STAGING AREAS.** The proposed staging area is shown on the plans. Prior to the start of construction, the Engineer will confirm the location for use by the Contractor. This area may be used for the Contractor's operations, and at the Contractor's option. 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 yards and the Contractor shall promptly comply with the directives of the Airport.

**101-2.2 SPECIAL REQUIREMENTS OF STAGING AREA(S).** The following special requirements shall be adhered to:

- a. **Obstruction Lighting.** Equipment of significant height, including cranes, 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, (most current edition), also refer to the Special Provision Section 60 for barricading and lighting.
- b. **Dust Control.** The Contractor shall use all measures to control dust from equipment. 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 area(s) in the dust control plan prior to commencing operations, in accordance with



SP 40.07. Vacuum sweeping equipment must be equipped and maintained by the Contractor such that excessive dust is not emitted while operating.

- b. Material Delivery Limitations.** Refer to Special Provisions Section 60 *Operations, Safety and Security*.
- c. Traffic Control.** The safety, convenience and the protection of persons and property, of the general public and residents along the streets, highways and areas adjacent to the work areas shall be provided for by the Contractor.
- d. Protection and Restoration of Staging Area.** The Contractor shall be responsible for all damage or injury to property of any character. The Contractor shall protect all existing utilities, fencing, concrete curb, sidewalk and other facilities on-site and at the staging area(s) in accordance with MAG Specification 107.9. The Contractor shall apply seeding to the soil at all staging/storage/access areas, in accordance with Special Provisions Item SP-90.01 *Seeding*, prior to final completion. The material and work necessary to complete the application of seeding contained in the above referenced special provision shall be considered incidental to the mobilization payment line item, (i.e. non-pay item).
- g. Mobile Telephones.** The Contractor's and each subcontractor's on-site superintendent, and foremen shall have mobile telephones. The mobile telephone numbers shall be provided to Engineer and Airport Manager.

#### METHOD OF MEASUREMENT

**101-3.1** Mobilization shall be measured for payment by the lump sum as a single complete unit of work.

#### BASIS OF PAYMENT

**101-4.1** Payment for the performance of the Mobilization work as specified above will be made at the contract lump sum price for the item Mobilization. Mobilization shall not exceed four (4) percent of the total bid for the bid schedule in which the item is included. This item shall include the movement of all personnel, all equipment, the establishment of all haul roads, temporary utilities, fencing, access gates, and track-out pad for the staging area, restoration and protection of the site(s) and seeding application to Engineer's approval, providing and for maintaining temporary security fence, gates.



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

**TABLE 1 – Payment Schedule for Mobilization**

Mobilization/ Demobilization Payment Number	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 Resident Engineer and the Critical Path Method Part I schedule has been submitted. The first payment for Mobilization shall be contingent upon Engineer receiving the Quality Control Program at least five (5) working days before the pre-construction conference.
2	25% of Lump Sum Amount	When 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 shall be contingent upon the Contractor submitting the revised Quality Control Program to 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 bid amount per schedule.
4	25% of Lump Sum Amount	On the first progress payment application following completion of (10) percent of the bid amount per schedule.

1. If the price for Mobilization exceeds four (4) percent of the total bid for the bid schedule in which it is included, any excess will be paid to the Contractor upon final completion of the project.

Payment will be made under:

- Item P-101-4.1      Mobilization (Base Bid) – per Lump Sum
- Item P-101-4.2      Mobilization (Add Alt No. 2) – per Lump Sum

**END OF ITEM P-101**



## ITEM P-104 REMOVAL OF PAVEMENT

### DESCRIPTION

**104-1.1** This item shall consist of saw cutting, milling, and the removal of asphaltic concrete pavement identified on the plans and the disposal and clean-up of all pavement materials transported to an off-site location by the Contractor. All removed material shall become the property of the Contractor and shall be disposed of off-site in accordance with local regulations.

### MATERIALS

**104-2.1** All other materials used in conjunction with this work shall be furnished by the Contractor and will be considered incidental to these P-104 items.

### CONSTRUCTION METHODS

**104-3.1 GENERAL.** The removal of existing structures and utilities required to permit orderly progress of work shall be accomplished by the Contractor, unless otherwise shown on the plans. See Technical Specification Item P-151, *Removal of Existing Facilities*.

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 compacted in accordance with Technical Specification P-152 *Excavation and Embankment* and restored to as near as the original condition as can be determined or as shown on the plans.

**104-3.2 PAVEMENT SAW CUTTING.** Existing asphalt pavement to be removed shall be cut to the depth of the bituminous material as estimated on the plans around the perimeter of the area to be removed and 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 machine shall be capable of cutting a vertical edge without chipping or spalling the edges of the pavement to remain. The machine shall have a positive method of controlling the depth of cut. 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 all match lines to existing pavement that is to remain, per section 104-3.4.

**104-3.3 PAVEMENT REMOVAL.** Pavement to be removed shall be sawcut from adjoining pavement and removed and disposed of off-site by the Contractor, except as noted below.

The bituminous pavement designated for removal shall be saw cut, as shown on the plans or as directed by the Resident Engineer, and removed by milling or breaking up and disposed of off-site. Stockpiling of the removed bituminous material shall not be allowed in the Air Operations Area (AOA). All material shall be immediately hauled off site of the Airport.

The Contractor shall use care when removing existing pavement adjacent to pavement that is proposed to remain, such that lower-paving courses 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 to the satisfaction of the Resident Engineer and at no additional cost to the Airport.

**104-3.4 PAVEMENT MATCHING.** Existing asphalt pavement that is 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 and as outlined in sections 104-3.2 and 104-3.3.

- a. **Matching Asphalt Pavement.** The existing asphalt pavement trimmed shall be cut full depth and a coating of asphalt cement or emulsified asphalt shall be immediately applied prior to constructing the new asphaltic concrete in accordance with MAG Standard Specification Section 329 (SS-1h). No separate payment will be provided for the material or application of the asphalt cement or emulsified asphalt and all costs incurred in performing this work shall be considered incidental to those items associated for that work.

**104-3.5 ADJOINING PAVEMENTS DESIGNATED TO REMAIN.** The matching edge of all existing pavements designated to remain shall be saw cut in a straight and true line and as outlined in sections 104-3.3 and 104-3.4. The saw cut edge shall be protected from damage until the finished surface has been completed. 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 Owner.

## CONTRACTOR QUALITY CONTROL

**104-4.1 QUALITY CONTROL PROGRAM.** The Contractor shall develop a Quality Control Plan in accordance with Technical Specification P-100. The program shall address all elements that affect the quality of the pavement to be milled, including, but not limited to:

- a. Maximum gradation of the milled material;
- b. Fugitive dust control from the milling operation;
- c. Inspection and testing of placement and compaction of materials stated in Item P-104; and
- d. Inspection and documentation for saw cut irregularities.

**104-4.2 CORRECTIVE ACTION.** The Quality Control (QC) Plan shall indicate that appropriate action shall be taken when the milling process is believed to be out of tolerance. The QC 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. **Gradation of Milled Asphalt.** When the maximum size gradation exceeds 2-inches, the Contractor shall make the appropriate adjustments to effectively control the gradation.



- b. 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**

**104-5.1** Measurement for Saw Cut Existing AC Pavement (Full Depth) shall be made by the number of lineal feet, completed in conformance with these specifications. Measurement for any variation in depth or thickness shall not be considered. Measurement shall be made to the nearest foot. The Contractor is made aware that the existing AC pavement varies between 3-1/2" and below.

**104-5.2** Measurement for Removal of Existing AC Pavement (Full Depth) shall be the number of square yards completed in conformance with these specifications. Measurement for various depths or thicknesses shall not be made for the miscellaneous bituminous pavement removed. Measurement shall be calculated to the nearest square yard. The Contractor is made aware that the existing AC pavement varies between 3-1/2" and below.

### **BASIS OF PAYMENT**

**104-6.1** Payment for Saw Cut Existing AC Pavement (Full Depth) shall be made at the bid proposal unit price per lineal foot. 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. There will be no separate measurement or payment for varying depths. The Contractor is made aware that the existing AC pavement varies between 3-1/2" and below.

**104-6.2** Payment for Removal of Existing AC Pavement (Full Depth) shall be made at bid proposal unit price per square yard. This unit price shall be full compensation for furnishing all labor, equipment, materials, tools and incidentals necessary to complete the work, including hauling and disposal of the pavement to an off-site approved location. There will be no separate measurement or payment for varying depths. The Contractor is made aware that the existing AC pavement varies between 3-1/2" and below.

Payment will be made under:

- Item P-104-6.1 Saw Cut Existing AC Pavement (Full Depth) – per Lineal Foot
- Item P-104-6.2 Removal of Existing AC Pavement (Full Depth) – per Square Yard

**END OF ITEM P-104**



## ITEM P-151 REMOVAL OF EXISTING FACILITIES

### DESCRIPTION

**151-1.1** This item shall consist of clearing the work area of all existing facilities including but not limited to the removal of non-airfield pavements, removal of underground and above-ground utilities (encased or non-encased), utility pipes, storm drains, sanitary sewers, irrigation items, structures and obstructions, fences, debris and rubbish of any nature, natural obstructions, removal of all trees, stumps, down timber, logs, snags, brush, cacti (excluding Saguaro cacti), undergrowth, hedges, heavy growth of grass or weeds, including the clearing and grubbing of foundations or such material which in the opinion of the Resident Engineer is unsuitable for the foundation of any new construction, and including the disposal of these aforementioned waste materials resulting from clearing as required by the Engineer.

Removal of airfield pavements is included under Technical Specification Item P-104 *Removal of Pavement*.

### MATERIALS

**151-2.1** All materials used in conjunction with this work shall be furnished by the Contractor and will be considered incidental to the item.

### CONSTRUCTION METHODS

**151-3.1 GENERAL.** Clearing and grubbing shall be performed in the areas denoted on the plans as the removal or grading limits as well as all areas under proposed embankments or excavations. The clearing shall be done at a satisfactory distance in advance of any grading operations. All spoil materials removed by clearing shall be disposed of by hauling to an off-site disposal area, such as a landfill, at the time of the excavation in accordance with local regulations. Burning of spoil materials shall not be permitted on airport property.

The removal of existing structures, utilities, utility pipes, storm drains, airfield electrical facilities, fences, and non-airfield pavements and other existing improvements required to permit the orderly progress of work shall be accomplished by the Contractor, unless otherwise shown on the plans. Whenever a facility not indicated to be removed on the plans (pipeline, conduit, sewer, or other utility) is encountered and must be removed or relocated, the Contractor shall advise the Engineer who will notify the Airport and/or the proper local authority or owner and attempt to secure prompt action.

**151-3.2 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 in depth are to be made outside of paved areas. In cases where such depth of embankments is to be made, all unsatisfactory materials shall be removed, but sound trees, stumps, and brush can be cut off within 6 inches above the ground and allowed to remain. Tap roots and other projections over 1-1/2 inches in diameter shall be grubbed out to a depth of at least 12 inches below the finished subgrade or slope elevation.

All holes remaining after the grubbing operation in embankment areas shall have the sides broken down to flatten out the slopes, and shall be filled with acceptable material, moistened and properly compacted in

layers to the density required in Item P-152 and to the lines and grades shown in the plans. The same construction procedure shall be applied to all holes remaining after grubbing in excavation areas where the depth of holes exceeds the depth of the proposed excavation.

**All necessary clearing and grubbing as identified in the specifications and the plans shall be considered incidental to related items of work.**

**151-3.3 REMOVAL OF EXISTING STRUCTURES.** The Contractor shall clear the indicated areas of all objectionable materials by removing all structures, obstructions, and miscellaneous concrete, including all or portions of drainage structures, concrete box culverts, foundations, footings, tie-downs, electrical structures, etc. All existing concrete and structures shall be removed to its full depth, unless otherwise specified in the special provisions, designated on the plans, or directed by the Engineer. Although all earthwork associated with the removal of these items is considered incidental to the item, backfill shall be accomplished in accordance with the requirements of Technical Specification P-152 *Excavation and Embankment*.

All non-airfield bituminous pavements to be removed shall be disposed of off-site. Prior to removal, bituminous pavement shall be sawcut in accordance with Technical Specification P-104, as shown on the plans, or as directed by the Engineer.

Fencing materials identified to be removed and shall be hauled off-site by the Contractor. Where fence fabric, rails, wire, hardware and accessories which are in satisfactory condition and the correct size, the Contractor may be reused upon approval of the Engineer for fence relocations and/or temporary fencing. Excess fence fabric and barbed wire shall be neatly rolled and stored on the airport at a designated location (if desired by the Airport at the time of removal). Posts and other material deemed by the Engineer unsuitable for re-use shall be disposed of off-site by the Contractor.

**151-3.4 REMOVAL OF EXISTING PIPE, TRENCH DRAINS, DUCTS AND CONDUIT.** Existing pipe, trench drains, underground electrical concrete encased ducts, underground electrical concrete encased conduits, underground electrical direct buried ducts and underground electrical direct buried conduits to be removed shall be cut with straight and smooth edges on a plane perpendicular to the centerline of the structure. Backfill of the trench left behind shall be accomplished in accordance with the requirements of Technical Specification P-152. Unless otherwise indicated on the plans, the ends of any abandoned structure that remain in the ground shall be plugged in accordance with applicable MAG Standards.

**There shall be no separate measurement or payment for any backfill required after the removal of structures or utilities (see below), but shall be considered incidental to the associated removal item.**

**151-3.5 FILLING OF EXISTING PIPE.** If indicated on the plans to be abandoned in place and filled, all such pipes shall be filled from low to high with Controlled Low-Strength Material (CLSM), (refer to Technical Specification P-153), material that is able to flow into the pipe and fill all voids. There shall be no measurement or payment for this item but shall be considered incidental to the associated item.

**151-3.6 REMOVAL OF UTILITIES.** If so noted or shown on the plans, all utilities within the clearing limits shall be uncovered and completely removed, not abandoned in place. Prior to removal, the Contractor shall contact and coordinate the removal with the utility owner. If utility pipes are indicated on the plans, or directed by the utility owner, to be abandoned in place, all such utility pipes shall be filled from high to low with CLSM that is able to flow into the pipe and fill all voids.

**151-3.6 REMOVAL OF PAINT AND RUBBER.** All paint and rubber that will affect pavement bonding shall be removed from the surface of the existing pavement. Chemicals, high-pressure water, heater scarifier (asphaltic concrete only), or cold milling may be used. If cold milling is used, the Contractor shall clear the area of any Foreign Object Debris (FOD) immediately upon completion. Any methods used shall not cause major damage to the pavement or leave behind any FOD. Major damage is defined as changing the properties of the pavement or removing pavement over 1/8 inch deep. If chemicals are used, they shall comply with the state's environmental protection regulations. No material shall be deposited on the runway shoulders. All wastes shall be disposed of in areas indicated in this specification or shown on the plans.

A MasterSeal material or approved equivalent must be applied to all AC pavements that are to remain, that were impacted by the removal of paint operations. This action must take place before Substantial Completion is met. The Contractor shall submit MasterSeal material and application shop drawings for the review and approval of the Engineer. All equipment, material, and labor required to repair the AC pavement to its original condition shall be considered incidental to the associated item of work, (i.e. Obliterate Existing Pavement Markings).

**151-3.7 BACKFILLING.**

**a. Under Aircraft Loaded Pavements.** Backfill following removals within runways, taxiways, connecting taxiways, aprons or associated shoulder pavements shall consist of select material meeting the requirements of and placed in accordance with Technical Specification Item P-152, and compacted to not less than 100% of maximum dry density as determined by ASTM D 698. The select backfill shall be placed up to the bottom of the overlaying pavement base course. The backfill shall be considered incidental to the item being removed.

**b. Under Non-Aircraft Loaded Pavements.** Backfill following removals within infields or other non-aircraft loaded pavements shall consist of 3-inch minus native materials and shall be placed and compacted in layers not exceeding 8-inches in compacted thickness. The native material shall be placed to the bottom of the infield pavement in paved infields, bottom of base course under non-aircraft loaded pavements or within 6-inches of the top of finished grade in unpaved areas. The top 6-inches in unpaved areas shall contain 3-inch minus material. All native backfill material shall be compacted to a minimum of 95% maximum density per ASTM D 698.

**151-3.8 ADJUSTING UTILITY FRAMES, COVERS AND VALVE BOXES TO GRADE.** Unless otherwise noted elsewhere in the plans or specifications all existing frames, covers and valve boxes within the project limits shall be adjusted to grade in accordance with MAG Standard Specification 345 for utilities to remain. Unless otherwise noted in the plans and specifications, this work shall be incidental to the work most closely related (earthwork or paving).

**151-3.9 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 Technical Specification P-151, in accordance with Technical Specification P-100.



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### METHOD OF MEASUREMENT

**151-4.1** Measurement for the Removal of Existing Tie-Downs shall be per each including all labor, equipment, hauling and materials required to remove the item. No separate measurement shall be made for select backfill.

**151-4.2** Measurement for the Removal of Existing Chain-Link Fence shall be per linear foot including all labor, equipment, hauling and materials required to remove the item including posts, foundations, and fencing material. No separate measurement shall be made for select backfill.

### BASIS OF PAYMENT

**151-5.1** Payment for the Removal of Existing Tie-Downs shall be per each including all labor, equipment, hauling and materials required to remove the item. No separate payment shall be made for select backfill.

**151-5.2** Payment for the Removal of Existing Chain-Link Fence shall be per linear foot including all labor, equipment, hauling and materials required to remove the item including posts, foundations, and fencing material. No separate payment shall be made for select backfill.

Airfield pavement removal will be measured and paid for separately under Civil Technical Specification Item P-104, *Removal of Pavement*.

Payment will be made under:

- Item P-151-5.1    Removal of Existing Tie-Downs — per Each
- Item P-151-5.2    Removal of Existing Chain-Link Fence — per Linear Foot

**END ITEM P-151**



## ITEM P-152 EXCAVATION 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 taxiways, aprons, and intermediate 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.

**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 within the specifications.

**b. Borrow Excavation.** Borrow excavation shall consist of approved material required for the construction of embankment or for other portions of the work in excess of the quantity of usable material available from required excavations. Borrow material shall be obtained from areas within the limits of the airport property but outside the normal limits of necessary grading, or from areas outside the airport as approved by the Engineer.

**c. Over-excavation of Unsuitable Materials.** Over-excavation of Unsuitable Materials shall consist of the removal and disposal of deposits of any material containing vegetable or organic matter, such as muck, peat, organic silt, or sod considered unsuitable for foundation material or for use in embankment construction. Material, when approved by the Engineer as suitable to support vegetation, may be used on the embankment slope.

**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, when approved by the Engineer as suitable to support vegetation, may be used on the embankment slope.

### CONSTRUCTION METHODS

**152-2.1 General.** Before beginning excavation, grading, and embankment operations in any area, the area shall be completely cleared in accordance with Item P-151. Clearing before any excavation shall be considered incidental to the associated item, unless specifically scheduled in the bid for certain areas as designated in the Plans.

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. 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 pavement areas in which the top layer of soil material has become compacted, by hauling or other activities of the Contractor shall be scarified and disked to a depth of 4-inches in order 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 shall, at his/her own expense, 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 elevations and measurements of the ground surface. All suitable excavated material shall be used in the formation of embankment, subgrade, or for 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 of as directed. When the volume of excavation is not sufficient for constructing the fill to the grades indicated, the deficiency shall be obtained from borrow areas as contained in 152-1.2.b.

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 as 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 for rehandling as specified in paragraph 152-3.3.

**b. Over-excavation of Unsuitable Materials.** Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or any areas intended for turfing shall be excavated to a minimum depth of 12-inches, or to the depth specified by the Engineer, below the subgrade. 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 off-site at the Contractor's discretion. This excavated material shall be paid for at the contract unit price per cubic yard. The excavated area shall be refilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. The necessary refilling will constitute a part of the embankment. Where rock cuts are made and refilled



with selected 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. The Engineer shall determine if the displacement of such material was unavoidable and his/her decision shall be final. All overbreak shall be graded or removed by the Contractor and disposed of as directed; however, 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 for at least 2 feet below the top of subgrade or as indicated on the plans, and the material disposed of as directed. All foundations thus excavated shall be backfilled with suitable material and compacted as specified herein.

**e. Compaction Requirements.** The subgrade under areas to be paved shall be compacted to a depth of 8-inches and to a density of not less than 95 percent of the maximum density as determined by ASTM D 698. The material to be compacted shall be within (+/-) 2 percent of optimum moisture content before rolled to obtain the prescribed compaction (except for expansive soils).

The in-place field density shall be determined in accordance with ASTM D 1556 or ASTM D 2167. Stones or rock fragments larger than 4-inches in their greatest dimension will not be permitted in the top 8-inches of the subgrade. The finished grading operations, conforming to the typical cross section, shall be completed and maintained as directed by the Engineer.

In cuts, all loose or protruding rocks on the back slopes shall be barred loose or otherwise removed to line of finished grade of slope. 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 will not be permitted.

**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.

When borrow sources are outside the boundaries of the airport property, it shall be the Contractor's responsibility to locate and obtain the supply, subject to the approval of the Engineer. The Contractor shall notify the Engineer at least 15 calendar days prior to beginning the excavation so necessary measurements and tests can be made. All unsuitable material shall be disposed of by the Contractor. All borrow pits shall be opened up to expose the vertical face of various strata of acceptable material to enable obtaining a uniform product. 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, for temporary levee construction; or for any other type as designed or as shown on the plans. The work shall be performed in the proper sequence with the other construction. All satisfactory material shall be placed in fills; unsuitable material shall be placed in waste areas or as directed. Intercepting ditches shall be constructed prior to starting adjacent excavation operations. All necessary work shall be performed to secure a finish true to 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 vegetable matter shall be removed from the surface upon which the embankment is to be placed, and the cleared surface shall be completely broken up by plowing or scarifying to a minimum depth of 8-inches. This area shall then be compacted as indicated in paragraph 2.6. When the height of fill is greater than 4-feet, sod not required to be removed shall be thoroughly disked and recompact to the density of the surrounding ground before construction of embankment.

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 grading operations shall be conducted, and the various soil strata shall be placed, to produce a soil structure as shown on the typical cross section or as directed. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing, or other unsatisfactory conditions of the field. The Contractor shall drag, blade, or slope the embankment to provide proper surface drainage.

If imported fill is required, it shall meet the following requirements for imported fill/select backfill:

<u>Sieve Size</u>	<u>Percent Passing</u>
3 inch	100
No. 4	20-60
No. 40	10-40
No. 200	5-30



The maximum Plasticity Index (P.I.) per ASTM D 4318 should not exceed 8. A higher P.I. may be approved at the discretion of the Engineer provided that the percent passing the No. 40 sieve and No. 200 sieve does not exceed 20 percent and 10 percent respectively.

The material in the layer shall be within (+/-) 2 percent of optimum moisture content before rolling to obtain the prescribed compaction. In order to achieve a uniform moisture content throughout the layer, wetting or drying of the material and manipulation shall be required when necessary. Should the material be too wet to permit proper compaction or rolling, all work on all of the affected portions of the embankment shall be delayed until the material has dried to the required moisture content. Sprinkling of dry material to obtain the proper moisture content shall be done with approved equipment that will sufficiently distribute the water. Sufficient equipment to furnish the required water shall be available at all times. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken for the those to be used in the construction of embankments for areas in which concrete bases and/or foundations will be installed (sign bases, vault foundation, etc.) Based on these tests, the Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content in order to achieve the correct embankment density.

Rolling operations shall be continued until the embankment is compacted to not less than 95 percent of maximum density for noncohesive soils, and 90 percent of maximum density for cohesive soils as determined by ASTM D 698. On all areas outside of the pavement areas, no compaction will be required on the top 4 in. Under all areas to be paved, the embankments shall be compacted to a depth of 8-inches and to a density of not less than 100 percent of the maximum density as determined by ASTM D 698.

The in-place field density shall be determined in accordance with ASTM D 1556 or ASTM D 2167. Compaction areas shall be kept separate, and no layer shall be covered by another until the proper density is obtained.

During construction of the embankment, the Contractor shall route his/her equipment at all times, both when loaded and when empty, over the layers as they are placed and shall distribute the travel evenly over the entire width of the embankment. The equipment shall be operated in such a manner that hardpan, cemented gravel, clay, or other chunky soil material will be broken up into small particles and become incorporated with the other material in the layer.

In the construction of embankments, layer placement shall begin in the deepest portion of the fill; as placement progresses, 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 8-inches of the subgrade. Rockfill shall be brought up in layers as specified or as directed and every effort shall be exerted to fill the voids with the finer material 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 by the Resident 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 leveling equipment and by distribution of spalls and finer fragments of rock. These type lifts shall not be constructed above an elevation 4-feet below the finished subgrade.

Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material.

There will be no separate measurement of payment for embankment or local borrow.

**152-2.7 FINISHING AND PROTECTION OF SUBGRADE.** After the subgrade has been substantially completed the full width shall be conditioned by removing any soft or other unstable material that will not compact properly. The resulting areas and all other low areas, holes or depressions 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 take all precautions necessary to protect the subgrade from damage. He/she shall limit hauling over the finished subgrade to that which is essential for construction purposes.

All ruts or rough places that develop in a completed subgrade shall be smoothed 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. Its cost shall be considered by the Contractor and included 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 16-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 or pins. Any deviation in excess of these amounts shall be corrected by loosening, adding, or removing materials; reshaping; and recompacting by sprinkling and rolling.

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.

### **METHOD OF MEASUREMENT**

**152-3.1** Measurement for “Subgrade Preparation” shall include all scarifying, moisture conditioning, compaction (8-inch depth) and grading of all areas to specified densities and tolerances prior to placement of final pavement sections. Measurement and payment for Subgrade Preparation shall be made by the square yard (8-inch depth) processed, graded and compacted, to the elevations in accordance with the plans and specifications and accepted by the Engineer. All clearing and grubbing, hauling, and off-site removal of any unwanted spoils shall be considered incidental to the Subgrade Preparation Payment Line Item provided below. This price shall include full compensation for all labor, materials, and equipment necessary to complete the item.

**152-3.2** Measurement for “Unclassified Excavation” shall include furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item, including excavation, hauling, construction of embankment, and removal of waste excavation from the airport. Unclassified Excavation shall include the excavation from the bottom of existing pavement to the top of subgrade that is identified in the plans to, (less any unsuitable materials that may be encountered). Unclassified Excavation shall be measured by the cubic yard.

**152-3.3** “Over-Excavation and Replacement of Unsuitable Materials” shall be measured by the cubic yard from its original position of the surface prior to excavation of unsuitable material less the measured surface after excavation of unsuitable material when complete. Measurement shall include furnishing all materials, labor, equipment, tools, and incidentals necessary to excavate, remove, haul and properly dispose of the unsuitable material off-site, mixing, placement, compaction and finishing of the suitable material in its place including the hauling of any embankment. This is a Contingent item and measurement shall not include the quantity of materials excavated without prior approval by the Engineer, or the quantity of material used for purposes other than those directed.

**152-3.4** There will be no separate payment for Clearing and Grubbing.

**152-3.5** For payment specified by the cubic yard, measurement for all excavation shall be computed using the measured area, the existing pavement thickness, and the new pavement sections as indicated in the plans and this specification.

Measurement will be based on plan quantities and the actual pavement thicknesses verified by the Engineer in the field.

### **BASIS OF PAYMENT**

**152-4.1** For “Subgrade Preparation” payment shall be made at the contract unit price per square yard of subgrade preparation (8-inch minimum depth), including clearing and grubbing, scarifying,



moisture conditioning, and compacting in-place to the specified density and tolerance prior to placement of remainder of the final pavement section. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

**152-4.2** Payment for “Unclassified Excavation” shall include furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item, including excavation, hauling, construction of embankment, and removal of waste excavation from the airport. Unclassified Excavation shall include the excavation from the bottom of existing pavement to the top of subgrade that is identified in the plans to be stabilized with lime, (less any unsuitable materials that may be encountered). Unclassified Excavation shall be paid by the cubic yard.

**152-4.3** Payment for “Over-Excavation and Replacement of Unsuitable Materials” shall be by the cubic yard from its original position of the surface prior to excavation of unsuitable material less the measured surface after excavation of unsuitable material when complete. Payment shall include furnishing all materials, labor, equipment, tools, and incidentals necessary to excavate, remove, haul and properly dispose of the unsuitable material off-site, mixing, placement, compaction and finishing of the suitable material in its place including the hauling of any embankment. This is a Contingent item and measurement shall not include the quantity of materials excavated without prior approval by the Airport, or the quantity of material used for purposes other than those directed.

Payment will be made under:

- Item P-152-4.1 Subgrade Preparation (8-Inch Depth) – per Square Yard
- Item P-152-4.2 Unclassified Excavation – per Cubic Yard
- Item P-152-4.3 Over-Excavation and Replacement of Unsuitable Materials, Backfill & Compaction (Contingent Item) – per Cubic Yard

#### TESTING REQUIREMENTS

- ASTM D 698 Test for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-pound (2.49 kg) Rammer and 12 in (305 mm) Drop
- ASTM D 1556 Test for Density of Soil In Place by the Sand-Cone Method
- ASTM D 2167 Test for Density and Unit Weight of Soil In Place by the Rubber Balloon Method.
- ASTM D 6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods

**END OF ITEM P-152**



## 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 at other locations shown on the plans or as directed by the Engineer.

### MATERIALS

#### 153-2.1 MATERIALS

**a. Portland Cement.** Portland cement shall conform to the requirements of ASTM C 150 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. Flyash.** Flyash shall conform to ASTM C 618, Class C or F.

**c. Fine Aggregate (Sand).** Fine aggregate shall conform to the requirements of ASTM C 33 except for aggregate gradation. Any aggregate gradation which produces performance characteristics of the CLSM specified herein will be accepted, except as follows.

Sieve Size	Percent Passing by weight
3/4 in (19.0 mm)	100
No. 200 (0.075 mm)	0 - 12

**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 PROPORTIONS.** The contractor shall submit, to the Engineer, a mix design including the proportions and source of materials, admixtures, and dry cubic yard batch weights. The mix shall contain a minimum of 50 pounds of cement and 250 pounds fly ash per cubic yard, with the remainder of the volume composed of sand, water, and any approved admixtures.

**a. Compressive Strength.** CLSM shall be designed to achieve a 28-day compressive strength of 100 to 200 psi when tested in accordance with ASTM D 4832. There should be no significant strength gain after 28 days. Test specimens shall be made in accordance with ASTM D 4832.

**b. Consistency.** Consistency of the fresh mixture shall be such that the mixture may be placed without segregation. A desired consistency may be approximated by filling an open-ended 3-inch diameter cylinder, 6-inches high to the top, with the mixture and the cylinder immediately pulled straight up. The correct consistency of the mixture will produce an approximate 8-inch diameter circular-type spread without segregation. Adjustments of the proportions of materials should be made to achieve proper solid suspension and flowable characteristics, however the theoretical yield shall be maintained at one cubic yard for the given batch weights.

## CONSTRUCTION METHODS

### 153-4.1 PLACEMENT.

**a. Placement.** CLSM may be placed by any reasonable means from a mixing unit into the space to be filled. Agitation is required during transportation and waiting time. Placement shall be performed in such a manner that structures or pipes are not displaced from their desired final position and intrusion of CLSM into undesirable areas is avoided. The material shall be brought up uniformly to the fill line shown on the plans or as directed to the Engineer. Each placement of CLSM shall be as continuous an operation as possible. If CLSM is placed in more than one layer, the base layer shall be free of surface water and loose of foreign material prior to placement of the next layer.

**b. Limitations of Placement.** CLSM shall not be placed on frozen ground. Mixing and placing may begin when the air or ground temperature is at least 35 °F and rising. At the time of placement, CLSM shall have a temperature of at least 40 °F. Mixing and placement shall stop when the air temperature is 40 °F and falling or when the anticipated air or ground temperature will be 35 °F or less in the 24-hour period following proposed placement.

### 153-4.2 CURING AND PROTECTION

**a. Curing.** The air in contact with the CLSM should be maintained at temperatures above freezing for a minimum of 72 hours. If the CLSM is subjected to temperatures below 32 °F, the material may be rejected by the Engineer if damage to the material is observed.

**b. Protection.** The CLSM shall not be subject to loads and shall remain undisturbed by construction activities for a period of 48 hours or until a compressive strength of 75% of the design strength is obtained. The Contractor shall be responsible for providing evidence to the Engineer that the material has reached the desired strength. Acceptable evidence shall be based upon compressive tests made in accordance with paragraph 153-3.1a.

## MATERIAL ACCEPTANCE

**153-5.1 Acceptance.** Acceptance of CLSM delivered and placed as shown on the plans or as directed by the Engineer shall be based upon mix design approval and batch tickets provided by the Contractor to confirm that the delivered material conforms to the mix design. The Contractor shall verify by additional testing the CLSM material placed/used each day during the project.. Verification shall include confirmation of material proportions and tests of compressive strength to confirm that the material meets the original mix design and the requirements of CLSM as defined in this specification. Adjustments shall be made as necessary to the proportions and materials prior to further production.

## METHOD OF MEASUREMENT

**153-6.1 Measurement.** There will be no separate measurement for CLSM. It shall be considered incidental to the associated item in which the CLSM is being constructed.



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### BASIS OF PAYMENT

**153-7.1 Payment.** There will be no separate payment for CLSM. It shall be considered incidental to the associated item in which the CLSM is being constructed.

### TESTING REQUIREMENTS

ASTM D 4832 Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

### 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 C 595 Specification for Blended Hydraulic Cements

**END OF ITEM P-153**

## ITEM P-208 AGGREGATE BASE COURSE (MAG)

### DESCRIPTION

**208-1.1 GENERAL.** Maricopa Association of Governments (MAG) crushed aggregate base course (modified) shall be crushed aggregate base course, consisting of crushed aggregate constructed on a prepared course in accordance with MAG 702, this specification, and in conformity to the dimensions and typical cross-sections shown on the plans.

### MATERIALS

**208-2.1 UNCRUSHED COARSE AGGREGATE.** The base course material shall consist of hard, durable particles or fragments of stone or gravel mixed or blended with sand, stone dust, or other similar binding or filler materials produced from approved sources. All oversized stones, rocks and boulders occurring in the pit or quarry material shall be wasted; those of acceptable quality may be crushed and become a part of the base material, provided the blend meets the specified gradations. The aggregate shall be free from vegetation, lumps, or excessive amounts of clay and other objectionable substances. The coarse aggregate shall have a percent of wear not more than 45 at 500 revolutions as determined by ASTM C 131.

**208-2.2 CRUSHED COARSE AGGREGATE.** The aggregates shall consist of both fine and coarse fragments of crushed stone, crushed slag, or crushed gravel mixed or blended with sand, screenings, or other similar approved materials. The crushed stone shall consist of hard, durable particles or fragments of stone and shall be free from excess flat, elongated, soft or disintegrated pieces, dirt, or other objectionable matter.

The crushed slag shall be air-cooled, blast furnace slag and shall consist of angular fragments reasonably uniform in density and quality and shall be reasonably free from thin, elongated, or soft pieces, dirt, and other objectionable matter. It shall weigh not less than 70 pounds per cubic foot as determined by ASTM C 29.

The crushed gravel shall consist of hard, durable stones, rock, and boulders crushed to specified size and shall be free from excess flat, elongated, soft or disintegrated pieces, dirt, or other objectionable matter. The method used in production of crushed gravel shall be such that the fractured particles occurring in the finished product shall be as nearly constant and uniform as practicable and shall result in a minimum of 60% of the material retained on the No. 4 sieve having at least 2 fractured faces and 75% having at least 1 fractured face.

If necessary to meet this requirement or to eliminate an excess of fine, uncrushed particles, the gravel shall be screened before crushing. All stones, rocks, and boulders of inferior quality in the pit shall be wasted.

The crushed coarse aggregate shall have a percent of wear not more than 50 at 500 revolutions as determined by ASTM C 131.

All material passing the No. 4 mesh sieve produced in the crushing operation of either stone, slag, or gravel shall be incorporated in the base material to the extent permitted by the gradation requirements.



**208-2.3 GRADATION.** The gradation of the uncrushed or crushed material shall meet the requirements of one of the gradations given in **Table 1** (below) when tested in accordance with ASTM C 117, ASTM C 136, and ASTM D 422.

Samples of aggregates to check gradation shall be taken by the Engineer at least two per lot. The lot will be consistent with acceptable sampling for density. The samples shall be taken from the in-place, compacted material. Sampling shall be in accordance with ASTM D 75, and testing shall be in accordance with ASTM C 136 and ASTM C 117.

**Table 1 Requirements for Gradation of Aggregate**

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
2 in	--
1-1/2 in	100
1 in	90 - 100
3/4 in	38-65
No. 4	25 - 60
No. 40	10 - 40
No. 200	3 - 12
Plastic Index, max	5

Gradations in Table 1 represent the limits that shall determine suitability of aggregate for use from the sources of supply. The final gradations decided on, within the limits designated in the table, shall be well-graded from course to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieves, or vice versa.

The Plasticity Index shall be as noted in Table 1 above when tested in accordance with AASHTO T-146 Method A (Wet Preparation), T-89 and T-90.

**208-2.4 FILLER FOR BLENDING.** If filler, in addition to that naturally present in the base course material, is necessary for satisfactory bonding of the material, for changing the soil constants of the material passing the No. 40 mesh sieve, or for correcting the gradation to the limitations of the specified gradation, it shall be uniformly blended with the base course material at the crushing plant or at the mixing plant. The material for such purpose shall be obtained from sources approved by the Engineer and shall be of a gradation necessary to accomplish the specified gradation in the finally processed material.

The additional filler may be composed of sand, but the amount of sand shall not exceed 20% by weight of the total combined base aggregate. All the sand shall pass a No. 4 mesh sieve and not more than 5% by weight shall pass a No. 200 mesh sieve.

### CONSTRUCTION METHODS

**208-3.1 OPERATIONS IN PITS AND QUARRIES.** All work involved in clearing and stripping pits and quarries, including handling of unsuitable material, shall be performed by the Contractor. All

material shall be handled in a manner that shall secure a uniform and satisfactory base product. The base course material shall be obtained from sources that have been approved.

**208-3.2 PREPARING UNDERLYING COURSE.** The underlying course shall be checked and accepted by the Engineer before placing and spreading operations are started. Any ruts or soft, yielding places due to improper drainage conditions, hauling, or any other cause, shall be corrected and rolled to the required density before the base course is placed thereon.

To protect the underlying course and 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.

### **208-3.3 METHODS OF PRODUCTION**

**a. Plant Mix.** When provided in the proposal, or when selected by the Contractor and approved by the Engineer, the base material shall be uniformly blended or mixed in an approved plant. The mixing plant shall include bins for storage and batching of the aggregate, pump and tanks for water, and batch mixers of either the pugmill or drum type. All mineral aggregates shall be batched into the mixer by weight. The agitation shall be such that a thorough dispersion of moisture is obtained. The size of the batch and the time of mixing shall be fixed by the Engineer and shall produce the results and requirements specified. The base course material produced by combining two or more materials from different sources shall be mixed in a mixing plant described herein. The mixture material shall be at a satisfactory moisture content to obtain maximum density.

**b. Travel Plant.** When the use of a traveling plant is allowed, the plant shall blend and mix the materials to meet these specifications. It shall accomplish a thorough mixing in one trip. The agitation shall be such that the dispersion of the moisture is complete. The machine shall move at a uniform rate of speed and this speed shall be regulated to fix the mixing time. If a windrow-type of travel plant is employed for mixing, the aggregate shall be placed in windrows parallel to the pavement centerline.

The windrow volume shall be sufficient to cover exact areas as planned. The windrow contents shall produce a mixture of the required gradation and bonding qualities. If a travel plant is used which is of the type that mixes previously spread aggregates in-place, the material shall have been spread in such thickness and proportions as may be handled by the machine to develop a base course of the thickness of each layer and of the gradation required. With either type of equipment, the mixed material shall be at a satisfactory moisture content to obtain the maximum density.

**c. Materials of Proper Gradation.** When the entire base course material from coarse to fine is secured in a uniform and well-graded condition and contains approximately the proper moisture, such approved material may be handled directly to the spreading equipment. The material may be obtained from gravel pits, stockpiles, or produced from a crushing and screening plant with the proper blending. The materials from these sources shall meet the requirements for gradation, quality, and consistency. The intent of this section of these specifications is to secure materials that will not require further mixing. The base material shall be at a satisfactory moisture content to obtain maximum density. Any minor deficiency or excess of moisture may be corrected by surface sprinkling or by aeration.

In such instances some mixing or manipulation may be required immediately preceding the rolling to obtain the required moisture content. The final operation shall be blading, if necessary, to obtain a smooth uniform surface true to line and grade.

#### **208-3.4 PLACING.**

a. The aggregate base material that is correctly proportioned, or has been processed in a plant, shall be placed on the prepared underlying course and compacted in layers of the thickness shown on the plans. The depositing and spreading of the material shall commence where designated and shall progress continuously without breaks. The material shall be deposited and spread in lanes in a uniform layer and without segregation of size to such loose depth that, when compacted, the layer shall have the required thickness. The base aggregate shall be spread by spreader boxes or other approved devices having positive thickness controls that shall spread the aggregate in the required amount to avoid or minimize the need for hand manipulation. Dumping from vehicles in piles that require rehandling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

b. The aggregate base material that has been processed in a traveling plant, or mixed and blended in-place, shall be spread in a uniform layer of required depth and width and to the typical cross section. The spreading shall be by a self-powered blade grader, mechanical spreader, or other approved method. In spreading, care shall be taken to prevent cutting into the underlying layer. The material shall be bladed until a smooth, uniform surface is obtained, true to line and grade.

c. The base course shall be constructed in a layer 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 sq yd in advance of the rolling. Any necessary sprinkling shall be kept within these limits. No material shall be placed in snow or on a soft, muddy, or frozen course.

When more than one layer is required, the construction procedure described herein shall apply similarly to each layer.

During the mixing and spreading process, sufficient caution shall be exercised to prevent the incorporation of subgrade, subbase, or shoulder material in the base course mixture.

**208-3.5 COMPACTION.** Immediately upon completion of the spreading operations, the aggregate shall be thoroughly compacted. The number, type, and weight of rollers shall be sufficient to compact the material to the required density.

The moisture content of the material during placing operations shall not be below, nor more than 2 percentage points above, the optimum moisture content as determined by ASTM D 698.

If nuclear density machines are to be used for density determination, the machines shall be calibrated in accordance with ASTM D 6938. The nuclear equipment shall be calibrated using blocks of materials with densities that extend through a range representative of the density of the proposed base material. When using the nuclear method, ASTM D 6938 shall be used to determine the moisture content of the material. See Section 120 of the General Provisions for additional guidance.

**208-3.6 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY.** Aggregate base course shall be accepted for density on a lot basis. A lot will consist of the total amount of aggregate base course used on the project, and no asphalt paving or concrete placement shall occur on top of the base course prior to all of the base course being installed.

Each lot shall be divided into two equal sublots. One test shall be made for each subplot. Sampling locations will be determined by the Engineer on a random basis in accordance with statistical procedures contained in ASTM D 3665.

Each lot will be accepted for density when the field density is at least 100 percent of the maximum density of laboratory specimens prepared from samples of the material delivered to the jobsite. The specimens shall be compacted and tested in accordance with ASTM D 698. The in-place field density shall be determined in accordance with ASTM D 1556 or ASTM D 2167. If the specified density is not attained, the entire lot shall be reworked and/or recompacted and two additional random tests made. This procedure shall be followed until the specified density is reached.

If nuclear density machines are to be used for density determination, the machines shall be calibrated in accordance with ASTM D 6938. The nuclear equipment shall be calibrated using blocks of materials with densities that extend through a range representative of the density of the proposed base material. When using the nuclear method, ASTM D 6938 shall be used to determine the moisture content of the material. See Section 120 of the General Provisions for additional guidance.

**208-3.7 SURFACE TEST.** After the course has been completely 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, reshaped, recompacted, and otherwise manipulated as the Engineer may direct until the required smoothness and accuracy are obtained. The finished surface shall not vary more than 3/8-inch from a 16-foot straightedge when applied to the surface parallel with, and at right angles to, the centerline.

**208-3.8 THICKNESS.** The thickness of the base course shall be determined by depth tests or cores taken at intervals in such manner that each test shall represent no more than 300 sq yd. When the base deficiency is more than 1/2-inch, the Contractor shall correct such areas by scarifying, adding satisfactory base mixture, rolling, sprinkling, reshaping, and finishing in accordance with these specifications. The Contractor shall replace, at his/her expense, the base material where borings have been taken for test purposes.

**208-3.9 PROTECTION.** Work on the base course shall not be accomplished during freezing temperatures nor when the subgrade is wet. When the aggregates contain frozen materials or when the underlying course is frozen, the construction shall be stopped.

Hauling equipment may be routed over completed portions of the base course, provided no damage results and provided that such equipment is routed over the full width of the base course to avoid rutting or uneven compaction. However, the Engineer in charge shall have full and specific authority to stop all hauling over completed or partially completed base course when, in his/her



opinion, such hauling is causing damage. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor at his/her own expense.

**208-3.10 MAINTENANCE.** Following the completion of the base course, the Contractor shall perform all maintenance work necessary to keep the base course in a condition satisfactory for priming. After priming, the surface shall be kept clean and free from foreign material. The base course shall be properly drained at all times. If cleaning is necessary, or if the prime coat becomes disturbed, any work or restitution necessary shall be performed at the expense of the Contractor.

Before preparations begin for the application of a surface treatment or for a surface course, the base course shall be allowed to partially dry until the average moisture content of the full depth of base is less than 80% of the optimum moisture of the base mixture. The drying shall not continue to the extent that the surface of the base becomes dusty with consequent loss of binder. If during the curing period the surface of the base dries too fast, it shall be kept moist by sprinkling until such time as the prime coat is applied as directed.

The Contractor shall remove all survey and grade hubs from the base courses prior to placing any bituminous surface course.

#### **METHOD OF MEASUREMENT**

**208-4.1** The quantity of Crushed Aggregate Base Course (MAG) to be paid for will be determined by the measurement of the number of cubic yards of material actually constructed and accepted by the Airport as complying with the plans and specifications, regardless of the thickness.

#### **BASIS OF PAYMENT**

**208-5.1** Payment shall be made at the bid proposal unit price cubic yard for Crushed Aggregate Base Course (MAG). 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:

P-208-5.1            Crushed Aggregate Base Course (MAG) – per Cubic Yard

#### **TESTING REQUIREMENTS**

ASTM C 29	Unit Weight of Aggregate
ASTM C 117	Materials Finer than 75 $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 136	Sieve Analysis of Fine and Coarse Aggregates



ASTM D 422	Particle Size Analysis of Soils
ASTM D 698	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb (2.49 kg) Rammer and 12 in (305 mm) Drop
ASTM D 1556	Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	Test for Laboratory Compaction Characteristics of Soil Using Modified Effort
ASTM D 2167	Density of Soil in Place by the Rubber-Balloon Method
ASTM D 3665	Random Sampling of Paving Materials
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods

**END OF ITEM P-208**



## ITEM P-405 ASPHALT CONCRETE PAVEMENT (MAG)

### DESCRIPTION

**405-1.1** Maricopa Association of Governments (MAG) Asphalt Concrete (modified) pavement shall consist of bituminous paving in accordance with MAG Standard Specifications Sections 321 and 710. Asphalt concrete supplied shall have a nominal maximum aggregate size of 3/4-inch for Surface Course Material. The supplied mix design shall be intended for low volume traffic as defined by Section 710.

### MATERIALS AND MANUFACTURER

**405-2.1 GENERAL.** Materials and manufacture shall conform to MAG Section 710 for the type specified, except as provided in this specification.

**405-2.2 JOB MIX FORMULA.** No bituminous mixture for payment shall be produced until a job mix formula has been approved by The Engineer. The job mix formula for the mixes shall be as shown in MAG Section 710 Marshal Mix Design Criteria (low traffic mix), using PG 64-22 asphalt oil and a targeted 3/4-inch maximum aggregate, pending the Job Mix Formula, (i.e. Surface Course).

**405-2.3 RECYCLED ASPHALT.** Recycled asphalt concrete will not be allowed on this project.

### CONSTRUCTION METHODS

**405-3.1 WEATHER AND MOISTURE CONDITIONS.** Asphalt concrete shall be placed only when the surface is dry, and when the atmospheric temperature in the shade is forty degrees Fahrenheit (40°F) or above. Asphalt Concrete for base course which is less than two (2) inches in thickness shall be placed only when the surface is dry, and when the surface temperature is equal to or greater than fifty degrees Fahrenheit (50°F).

No asphalt concrete shall be placed when the weather is foggy or rainy, or when the base on which the material is to be placed contains moisture in excess of the optimum. Asphalt concrete shall be placed only when the Engineer determines weather conditions are suitable.

**405-3.2 APPLICATION OF TACK COAT.** If the Contractor places multiple layers of asphaltic concrete pavement, a tack coat shall be applied to all existing or new bituminous surface prior to the placing of a succeeding layer of bituminous mixed material. The preparation, material, and application of tack coat shall comply with MAG Standard Specifications 329, 330, 333, and 713.

This same material shall also be applied to the vertical surfaces of existing pavements, curbs, and gutters, against which asphalt concrete is to be placed. The surface to be covered may require repair or patching as directed by the Engineer.

The shall be no separate measurement or payment for the application of any tack coat, but shall be considered incidental to the associated item of work, (i.e. construction of asphalt concrete).



**405-3.3 PLACING, SPREADING AND FINISHING.** Asphalt concrete shall be delivered and placed within the job mix formula limits specified in MAG Section 710, unless otherwise shown within this specification. Tarpaulins shall be furnished and used to cover all loads during transportation if the temperature of the mixture is below two hundred-sixty degrees Fahrenheit (260°F). The temperature shall be taken by the Contractor's Quality Control personnel, at a point six (6) inches below the exposed surface of the material, in the truck, on the job site, and just prior to placement. When releasing agents are placed in the truck beds, no free fluid shall be present in the truck bodies at the time of asphalt concrete is loading. Diesel fuel shall not be used as a releasing agent.

The handling of the completed mixture shall at all times be such as to prevent segregation, and the material as spread shall be free from areas of excess course or fine material. Float rock developed in the process of raking shall be placed on an underlying course or otherwise disposed of. In no case shall it be scattered over the surface of a final course.

Placement shall begin on pavement at points farthest from the source of supply, and progress continuously toward the source of supply, unless otherwise ordered by the Engineer, and no more than one-half (1/2)-day's delivery to the project shall be placed in any one lane in advance of other lanes. Transverse joints in adjacent lanes shall be offset a minimum of ten (10) feet.

At locations where the mixture is to be placed over areas inaccessible to the required spreading or compacting equipment or over areas where the use of the required spreading and compacting equipment would not be practicable, the mixture may be spread or compacted by other means approved by the Engineer.

**a. Base Preparation.** The base on which the asphalt concrete is to be placed shall be prepared by the Contractor, and shall be smooth, firm, and true to grade and cross-section as shown on the plans, and shall be so maintained throughout the period of placing asphalt concrete. If necessary, in order to obtain the above-specified base condition, and if ordered by the Engineer, aggregate base shall be spread to level out any irregularities such as dips, depressions, and sags. All irregularities such as humps or high spots shall be removed in order to provide a smooth base of uniform grade and cross-section, so subsequent surfacing will be of uniform thickness. The finished surface of the base shall not vary more than one-half (1/2)-inch when tested with a sixteen (16)-foot straight edge applied parallel with or at right angles to the centerline. Any deviation in excess of this amount shall be corrected by the Contractor at the Contractor's expense.

No additional compensation will be allowed for furnishing and placing these materials. Full compensation for all materials and for all work incidental to the correcting of irregularities will be considered as included in the contract price for asphalt concrete.

**b. Spreading and Finishing Equipment.** Self-propelled mechanical spreading and finishing equipment shall be provided with a vibrating screed or strike off assembly capable of distributing not less than the full width of a paving lane. The term screed includes any strike-off device which operates by cutting, crowding, or other practical action which is effective on mixtures at workable temperatures without tearing, shoving, or gouging, and which will produce a finished surface of the smoothness and texture required. The screed shall be adjustable to the required template and elevation. The forward speed of operation of self-propelled mechanical spreading and finishing equipment shall be so regulated so no irregularities will result in the surface texture or smoothness



of the mat due to excessive forward speed of the spreading machine. The forward speed of operation shall not exceed fifty-five (55) feet per minute, unless the Contractor can demonstrate to the satisfaction of the Engineer higher speeds will not affect the smoothness of the mat.

All material within the self-propelled mechanical spreading and finishing equipment shall be handled to prevent segregation of the aggregate. This includes but is not limited to devices such as augers, screws or slat conveyors. These devices shall extend to the final or termination point where the material is being transported within the equipment. If any of the devices fail to function, the paving operation shall be terminated immediately until repairs are completed. In the case of the screed, auger extensions and vibrators shall be installed wherever the screed is extended more than one (1) foot beyond the end of the base auger or auger extension. However, when placing material against an extremely uneven edge over a short distance, the Engineer may waive the auger extensions and vibrators.

Self-propelled mechanical spreading and finishing equipment shall be equipped with control system capable of automatically maintaining the screed elevation as specified herein.

The control system shall be automatically actuated from a laser system of mechanical sensors or sensor directed mechanisms or devices which 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 plus or minus 0.1 percent. When directed by the Engineer, the transverse slope control system shall be made inoperative and the screed shall be controlled by sensor directed automatic mechanisms which will independently control the elevation of each end of the screed from reference lines or surfaces.

The controls shall be capable of working in conjunction with a thirty (30) or longer ski taut string line (wire) set to grade, short ski or laser control. The Contractor shall furnish all necessary equipment to perform the paving operation.

When trucks are backed into the self-propelled mechanical spreading and finishing equipment, it shall be in such a manner that the equipment will not be jarred excessively or moved out of line. Once in position, the truck shall be securely attached to the equipment during spreading and finishing.

When the Engineer deems that the automatic screed control operation is not practical under a particular set of conditions, he/she may order the use of manual control in lieu thereof. However, the machine shall be equipped with the automatic device.

Use of the spreader boxes will be permitted by the Engineer only in writing, under certain conditions, such as in narrow paving projects where it is not practical to use self-propelled equipment. The spreader box will be equipped with a readily adjustable strike off blade. In order to obtain a smooth surface manipulation of the controls of the spreader box shall be held to a minimum. Trucks shall be backed into the spreader box in such a manner that the box will not be jarred excessively or moved out of line and the trucks shall be securely attached to the spreading and finishing.

The asphaltic concrete materials shall not be placed with a self-propelled pneumatic tired blade grader.

**c. Compaction Equipment.** All rollers used in compaction of asphalt concrete shall be self-propelled and reversible, with a minimum weight of eight (8) tons. All rollers shall be maintained to insure smooth operation in respect to steering, the ability to stop, start and reverse. All rollers shall be equipped with an automatic device or devices capable of properly dispensing an approved releasing agent on the wheels to prevent the wheels from picking up the asphalt concrete. Diesel fuel shall not be used as a releasing agent. All rollers shall be equipped with scrapers to keep the wheels clean from asphalt and other debris.

Pneumatic-tired rollers shall be of the two (2)-axle tandem type having a rolling width of not less than five (5) feet. All tires shall not be less than twenty (20) inches in diameter, shall be of the same size and shall have treads satisfactory to the Engineer. The roller shall be so constructed that the operating weight per tire shall not be less than two thousand (2,000) pounds and the tires shall be spaced so that the entire gap between adjacent tires will be covered by the tread of the following tire. Except as otherwise specified, each tire shall be inflated to ninety (90) psi and at all times the air pressure in each tire shall not vary more than five (5) psi from the specified pressure. Pneumatic-tired rollers shall be equipped with skirt-type devices mounted around the tires so that the temperature of the tires will be maintained during the rolling process.

Steel-wheeled tandem rollers or vibratory rollers may be used where applicable. In all cases, the larger of the two roller wheels will be operated in the forward position. The steel wheels shall be straight, free from grooves and/or pits. Vibratory rollers shall be operated in accordance with standard practices and manufacturer recommendations.

**d. Asphalt Surface Course.** Asphalt surface course (3/4") shall be spread and finished by means of self-propelled mechanical spreading and finishing equipment as described and specified above, except as otherwise noted. The compacted thickness of layers placed shall be as shown on the plans, but in no case shall the compacted thickness of each lift exceed four (4) inches.

When more than one (1) course is placed, longitudinal joints of each course shall be staggered not less than one (1) foot with relation to the longitudinal joints of the underlying course. Transverse joints in adjacent lanes shall be offset a minimum of ten (10) feet.

Before another course is placed adjacent to cold transverse construction joint, the joint shall be trimmed to a vertical face by saw cutting the material back to its full depth to expose a fresh surface. The joint shall be cut on a ten-degree (10°) to fifteen-degree (15°) skew from a line perpendicular to the center line of the pavement. The joint formed when the fresh mixture is placed shall be dense and well-sealed. The transverse surface joints shall be tested with a sixteen (16)-foot straightedge and shall conform to the requirements herein for surface smoothness. For short overnight intermissions in paving, a full depth bulkhead (e.g., wooden member) can be placed near the end of the day's pavement. The bulkheads and excess material will be removed just prior to the placement of the following day's pavement.

An approved joint heater shall be used on cold transverse or longitudinal joints where conditions are such that it is deemed necessary by the Engineer. The joint heater shall be capable of heating the joint to a minimum temperature of two hundred degrees Fahrenheit (200°F).



Emulsified asphalt shall be applied to the exposed edge before new pavement is placed against the joint.

Sufficient rolling equipment shall be furnished to satisfactorily compact and finish the amount of mixture being placed. However, there shall be a minimum of two (2) rollers with two (2) operators on the project at all times. Upon direction of the Engineer, one of the rollers may be a pneumatic-tire roller. During rolling operations, the speed of the roller(s) shall not exceed 3 miles per hour. If an ample number of rollers are not present, the Contractor shall adjust the asphalt placement rate to accommodate the roller(s) speed. The type and required number of rollers shall be on the project and in acceptable operating condition, prior to the placement of any asphalt material. All rollers shall be operated continuously from the breakdown through finish rolling. The Contractor may use vibratory rollers in lieu of the steel-wheeled roller, however when the thickness of the asphalt is one (1) inch or less, all rolling will be done in the static mode.

When more than one width of asphalt concrete material will be placed, a six (6)-inch strip adjacent to the area on which future material is to be laid shall not be rolled until such material has been placed but shall not be left unrolled more than two (2) hours after being placed, unless the six (6)-inch unrolled strip is first heated with a joint heater. After the first strip or width has been compacted, the second width shall be placed, finished and compacted as provided for the first width, except that rolling shall be extended to include the six (6) inches of the first width not previously completed.

At any place not accessible to the roller, the mixture shall be thoroughly compacted with tampers and finished, where necessary, with a hot smoothing iron to provide a uniform and smooth layer over the entire area compacted in this manner.

Breakdown rolling shall begin as soon as the mixture will bear the roller without undue displacement. Rolling shall be longitudinal, overlapping on successive trips by at least thirty-four percent (34%) but not more than the width of the rear wheels. Alternate trips of the roller shall be of slightly different lengths. The motion of the roller shall at all times be slow enough to avoid displacement of the mixture.

Break down and compaction rolling shall be done by either steel-wheel or pneumatic-tire rollers. The Engineer may require a pneumatic-tire roller for one of the rolling operations. Rolling shall continue until the specific gravity of the compacted mixture is not less than ninety-five percent (95%) of the specific gravity of specimens composed of the same materials in similar proportions or composed of the same mixture compacted in the laboratory by the seventy-five (75) blow method of AASHTO T-245 if the mix was designed by the Marshall method. If the mix was designed by the Asphalt Institute's SP-2 Gyrator method, rolling shall continue until the specific gravity of the compacted mixture is not less than ninety-three percent (93%) of the maximum theoretical specific gravity (ASTM D-2041) of specimens composed of the same materials in similar proportions or composed of the same mixture compacted in the laboratory.

Finish rolling shall be done by means of steel-wheeled roller or a vibratory steel-wheel roller operated in the static mode.

The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. The surface shall not vary by more



than one-quarter (1/4)-inch from the lower edge of a sixteen (16)-foot straightedge when the straightedge is placed parallel to the centerline, and shall not vary by more than three-eighths (3/8)-inch from the lower edge of a sixteen (16)-foot straightedge when the straightedge is placed perpendicular, or in any other direction. This straightedge smoothness requirement applies to Taxiways, service roads, and other paved surfaces. The straightedge shall be furnished by the Contractor and shall be acceptable to the Engineer.

All areas paved shall be water tested by the Contractor for drainage in the presence of the Engineer or designated representative before final acceptance. Any areas not draining properly shall be corrected to the Engineer's satisfaction at the Contractor's expense. Water for this testing shall be provided and paid for by the Contractor.

When deviations in excess of the above tolerance are found, humps or depressions shall be corrected to meet the specified tolerance, or shall be saw cut out along neat straight lines and replaced with fresh hot mixture and thoroughly compacted to conform with and bond to the surrounding area. Materials and work necessary to correct such deviations shall be at no additional cost to the Engineer.

### MATERIAL ACCEPTANCE

**405-4.1 ACCEPTANCE SAMPLING AND TESTING.** The asphalt concrete shall be accepted as provided below. The Contractor shall make corrective requirements for deficiencies in thickness, density, asphalt cement content and mineral aggregate.

**a. Thickness.** When, in the opinion of the Engineer, there is reason to believe that the pavement may be deficient in thickness, cores will be taken by the Contractor, as directed by the Engineer. One (1) core shall be taken every ten (10) feet until the deficiency in thickness has been no longer determined. When a deficiency of more than one-quarter (1/4)-inch is found, the average of these cores will be used to determine the amount of the deficiency. Thickness of the cores shall be determined by the Engineer, and by using the average caliper measurement. Where pavement thickness is deficient by one-quarter (1/4)-inch or less, it will be paid for at the contract unit price.

Where the pavement is deficient in thickness by more than one-quarter (1/4)-inch but not more than one-half (1/2) inch, payment will be reduced per Table 1 following.

**TABLE 1. PAVEMENT THICKNESS PAYMENT REDUCTION, ASPHALT CONCRETE**

Specified Mat Thickness	Reduction in Payment
Less than 1.50"	50%
1.50" to 1.99"	33%
2.00" to 2.49"	25%
2.50" to 2.99"	20%
3.00" and Over	17%

When the deficiency of the pavement thickness exceeds 1/2-inch, the pavement shall be milled and overlaid on the area affected, but in no case less than the area that was cored, for the full width of pavement, with a new mat of material, equal in thickness to the deficiency but not less than one-and-one-half (1-1/2) inches in any instance. This is to be done at no additional cost to the Engineer.

**b. Density.** Nuclear densities shall be taken per ASTM D2950 for acceptance. A minimum of eight (8) nuclear density tests per shift's production shall be taken, not to exceed two thousand (2,000) tons. If the average density falls below ninety-five percent (95%), then four (4) cores shall be taken by the Contractor as directed by the Engineer to determine final density for that shift's production, not to exceed two thousand (2,000) tons.

**TABLE 2. PAVEMENT DENSITY PAYMENT REDUCTION, ASPHALTIC CONCRETE**

Deviation Below Specification	Reduction in Payment
2% points	2%
2 to 3% points	5%
3 to 5% points	10%

**c. Asphalt Cement Content.** When the asphalt cement content exceeds the limits established in section 405-2.2, two (2) additional core tests will be made for each deficient test taken, and the average of all three (3) tests made shall be used to determine the asphalt cement content.

When the asphalt cement content is in excess of that permitted, the Contractor shall remove any areas of bleeding, but in no case less than the specified roller width, as directed by the Engineer, and replace the affected material with new material meeting the specification requirements for the mix type involved. This shall be done, any time within a period of one (1) year until the bleeding has been corrected, at no additional cost to the Engineer. Should the stability of the mix be affected by the excess asphalt cement to such an extent that the pavement is displaced under normal traffic loads at the Engineer, within a period of one (1) year, the areas affected shall be removed and replaced with new material, at no additional cost to the Engineer.

When the asphalt cement content deviates from 0.0 to 0.2 percent points, weight of the total mixed material less than the minimum permitted in this specification, then payment to the Contractor for asphalt concrete pavement will be reduced per Table 3 following.

**TABLE 3. ASPHALT CEMENT CONTENT PAYMENT REDUCTION, ASPHALTIC CONCRETE**

Deviation from that Permitted	Payment Reduction
0.0 to 0.1% points	3%
Over 0.1 to 0.2% points	5%
Greater than 0.2% points	25%

The above corrective work, due to deviations from the requirements for asphalt content, shall be done at no additional cost to the Engineer.

**d. Mineral Aggregate.** When the mineral aggregate gradation deviates from the requirements of this specification in an amount which, in the opinion of the Engineer, will affect the stability or durability of the mix, the Contractor shall remove the asphalt concrete and replace it with material meeting the requirements of this specification.

The above corrective work, due to deviations from the requirements for mineral aggregate, shall be done at no additional cost to the Engineer.



## CONTRACTOR QUALITY CONTROL

**405-5.1 GENERAL.** The Contractor shall develop a Quality Control Program in accordance with Section 100 of the *General Provisions*. The program shall address all elements that affect the quality of the pavement including, but not limited to:

- |                         |                              |
|-------------------------|------------------------------|
| a. Mix Design           | f. Mixing and Transportation |
| b. Aggregate Grading    | g. Placing and Finishing     |
| c. Quality of Materials | h. Joints                    |
| d. Stockpile Management | i. Compaction and density    |
| e. Proportioning        | j. Surface smoothness        |

**405-5.2 TESTING LABORATORY.** The laboratory used to develop the job mix formula shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements shall be submitted to the Engineer prior to the start of construction. The certification shall contain as a minimum:

- a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.
- b. A listing of equipment to be used in developing the job mix.
- c. A copy of the laboratory's quality control system.
- d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program
- e. Evidence the laboratory is accredited, for the test methods required herein, by a nationally recognized laboratory accreditation organization.

**405-5.3 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 MAG specs.

**405.5.4 SAMPLING.** 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.

## METHOD OF MEASUREMENT

**405-6.1 MEASUREMENT.** Asphaltic concrete pavement for MAG 3/4" asphaltic concrete surface course, (to the depths shown within the typical sections in the plans), will be measured by the square yard, computed to the nearest square yard, for the mixture actually used as allowed above. No separate measurement will be made for the required quantities of mineral aggregates, filler material, asphalt cement, and sand.

Weighmaster's Certificates shall be provided by the Contractor. The weighing shall be done on certified platform scales sealed by the State Inspector as defined by ARS Sections 44-2112 and 44-



2116. The Contractor shall furnish the Engineer with duplicate weighmaster's certificates showing the actual net weights together with the information required by ARS Section 44-2142.

The price per square yard for MAG 3/4" Asphalt Concrete Pavement surface course shall include the cost of the asphalt cement in the percentages as specified in these specifications.

### **BASIS OF PAYMENT**

**405-7.1 PAYMENT.** The asphalt concrete measured as provided above will be paid for at the contract price per ton, (to the depths shown within the typical sections in the plans), and that price shall be full compensation for the item complete, as herein described and specified. The price shall be compensation for furnishing all materials, including bituminous material, for all preparation, mixing, transportation and placement of these materials, and for all labor, equipment, tools and incidentals necessary to complete the item. No separate payment will be made for corrective work.

No payment will be made for any overrun in quantity of asphaltic concrete in excess of ten percent (10%) based on actual field measurement of area covered, design thickness, and a unit weight of one hundred-fifty (150) pounds per cubic foot. The calculations for overrun will be by individual bid item.

Payment will be made under:

Item P-405-7.1 Bituminous Surface Course (MAG 3/4-Inch) – per Ton

### **TESTING REQUIREMENTS**

ASTM C 29	Unit Weight of Aggregate
ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	Test Method for Materials Finer than 75-um (No.200) Sieve in Mineral Aggregates by Washing
ASTM C 131	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C 183	Sampling Hydraulic Cement
ASTM C 566	Total Moisture Content of Aggregate by Drying
ASTM D 75	Sampling Aggregates
ASTM D 995	Requirements for Mixing Plants for Hot-Mixed Hot-Laid Bituminous Mixtures Paving
ASTM D 118	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens

ASTM D 1461	Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1559	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2041	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2489	Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
ASTM D 3203	Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D 2950	Density of Bituminous Concrete in Place by Nuclear Method
ASTM D 3665	Random Sampling of Paving Materials
ASTM D 3666	Inspection and Testing Agencies for Bituminous Paving Materials
ASTM D 4125	Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4791	Flat or Elongated Particles in Coarse Aggregate
ASTM D 4867	Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 6307	Asphalt Content of Hot Mix Asphalt by Ignition Method.
ASTM E 178	Practice for Dealing with Outlying Observations
AASHTO T 30	Mechanical Analysis of Extracted Aggregate

### **MATERIAL REQUIREMENTS**

ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 946	Asphalt Cement for Use in Pavement Construction



ASTM D 3381

Viscosity-Graded Asphalt Cement for Use in Pavement Construction

**END OF ITEM P-405**

## ITEM P-610 STRUCTURAL PORTLAND CEMENT CONCRETE

### DESCRIPTION

**610-1.1** This item shall consist of plain and reinforced structural Portland cement concrete, for use in concrete structures such as storm drain and electrical structures, prepared and constructed in accordance with these specifications, at the locations and of the form and dimensions shown on the plans.

### MATERIALS

**610-2.1 GENERAL.** Only approved materials, conforming to the requirements of these specifications, shall be used in the work. They may be subjected to inspection and tests at any time during the progress of their preparation or use. The source of supply of each of the materials shall be approved by the Airport before delivery or use is started. 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 insure the 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 therein.

In no case shall the use of pit-run or naturally mixed aggregates be permitted. Naturally mixed aggregate shall be screened and washed, and all fine and coarse aggregates shall be stored separately and kept clean. The mixing of different kinds of aggregates from different sources in one storage pile or alternating batches of different aggregates will not be permitted.

Aggregates shall be tested for deleterious reactivity with alkalis in the cement that may cause excessive expansion of the concrete. Acceptance of aggregates shall be based upon satisfactory evidence furnished by the Contractor that the aggregates, combined with other mixture constituents, do not produce excessive expansion in the concrete. This evidence shall include service records of concrete of comparable properties under similar conditions or exposure and certified records of tests by a testing laboratory that meets the requirements of ASTM C 1077. Tests shall be made in accordance with ASTM C 1260. Test specimens shall be produced using all components (e.g. coarse aggregate, fine aggregate, cement and fly ash) to be included in the produced concrete. If the mean expansion of the test specimens, tested in accordance with ASTM C 1260, does not exceed 0.10 % at 16 days from casting the aggregates shall be accepted. If the mean expansion at 16 days is greater than 0.10% but less than 0.15%, the aggregate may be accepted based upon satisfactory service records and acceptance of the aggregate by a State Highway Department specifically addressing Alkali-Silica Reactivity. If the expansion is greater than 0.15%, the aggregate shall not be accepted for use.

**610-2.2 COARSE AGGREGATE.** The coarse aggregate for concrete shall meet the requirements of ASTM C 33, #57 rock. All coarse aggregate shall be washed.

**610-2.3 FINE AGGREGATE.** The fine aggregate for concrete shall meet the requirements of ASTM C 33. The fine aggregate shall be well graded from fine to coarse and shall meet the requirements of Table 1,

when tested in accordance with ASTM C 136. All fine aggregate shall be washed and shall have a sand equivalent value of not less than 75.

**TABLE 1. GRADATION FOR FINE AGGREGATE**

Sieve Designation (Square Openings)	Percentage by Weight Passing Sieves
3/8-inches	100
No. 4	95-100
No. 16	45-80
No. 30	25-55
No. 50	10-30
No. 100	2-10

Blending will be permitted, if necessary, in order 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, provided that such deficiency does not exceed 5% and is remedied by the addition of pozzolanic or cementitious materials other than Portland Cement, as specified in 610-2.6 on admixtures, in sufficient quantity to produce the required workability as approved by the Airport.

**610-2.4 CEMENT.** Cement shall conform to the requirements of ASTM C-150 Type II. 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 Airport before permission to use the cement is granted. All such 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 free from sewage, oil, acid, strong alkalis, vegetable matter, and clay and loam. Unless potable water is used, water shall be tested in accordance with AASHTO T 26.

**610-2.6 ADMIXTURES.** The use of any material added to the concrete mix shall be approved by the Airport. Before approval of any material, the Contractor shall be required to submit the results of complete physical and chemical analyses made by an acceptable testing laboratory. Subsequent tests shall be made of samples taken by the Airport 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.

Pozzolanic admixtures shall be Type F fly ash meeting the requirements of ASTM C 618.

Air-entraining admixtures shall meet the requirements of ASTM C 260. Air-entraining admixtures shall be added at the mixer in the amount necessary to produce the specified air content.

Water-reducing, set-controlling admixtures shall meet the requirements of ASTM C 494, Type A, water-reducing or Type D, water-reducing and retarding. Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures in accordance with the manufacturer's printed instructions.

**610-2.7 PREMOLDED JOINT MATERIAL.** Premolded joint material for expansion joints shall meet the requirements of P-604. The Contractor shall submit proposed joint filler material for the Airport's review.



**610-2.8 JOINT FILLER.** The types of joint fillers and joint seals shall meet the requirements of Item P-605 or as shown on the plans. The Contractor shall submit proposed joint filler material for the Airport's review.

**610-2.9 STEEL REINFORCEMENT.** Reinforcing shall consist of Bar Mats, Welded Wire Fabric, or deformed Grade 60 rebar, conforming to the requirements of ASTM A 184, ASTM A 185, and ASTM A 615, respectively.

**610-2.10 COVER MATERIALS FOR CURING.** Curing materials shall conform to the following specification: Liquid Membrane-Forming Compounds for Curing Concrete, ASTM C 309, Type 2.

### 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 herein. All machinery and equipment owned or controlled by the Contractor, which he proposes to use on the work, shall be of sufficient size to meet the requirements of the work, and shall be such as to produce satisfactory work; all work shall be subject to the inspection and approval of the Airport.

**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 C 31 and tested in accordance with ASTM C 39. The concrete shall contain not less than 470 pounds of cement per cubic yard. The concrete shall contain 5 percent of entrained air, plus or minus 1 percent, as determined by ASTM C 231 and shall have a slump of not more than 4-inches as determined by ASTM C 143.

**610-3.3 ACCEPTANCE SAMPLING AND TESTING.** Concrete for each structure will be accepted on the basis of the compressive strength specified in paragraph 3.2. The concrete shall be sampled in accordance with ASTM C 172. Compressive strength specimens shall be made in accordance with ASTM C 31 and tested in accordance with ASTM C 39.

Concrete cylindrical test specimens shall be made in accordance with ASTM C 31 and tested in accordance with ASTM C 39. The Contractor shall cure and store the test specimens under such conditions as directed. the Airport will make the actual tests on the specimens at no expense to the Contractor.

**610-3.4 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 Airport and shall provide means of regulating the flow of aggregates into the batch box so that the required and exact weight of aggregates can be readily obtained.

**610-3.5 CONSISTENCY.** The consistency of the concrete shall be checked by the slump test specified in ASTM C 143.



**610-3.6 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 C 94.

**610-3.7 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 degrees Fahrenheit without permission of the Airport. 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 degrees Fahrenheit, not more than 90 degrees Fahrenheit. 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 delivery of concrete to the job shall be in such a manner that batches of concrete will be deposited at uninterrupted intervals.

**610-3.8 FORMS.** Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the Airport. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as designed 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 Contractor shall bear responsibility for their adequacy. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. The internal ties shall be arranged so that, when the forms are removed, no metal will show in the concrete surface or discolor the surface when exposed to weathering. All forms shall be wetted with water or with a non-staining mineral oil which shall be applied shortly before the concrete is placed. Forms shall be constructed so that they can be removed without injuring the concrete or concrete surface. The forms shall not be removed before the expiration of at least 30-hours from 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 that at least 60% of the design strength of the concrete has developed.

**610-3.9 PLACING REINFORCEMENT.** All reinforcement shall be accurately placed, as shown on the plans, and shall be firmly held in position during concreting. 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.

**610-3.10 EMBEDDED ITEMS.** Before placing concrete, any items that are to be embedded shall be firmly and securely fastened in place as indicated. All such items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The Contractor shall not embed wood into the concrete. The concrete shall be spaded and consolidated around and against embedded items.

**610-3.11 PLACING CONCRETE.** All concrete shall be placed during daylight, unless otherwise approved. The concrete shall not be placed until the depth and character of foundation, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved. Concrete shall be placed as soon as practical after mixing and in no case later than 1-hour after water has been added to the mix. The method and manner of placing shall be such to avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. Dropping the concrete a



distance of more than 5-feet, or depositing a large quantity at one point, will not be permitted. Concrete shall be placed upon clean, damp surfaces, free from running water, or upon properly consolidated soil.

The concrete shall be compacted with suitable mechanical vibrators operating within the concrete. When necessary, vibrating shall be supplemented by hand spading with suitable tools to assure proper and adequate compaction. Vibrators shall be manipulated so as to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. The vibration at any joint shall be of sufficient duration to accomplish Compaction but shall not be prolonged to the point where segregation occurs. Concrete deposited under water shall be carefully placed in a compact mass in its final position by means of a tremie, a closed bottom dump bucket, or other approved method and shall not be disturbed after being deposited.

The minimum frequency of mechanical vibrators shall be 8,000 vibration cycles per minute. Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective. The Contractor shall provide sufficient equipment to insure uninterrupted and continuous vibration of concrete.

**610-3.12 CONSTRUCTION JOINTS.** When the placing 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, such provisions shall be made for grooves, steps, keys, dovetails, reinforcing bars or other devices as may be prescribed. 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 previously placed concrete, surfaces that have been in place for eight (8) hours or more shall be cleaned by abrasive blast methods. Surfaces of concrete that have been in place for less than eight (8) hours may be cleaned with air and water jets provided that the surface laitance and curing compound is removed.

**610-3.13 EXPANSION JOINTS.** Expansion joints shall be constructed at such points and of such dimensions as may be indicated on the drawings. The premolded filler shall be cut to the same shape as that of the surfaces being joined. The filler shall be fixed firmly against the surface of the concrete already in place in such manner that it will not be displaced when concrete is deposited against it.

**610-3.14 DEFECTIVE WORK.** Any defective work disclosed after the forms have been removed shall be immediately removed and replaced. If any dimensions are deficient, or if the surface of the concrete is bulged, uneven, or shows honeycomb, which in the opinion of the Airport cannot be repaired satisfactorily, the entire section shall be removed and replaced at the expense of the Contractor.

**610-3.15 SURFACE FINISH.** All exposed concrete surfaces shall be true, smooth, free from open or rough spaces, depressions, or projections. The concrete in horizontal plane surfaces shall be brought flush with the finished top surface at the proper elevation and shall be 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.

When directed, 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 pointed and 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 rubbing machine.



**610-3.16 CURING AND PROTECTION.** All concrete shall be properly cured and protected by the Contractor. The work shall be protected from the elements, flowing water, and from defacement of any nature during the building operations. The Concrete shall be cured as soon as it has sufficiently hardened by covering with an approved material. If curing compound method is used, it shall be applied to the concrete immediately following the surface finishing operation in one or more applications totaling a rate of not less than on (1) gallon per 150 square feet.

Water-absorptive coverings shall be thoroughly saturated when placed and kept saturated for a period of at least three (3) days. 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 currents of air. Where wooden forms are used, they shall be kept wet at all times until removed to prevent the 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.

**610-3.17 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.

**610-3.18 COLD WEATHER PROTECTION.** When concrete is placed at temperatures below 40 degrees Fahrenheit, 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 in order to place the concrete at temperatures between 50 and 90 degrees Fahrenheit.

Calcium chloride shall not be used in any concrete containing steel reinforcement or steel embedded items.

**610-3.19 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 be started until after final curing and shall be done only when the concrete is completely dry. The cleaning and filling shall be carefully done with proper equipment and in a manner to obtain a neat looking joint free from excess filler.

### **CONTRACTOR QUALITY CONTROL**

**610-4.1** 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 General Provision Section 100.

### **METHOD OF MEASUREMENT**

**610-5.1** Portland Cement Concrete (PCCP) or reinforced PCCP shall not be measured, and shall be incidental to the structure or item into which it is incorporated.

**610-5.2** Reinforcing steel shall not be measured, and shall be considered incidental to the structure or item into which it is incorporated.

### **BASIS OF PAYMENT**

**610-6.1** There will be no separate measurement or payment for concrete, reinforced concrete, or reinforcement, payment will be per structure or item constructed as defined elsewhere.

### TESTING REQUIREMENTS

ASTM C 31	Making and Curing Test Specimens in the Field
ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C 136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C 138	Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143	Slump of Hydraulic Cement Concrete
ASTM C 231	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 666	Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 1077	Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1260	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

### MATERIAL REQUIREMENTS

ASTM A 184	Specification for Fabricated Deformed Steel Bar or Rod Mats for Concrete Reinforcement
ASTM A 185	Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 497	Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 704	Welded Steel Plain Bars or Rod Mats for Concrete Reinforcement
ASTM C 33	Concrete Aggregates
ASTM C 94	Ready-Mixed Concrete
ASTM C 150	Portland Cement
ASTM C 171	Sheet Materials for Curing Concrete



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ASTM C 172	Sampling Freshly Mixed Concrete
ASTM C 260	Air-Entraining Admixtures for Concrete
ASTM C 309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Chemical Admixtures for Concrete
ASTM C 595	Blended Hydraulic Cements
ASTM C 618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM D 1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
ASTM D 1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO T 26	Quality of Water to be Used in Concrete

**END OF ITEM P-610**



## ITEM P-620 AIRFIELD PAVEMENT MARKING

### DESCRIPTION

**620-1.1** This item shall consist of the 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.

### MATERIALS

**620-2.1 MATERIALS 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.

**620-2.2 PAINT.** Paint shall be Waterborne, in accordance with the requirements of Federal Specification TT-P-1952E. Paint shall be furnished in Yellow - 33538 or 33655, White - 37925, and Red - 31136 in accordance with Federal Standard No 595. Paint shall be furnished in Type II - Fast drying time for no-pick-up when tested in accordance with ASTM D 711.

**620-2.3 REFLECTIVE MEDIA.** Glass beads shall meet the requirements of Fed. Spec. TT-B-1325D, Type III. 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 WEATHER LIMITATIONS.** The 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. Markings shall not be applied when the pavement temperature is greater than 120°F. The Contractor should be aware of any manufacturer's minimum and maximum pavement surface temperatures.

**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.

**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 sweeping and blowing or by other



methods as required to remove all dirt, laitance, and loose materials without damage to the pavement surface. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the Engineer. Cleaning methods shall be chosen to eliminate or minimize generation of dust.

Paint shall not be applied to Portland cement concrete pavement until the areas to be painted are clean of curing material. Sandblasting or high-pressure water shall be used to remove curing materials.

**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.

If required by the Owner, prior to application of pavement markings, the Contractor shall test the airless-type marking spray at the location approved by the Owner. The Contractor shall test 100 linear feet of Centerline Marking to satisfaction of the Owner prior to application of markings for this project.

**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 Owner. The edges of the markings shall not vary from a straight line more than 1/2 in (12 mm) in 50 ft (15 m) and marking dimensions and spacing shall be within the following tolerances:

Dimension and Spacing	Tolerance
36 inches (910 mm) or less	±1/2 inch (12 mm)
greater than 36 inches to 6 feet (910 mm to 1.85 m)	± 1 inch (25 mm)
greater than 6 feet to 60 feet (1.85 m to 18.3 m)	± 2 inches (51 mm)
greater than 60 feet (18.3 m)	± 3 inches (76 mm)

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate(s) shown in Table 1. **Two coats of paint shall be applied, with the first coat applied at 33% of the Table 1 rate, and the second coat at 100% of the Table 1 rate.** The addition of thinner will not be permitted. A period of 7 days shall elapse between placement of concrete pavement, bituminous surface course, or seal coat and application of the paint.

**TABLE 1. APPLICATION RATES FOR PAINT & GLASS BEADS**

Paint Square feet per gallon, ft <sup>2</sup> /gal	Glass Beads, Type III Pounds per gallon of paint-lb./gal.
115 (maximum)	10 (minimum)

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.

Glass beads shall not be applied to temporary or black pavement markings.

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. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made.

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.

A 24-to-30 day waiting period after paving is recommended for all types of paints to be used for pavement marking. If the airport operations require pavement marking prior to the recommended waiting period, the paint may be applied in a temporary light coat application rate of 33% for temporary markings. Glass beads are not required for temporary markings. The final application should occur after the waiting period has passed.

**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. 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.

#### METHOD OF MEASUREMENT

**620-4.1** The quantity of pavement markings to be paid for shall be the number of square feet of painting, including both coats (33% and 100% as described in Paragraph 620-3.5) and the application of glass beads, performed in accordance with the specifications and accepted by the Owner.

#### BASIS OF PAYMENT

**620-5.1** Payment shall be made at the bid unit price per square foot for pavement marking, including both coats (33% and 100% as described in Paragraph 620-3.5). This price shall be full compensation for furnishing all materials (including glass beads) and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

- P-620-5.1            Airfield Pavement Markings (Yellow) – per Square Foot
- P-620-5.2            Airfield Pavement Markings (White) – per Square Foot
- P-620-5.3            Airfield Pavement Markings (Red) – per Square Foot

#### TESTING REQUIREMENTS

- ASTM C 136            Sieve Analysis of Fine and Coarse Aggregates
- ASTM C 146            Chemical Analysis of Glass Sand



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ASTM C 371	Wire-Cloth Sieve Analysis of Nonplastic Ceramic Powders
ASTM D 92	Test Method for Flash and Fire Points by Cleveland Open Cup
ASTM D 711	No-Pick-Up Time of Traffic Paint
ASTM D 968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1213-54 (1975)	Test Method for Crushing Resistance of Glass Spheres
ASTM D 1652	Test Method for Epoxy Content of Epoxy Resins
ASTM D 2074	Test Method for Total Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D 2240	Test Method for Rubber Products-Durometer Hardness
ASTM G 15453	Operating Light and Water-Exposure Apparatus (Fluorescent Light Apparatus UV-Condensation Type) for Exposure of Nonmetallic Materials.
Federal Test Method Standard No. 141D/GEN	Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling and Testing

#### **MATERIAL REQUIREMENTS**

ASTM D 476	Specifications for Dry Pigmentary Titanium Dioxide Pigments Products
Code of Federal Regulations	40 CFR Part 60, Appendix A – Definition of Traverse Point Number and Location
Code of Federal Regulations	29 CFR Part 1910.1200 – Hazard Communications
FED SPEC TT-B-1325D	Beads (Glass Spheres) Retroreflective
AASHTO M 247	Glass Beads Used in Traffic Paints
FED SPEC TT-P-1952E	Paint, Traffic and Airfield Marking, Waterborne
Commercial Item Description (CID) A-A-2886B	Paint, Traffic, Solvent Based
FED STD 595	Colors used in Government Procurement

**END OF ITEM P-620**

## ITEM D-701 PIPE FOR STORM DRAINS AND CULVERTS

### DESCRIPTION

**701-1.1** This item shall consist of the construction of pipe culverts and storm drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

### MATERIALS

**701-2.1** Materials shall meet the requirements shown on the plans and specified below.

**701-2.2 PIPE.** The pipe shall be Rubber-Gasketed Reinforced Concrete Pipe (RGRCP) Class V conforming to ASTM C 76, and Polyvinyl Chloride (PVC) Pipe conforming to ASTM D 3034 where called out on the plans.

**701-2.3 CONCRETE.** Concrete for storm drain pipe shall meet the requirements ASTM C 76, Class V, Type II cement per ASTM C 150, but in no case can it be below 4,000 psi at 28-days.

Concrete for other miscellaneous storm drain fittings and misc appurtenances not specifically identified elsewhere shall meet the requirements of Technical Specification P-610, (i.e. 4,000 psi at 28-days).

**701-2.4 RUBBER GASKETS.** Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C 443. Rubber gaskets for PVC pipe and polyethylene pipe shall conform to the requirements of ASTM F 477.

**701-2.5 JOINT MORTAR.** Pipe joint mortar shall consist of one part Portland Cement and two parts sand. The Portland Cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144 or AASHTO M-315.

**701-2.6 JOINT FILLERS.** Poured filler for joints shall conform to the requirements of ASTM D 1190.

**701-2.7 PLASTIC GASKETS.** Plastic gaskets shall conform to the requirements of AASHTO M 198 (Type B).

**701-2.8 CONCRETE ENCASEMENT.** Concrete encasement shall be in accordance with MAG Standard Detail 404-3. Where concrete encasement is shown on the plans, all joints shall have gaskets in accordance with 701-2.4. The concrete shall meet the requirements of Technical Specification P-610, (i.e. 4,000 psi at 28-days).

### CONSTRUCTION METHODS

**701-3.1 EXCAVATION.** The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but it shall not be less than the external diameter of the pipe plus 6 inches on each side. The trench walls shall be approximately vertical.

Where rock, hardpan, or other unyielding material is encountered, the Contractor shall remove it from below the foundation grade for a depth of at least 12 inches or one-half inch (1/2-Inch) for each foot of fill over the top of the pipe (whichever is greater) but for no more than three-quarters of the nominal diameter of the pipe. The width of the excavation shall be at least 1 foot greater than the horizontal outside diameter of the pipe. The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over 6 inches in uncompacted depth to form a uniform but yielding foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The Engineer shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

The excavation for pipes that are placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as shown on the plans.

There shall be no separate measurement and payment for excavation for storm drain pipe but shall be considered incidental to the installation of the associated storm drain pipe.

**701-3.2 BEDDING.** Bedding for reinforced concrete pipe shall consist of a continuous concrete cradle conforming to the plan details. For PVC and polyethylene pipe, the bedding material shall consist of coarse sands and gravels with a maximum particle size of 3/4 in. For pipes installed under paved areas, no more than 12 percent of the material shall pass the No. 200 sieve. For all other areas, no more than 50 percent of the material shall pass the No. 200 sieve. The bedding shall have a thickness of at least 6 in below the bottom of the pipe and extend up around the pipe for a depth of not less than 50 percent of the pipe's vertical outside diameter.

There shall be no separate measurement or payment for any storm drain pipe bedding material. All bedding material required for laying pipe shall be considered incidental to the associated storm drain pipe bid line item.

**701-3.3 LAYING PIPE.** The pipe laying shall begin at the lowest point of the trench and proceed upgrade. The lower segment of the pipe shall be in contact with the bedding throughout its full length. Bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes shall be placed facing upgrade.

Paved or partially lined pipe shall be placed so that the longitudinal center line of the paved segment coincides with the flow line.

**701-3.4 JOINING PIPE.** Joints shall be made with rubber gaskets per 701-2.4.

Rubber ring gaskets shall be installed to form a flexible watertight seal. Concrete pipe may be either bell and spigot or tongue and groove. The method of joining pipe sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even. Joints shall be thoroughly wetted before mortar or grout is applied.

Joints for PVC and Polyethylene pipe shall conform to the requirements of ASTM D 3212 when water tight joints are required. Joints for PVC and Polyethylene pipe shall conform to the requirements of



AASHTO M 304 when soil tight joints are required. Fittings for polyethylene pipe shall conform to the requirements of AASHTO M 252 or M 294M.

There shall be no separate measurement or payment for any required miscellaneous pipe materials, fittings, or appurtenances for storm drain pipe unless specifically identified in the bid schedule. All required miscellaneous pipe materials, fittings, or appurtenances for storm drain pipe construction shall be considered incidental to the installation of the associated storm drain pipe.

**701-3.5 BACKFILLING.** Pipes shall be inspected before any backfill is placed; any pipes found to be out of alignment, unduly settled, or damaged shall be removed and re-laid or replaced at the Contractor's expense.

Unless otherwise noted on the plans, details, and storm drain trench typical sections material for backfill shall be fine, readily compatible soil, granular material selected from excavation or a source of the Contractor's choosing; however, it shall meet the requirements of Technical Specification P-152 except as noted herein. It shall not contain frozen lumps, stones that would be retained on a 2-inch sieve, chunks of highly plastic clay, or other objectionable material.

When the top of the pipe is even with or below the top of the trench, the backfill shall be compacted in layers not exceeding 6 inches on both sides of the pipe and shall be brought up 1 foot above the top of the pipe or to natural ground level, whichever is greater. Care shall be exercised to thoroughly compact the backfill material under the haunches of the pipe. Material shall be brought up evenly on both sides of the pipe.

When the top of the pipe is above the top of the trench, the backfill shall be compacted in layers not exceeding 6 inches and shall be brought up evenly on both sides of the pipe to 1 foot above the top of the pipe. The width of backfill on each side of the pipe for the portion above the top of the trench shall be equal to twice the pipe's diameter or 12 feet, whichever is less.

All backfill and compaction for storm drain pipe shall meet the requirements of P-152.

There shall be no separate measurement or payment for any backfill required for storm drain pipe. All backfill material and compaction required for storm drain pipe construction shall be considered incidental to the installation of the associated storm drain pipe.

## **MATERIAL ACCEPTANCE**

**701-4.1 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 PMGAA at no cost to the Contractor. Testing organizations performing these tests shall meet the requirements of ASTM D 3666. All equipment in Contractor -furnished laboratories shall be calibrated by the testing organization prior to the start of operations. PMGAA's Acceptance Sampling and Testing will include CLSM strength and backfill compaction density.



**701-4.2 CONTRACTOR SHOP DRAWINGS.** The Contractor shall submit shop drawings of the Class V RGRCP Storm Drain pipe for review and approval of the Engineer. The Contractor shall also submit shop drawings for the bedding material and concrete for the pipe as specified.

### **CONTRACTOR QUALITY CONTROL**

**701-5.1 GENERAL.** The Contractor shall develop a Quality Control Program in accordance with Technical Specification P-100. The program shall address all elements that affect the quality of the pavement including, but not limited to control of trench excavation, pipe placement, verification of alignment and grade of pipe, placement of concrete encasement, placement and compaction of backfill. The contractor shall provide grade and alignment verification shots every 10-feet and at all storm drain inverts prior to backfilling. These shots shall be incorporated into the Contractor's as-built redlines.

### **METHOD OF MEASUREMENT**

**701-6.1** The length of pipe shall be measured in lineal feet of pipe in place, completed, and approved. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. All fittings shall be included in the footage as typical pipe sections in the pipe being measured. All preparation, excavation, removal of deteriorated pavement, bedding, backfill, and for all labor, equipment, tools, and incidentals necessary to complete the item as intended in the plans shall be considered incidental to the installation of storm drain pipe.

### **BASIS OF PAYMENT**

**701-7.1** Payment will be made at the contract unit price per lineal foot for pipe of the type and size designated including all connections and required material for complete installation in-place. These prices shall fully compensate the Contractor for furnishing and installation of required miscellaneous pipe materials, fittings, or appurtenances and for all preparation, excavation, removal of deteriorated pavement, bedding, backfill, and for all labor, equipment, tools, and incidentals necessary to complete the item as intended in the plans.

Payment will be made under:

- |                |  |
|----------------|--|
| Item D-701-7.1 | 12-Inch R.G.R.C.P. Class V Storm Drain Pipe w\ Concrete Encasement Per MAG Std Det 404-3 – per Lineal Foot |
| Item D-701-7.2 | 4-Inch PVC Pipe – per Lineal Foot  |



### **MATERIAL REQUIREMENTS**

ASTM C 14	Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 94	Ready Mixed Concrete
ASTM C 144	Aggregate for Masonry Mortar
ASTM C 150	Portland Cement
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 506	Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM D 6690	Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements

**END OF ITEM D-701**

## ITEM D-751 CONCRETE STORM DRAIN STRUCTURES

### DESCRIPTION

**751-1.1** This item shall consist of construction of manholes, catch basins, inlets, junction structures, headwalls, and inspection holes, in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the Engineer.

### MATERIALS

**751-2.1 CONCRETE.** Concrete and steel reinforcement used in structures, connections of pipes with structures, and the support of structures or frames shall conform to the requirements of Technical Specification P-610, (i.e. 4,000 psi at 28-days).

**751-2.2 FRAMES, COVERS, AND GRATES.** All covers for any type of manhole or catch basin shall be bolted down. The castings shall conform to one of the following requirements, (unless otherwise specified in the plans or specifications):

- a. Gray iron castings shall meet the requirements of ASTM A 48, Class 30B and 35B.
- b. Malleable iron castings shall meet the requirements of ASTM A 47.
- c. Steel castings shall meet the requirements of ASTM A 27.
- d. Structural steel for grates and frames shall conform to the requirements of ASTM A 283, Grade D.
- e. Ductile iron castings shall conform to the requirements of ASTM A 536.
- f. Austempered ductile iron castings shall conform to the requirements of ASTM A 897.

All castings or structural steel units shall conform to the dimensions shown on the plans.

Each frame and cover or grate 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 A 123.

The frames and covers shall be per the details in the plans.

All storm drain and catch basin covers shall be bolted down.

There will be no separate measurement or payment for any storm drain frames or covers but they shall be considered incidental to the associated storm drain structure.

## CONSTRUCTION METHODS

### 751-3.1 UNCLASSIFIED EXCAVATION.

a. The Contractor shall do all 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. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximately only; and the Engineer may order, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation. All earthwork for catch basins, manholes, and other items identified in this specification is considered incidental to the associated item.

b. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or 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 or crevices shall be cleaned out and grouted. All loose and 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, and excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

c. The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for the structure.

d. Unless otherwise provided, bracing, sheathing, or 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.

e. After each excavation is completed, the Contractor shall notify the Engineer to that effect; and concrete or reinforcing steel shall be placed after the Engineer has approved the depth of the excavation and the character of the foundation material.

f. There will be no separate measurement or payment for excavation required for storm drain structure installation but shall be considered incidental to the installation of the associated storm drain structure line item.

**751-3.2 CONCRETE STRUCTURES.** Concrete structures shall be built on prepared foundations, conforming to the dimensions and form indicated on the plans. The construction 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 poured. All invert channels shall be constructed and shaped accurately so as to be smooth, uniform, and cause minimum resistance to flowing water. The interior bottom shall be sloped downward toward the outlet.

**751-3.3 INLET AND OUTLET PIPES.** Inlet and outlet pipes shall extend through the walls of the structures for a sufficient distance beyond the outside surface to allow for connections but shall be cut off flush with

the wall on the inside surface, unless otherwise directed. For concrete or brick structures, the mortar shall be placed around these pipes so as to form a tight, neat connection.

**751-3.4 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. When frames or fittings are to be placed upon previously constructed masonry, the bearing surface or masonry shall be brought true to line and grade and shall present an even bearing surface in order that the entire face or back of the unit will come in contact with the masonry. The unit shall be set in mortar beds and anchored to the masonry as indicated on the plans or as directed and approved by the Engineer. All units shall set firm and secure. After the frames or fittings have been set in final position and the concrete or mortar has been allowed to harden for 7 days, then the grates or covers shall be placed and fastened down.

**751-3.5 INSTALLATION OF STEPS.** The steps shall be installed as indicated on the plans or as directed by the Engineer. When the steps are to be set in concrete, they shall be placed and secured in position before the concrete is poured. When the steps are installed in brick masonry, they shall be placed as the masonry is being built. The steps shall not be disturbed or used until the concrete or mortar has hardened for at least 7 days. After this period has elapsed, the steps shall be cleaned and painted, unless they have been galvanized.

When steps are required with precast concrete pipe structures, they shall be cast into the sides of the pipe at the time the pipe sections are manufactured or set in place after the structure is erected by drilling holes in the concrete and cementing the steps in place.

When steps are required with corrugated metal structures, they shall be welded into aligned position at a vertical spacing of 12 inches (300 mm).

In lieu of steps, prefabricated ladders may be installed. In the case of brick or concrete structures, the ladder shall be held in place by grouting the supports in drilled holes. In the case of metal structures, the ladder shall be secured by welding the top support and grouting the bottom support into drilled holes in the foundation or as directed.

#### **751-3.6 BACKFILLING.**

a. After a structure has been completed, the area around it shall be filled with approved material, in horizontal layers not to exceed 8 inches in loose depth, and compacted to the density required 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.

b. Backfilling 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 the concrete has been in place 7 days, or 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.

c. Backfill shall not be measured for direct payment. Performance of this work shall be considered on obligation of the Contractor covered under the contract unit price for the structure involved.

All backfilling in accordance with this specification, P-152, or as indicated on the plans shall be considered incidental to the associated storm drain structure to be installed.

**751-3.9 CLEANING AND RESTORATION OF SITE.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as ordered by the Engineer. The Contractor shall restore all disturbed areas to their original condition.

After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

#### METHOD OF MEASUREMENT

**751-4.1** All storm drain structures shall be measured by the unit completed in place and accepted.

#### BASIS OF PAYMENT

**751-5.1** The quantities of storm drain structures will be paid for at the contract unit price per each in place when completed and accepted. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling, compaction and placing of the materials; furnishing and installation of such specials and connections to pipes 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 including the reinforcement, frames, etc. as identified in the storm drain structure details in the plans.

Payment will be made under:

Item D-751-5.1      Catch Basin per Detail 4 on Sheet G1.6 – per Each

#### MATERIAL REQUIREMENT

ASTM D 698	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb (2.49 kg) Rammer and 12 in (305 mm) Drop
ASTM D 1556	Density of Soil in Place by the Sand-Cone Method
ASTM A 36	Carbon Structure Steel
ASTM C 150	Portland Cement



- |            |   |
|------------|---|
| ASTM C 283 | Low and Intermediate Tensile Strength Carbon Steel Plates       |
| ASTM C 478 | Precast Reinforced Concrete Manhole Sections                    |
| ASTM C 615 | Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |

**END OF ITEM D-751**



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## 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 improvement. Work under this section shall include, but not be limited to, the location of all underground facilities. Underground facilities means any item that is buried or placed below ground for use in connection with the storage or conveyance of water, sewage, electronic, telephone or telegraphic communications, electric energy, oil, gas or other substances, and shall include, but not be limited to pipes, sewers, conduits, cables, valves, lines, wires, manholes, attachments and those portions of poles and their attachments below ground, including electrical and communication ducts, airfield lighting and control cables, fiber optic lines, storm drains, electrical and telephone lines.

**The Contractor shall employ a private utility location service or perform his own service to locate the existing Owner and non-Owner utilities prior to starting the work. The Contractor shall pot hole and use prudent care when excavating and locating said utilities.**

The Contractor shall, after October 1, 1988, comply with the State requirements regarding excavation and underground utilities per A.R.S., Chapter 2, Article 6.3. and Sections 40.360.31 and other pertinent Sections of the Blue Stake Law. The Airport is not a member, but has distribution systems for gas, electrical, water, and sewer on the site. The Contractor shall be responsible for locating all Owner and non-Owner utilities.

The Contractor's attention is directed to the following Arizona Revised Statutes:

**a. ARS 40-360.22.** Excavations, determining location of underground facilities; providing information. This statute requires that no person shall begin excavation before the location and marking are complete or the excavator is notified that marking is unnecessary and requires that upon notification, the Owner of the facility shall respond as promptly as practical, but in no event later than two (2) working days. This section is not applicable to an excavation made during an emergency that involves danger to life, health or property if reasonable precautions are taken to protect underground facilities.

**b. ARS 40-360.23.** Making excavations in careful, prudent manner; liability for negligence. This statute states that obtaining information as required does not excuse any person making any excavation from doing so in a careful and prudent manner no shall it excuse such persons from liability for any damage or injury resulting from his negligence.

**c. ARS 40-360.28.** Civil penalty; liability. If the Owner or operator fails to locate, or incorrectly locates the underground facility, pursuant to this article, the Owner or operator becomes liable for resulting damages, costs and expenses to the injured party.

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

### 200-2.1 GENERAL.

- a. Utilities, utility appurtenances and cables 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 a utility location is 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 excavation/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, Airport Operations, and FAA Sector 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 maintaining a field survey and plan of the marker locations and shall replace any disturbed markers at his own expense. Do not use power equipment with teeth when excavating where cables are marked. Obtain Airport's approval of proposed marking devices. Use semi-permanent markers 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 had 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

**200-3.1** 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 Technical Specification P-100.



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## METHOD OF MEASUREMENT

**200-4.1** Measurement for “Location of Underground Utilities 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 MAG Uniform Specifications, Section 109, as modified by Special Provision Section 50. Underground Utility Location costs will be subject to daily monitoring and approval by the Engineer.

## BASIS OF PAYMENT

**200-5.1** Payment for location of underground utilities, measured as prescribed above, shall be paid per Allowance based on approved actual costs. Such payment shall be full compensation for furnishing all labor, equipment tools and materials and for all designation, preparation, excavation, backfilling and placing of materials; and for all incidentals necessary. Payment for the cost 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-200-5.1 Location of Underground Utilities (Allowance) – per Allowance

**END ITEM U-200**

**ELECTRICAL TECHNICAL SPECIFICATIONS**

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## SECTION 16000 GENERAL ELECTRICAL REQUIREMENTS

### GENERAL

#### 1.01 SCOPE OF WORK

- A. It is the intent of this part of the Contract Documents to cover the work and materials necessary for erecting a complete electrical system, tested and ready for continuous use. The system shall be constructed in accordance with the Contract Documents, and Federal, State, and Local codes and regulations.

#### 1.02 RELATED SECTIONS

- A. The Contractor shall coordinate the work with other trades, and furnish and install the equipment in accordance with the manufacturers' requirements.
- B. The Related Work can be found in other Divisions of these specifications, such as, but not limited to:

Division 0	Bidding Requirements, Contract Forms, and Conditions of the Contract
Division 1	General Requirements
Division 2	Trenching, back filling, and compacting
Division 3	Concrete formwork, reinforcement, and concrete material, mixing, placing, jointing, curing and finishing
Division 9	Painting and protective coatings
Division 11	Equipment
Division 13	Special Construction

#### 1.03 GENERAL PROVISIONS

- A. Minimum sizes of equipment, and electrical devices, are indicated but it is not intended to show every offset and fitting, nor every structural or mechanical difficulty that will be encountered during the installation of the work.
- B. Work indicated on the Plans is approximately to scale. Actual dimensions and detailed Plans should be followed as closely as field conditions permit. Field verification of scaled dimensions on Plans is governed by field conditions. Installation of systems and equipment is subject to clarifications as indicated in reviewed shop drawings and field coordination.
- C. Discrepancies indicated on different Plans, between Plans and actual field conditions, or between Plans and Contract Documents shall be promptly brought to the attention of the Engineer for clarification, prior to purchasing and installing equipment.



- D. The alignment of equipment and conduit shall be adjusted to accommodate architectural changes, and coordinate with work of other trades, without extra expense to the Owner.
- E. The Contractor shall furnish and install the parts and pieces necessary to the installation of equipment, in accordance with the best practice of the trade, and in conformance with the requirements of these Contract Documents and equipment manufacture's recommendations.
- F. Items not specifically mentioned in these Contract Documents, or noted on the Plans, or indicated on reviewed shop drawings, but which are necessary to make a complete working installation, shall be deemed to be included herein.
- G. The Contractor shall lay out and install electrical work prior to completion of floors and walls. Furnish and install sleeves and openings through floors and walls, required for installation of conduits. Sleeves shall be rigidly supported and suitably packed, or sealed, to prevent ingress of wet concrete. Spacers shall be installed in order to prevent conduit movement. Dimensions indicated for electrical equipment and their installation are minimum dimensions.
- H. The Contractor shall furnish and install inserts and hangers required to support conduits and other electrical equipment. If the inserts, hangers, sleeves, or other mounting hardware are improperly placed, or installed, the Contractor shall do necessary work, at his/her own expense, to rectify the errors.
- I. Electrical equipment shall be capable of operating successfully at full-rated load, without failure, at an ambient air temperature of 60 degrees C, and specifically rated for the altitude indicated on the Plans. Electrical equipment not rated for operation at that temperature shall be provided with air conditioning to meet the manufacturers' operating temperature.
- J. If any contradictions, nonhomogeneity, or inconsistency appears, the most strict criteria noted and the collective requirements in any and all of the project documents shall apply.
- K. The Contractor shall perform necessary saw cutting, core drilling, excavating, removal, shoring, backfilling, and other work required for the proper installation of conduits, whether inside, or outside of the buildings and structures. The Contractor shall repair and patch where demolition has taken place in a manner to match existing original structure.

#### **1.04 REGULATIONS, CODES, AND STANDARDS**

- A. Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations, codes, and standards, of the following:
  - 1. National Electrical Code (NEC)
  - 2. State and local codes
  - 3. Institute of Electrical and Electronic Engineers (IEEE)
  - 4. American National Standards Institute (ANSI)
  - 5. American Society for Testing and Materials (ASTM)
  - 6. Insulated Cable Engineers Association (ICEA)



7. National Electrical Manufacturers Association (NEMA) Standards
8. Federal Occupational Safety and Health Act (OSHA)
9. National Fire Protection Association (NFPA)

- B. When applicable, the material used in the performance of the electrical work shall be listed by the Underwriters' Laboratories, Inc. (UL) for the class of service for which they are intended.

#### **1.05 SUBMITTALS**

- A. It is the obligation of the Contractor to organize his/her work, so that a complete electrical, instrumentation, and control system for the facility will be provided, and will be supported by accurate shop and record drawings, and O&M manuals.
- B. The Contractor shall submit detailed shop drawings and data prepared and organized by the suppliers. The quantity of submittal sets required shall be as specified in the Contract Documents.
- C. The submittals shall be neatly grouped and organized by specification section number, and sub-section. Related information shall be highlighted, and the specific product shall be indicated. All submittals shall be complete, and presented in one package. Incomplete submittals will be returned without review. If a portion of the project requires a fast track schedule, that portion only may be submitted earlier under a separate cover letter after securing the Engineer's written permission. The following shall be submitted to the Engineer and returned, reviewed to the Contractor before fabrication is started.
1. A complete list of the equipment and materials, including the manufacturer's name, product specification, descriptive data, technical literature, performance charts, catalog cuts, installation instructions, and spare part recommendations for each different item of equipment specified. The above shall clearly show all the specified requirements as described in the Specifications including but not limited to specific U.L. and NEMA rating, technical capabilities, test result verifications, and acceptance letters.
  2. Drawings containing complete wiring and schematic diagrams, control diagrams, and any other details required to demonstrate that the system has been coordinated and will operate as intended. Drawings shall show proposed layout, anchoring, support, and appurtenances of equipment, and equipment relationship to other parts of the work including clearances for maintenance and operations.
  3. Upon Project acceptance, the Contractor shall submit four sets of "Record Drawings" of the electrical, control, and instrumentation, along with step-by-step procedure manuals for the installation, operation start-up, and maintenance of the equipment. Each set shall include installation, operating, troubleshooting, maintenance and overhaul instructions in complete detail. It shall also include possible breakdowns and repairs, and troubleshooting guides, as well as simplified wiring and control diagrams of the system installed. This shall provide the Owner with comprehensive information on all systems and components to enable operation, service, maintenance and repair. Exploded, or other detailed views of all equipment, devices, assemblies, and accessory

components shall be included, together with complete parts lists and ordering instructions.

4. Record Drawings:
  - a. The Contractor shall maintain a marked up set of Contract Document Plans showing actual installed circuit numbers, conduit sizes, cable tray routing, number of conductors, conductor sizes (larger than #12 AWG), and all other deviations from the design Plans.
  - b. Underground conduit and concealed items shall be dimensioned on the Plans from permanent, visible, building features.
  - c. The Contractor shall provide actual motor size, starter size, and overload heater size, along with all other protective equipment for all 480 V and 4160 V motor circuits as part of the one-line record drawings.
  - d. The Contractor shall revise all conductor identification and panel schedules to indicate as-built conditions.

## PRODUCTS

### 2.01 GENERAL MATERIALS AND METHODS

- A. Materials, equipment, and parts comprising any unit, or part thereof, specified or indicated on the Plans, shall be new and unused, of current manufacture, and of highest grade consistent with the state of the art. Damaged materials, equipment, and parts, are not considered to be new and unused, and will not be accepted.
- B. Field verification of scaled dimensions on Plans is directed, since actual locations, distances, and levels will be governed by actual field conditions. The Contractor shall also review architectural, structural, yard, mechanical, and other Plans, and the accepted electrical and mechanical shop drawings, and shall adjust their work to conform to the conditions indicated therein.
- C. The fabricator of major components, such as distribution panelboards, switchgear, and motor control centers, shall also be the manufacturer of the major devices therein.
- D. Refer to various Division sections for individual equipment manufacturers. Indicated manufacturers are subject to strict compliance with the specifications and complete project documents. The reference to a particular manufacturer does not relieve the Contractor from conforming to the specified requirements.

### 2.02 NAMEPLATES

- A. Where indicated elsewhere in these specifications, or on the Plans, the Contractor shall furnish and install nameplates, which shall be black laminate with white letters. The nameplates shall be fastened to the various devices with round head stainless steel screws. Each disconnect



means for service, feeder, branch, or equipment conductors, shall have nameplates indicating its purpose.

### **2.03 SHOP WORK**

- A. The assembly of process control panels and/or modifications to equipment assemblies shall be done at a UL approved shop. The entire unit shall be completely assembled and tested prior to shipment to the project site. In addition, owner personnel shall be allowed to inspect the unit(s) prior to job-site shipping. This inspection shall not be construed as final acceptance of unit(s) by the owner.

### **2.04 LISTED EQUIPMENT ASSEMBLIES**

- A. Service Entrance equipment, Switchgear, Switchboards, Panelboards, Control and Distribution Panels, and other factory assembled electrical enclosures shall bear a UL label. Custom built electrical enclosures and control panels shall bear a UL508 label. Where UL listing is not available, CSA or ETL shall be considered during submittal review.

### **2.05 SUBSTITUTION OF MATERIAL AFTER AWARD OF CONTRACT**

- A. Any exceptions to these specifications shall be submitted to the Engineer, with the reasons for requesting such exceptions, with calculations and drawings for redesign of related components, including detailed drawings showing internal and assembly details, with installation instructions. Proposed layout changes showing any modifications or exceptions to related work made necessary by the(se) exception(s), with calculations and drawings showing such modifications or exceptions, shall also be included.
- B. Items if material and equipment may be offered (at the Contractor's option) as alternates to specified items. Such offer shall be in writing under Bidder's letterhead.
- C. Such alternate proposals shall be accompanied by full descriptive data on the proposed equipment. If alternate material proposals are considered, the Contractor shall submit a list of the proposed alternate substitution items in accordance with the requirements of "Review of Proposed Substitutions".

## **EXECUTION**

### **3.01 INSTALLATION OF ELECTRICAL EQUIPMENT**

- A. Coordinate the installation of electrical equipment with other trades.
  - 1. Arrange for the building in of equipment during structure construction.
  - 2. Where equipment cannot be built-in during construction, arrange for sleeves, box-outs, and other openings, as required to allow installation of equipment after structure construction is complete.
- B. Verify that equipment will fit support layouts indicated.

- C. Equipment Dimensions and Clearances:**
1. Do not use equipment that exceeds the indicated dimensions. Except as approved in writing by the Engineer.
  2. Do not use equipment or arrangements of equipment that reduce required clearances or exceed the space allocation.
- D. Install equipment in accordance with the manufacturer's instructions.**
- E. Equipment Access:**
1. Install equipment so it is readily accessible for operation and maintenance.
  2. Equipment shall not be blocked or concealed.
  3. Do not install electrical equipment such that it interferes with normal maintenance requirements of other equipment.
- F. Equipment shall be installed plumb, square and true with the building construction, and shall be securely fastened.**
- G. Outdoor wall-mounted equipment, and indoor equipment mounted on earth, or water bearing walls, shall be provided with corrosion-resistant spacers to maintain ¼-inch separation between the equipment and the wall.**
- H. Screen or seal all openings in outdoor equipment to prevent the entrance of rodents and insects.**
- I. Equipment fabricated from aluminum shall not be imbedded in earth or concrete.**
- J. Provide all necessary anchoring devices and supports.**
1. Use supports as detailed on the Plans and as specified.
  2. Supports and anchoring devices shall be rated and sized based on dimensions and weights verified from approved equipment submittals.
  3. Hardware shall be stainless steel.
  4. Do not cut, or weld to, building structural members.
  5. Do not mount safety switches and external equipment to other equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.
- K. Contractor shall verify exact rough-in location and dimensions for connection to electrical items furnished by others.**
1. Shop drawings shall be obtained from those furnishing the equipment.
  2. Proceeding without proper information may require the Contractor to remove and replace work that does not meet the conditions imposed by the equipment supplied.
  3. Provide sleeves wherever openings are required through new concrete or masonry members. Place sleeves accurately and coordinate locations with the Engineer.

4. Should any cutting and patching be required on account of failure of the Contractor to coordinate penetrations, such cutting and patching shall be done at the expense of the Contractor.
  - a. The Contractor shall not endanger the stability of any structural member by cutting, digging, chasing, or drilling and shall not, at any time, cut or alter the work without the Engineer's written consent.
    - 1) Provide additional reinforcing if required.
    - 2) Cutting shall be done neatly using proper tools and methods.
  - b. Subsequent patching to restore walls, ceilings, or floors to their original condition shall be done by the Contractor.
  
- L. Provide concrete foundations or pads required for electrical equipment as indicated or specified. Floor-mounted equipment shall be mounted on a 4-inch concrete housekeeping pad. Pad shall be poured on top of the finished floor or slab.

### 3.02 TEMPORARY POWER

- A. The Contractor shall furnish, install, and maintain, temporary power and lighting systems needed for construction. This temporary system shall include weatherproof panel(s) for the Contractor's main breakers and distribution system. Ground fault interrupting equipment shall be installed. Connections shall be watertight, with wiring done with Type SO portable cable. After construction is completed, the Contractor shall remove temporary power equipment and devices.

### 3.03 CUTTING AND REPAIRING

- A. Where it becomes necessary to cut into existing work for the purpose of making electrical installations, core drills shall be used for making circular holes. Other demolition methods for cutting or removing shall be reviewed by the Engineer prior to starting the work.
- B. The Contractor shall repair damage caused by construction, or demolition work, and restore damaged areas to original condition.

### 3.04 CORROSION PROTECTION

- A. Wherever dissimilar metals, except conduit and conduit fittings, come in contact, the Contractor shall isolate these metals, as required, with neoprene washers, 9 mil polyethylene tape, or gaskets. Where fastening conduit, electro plated, or equivalent fasteners and stainless steel bolts shall be used.
- B. Factory finishes damaged during shipping, or construction, shall be restored to original new condition. Rust shall be removed, and bare metal surfaces shall be primed and painted to match the original surrounding finish.
- C. Electrical panels, switchgear, motor control centers, and other electrical equipment, shall be shipped in sealed dust and moisture proof plastic sheet enclosures, and the seal maintained

until units are installed. Said units shall be new and free of any dirt, dust, water, grease, rust, damaged parts or components. Relays, starters, circuit breakers, switches, contacts, insulators, mechanisms, and buses shall be free of dust, dirt, oil, moisture, metal shavings, and other debris before testing and energizing.

- D. Once equipment is installed, it shall be protected at all times with plastic sheet covers until the area is free of dirt, dust, paint spray, water, and other trades. Heat shall be provided to eliminate condensation.

### **3.05 COORDINATION OF THE ELECTRICAL SYSTEM**

- A. The Contractor shall verify actual equipment, and motor full-load, and locked-rotor current ratings. The necessary minimum equipment, wire, and conduit sizes are indicated on the Plans. If the Contractor furnishes equipment of different ratings, the Contractor shall coordinate the actual current rating of equipment furnished with the branch circuit conductor size, the overcurrent protection, the controller size, the motor starter, and the branch circuit overcurrent protection. The branch circuit conductors shall have a current carrying capacity of not less than 125 percent of the actual full-load current rating.

### **3.06 TEST**

- A. The electrical work shall be free from improper grounds, and from short circuits. The correctness of the wiring shall be verified first by visual comparison of the conductor connections with connection diagrams. Next, individual circuit continuity checks shall be made by using electrical circuit testers. Last, the correctness of the wiring shall be verified by the actual electrical operation of the electrical and mechanical devices. Any deviation from the wiring indicated on the Plans, or accepted Drawings, shall be corrected and indicated on the record drawings.
- B. Each conductor shall be identified as required by the Contract Documents. This identification shall be indicated on the record drawings to enable rapid, and accurate circuit tracing by maintenance personnel.

### **3.07 SINGLE LINE DIAGRAMS**

- A. Single line diagrams, as indicated on the Drawings, show circuit voltages, circuit protection rating, and other pertinent data. Where conflicts exist on the Drawings, the single line diagrams shall take precedence. Grounding conductors are not necessarily indicated. See grounding requirements specified elsewhere herein.

## **METHOD OF MEASUREMENT**

**100-4.1 ELECTRICAL SERVICES.** The electrical services to be paid under this Item shall include:



- a. Installation of new fuel area canopy structure complete as specified on Plans (part of Base Bid).
- b. Installation of fuel area lighting and receptacle circuit to include the following:  
New 120V, 20A / 1 pole circuit breaker in existing fuel farm panelboard, conduit and wire including trench and backfill requirements, and all Class 1, Division 1 hazardous rated fittings and components as required per the National Electric Code and as specified on the Plans complete with connections to all new light fixtures and receptacles (part of Base Bid).
- c. Installation of shade port area lighting and receptacle circuit to include the following:  
New 240V, 20A / 2 pole and 120V, 20A / 1 pole circuit breakers in existing modular building panelboard, conduit and wire including trench, concrete encasement and backfill requirements, and NEMA 3R junction box as specified on the Plans complete with connections to all new light fixtures and receptacles (part of Add Alternate No. 2).

**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. The unit price of each of these items shall also include the Contractor's overhead, profit and markup.

**Payment will be made under:**

**Base Bid – Fuel Farm Improvements**

- Item 16000-5.1 Fuel Area Canopy – Lump Sum
- Item 16000-5.2 Fuel Area Lighting and Receptacle Circuit - Lump Sum

**Add Alternate No. 2 – Shade Port Lighting**

- Item 16000-5.3 Shade Port Lighting and Receptacle Circuits - Lump Sum

**END OF ITEM -16000**



## SECTION 16050 BASIC MATERIALS AND METHODS

### GENERAL

#### 1.01 DESCRIPTION

- A. This section consists of general electrical materials and methods. Electrical materials that are a part of equipment specified under other sections shall meet the requirements of this section, unless part of larger factory-assembled equipment.

#### 1.02 SUBMITTALS

- A. Submit manufacturer's literature for raceways and fittings, boxes, wires and cables, wiring devices, nameplates, legend plates, labels, panelboards, and safety switches, service entrance equipment, control panels and any other electrical component utilized in this project.

#### 1.03 QUALITY ASSURANCE

- A. Refer to Section 16000.

#### 1.04 SPARE PARTS

- A. Provide spare components as indicated on plans and elsewhere herein.

### PRODUCTS

#### 2.01 BASIC MATERIALS

- A. Electrical safety switches, distribution and control equipment shall be rated for heavy duty service.
- B. Wiring devices shall be specifications grade.

#### 2.02 MISCELLANEOUS METAL AND MOUNTING CHANNELS

- A. Metal Framing:
  - 1. Unless otherwise shown, mounting channels shall be cold rolled from mild strip steel, 12-gauge, 1-5/8 inches by 1-5/8 inches, with a galvanized finish by Unistrut, Unistrut P-1000, as manufactured by Unistrut, or equal.
  - 2. Screws, bolts, washers and nuts shall be stainless steel. Parts and brackets for assembly of channels shall be hot dipped galvanized.
- B. Miscellaneous Metal: Galvanized steel, unless otherwise shown.

#### 2.03 NAMEPLATES, LEGEND PLATES, AND LABELS



- A. Nameplates: Laminated sheet plastic, approximately 1/16 inch-thick, with engraved white letters on a black background, with adhesive backing and mounting screw holes. Stainless steel or brass screws, minimum height of letters, 5/16 inch. Card holders are not acceptable.
- B. Legend Plates: Type KN-3 standard legend plates, Square D, or equal.
- C. Control Wire Markers: Pressure-sensitive or heat shrink sleeve types, manufactured by W.H. Brady Company, or equal.

## EXECUTION

### 3.01 BASIC MATERIALS

- A. The completed installation shall conform to all applicable federal, state, and local code ordinances and regulations. Contractor shall obtain necessary permits and inspections required by the governing authorities. Work shall be done in a neat, workmanlike, finished and safe manner, according to the latest published N.E.C.A. standards of installation, under competent supervision. Install grounding as required by the National Electrical Code.

### 3.02 MISCELLANEOUS METAL AND MOUNTING CHANNELS

- A. Install where electrical equipment is to be surface mounted to walls and where indicated on Plans. Where two or more devices are to be installed side by side, support on metal framing, bolt together, and brace as required to form a rigid structure.
- B. Clean cuts and welds. Coat unpainted surfaces with cold application zinc galvanizing. Coat cuts and welds on painted surfaces with zinc chromate primer and finish to match existing paint.

### 3.03 NAMEPLATES, LEGEND PLATES, AND LABELS

- A. Nameplates: Identify panels, switchgear, regulators, load-break junction boxes, disconnect switches, and component enclosures. Fasten nameplates with stainless steel, self-tapping screws or rivets.
  - 1. Panels: Identify panel number, voltage and amperage of panel bus.
  - 2. Switchgear: Identify equipment, voltage, amperage and phase and number of wires.
  - 3. Safety Switches and Relays: Identify equipment controlled and circuits from which they are fed.
- B. Legend Plates: Install on selector switches, pushbuttons, pilot lights, starters, and other components.
- C. Control Wire Markers: Install at both ends of each control wire interconnecting between such items as control panels, sensors, and control devices, and each end of control wires within control panels, and other such enclosures. Wiring markers shall correspond to control wire numbers on approved wiring diagrams.



#### **4.01 BASIS OF PAYMENT**

- A.** Payment for items described in this section will be made as part of payment for other system components as described in each section containing pay items.

**END OF SECTION 16050**



## SECTION 16111 CONDUITS

### GENERAL

#### 1.01 SCOPE OF WORK

- A. Furnish and install conduits as required, and as shown on the Plans. Materials employed shall be as shown on the Plans.

#### 1.02 SUBMITTALS

- A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.
- B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work.
- C. Proposed routing of conduits buried under floor slabs-on-grade.
- D. Identify conduit by tag number of equipment served or by circuit schedule number.
- E. Proposed routing and details of construction including conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served or by circuit schedule number.
- F. Proposed location and details of construction for openings in slabs and walls for raceway runs.
- G. Refer to Section 16000 for further submittal requirements.

#### 1.03 REFERENCES

- A. American National Standards Institute (ANSI): C80.1, Rigid Steel Conduit - Zinc-Coated, and C80. 3, Electrical Metallic Tubing, Steel Galvanized.
- B. National Electric Manufacturers Association (NEMA): RN-1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit, and FB-1, EMT Conduit Fittings.
- C. Underwriters Laboratories Inc. (UL):
  - 1. 1, Flexible Metal Conduit.
  - 2. 6, Rigid Metal Conduit.
  - 3. 360, Liquid-Tight Flexible Steel Conduit.
  - 4. 467, Grounding and Bonding Equipment.

5. 514, Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers, and 514B, EMT fittings.
6. 651, Schedule 40 and 80 Rigid PVC Conduit.
7. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
8. 884, Underfloor Raceways and Fittings.
9. 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
10. 797, Electrical Metallic Tubing.

## **2.01 RACEWAYS**

- A. Exposed conduit in an unclassified or hazardous area shall be galvanized rigid steel (GRS) unless specifically indicated otherwise on the Plans. Conduits in the corrosive areas shall be PVC coated GRS unless otherwise indicated. Underground and/or concrete encased conduits shall be PVC, unless otherwise indicated. All wiring, except as otherwise noted, shall be in conduit. Conduit size shall not be less than the National Electrical Code (NEC) size required for the conductors therein and shall not be smaller than 3/4-inch. No underground conduit shall be less than one inch, unless otherwise indicated on Plans.
- B. Condulet type fittings shall be Crouse-Hinds, Appleton, or equal with wedge nut covers. All condulets located outdoors or in wet locations shall be weathertight.
- C. In unclassified areas, flexible conduit shall be grounding type, weatherproof, corrosion resistant, and watertight.
- D. Couplings, connectors, and fittings shall be standard types specifically designed and manufactured for the purpose. They shall be installed to provide a firm mechanical assembly and electrical conductivity throughout.
- E. Expansion fittings shall be OZ type AX with jumper for exposed locations and type DX at structural expansion joints, Spring City, or equal. Conduits shall have expansion fittings in accordance with NEC.
- F. The conduits and fittings shall be supported per NEC requirements as a minimum.

## **2.02 GALVANIZED RIGID STEEL (GRS)**

- A. Conduit and couplings shall be hot-dipped galvanized with zinc coated threads and outer coating of zinc bichromate, in accordance with ANSI C80.1 standards, as manufactured by Jones & Laughlin Steel Corporation, Allied Tube & Conduit Corporation, Triangle PWC, or equal.
- B. Steel conduit shall not be buried in earth without concrete encasement and additional corrosion protection. A half lapped rapping of 20 mil PVC based corrosion protection tape shall be used.

## **2.03 RIGID NONMETALLIC – PVC**

- A. Where specifically indicated on the Plans, or elsewhere specified, conduit may be high density Schedule 40, 90 degrees C, heavy-duty PVC. The conduit shall be manufactured from virgin polyvinyl chloride compound which meets ASTM D1784, NEMA TC-2, ANSI C33.91, and UL 651 standards. Smoke emissions shall be limited to less than 6 grams per 100 grams of material tested.
- B. Where conduit concrete encasement is indicated on the Plans, conduit supports shall be installed at eight foot intervals. PVC conduit shall be manufactured by Carlon, Triangle Conduit & Cable, or equal.

#### **2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT**

- A. Liquidtight flexible metal conduit shall be liquid and vaportight, oil and ultraviolet ray resistant and manufactured in accordance with UL 360 standards. Liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, galvanized steel core with an extruded PVC jacket. The PVC jacket shall be rated for high ambient heat applications, 90 degrees Celsius.
- B. For corrosive locations, liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, aluminum core with an extruded PVC jacket. The PVC jacket shall be impervious to corrosive liquids and vapors.
- C. An external bonding conductor shall be required for flexible conduit connections containing circuits rated at 60 amps or greater and for sizes 1 1/2 " or larger. Flexible conduit and connectors for 1 1/4 " and smaller shall be listed for grounding.
- D. Connectors for liquidtight flexible conduit shall be galvanized, furnished with a sealing ring and locknut, and suitable for wet locations.

#### **2.05 ELECTRICAL METALLIC TUBING (EMT)**

- A. Conduit shall be galvanized Electrical Metallic Tubing (EMT) manufactured in accordance with UL 797 and as manufactured by Allied Tube & Conduit Corporation, or equal.
- B. EMT shall be made of high grade mild steel for durability and shall be hot galvanized with a clear organic polymer top-coat for protection against corrosion.
- C. Connectors with insulated throat and couplings for EMT shall be O-Z/Gedney or equal, compression type, UL file No. E35001, Zinc or galvanized for corrosion protection.
- D. EMT shall only be installed inside structures where indicated on Contract Drawings and in accordance with the NEC and UL general information card #FJMX.
- E. EMT shall not be installed in damp or corrosive locations or buried or encased in concrete.

### **EXECUTION**

### 3.01 INSTALLATION

- A. Conduit runs are schematic only, and shall be modified as required to suit field conditions, subject to review and acceptance by the Engineer.
- B. Conduit shall run continuously between outlets and shall be provided with junction boxes where connections are made. Couplings, connectors, and fittings shall be acceptable types designed and manufactured for the purpose, and shall provide a firm mechanical assembly, and electrical conductivity throughout.
- C. Conduit runs shall be straight and true. Elbows, offsets, and bends shall be uniform and symmetrical. Changes in direction shall be made with long radius bends, or with fittings of the conduit type.
- D. Conduit runs in buildings and structures shall be exposed except as specifically noted, or accepted by the Engineer.
- E. Conduit runs shall not interfere with the proper and safe operation of equipment, and shall not block or interfere with ingress or egress, including equipment removal hatches.
- F. Exposed conduits shall be securely fastened with clamps, or straps, intended for conduit use. All exposed conduit shall be run on the walls and ceiling only and shall be parallel to the planes of the walls or ceiling. No diagonal runs will be permitted. Flexible conduit shall be used only for short lengths required to facilitate connections between rigid conduit to motors from junction boxes, or control equipment. The maximum length of flexible conduit shall be 3 feet.
- G. Conduit runs on water-bearing walls shall be supported one inch away from the wall on an accepted channel. When channel galvanizing, or other coating, is cut or otherwise damaged, it shall be field coated to original condition. No conduit shall be run in water-bearing walls, unless specifically designated otherwise.
- H. Conduit shall be thoroughly reamed to remove burrs. IMC or GRS shall be reamed during the treading process, and Rigid Nonmetallic PVC or EMT shall be reamed before applying fittings. A zinc rich cold galvanizing shall be used to restore corrosion protection on field cut threads. Bushings and lock nuts or hubs shall be used at conduit termination's. The total number of bends in any run between pull points shall not exceed 360 degrees. Junction boxes and pull boxes shall be installed at points acceptable to the Engineer. Conduit ends shall be plugged to prevent the entrance of moisture or debris during construction. All spare conduits shall be adequately capped and shall contain a suitable pull string.
- I. Joints shall be set up tight. Hangers and fastenings shall be secure, and of a type appropriate in design, and dimensions, for the particular application.
- J. Conduit runs shall be cleaned and internally sized (obstruction tested) so that no foreign objects, or obstructions remain in the conduit prior to pulling in conductors.

- K. After installation of complete conduit runs 2 inches and larger, conduits shall be snaked with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of the nominal diameter of the conduit. Conduits through which the mandrel will not pass shall be prepared or replaced.
- L. Expansion fittings shall be installed across all expansion joints and at other locations where necessary to compensate for thermal expansion and contraction.
- M. Provide trenching, backfill, and compaction for conduits installed underground. Multiple underground conduits shall maintain a 7 ½" separation measured from the center of each conduit for M.V. cable and a 2" separation measured from outside wall to outside wall for low voltage and signal wires, or as otherwise noted on the drawings.
- N. Trench bottoms for conduits with concrete slurry encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit along entire length. When two or more conduits are installed in the same trench, the Contractor shall space them not less than 1-1/2 inches apart (measured from outside wall to outside wall) using spacers applicable to the type of duct. As the duct laying progresses, slurry not less than 3 inches thick shall be placed around the sides and top of the duct bank. End bells or couplings shall be installed flush with the concrete handhole walls. Trenches shall be opened the complete length and the bottom of the trench shall be free of loose material and debris before slurry is laid is installed so that if any obstructions are encountered, proper provisions can be made to avoid them.

#### **BASIS OF PAYMENT**

##### **4.01 BASIS OF PAYMENT**

- A. Payment for items described in this section will be made as part of payment for other system components as described in each section containing pay items. See pay items in Section 16000.

**END OF SECTION 16111**

## SECTION 16123 600 VOLT CLASS CABLE

### GENERAL

#### 1.01 SCOPE OF WORK

- A. This section covers the furnishing and installation of 600 Volt Class cables and conductors, terminations and splicing, and pulling lubricants.

#### 1.02 SUBMITTALS

- A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

#### 1.03 REFERENCES

- A. Insulated Cable Engineers Association/National Electrical Manufacturers Association (ICEA/NEMA):
  - 1. S-68-516/WC 8, ethylene-propylene rubber-insulated wire and cable for the transmission and distribution of electrical energy.
  - 2. S-61-402/WC 5, thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy.
  - 3. S-66-524/WC 7, cross-linked thermosetting-polyethylene-insulated wire and cable for transmission and distribution of electrical energy.
- B. Underwriters Laboratory, Inc.
  - 1. 44, rubber insulated wires and cables.
  - 2. 83, thermoplastic-insulated wires and cables.
  - 3. 486A, wire connectors and soldering lugs for use with copper conductors.
  - 4. 486B, wire connectors for use with aluminum conductors.
  - 5. 510, insulating tape.
- C. National Electric Code
- D. Insulated Cable Engineers Association

### PRODUCTS

#### 2.01 ACCEPTED MANUFACTURERS

- A. Conductors and Multi Conductor Cables (MCC), subject to compliance with Contract Documents, the following manufacturers are acceptable: American Insulated Wire Corporation, Cablec Corporation, Okonite Company, Southwire Company, or equal.

## 2.02 CONDUCTORS

- A. Wire sizes shall be American Wire Gauge (AWG) sizes with Class B stranded construction. Number 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape. Conductors sized No. 1 and larger shall be Type 2, rated for 90 degrees C. All circuit conductors, #6 or smaller shall be "THWN" stranded copper. All other conductors shall be "XHHW" stranded copper.
- B. Individual or multiple conductor cables for power, control, and alarm circuits of 480 volts or less shall be insulated for not less than 600 volts and shall have insulation type as indicated on the Plans. "THWN" shall conform to ICEA S-61-402/NEMA WC 5 and UL 83 and "XHHW" shall conform to ICEA S-66-524/NEMA WC 7 and UL 44. Where wire size is not indicated, they shall be of the size required by the NEC, except that no wire external to panels and motor control centers shall be less than No. 12 AWG, unless specifically noted on the Plans. Panel control wiring shall not be less than No. 14 AWG. Where cable is indicated to be run in cable tray, said cable shall be UL listed for cable tray use.
- C. All wiring shall be as indicated on the Plans. Wires shall be new and shall be soft drawn copper with not less than 97 percent conductivity. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's name permanently marked on the outer covering at not more than 2-foot intervals. All wires shall conform to the latest Standards of the ASTM, and ICEA, and shall be tested for their full length by these Standards. Insulation thickness shall be not less than that specified by the National Electrical Code.

## 2.03 TERMINATIONS AND SPLICES

- A. Cable shall be rated 600 volts. Other parts of cable systems such as splices and terminations shall be rated at not less than 600 volts. Splicing shall join conductors mechanically and electrically to provide a complete circuit prior to installation of insulation.
- B. Splices in wires No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, Type I, Class 1, Grade B, Style G, or Type II, Class 1 of FS W-S-610 and conforming to the applicable requirements of UL 486A.
- C. Splices in wires No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, Type II, Class 2 of FS W-S-610, conforming to the applicable requirements of UL 486A and UL 486B. They shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket.
- D. All splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.



- E. Conductors, including grounding conductors, of different sizes shall be spliced and then soldered or welded. Splices in wet locations and all splices below grade shall be of the Exothermic type.

**2.04 PULLING LUBRICANT**

- A. All cables shall be properly coated with pulling compound (Aqua Gel, CRC, or equal) before being pulled into conduits so as to prevent mechanical damage to the cables during installation. "Yellow 77" is not acceptable.
- B. Other lubricants to be substituted must be accompanied by a statement from the cable manufacturer as to its acceptable use with the cable being installed.

**2.05 IDENTIFICATION**

- A. All conductors shall be numbered with "tube sleeve" type tags with heat impressed letters and numbers.

- B. Color code all wiring as follows:

		<u>120/208 VAC</u>	<u>480VAC</u>	<u>24V DC</u>	<u>120 VAC Control/ Power</u>
1.	Lighting and power wiring:				
a.	Phase 1	Black	Brown	Blue	Red
b.	Phase 2	Red	Orange		
c.	Phase 3	Blue	Yellow		
d.	Neutrals	White	White		White
e.	Ground	Green	Green		
2.	Color code ends of feeder phase conductors only.				

**EXECUTION**

**3.01 INSTALLATION**

- A. The pulling tension and side-wall pressures, as recommended by the cable manufacturer, shall not be exceeded. Additional pull boxes shall be installed, as required, to meet the cable manufacturer's recommendations.
- B. As far as practical, all circuits shall be continuous from origin to termination without splices in intermediate pull boxes. Sufficient slack shall be left at the termination to make proper connections. In no case shall a splice be pulled into the conduit. Conductor splicing shall not be permitted without the Engineer's approval.
- C. Install all cables in conduit.



- D.** Each feeder and branch circuit shall be installed in its own individual conduit unless combining feeder and branch circuits is permitted as defined in the following:
- 1.** As specifically indicated on the Plans.
  - 2.** For lighting, multiple branch circuits may be installed in a conduit as allowed by the NEC and with the wire ampacity derated in accordance with the requirements of the NEC. Conduit fill shall not exceed the limits established by the NEC.
  - 3.** When field conditions dictate and written permission is obtained from the Engineer.
- E.** Feeder and branch circuits shall be isolated from each other and from all instrumentation and control circuits.
- F.** Control circuits shall be isolated from all other feeder, branch and instrumentation circuits, except as noted above.
- 1.** 12 V DC, 24 V DC and 48 V DC control circuits may be combined in common conduit.
  - 2.** 125 V DC control circuits shall be isolated from all other DC and AC control circuits.
  - 3.** 120 V AC control circuits shall be isolated from all DC control circuits.
- G.** Make splices only at pull or junction boxes.
- 1.** Crimp or indenter-type connectors are not allowed, except for control circuits landed on terminal strips.
  - 2.** For wire smaller than #6 AWG: Use insulated conical spring type connectors, or "wirenuts".
  - 3.** For #6 AWG and larger wire: Use solderless lugs and screw type connectors.

## **BASIS OF PAYMENT**

### **4.01 BASIS OF PAYMENT**

- A.** Payment for items described in this section will be made as part of payment for other system components as described in each section containing pay items. See pay items in Section 16000.

**END OF SECTION 16123**



## SECTION 16140 OUTLET, SWITCH, PULL AND JUNCTION BOXES

### GENERAL

#### 1.01 SCOPE OF WORK

- A. This section covers outlets, switches, pulls and junction boxes.

#### 1.02 SUBMITTALS

- A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

### PRODUCTS

- 2.01 Subject to compliance with the Contract Documents, the boxes shall be manufactured by Crouse-Hinds, Appleton, Steel City or equal.

#### 2.02 BOXES

- A. Pull and junction boxes for wet areas shall be 14 GA steel with polyester power coating inside and out over phosphatized surfaces with seams continuously welded, ground smooth, no knockouts and stainless steel clamps on four sides and flat cover with oil resistant gasket. Boxes shall be NEMA 4 classification and UL listed.
- B. Outlet and switch boxes shall be cadmium plated, cast, ferrous, metal, with threaded hubs and mounting tabs for exposed wiring. For concealed wiring, outlet and switch boxes shall be hot-dip galvanized steel with grounding screws, plaster rings and barriers between switches in boxes with 277 V switches on opposite phases.

### EXECUTION

#### 3.01 INSTALLATION

- A. Install boxes in accordance with NEC rules and regulations.
- B. Outlet and switch boxes for concealed wiring shall be mounted with manufactured or field fabricated brackets. Mounting brackets shall be submitted to the Engineer for review prior to installation.

### BASIS OF PAYMENT

- 4.01 Payment for items described in this section will be made as part of payments of other system components as described in each section containing pay items. See pay items listed in sections 16000 and 16141.

## SECTION 16141 RECEPTACLES

### GENERAL

#### 1.01 SCOPE OF WORK

- A. This section covers devices for the control and supply of electrical power.

#### 1.02 SUBMITTALS

- A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

#### 1.03 REFERENCES

- A. NEC
- B. UL

### PRODUCTS

#### 2.01 MATERIALS

- A. Explosion Proof Receptacles. Receptacles for Explosive areas shall be explosion-proof, UL listed for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2, Groups F and G, Factory-sealed malleable iron receptacle with spring-loaded cover, malleable iron mounting box, rated 20 A, 125 V AC, "dead-front" construction requiring plug to be inserted and rotated to activate receptacle, and type as indicated on Drawings.
- B. Ground fault circuit interrupter receptacle shall be straight blade, grounding type, specification grade, rated 20 A, 125 V AC, UL listed, with test and reset buttons. Wall plates shall be 304 stainless steel for indoors or weatherproof as required, feed-thru type. Restroom, exterior, and wet areas receptacles shall be GFCI type.

### EXECUTION

#### 3.01 INSTALLATION

- A. Install receptacles in accordance with NEC rules and regulations (and ADA when applicable).

### BASIS OF PAYMENT

#### 4.01 RECEPTACLES



- A.** Payment for new receptacles will be made at the contract unit price, installed and accepted, which price and payment shall constitute full compensation for furnishing all materials and for all preparation and installation of equipment, tools, junction boxes, and incidentals necessary to complete the work. The unit price of each of these items shall also include the Contractor's overhead, profit, and markup.

Payment will be made under:

**Base Bid – Fuel Farm Improvements**

Item 16141-4.1            20A, GFCI WP Duplex Receptacle Hazardous Rated – per each

**Add Alternate No. 2 – Shade Port Lighting**

Item 16141-4.2            20A, GFCI WP Duplex Receptacle – per each

**END OF SECTION 16141**

## SECTION 16170 GROUNDING

### GENERAL

#### 1.01 SCOPE OF WORK

- A. A ground grid system consisting of the indicated configuration of copper wires, and ground rods, or concrete encased grounding electrodes ("UFERs") shall be provided to minimize station potential gradient irregularities and drain leakage and fault currents to earth.
- B. Whether indicated on the Plans or not, neutral conductors, cable shields, metallic conduits, cable terminations, junction boxes, poles, surge arresters, and other noncurrent-carrying metallic parts of equipment shall be grounded.

#### 1.02 SUBMITTALS

- A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

#### 1.03 REFERENCES

- A. National Electrical Code (NEC) Article 250

### PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

- A. A resistance of not greater than 25 ohms shall be provided, unless otherwise specified. Ground resistances shall be measured as herein described. Resistances of systems requiring separate ground rods shall be measured separately before bonding below grade. The combined ground resistance of separate systems bonded together below grade may be used to meet the specified ground resistance, but the minimum number of rods indicated must still be provided.

#### 2.02 GROUND RODS

- A. Ground rods shall be copper-clad steel conforming to UL 467, 3/4 inch in diameter by 10 feet in length. Unless otherwise indicated, ground rods shall be driven into the ground until tops of rods are approximately 6 inches below finished grade. Where the specified ground resistance cannot be met with the indicated number of ground rods, additional ground rods, longer ground rods, or deep-driven sectional rods shall be installed and connected until the specified resistance is obtained, except that not more than three additional ground rods shall be



required at any one installation. Ground rods shall be spaced as evenly as possible at least 6 feet apart and connected below grade.

### **2.03 CONNECTIONS**

- A. Connections above grade shall be made with bolted solderless connectors, and those below grade shall be made by a fusion-welding process. In lieu of a fusion-welding process, a compression ground grid connector of a type which uses a hydraulic compression tool to provide the correct circumferential pressure may be used. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

### **2.04 GROUNDING ELECTRODE CONDUCTOR**

- A. Service entrance ground wires shall be sized in accordance with NEC Table 250-66, unless otherwise indicated on the Plans. After being located to provide maximum physical protection, exposed ground wires shall be securely attached to structural supports at not more than 2-foot intervals with suitable fasteners. Bends greater than 45 degrees in ground wires are not permitted. Routing of ground conductors through concrete should be avoided, except where specifically called for in these Documents. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit, so as to provide an opening for the ground wire. The opening shall be sealed with a suitable compound after installation of the ground wire.

### **2.05 EQUIPMENT GROUNDING CONDUCTOR**

- A. Neutral conductors shall be grounded where indicated. Equipment grounding conductors shall be sized in accordance with NEC Table 250-122, unless otherwise indicated. Ground wires shall be protected by conduit, where such wires run exposed above grade in nonfence-enclosed areas, or are run through concrete construction. Where concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit, so as to provide an opening for the ground wire. The opening shall be sealed with a suitable compound after installation of the ground wire. Bends greater than 45 degrees in ground wire connections to the ground rods are not permitted.

### **2.06 EQUIPMENT GROUNDING**

- A. Equipment frames of motor housings, metallic tanks, metallic equipment enclosures, metal splicing boxes, and other metallic noncurrent-carrying metal items, shall be grounded. Connections to earth shall be made in the same manner as required for system grounding. Equipment or devices operating at less than 750 volts may be connected to secondary neutral grounding electrodes.

### **2.07 METALLIC STRUCTURES**



- A. Metallic structures and buildings shall be grounded per NEC.

## **2.08 GROUNDING RINGS**

- A. When required, grounding rings shall be installed using bare copper cable with ground rods at least 25 feet intervals using exothermic weld connecting means as indicated on the plans in accordance with NEC requirements.

## **EXECUTION**

### **3.01 INSTALLATION**

- A. It is the intent of these Contract Documents that all device and equipment grounds shall be run as a separate conductor in the conduit from the equipment to the distribution panels or system ground. Wireways and enclosures shall be properly bonded and grounded, and ground conductors shall be run for all circuits.
- B. Equipment cases and devices shall be grounded. Ground rods shall be driven, and concrete encased conduits installed, before a building, or structure is built, and ground conductors brought through the concrete to accessible points for grounding equipment. These systems shall be installed at each structure, where transformers, switchboards, panelboards, and MCCs are installed.
- C. Duct banks shall contain a concrete encased system bare copper ground conductor. The system ground conductors shall run continuously in duct banks, through handholes and other raceway boxes. The system ground shall be connected to the structure grounding systems to provide a continuous grounding system. Each metallic raceway, panel, switchboard, and other metallic devices associated with the electrical and control systems shall be bonded to this grounding system.
- D. Ground rod shall be installed not less than 6 inches below grade. Equipment, neutral, and surge arrester ground wires shall be connected to the ground grid as indicated.

### **3.02 TESTS**

- A. Pre-Energization Tests

Pre-energization tests shall include, but shall not be limited to tests that the equipment engineer is required to perform under paragraph "GENERAL REQUIREMENTS." No part of the electrical system shall be energized until all station grounding system components have been tested and demonstrated to comply with the requirements specified, and until associated test reports have been submitted and approved.

- B. Operating Test



After the installation is completed, the Contractor shall conduct an operating test for approval. Equipment shall be demonstrated to operate in accordance with the requirements herein. Tests shall be performed in the presence of the Engineer. The Contractor shall furnish instruments and personnel required for the test.

**C. Ground-Resistance Measurements**

Ground-resistance measurements of each ground rod shall be taken and certified by the Contractor to the Engineer. No part of the electrical distribution system shall be energized prior to the resistance testing of that system's ground rods and grounding system and submission of test results to the Engineer. Test reports shall indicate the location of the ground rod and grounding system and the resistance and the soil conditions at the time the test was performed. When the building water service is used as a ground or part of the grounding system, ground-resistance measurements shall also be made of this connection. Ground-resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds. The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 142 and Std 81.

**3.03 TEST RESULTS**

- A.** The Contractor shall perform the above tests and complete the following report:

**GROUNDING REPORT**

- 1.** Pre-Energization Tests
  - a.
  - b.
  - c.
- 2.** Operating Test
  - a.
  - b.
  - c.
- 3.** Ground-Resistance Measurements
  - a.
  - b.
  - c.

**BASIS OF PAYMENT**

**4.01 GROUNDING**

- A.** Payment for items will be made on a lump sum basis for system grounding, for all ground rods at each canopy per plan with exothermic weld to ground rod and canopy column, and upon inspection by authority having jurisdiction. 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 necessary to complete this item. The lump sum price of each of these items shall include the contractor's overhead, profit and markup.

Payment will be made under:

**Base Bid – Fuel Farm Improvements**

Item 16170-4.1 Fuel Area Canopy Grounding – per lump sum

**Add Alternate No. 2 – Shade Port Lighting**

Item 16170-4.2 Shade Port Grounding – per lump sum

**END OF SECTION 16170**



## SECTION 16195 ELECTRICAL IDENTIFICATION

### GENERAL

#### 1.01 SCOPE OF WORK

- A. Electrical identification work specified in this section covers the following:
1. Buried cable warnings
  2. Electrical power, control and communication conductors
  3. Operational instructions and warnings
  4. Danger signs
  5. Equipment/system identification signs

#### 1.02 SUBMITTALS

- A. Submittals to the engineer shall include the following:
1. Manufacturers data on electrical identification materials and products
  2. Samples of each color, lettering style and other graphic representation required for each identification material or system

#### 1.03 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering electrical identification products maybe incorporated in the work include, but not limited to, the following:
1. Brady, W.H. Co.
  2. Ideal Industries, Inc.
  3. Panduit Corp.
  4. Equivalent

#### 1.04 QUALITY COMPLIANCE

- A. Comply with applicable requirements of UL Std. 969, "Marking and Labeling Systems", pertaining to electrical identification systems.
- B. Comply with applicable requirements of NEMA Std. No's WC-1 and WC-2 pertaining to identification of power and control conductors.

### PRODUCTS

#### 2.01 GENERAL



- A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

## **2.02 COLOR-CODED CONDUIT MARKERS**

- A. Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, plastic-sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesive, adhesive lap joint of marker, matching adhesive plastic tape at each end of marker, or pretensioned snap-on. Except as otherwise indicated, provide lettering which indicates voltage of conductor(s) in conduit. Provide 8" minimum length for 2" and smaller conduit, 12" length for larger conduit.
- B. Unless otherwise indicated or required by governing regulations, provide white markers with black letters.

## **2.03 CABLE AND CONDUCTOR WIRE MARKERS**

- A. Cable and conductor wire markers shall be self laminating vinyl on white background, printed using a BRADY XC PLUS printer, or equal. Handwritten wire markers are not acceptable.

## **2.04 SELF-ADHESIVE PLASTIC SIGNS**

- A. Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.
- B. Unless otherwise indicated or required by governing regulations, provide white signs with black lettering.

## **2.05 LETTERING AND GRAPHICS**

- A. Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

# **EXECUTION**

## **3.01 INSTALLATION**

- A. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NEC.



- B. Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
- C. Comply with governing regulations and requests of governing authorities for identification of electrical work.

### **3.02 CONDUIT IDENTIFICATION**

- A. Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by a color-coded method, apply color-coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated use white as coded color for conduit.

### **3.03 CABLE/CONDUCTOR IDENTIFICATION**

- A. Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work.

### **3.04 EQUIPMENT/SYSTEM IDENTIFICATION**

- A. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication-control-signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
  1. Panelboards, electrical cabinets and enclosures.
  2. Access panel/doors to electrical facilities.
  3. Major electrical switchgear.
- B. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with brass or stainless steel screws, except use adhesive where screws should not or cannot penetrate the substrate.

### **3.05 CIRCUIT IDENTIFICATION**

- A. The 3-phase wires shall be identified at the switchgear, panelboards and motor control centers as Phases A, B, and C. At 277/480V, Phase A shall be brown, Phase B shall be orange, and Phase C shall be yellow. The neutral shall be grey.

- B. In addition to color coding all conductors, each conductor shall be identified in each pull box, manhole, panelboard, cable tray, or termination with circuit identification markers. This identification is applicable to all power, control, alarm, and instrumentation conductors and these markings shall be recorded on the Record Documents. Markers shall be slip-on PVC sleeve type as manufactured by Brady, Seaton, or equal.
- C. Markers for other cabling shall be B-292 vinyl as manufactured by Brady, Seaton, or equal.
- D. Exposed medium voltage conduits shall be labeled at 50 foot intervals with 1 inch letters stating the voltage - example - "12,470 volts". Labels shall be vinyl plastic as manufactured by Brady, Seton, or equal.

### **3.06 CONDUCTOR FASTENERS**

- A. Glue-on type conductor fasteners shall not be used in any panels, panelboards, switchboards, switchgear, motor control centers, or other enclosures containing electrical devices and/or conductors.

## **BASIS OF PAYMENT**

### **4.01 PAYMENT**

- A. Payment for items described in this section will be made as part of payments of other system components as described in each section containing pay items. See pay items listed in section 16000.

## **END OF SECTION 16195**



## **SECTION 16476 LOW VOLTAGE (600V AND BELOW) CIRCUIT BREAKERS**

### **GENERAL**

#### **1.01 SCOPE OF WORK**

- A.** The Contractor shall furnish and install, low voltage circuit breakers, as indicated on the Plans and specified herein.

#### **1.02 SUBMITTALS**

- A.** Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

### **PRODUCTS**

#### **2.01 GENERAL**

- A.** Circuit breakers shall be as manufactured by Square D, Cutler-Hammer, General Electric, or equal.
- B.** Circuit breaker frame, trip, short circuit, and interruption ratings shall be as indicated on the Plans, except that they shall be coordinated with the ratings of the equipment actually furnished, and shall be modified where necessary to suit the equipment. Circuit breakers to be used in motor control centers shall be as indicated on the Plans. Where no indication of type is given on the Plans circuit breakers protecting motors shall be motor circuit protectors, and other circuit breakers shall be molded case type.
- C.** Each pole of the circuit breaker shall provide inverse time delay, and instantaneous circuit protection.
- D.** Circuit breakers shall conform to the applicable requirements of NEMA Standards Publication No. AB1.
- E.** Unless mounted in a switchboard, or panelboard, circuit breakers shall be housed in a NEMA rated enclosure as described elsewhere in these specifications.
- F.** Circuit breakers for mounting inside panelboards shall be bolt-on type with a short circuit rating equal to or greater than the bracing of the panelboard bus.
- G.** Circuit breakers for mounting inside existing panelboards shall match existing circuit breaker type and shall have circuit rating equal to or greater than the bracing of the panelboard bus.



## **EXECUTION**

### **3.01 INSTALLATION**

- A.** Circuit breakers shall be installed as indicated on the plans and per manufacturer's instructions.

### **BASIS OF PAYMENT**

- 4.01** Payment for items described in this section will be made as part of payment for other system components as described in each section containing pay items. See pay items in section 16000.

**END OF SECTION 16476**

## SECTION 16500 LIGHTING

### GENERAL

#### 1.01 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install lighting fixtures.

#### 1.02 QUALITY ASSURANCE

A. Reference Standards:

1. National Electrical Code (NEC)
2. UL Standard #1598, Electric Lighting Fixtures
3. UL Standard #8750, Light Emitting Diode (LED)
4. Illuminating Engineering Society (IES)
5. All applicable local lighting ordinances

B. Miscellaneous:

1. Lamps are identified for each luminaire in the Lighting Fixture Schedule on the Plans.
2. Lighting fixtures and electrical components:
  - a. UL labeled, complete with lamps.
  - b. Rated for area classification as indicated.
3. Location of lighting fixtures on Plans are intended to be used as a guide.
  - a. Field conditions may affect actual locations.
  - b. Coordinate with other trades to avoid conflicts in mounting of fixtures and other equipment.
4. The quality standard is established by the fixture listed in the Lighting Fixture Schedule.
  - a. This quality standard includes, but is not necessarily limited to construction features, materials of construction, finish, and photometrics.

#### 1.03 SUBMITTALS

A. The following shall be submitted to the Engineer for review:

1. Acknowledgment that products submitted meet requirements of standards referenced.
2. Manufacturer's technical information on products to be used including photometric performance curves for the fixture and ballast data.
3. Acknowledgment that products submitted are UL or ETL listed.
4. When general data sheets constitute part of the submittal, identify the products to be used on this project.
5. Manufacturer's installation instructions.
6. Identification of fixtures by Lighting Fixture Schedule.

7. UL nameplate data (Voltage, wattage, etc.).
  8. Finishes, colors, and mounting type.
- B. Contractor shall submit shop drawings, manufacturer's data sheets, and a complete wiring diagram detailing all connections to the electrical system in accordance with Section 16000, and other requirements of the Contract Documents.

## PRODUCTS

### 2.01 MANUFACTURERS

- A. Lamps shall be manufactured by General Electric, North American/Phillips, Sylvania, or equal.
- B. Lighting fixtures shall be provided as indicated on the Lighting Fixture Schedule on the Plans.
- C. Lighting ballasts shall be manufactured by General Electric, Advance, Jefferson, Universal, Bodine, Lithonia, or equal.

### 2.02 MATERIALS

- A. General:
  1. Lamps:
    - a. See lighting fixture schedule on Plans for wattage, voltage and number required.
  2. All Fixtures:
    - a. There shall be no live parts normally exposed to contact.
    - b. When intended for use in wet area:
      - (1) Mark fixtures "suitable for wet locations."
    - c. When intended for use in damp areas:
      - (1) Mark fixtures "suitable for damp locations" or "suitable for wet locations."
    - d. In wet or damp area, install fixtures so that water cannot enter or accumulate in the wiring compartment, lampholder, or other electrical parts.
    - e. Gasket seals: Urethane foam
    - f. Diffusers: UV stabilized acrylic plastic
  3. Underground wiring:
    - a. Provide all wiring runs with separate green grounding conductor.
    - b. Ground all pole bases.
- C. Light Emitting Diodes (LED)
  1. Colour Temperature 4,100k
  2. 80,000 lamp life

## 2.03 FIXTURES

### A. Light Emitting Diode (LED) Fixtures:

1. Drivers for Light emitting Diode (LED) fixtures:
  - a. Type: Solid State
  - b. Operates at 50-60Hz with a power factor greater than 95%
  - c. 9Kv surge suppression
  - d. Power supply shall operate between -40°F to +140°F.
  - e. Vibration test to ANSI C136.31-2001 for Roadway Luminaire Vibration.
  - f. Salt fog tested to ASTM B117 for a minimum of 1,000 hours.
  - g. Intrusion Protection 66
  - h. Integral heat sink
  - i. Optical system (Full cut-off)
  - j. Dual driver (175mA/525mA)

## 2.04 MISCELLANEOUS ELECTRIC DEVICES

### A. PHOTOELECTRIC CONTROL UNITS shall meet the following requirements:

1. Cadmium sulfide photocell
2. Aluminum weatherproof enclosure
3. 30 amp rated contacts
4. 120-volt AC power

## EXECUTION

### 3.01 INSTALLATION

- A. Surface and flush mounted fixtures shall be solidly connected to a junction box. Suspended fixtures shall be hung utilizing pendant mounting or stainless steel chains and hooks. Each suspended fixture shall be electrically connected by a length of Type SO flexible cord, 3 conductor No. 14 AWG, minimum, with a twist-lock receptacle mounted in an individual junction box. Plugs and receptacles shall be as manufactured by Hubbell, General Electric Company, or equal.
- B. Provide mounting brackets and/or structural mounting support for fixtures.
  1. Do not support fixture from conduit system.
  2. Do not support fixture from outlet boxes.
- C. Install with approved mounting hardware following manufacturer's recommendations.
- D. Fixture mounting heights and locations indicated on the Plans are approximate and are subject to revision in the field where necessary to avoid conflicts and obstructions.

### 3.02 ADJUSTING AND CLEANING



- A. Wipe all lighting fixture reflectors, lenses, lamps, and trims clean after installation and prior to acceptance of Project by Owner.

### METHOD OF MEASUREMENT

4.01 The quantity of each payment item under this section shall include the following:

- a. Installation of fuel area lighting fixtures and one photocell complete per each (part of Base Bid).
- b. Installation of shade port area lighting fixtures and one photocell complete per each (part of Add Alternate No. 2).

### BASIS OF PAYMENT

#### 5.01 System Components

- A. Payment will be made at the contract unit price for each complete system component listed below installed in place by the Contractor and accepted by the Owner or Owner's Representative. 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. The unit price for these items shall also include Contractor's overhead, profit, and markup.

Payment will be made under:

#### Base Bid – Fuel Farm Improvements

Item 16500-5.1            Lighting Fixture Schedule Item "C" – per each

#### Add Alternate No. 2 – Shade Port Lighting

Item 16500-5.2            Lighting Fixture Schedule Item "A" – per each

Item 16500-5.3            Lighting Fixture Schedule Item "B" – per each

**END OF SECTION 16500**



## SECTION 16904 UNLIT AIRSIDE GUIDANCE SIGN (FAA ITEM L-858)

### DESCRIPTION

The following specification is based upon FAA AC 150/5345-44J, *Specification for Runway and Taxiway Signs*. Modifications have been made where appropriate to account for local conditions and project specifics.

### GENERAL

The CONTRACTOR shall perform all work required by the plans to provide installation of the unlit airside guidance signs in accordance with FAA Specification Item L-858, as included and modified hereafter, and as shown on the plans.

**858-1.1** This item shall consist of furnishing and installing the L-858 guidance signs in accordance with these specifications.

This item shall also include the furnishing and installing of all necessary mounting structures including concrete bases. It shall also include the testing of the installation and all incidentals necessary to place the signs in operation as completed units to the satisfaction of the Engineer.

### EQUIPMENT AND MATERIALS

**858-2.1 L-858.** The L-858 signs shall conform to the requirements FAA Advisory Circular 150/5345-44 (latest revision) "Specification for Runway and Taxiway Signs" and FAA "Engineering Brief No. 67" (current edition). The L-858 signs shall be manufactured by an FAA certified manufacture, as listed in FAA Advisory Circular 5345-53 "Airport Lighting Equipment Certification Program" (current edition).

**858-2.2 EQUIPMENT SUPPLIED.** L-858 signs shall be supplied in the quantities specified in the plans with 1 pre-attached tether per module. Each lot shipment shall include one Instruction Manual. The manufacturer shall also have a downloadable electronic version of the manual available on their web site.

**858-2.3 UNLIGHTED L-858 SIGN.** The unlighted sign shall be size 1, 2 or 3 module taxiway guidance sign. All mounting hardware for the sign shall be stainless steel. An insulating material must be used between any aluminum and steel material in contact to prevent galvanic corrosion.

The sign shall be concrete pad mounted, and shall include all mounting hardware necessary to mount the sign.



Sign panels must be made from aluminum. The aluminum sheet must be free from any laminations, blisters, open seams, pits, holes, or other defects. The aluminum sheet must be uniform thickness. Any retroreflective material used must meet both the color and reflectivity requirements of ASTM D4956, Specification for Retroreflective Sheeting for Traffic Control, for Type III or Type IV sheeting.

### CONSTRUCTION METHODS

**858-3.1 PLACING THE L-858 SIGNS.** The contractor shall furnish and install each L-858 sign as specified in the proposal and shown in the plans. The L-858 shall be mounted on concrete pads at the location shown on the plans.

### METHOD OF MEASUREMENT

**858-4.1 UNLIGHTED L-858 SIGNS.** The quantity of signs to be paid for under this item shall be for the quantity of unlighted L-858 signs (with tether) installed as shown on the plans installed and accepted as completed units, in place, ready for operation.

### BASIS FOR PAYMENT

**858-5.1 UNLIGHTED L-858 SIGNS.** Payment will be made at the contract unit price for the completed total quantity of unlighted L-858 signs installed, in place by the Contractor, and accepted by the Engineer. 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:

#### Base Bid – Fuel Farm Improvements

<b>Item 16904-5.1</b>	New Size 1, 2 Module Unlit Airfield Guidance Sign Installed – per each
<b>Item 16904-5.2</b>	New Size 1, 3 Module Unlit Airfield Guidance Sign Installed – per each

### END OF SECTION 16904



## SECTION 16905 TAXIWAY RETROREFLECTIVE MARKERS (FAA ITEM L-853)

### DESCRIPTION

The following specification is based upon FAA AC 150/5345-39D, *Specification for L-853 Runway and Taxiway Retroreflective Markers*. Modifications have been made where appropriate to account for local conditions and project specifics.

### GENERAL

The CONTRACTOR shall perform all work required by the plans to provide installation of the taxiway retroreflective markers in accordance with FAA Specification Item L-853, as included and modified hereafter, and as shown on the plans.

**853-1.1 RELATED DOCUMENTS.** The General Provisions of the Contract, including General and Special Conditions apply to work specified in this Item.

**853-1.2 GENERAL.** This Item shall consist of the requirements for and installation of new L-853 taxiway retroreflective markers in accordance with these specifications and at the locations shown on the plans.

**853-1.3 CLASSIFICATION.** The type of retroreflective marker covered under this specification is as follows.

- a. Type II, Elevated marker for edge marking.

**853-1.4 FAA ADVISORY CIRCULARS.** Additional details pertaining to the specific elements covered in this Item are contained in the following FAA Advisory Circulars:

AC 150/5345-39	Specification for L-853, Runway and Taxiway Retroreflective Markers
AC 150/5345-53	Airport Lighting Equipment Certification Program
AC 150/5340-30	Design and Installation Details for Airport Visual Aids

**853-1.5 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, installation and operation instructions, etc., for the following equipment:

- a. L-853 Retroreflective marker



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 hard-bound cover. Partial submissions will not be reviewed or considered.

### **MATERIALS**

**853-2.1 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 retroreflective markers shall meet the requirements of AC 150/5345-39.

**853-2.2 RETROREFLECTIVE MATERIAL.** Retroreflective material is designed to reflect light at an oblique angle back toward its source. The type of retroreflective material to be used shall be as follows:

- a. Flexible sheeting with a smooth face, embedded optical retroreflective elements, and an adhesive backing (referred to herein as sheet reflectors).

**853-2.3 CONFIGURATION.** The configuration of the retroreflective material on the marker is designed to maximize its visibility. The marker must be visible as a single color with a continuous unbroken surface. Separated color strips (bands) of the same color or differing colors laid out across the marker face must not be used.

**853-2.4 TYPE II SHEET RETROREFLECTORS.** Taxiway edge markers are to be solid blue in color.

**853-2.5 SHEET RETROREFLECTOR REQUIREMENTS.** Material requirements for sheet retroreflector are as follows:

- a. Must be manufactured and perform per the requirements of ASTM D 4956-09, Standard Specification for Retroreflective Sheeting for Traffic Control. Class 1 through 4 adhesive backing.
- b. Must be Type III Sheeting or high per ASTM D 4956-09. See ASTM D 4956-09, Table 4, Type III Sheeting, for a minimum reflection coefficients for colors (blue).

**853-2.6 TYPE II MARKER.** The configuration of the Type II marker shall be a cylindrical surface with sheet retroreflectors attached. The retroreflective material shall be 3" above the finished grade.

- a. Dimensions:
  - 1. A minimum of 96 in<sup>2</sup> of sheet retroreflective material must be wrapped uniformly about the cylinder. The sheeting must extend to the top of the cylinder.

2. The maximum cylinder diameter is not to exceed 8 inches.
3. The standard installed height of the reflector must be 14 inches above finish grade.

**b. Mounting System:**

1. The manufacturer shall supply a mounting system that is appropriate for the type of surface, (asphalt, grass, concrete).
2. The mounting system shall withstand wind speeds of up to 100 mph from any direction.
3. The mounting system must be design to prevent the marker or its components from being ingested by jet aircraft.

**c. Frangibility and Tethering:**

1. Marker must be either flexible or mounted with a frangible fitting (with breaking point no more than 3 inches above grade).
2. The marker and mounting system must withstand a wind speed of 100 mph without permanent deformation and must retain its original shape and position in winds up to 50 mph.
3. A tether anchor hard point is required for Type II markers that are designed to break rather than bend or flex. The tether must be a weather and corrosion resisting material capable of securing the retroreflector when separated from its base, to prevent a Foreign Object Debris (FOD) hazard.

**d. Materials:**

1. All metal used in the Type II marker and associated hardware shall be corrosion resisting, plated, or treated to resist corrosion.
2. The sheet retroreflector material shall be securely fastened to the marker body, so that it will not become loose.

### **METHOD OF MEASUREMENT**

**853-3.1 L-853 TAXIWAY RETROREFLECTIVE MARKER.** The quantity to be measured shall be for the installation of the new taxiway retroreflective edge markers in accordance with the plans and specifications and as accepted by the Owner.

### **BASIS OF PAYMENT**



**853-4.1 L-853 TAXIWAY RETROREFLECTIVE MARKER.** Payment for the installation of new taxiway retroreflective edge markers shall be made at the contract unit price for installing said markers. 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.

Payment will be made under:

**Base Bid – Fuel Farm Improvements**

- |                         |  |
|-------------------------|--|
| <b>Item L-16905-4.1</b> | New L-853 Elevated Retroreflective Taxiway Edge Marker -- per each                   |
| <b>Item L-16905-4.2</b> | Relocate Existing L-853 Elevated Retroreflective Taxiway Edge Markers<br>-- per each |

**END OF ITEM L-853**

# CONSTRUCTION SAFETY AND PHASING PLAN

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List of Exhibits (located at the end of the report)

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**Exhibit A** – Airport and Project Site Plan

**Exhibit B** – Construction Phasing Plan

## **1. COORDINATION**

### **A. General Project Information**

San Manuel Airport (Airport or E77) is situated on approximately 154 acres of land located in the southeastern corner of Pinal County, Arizona, approximately two miles west of the community of San Manuel, (see Exhibit A – Airport and Project Site Plan). The Airport's elevation is approximately 3,274 feet above Mean Sea Level (MSL). The Airport is owned by BHP Billiton, a mining company, and has been leased to, maintained, and operated by Pinal County for the past 38 years.

The Airport serves a number of aviation needs locally and regionally. It is used primarily by private general aviation traffic with occasional business aircraft traffic due to the proximity of the BHP mine to the Airport. It is also used during the summer months for firefighting operations in central and eastern Arizona. The 2011-2015 National Plan of Integrated Airport Systems (NPIAS) classifies E77 as a General Aviation Airport.

The airfield consists of one runway (11-29) approximately 4,214' long by 75' wide. The runway is served by one newly-constructed parallel taxiway (Taxiway A), and several connecting taxiways (Taxiways A1, A2, A3, A4, and A5). All facilities can be seen in Exhibit B – Draft Airport Layout Drawing (as submitted by Armstrong Consultants after the construction of Taxiway A in 2010). The current Airport Reference Code (ARC) for E77 is Approach Category/Design Group B-I, but a number of airfield facilities meet design standards for ARC B-II.

This project is located north of Runway '11-29' and parallel to Taxiway 'A', encompassing the entirety of the apron on both sides of connector Taxiway 'A4'. The existing asphalt concrete (AC) pavement at the apron is exhibiting signs of major distress as it has reached the end of its useful life and is in need of full reconstruction.

The goal of this project is to provide increased operational safety through a new aircraft parking layout and a new structural pavement section within the parking apron appropriate for the aircraft that frequent the Airport, (i.e. based and transient), and in accordance with applicable FAA criteria and requirements. It is also the goal of this project to provide a new shade port structure for aircraft parking on the apron to be protected from the elements, (i.e. wind, dust storms, etc.), and provide for an opportunity of additional revenue potential for Pinal County.

The existing Pilot/Airport user demand to have a more appropriate/appealing airfield parking apron, including the ability to have covered aircraft parking to protect aircraft parked on the apron from the elements (i.e. wind, dust storms, etc.) is increasing. Additionally, the existing ramp does not have any current aircraft parking positions that have been targeted to accommodate the larger B-I or potential B-II transient or based aircraft. The project limits are identified on **Exhibit A**.

In addition to a new structural pavement section appropriate for the aircraft that frequent the Airport, the goal of this project is to also provide a new apron design to maximize aircraft parking positions, accommodating the occasional or transient larger B-I/B-II aircraft, and the addition of a new shade port structure that will provide 8 covered aircraft parking positions.

This Construction Safety and Phasing Plan provides specific information to the Contractor and/or Subcontractors selected to carry out the construction contract for the Apron Reconstruction and Shade Ports project. This plan includes the requirements and procedures for accident prevention, safety requirements, and security considerations at the Airport. The Airport's safety objective is to achieve accident-free construction projects. Furthermore, the Contractor must be in full compliance with FAA Advisory Circular (AC) 150/5370-2F, *Operational Safety on Airports during Construction*. This will be discussed at the Pre-Bid and Pre-Construction Conferences.

The Contractor or Subcontractor shall conduct their operations in a manner that will provide safe working conditions for all employees, the protection of the public and all others who may be affected by construction activities. Nothing contained in this plan is intended to relieve the Contractor, subcontractor or supplier of the obligations assumed by the Contractor under contract with the Airport or as required by law.

Safety must be an integral part of the job. Full participation, cooperation, and support are necessary to ensure the safety and health of all persons and property involved in the project. The purpose of phasing, marking, barricading, and lighting of airside construction areas is to delineate hazardous areas and prevent unauthorized incursions into the areas by personnel, vehicles, equipment, and aircraft during construction; and to positively separate construction activity from aircraft operations.

A Pre-Construction Conference will be scheduled prior to the issuance of the Notice to Proceed. Invitees and attendees will include the Airport Design, Construction, and Operations personnel, the Engineer, the Contractor's Project Superintendent, and representatives from ADOT (in person or by phone). Relevant safety-related issues will be discussed in detail at this meeting.

Topics of discussion will include the FAA Advisory Circular (AC) 150/5370-2F, *Operational Safety on Airports during Construction*, project scope, the Resident Engineer's responsibility and authority, identifying the Contractor's Superintendent, NOTAM responsibility, phasing and scheduling of work, Notice to Proceed date, safety during construction, security, badging and escorting requirements, quality control and testing, test reports, maintenance of record drawings, and other federal requirements.

The Pre-Construction Meeting has not yet been scheduled.

**B. Contractor Progress Meetings**

Weekly construction progress meetings will be held where the invitees and attendees will include at minimum the Airport personnel, the Resident Engineer, the Contractor's Project Superintendent, and the lead personnel of each Subcontractor. In addition to the discussions on the progress of the project, operational safety procedures identified within this Safety Plan will be reviewed and discussed.

**C. Scope or Schedule Changes**

The Contractor will be required to immediately notify the Airport and Engineer of any anticipated changes to the original project scope or schedule. The Airport will coordinate (as needed) any changes with the impacted stakeholders, (i.e. ATCT, tenants, FAA, etc.). Pending the appropriate

funding agencies, approval from the Airport, ADOT, and FAA may be required in advance of the work being performed by the Contractor.

**D. FAA ATO coordination**

The Airport staff will be responsible for continually coordinating as required with the FAA/ATO during construction.

**2. PHASING**

The Apron Reconstruction and Shade Ports project is anticipated to be constructed in multiple construction phases. The construction phasing was developed based on a number of factors including: minimizing impact to aircraft traffic, airport operations, and hangar access.

Requirements and procedures in this phasing and safety plan and accompanying exhibits may be altered, on a case-by-case basis, if determined by the Airport, so that safety is not compromised and the proposed alternative improves operational or project conditions. Any such alterations or deviations shall be at the sole discretion of the Airport.

**A. Phase Elements**

The phase schedule and timeline below have been provided to assist the Contractor. Ultimately the Contractor will be responsible to submit his own construction safety and phasing compliance document at the Pre-Construction Conference for review and approval by the Engineer and Airport. The Contractor will have a total of 70 calendar days to reach substantial completion for all construction phases.

A detailed phasing and barricade plan has been developed to minimize impact to airport operations, accommodate existing tenants, and minimize constructability conflicts and construction costs. The construction has been broken into four separate phases to allow for temporary relocation of based and transient aircraft, (reference **Exhibit B**).

Phase A will include the area adjacent to the existing fuel tank. Phase A also includes the construction of a new taxilane at the southeast corner of the apron allowing a secondary access to the fuel farm from Taxiway 'A' during subsequent phases that prohibit aircraft access through the existing ramp. Phase A will have a construction duration of 14 calendar days. It will most likely be necessary to close a portion of Taxiway 'A' if construction equipment impacts the OFA during this phase.

Phase B will consist of the remaining apron east of Taxiway 'A4'. Phase C, adjacent to and west of the Taxiway/Taxilane 'A4', will consist of the northwest portion of the apron, while Phase D contains the remaining apron to the southwest. A portion of work in Phases C and D is dependent on the awarding of Additive Alternate No. 1. If Additive Alternate No. 1 is not awarded the proposed area of pavement reconstruction will be reduced to the limits identified as Base Bid. Phase B has a construction duration of 21 calendar days; Phase C has a construction duration of 21

calendar days; Phase D has a construction duration of 14 calendar days. It will most likely be necessary to close a portion of Taxiway 'A' if construction equipment impacts the OFA during this phase.

Taxiway 'A', east of Taxiway 'A4' will be required to be closed when construction operations along the southern portion of the apron impact the Taxiway Object Free Area (TOFA). This boundary is identified on **Exhibit B** and on the plans for reference. The contractor will be required to coordinate with the airport prior to any closure.

#### **B. Construction Safety Drawings**

The overall construction phasing, shown in **Exhibits B**, provides a summary of the required construction phases and inter-relationship between the construction phases.

### **3. AREAS AND OPERATIONS AFFECTED BY THE CONSTRUCTION ACTIVITY**

#### **A. Affected Areas on the Airfield**

This project consists of reconstructing existing AC pavement along the existing Apron. There will be three construction phases that will each impact Taxiways 'A' and 'A4' differently. The limits of apron pavement reconstruction and impacts to these taxiways are shown in **Exhibit B**.

##### *1) Closed or Partially Closed Facilities*

Depending on the particular construction phase, a portion of Taxiways 'A' and all of Taxiway 'A4' will be closed. Reference Section 2.

##### *2) ARFF Access Routes*

This project will have no impacts to ARFF Access Routes.

##### *3) Airport and Airline Support Vehicle Access Routes*

Airport support vehicle access routes will be maintained throughout the project.

##### *4) Utilities for Firefighting*

No underground utilities used for firefighting (including water) within the AOA are anticipated to be impacted by the construction of this project.

##### *5) Affected Approach and Departure Surfaces*

The Contractor's operations are not anticipated to impact any Approach/Departure Surfaces.

Construction activity shall be prohibited when equipment penetrates the imaginary surface described in Title 14 CFR Part 77 and any restricted area as defined in the current edition of FAA AC 150/5300-13, Airport Design, unless a favorable airspace finding has been made by the FAA and the Airport, and approved by the Operations Specialist on Duty. Equipment that penetrates the Part 77 imaginary surface must display a red obstruction light during nighttime use and an orange and white checkered flag during the day.

## 6) *Affected Instrument Approach Procedures and NAVAID Critical Areas*

It is not anticipated that any Instrument Approach Procedure or NAVAID Critical Area will be impacted by this project.

### **B. *Mitigation of Effects***

#### 1) *Construction Staging Area and Haul Routes*

The Contractor's Staging and Storage Area haul routes, and construction access areas are shown in **Exhibits A and B**. The Contractor's Staging Area and Stockpile Area are located outside of all Object Free Areas. Construction access areas and haul routes have been established to minimize impact to airfield operations.

The Contractor will be required to supply gate guards at all construction entrances to the airfield when in use. Gate guards will not be required as long as the gates are closed and locked. Gate Guards must be badged by the Airport. Additionally, crossing guards will be required at either side of an active taxiway/taxilane when impacted by the Contractor's haul route.

Transient haul truck drivers are not required to obtain an Airport ID badge but are required to check in with the contractor security guard. The driver shall be issued an orange/white checkered flag to be mounted on the highest point of the truck; and shall be returned to the security guard upon check out. The driver shall be advised to remain on the marked haul route and follow the appropriate signs to the intended work area. At no time shall a driver unfamiliar with the worksite be allowed to deviate from the marked haul route. Additionally, during times of low visibility or darkness, the drivers shall be required to use an amber beacon.

#### 2) *Temporary Taxi Operations*

When Contractor's operations impact any Taxiway Object Free Area (OFA), the respective taxiway will be closed as required in FAA AC 150/5370-2F, *Operational Safety on Airports During Construction*. Reference Section 2, *Phasing*, for further information on the required, temporary taxiway closures for each construction phase.

#### 3) *Detours for ARFF and Other Airport Vehicles*

All determined airport support vehicle access routes or alternate routes, including established AFFF routes, will be coordinated and maintained throughout the project by the Contractor and Airport personnel. However, because each construction situation is different, the Contractor must coordinate construction vehicle traffic with the Airport Operations for each phase of construction. Contractor vehicle movements to and from the site must conform to approved Access and Haul Roads or as directed by the Airport at the weekly construction meetings. The Airport will coordinate with all stake holders any detours from existing Airfield Service Roads as needed, throughout the duration of the project.

#### 4) *Maintenance of Essential Utilities*

Essential utilities for structures/buildings may be impacted during construction. The Contractor will be required to provide temporary means to any impacted utilities until the impacted utilities are restored.

#### 5) *Temporary ATC Procedures*

San Manuel Airport is not equipped with an Air Traffic Control Tower (ATCT). However, all construction activities and runway/taxiway closures will be detailed in weekly Notices to Airmen (NOTAM's), which will be completed by Pinal County staff. All NOTAM's for construction activities will be posted approximately one week in advance of the commencement of said activities.

### **4. PROTECTION OF NAVIGATIONAL AIDS (NAVAIDS)**

#### **A. NAVAID Critical Areas**

There are no existing NAVAID's at San Manuel Airport.

#### **B. Effects of Construction on NAVAID Performance**

There are no existing NAVAID's at San Manuel Airport.

#### **C. Protections of NAVAID Facilities**

There are no existing NAVAID's at San Manuel Airport.

#### **D. Required Distance from NAVAIDs to Construction Areas**

There are no existing NAVAID's at San Manuel Airport.

#### **E. Coordination Procedures with FAA/ATO**

There are no existing NAVAID's at San Manuel Airport.

### **5. CONTRACTOR ACCESS**

#### **A. General Items**

##### 1) *Contractor Access Areas*

Any time access is required within the Restricted Areas the Contractor shall be responsible for assuring that no breaches of airport security occur. Restricted areas are fenced and must remain fenced at all times. The gates will remain closed and locked or a guard will be provided at the Contractor's expense. The Contractor will furnish the guard with a roster of his personnel and ensure that each individual has adequate identification. The duplicate keys for each lock will be turned over to Airport authorities. The following additional measures must also be taken:

- No person shall enter the contractor worksite without authorization. Any person found within the worksite without proper identification as described herein shall be considered unauthorized and shall be removed from the worksite.
- All persons authorized access to the worksite shall display a valid Airport ID badge issued by the Airport or be under authorized escort.
- Persons authorized to provide escorts include Airport staff and designated contractor supervisors. The number of personnel being escorted shall not exceed ten (10) non-badged personnel; this includes vendors, subcontractors, visitors and part-time workers. Failure to provide an escort can result in loss of escort privileges, fines, revocation of the security badge, or all three.

## 2) 49 CFR Part 1542 Airport Security

This project will require that the Contractor and any employees, Subcontractors, and delivery staff working on the airfield to be vigilant in helping maintain security of the airfield. The Contractor will be responsible for posting employees/gate guards at Contractor access points into the secured area of the airfield, and locking each access gate when leaving the project each day.

The Contractor shall be responsible for the protection of the construction site, and all work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons. Security measures shall include items such as additional security fencing, barricades, lighting, and other measures as the Contractor may deem necessary to protect the site.

The Contractor's responsibilities for work areas are as follows:

- The Contractor shall be held responsible for controlling his employees, subcontractors, and their employees with regard to traffic movement.
- 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.
- 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, reconstruction of the existing pavement per the typical sections provided in the plans. 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.
- The Contractor shall submit to the Engineer in writing a plan, by construction phase, for controlling construction equipment and vehicular movements in the Air Operations Area (AOA). This plan shall be submitted at the Pre-Construction Meeting. No work may commence until this plan is approved. The Plan must include material haul roads.

## **B. Location of stockpiled construction materials**

All contractor materials, equipment and supplies shall be within the Contractor's designated staging and storage area. All storage areas shall be marked; debris boxes covered and area kept neat and clean of debris.

The Contractor's staging and storage area is located to the west of the existing T-Hangar facilities. It is located well beyond any Object Free Areas. The Contractor will be required to install temporary fence around the Staging and Storage Area given its vicinity to the T-Hangars and Taxiway A to help identify the area to Airport users. This will help protect the users from wandering into the Contractor's work area, and help protect the Contractor's equipment and construction materials.

For equipment that must remain in the work area, the following conditions must be met:

- Be located outside of the runway/taxiway safety and object free areas.
- Be marked with lighted barricades around the equipment perimeter with a spacing of no more than 10 feet.
- Be coordinated at least 48 hours in advance with the Engineer.
- The highest point of the equipment marked and lit with a red flashing/steady burning omnidirectional obstruction light.

Stockpiled materials are allowed only within the Contractor's designated staging and storage area:

- Remove daily all stockpiled material from within aircraft movement areas, unless otherwise directed by the Engineer.
- No excavated or stored materials may remain within active runway or taxiway safety areas and object free zones.
- Stockpiled material may be located within the Air Operations Area only upon prior coordination and approval of the Engineer.

Furthermore, Construction activity shall be prohibited when equipment penetrates the imaginary surface described in Title 14 CFR Part 77 and any restricted area as defined in the most current edition of FAA AC 150/5300-13, *Airport Design*, unless a favorable airspace finding has been made by the FAA and the Airport. Equipment that penetrates the Part 77 imaginary surface must display an orange and white checkered flag during daytime operations and a red obstruction light during nighttime use.

### **1) Stockpiles Within Runway Object Free Areas (ROFAs)**

No large stockpiles within the Runway Object Free Area are anticipated for this project.

### **2) Proper Stockpiling of Materials**

Stockpiled materials must be stabilized with water in order to avoid dust during windy conditions. Daily inspections by the Contractor will be required of the stockpiles and other areas within the

construction limits that may be affected by windy conditions. Construction Administration personnel will also be performing daily inspections on these areas to insure compliance with this aspect.

### 3) *Construction Site Parking*

Construction parking will be allowed in the Contractor's Staging and Storage Area, which is outside of any Object Free Areas. No personal vehicles will be allowed onto the airfield with the exception of inside the Contractor's staging and storage area. See Section 5.A.1, *Contractor Access Areas* for further information.

### 4) *Construction Equipment Parking*

Construction equipment parking will be in the Contractor's Staging and Storage Area for any equipment that is not in use.

## **C. *Vehicle & Pedestrian Operations***

### 1) *Access and Haul Roads*

Contractor access and haul roads can be seen on **Exhibits A and B**. See Section 5.A.1, *Contractor Access Areas* for further information.

### 2) *Marking and Lighting of Construction Vehicles*

All Contractor and Subcontractor vehicles must be properly marked with the company name at least four (4) inches in height on both sides of the vehicle. All vehicles must have a 3' x 3' orange and white checkered flag at the tallest point on the vehicle for daytime construction activities, and a flashing amber or yellow beacon, mounted at the highest point, for nighttime construction activities, and a flashing amber beacon during the nighttime operations.

All vehicle marking and lighting must comply with the most recent version of Advisory Circular 150/5210-5D, *Painting, Marking and Lighting of Vehicles Used on an Airport*.

### 3) *Construction Vehicle Operations Within AOA*

For the purposes of this project, the AOA is defined as any area within the secured (fenced) area of the Airport except the Contractor's Staging and Storage Area, see **Exhibits A and B**. No vehicle shall operate within the Air Operations Area (AOA):

- In a careless or negligent manner.
- With disregard of the rights and safety of others.
- At a speed or in a way which endangers persons or property.
- While the driver is under the influence of drugs or alcohol.
- If such vehicle is loaded or maintained as to endanger persons or property.

#### 4) *Vehicle Driver Training Requirements*

All construction personnel that will be driving a vehicle on Airport property will be required to adhere to the requirements as noted above. The driver training requirements, along with the identification of the RSA, OFZ and TSA's will be discussed at length during the Pre-Construction Conference.

#### 5) *Two-Way Radio Communications Procedures*

Two-way radios will not be required for this project as there is no ATCT at San Manuel Airport.

#### 6) *Maintenance of Airport Secured Area*

The Contractor will be required to maintain the Airport fence gates used by the Contractor during the duration of the project. This will include securing and locking the applicable gate(s) after each use and/or posting a gate guard at the applicable gates to insure security of the airfield. The Contractor will also be required to report suspicious situations, persons, and/or materials to the Pinal County Airport Economic Development Director (Airport Manager) Jim Petty

### **6. WILDLIFE MANAGEMENT**

#### **A. *Trash***

The contractor shall perform daily inspections of the work areas (including the Contractor's Staging Area) to remove any trash, debris and food scraps and place these items in an appropriate trash receptacle.

#### **B. *Standing Water***

The contractor shall approach his\her operations to minimize the potential for standing water. When water begins to stand on site, the contractor shall begin pumping water to drain the area within 24 hours to prevent the attraction of wildlife.

#### **C. *Tall Grass & Weeds***

The contractor shall mow areas under his\her responsibility including, but not limited to, project site staging and storage areas and exclusive use haul roads to prevent the growth of vegetation over 6-inches.

#### **D. *Poorly maintained Fencing and Gates***

The contractor shall close and lock any airfield access gates that are not in use. Any fencing installed by the contractor shall be maintained to prevent the intrusion of wildlife.

#### **E. *Disruption of existing Wildlife Habitat***

The contractor shall report any significant wildlife sightings within the AOA to the nearest Airport employee.

## **F. Airport Wildlife Management Procedures**

The Contractor will be required to follow any Airport Wildlife Management Procedures that are in place at the Airport; however, at a minimum the Contractor will be required to perform the following:

- Close and lock any airfield access gates that are not in use.
- Report any significant wildlife sightings within the AOA to the nearest Airport employee.

## **7. FOREIGN OBJECT DEBRIS MANAGEMENT**

This project will include the movement of construction vehicles adjacent to active airfield pavements, therefore the Contractor will be required to maintain a fully-operational sweeper vehicle on-site during the project. For phases of the project requiring the daily/nightly re-opening of aircraft pavements, the pavements shall be swept clean of FOD. Following the sweeping activities, the Contractor will be required to conduct a FOD check prior to the re-opening of that facility at the scheduled time.

The Contractor will be required to keep water on construction areas to minimize the possibility of FOD generated by wind. The Contractor will be required to conduct FOD checks at the end of each working shift/day to remove any FOD that has made its way onto the airfield pavements from the Contractor's construction activities. Airport Operations and Construction Administration personnel will be present for these FOD checks to insure compliance.

## **8. HAZARDOUS MATERIALS MANAGEMENT**

Any hazardous or regulated waste material produced by the Contractor's operations shall be properly disposed of at the Contractor's expense pursuant to all local, state and federal regulations. The Contractor may be required to provide test results to confirm that a contaminated area has been properly remediated.

Any hazardous materials situation that poses a threat to safety or property shall be immediately reported to emergency personnel by dialing '911' and to the nearest Airport employee.

## **9. NOTIFICATIONS OF CONSTRUCTION ACTIVITIES**

### **A. Maintenance of a List of Responsible Representative/Points of Contact**

A full list of Points of Contact and Contact Procedures will be developed prior to the Pre-Construction Meeting for this project. The Resident Engineer will generally be the central point of contact with all communications relating to construction being filtered through him. Matters relating to Airport Operations and Airport Traffic Control will be handled through the Airport and the ATCT, with assistance from the Resident Engineer and/or Contractor as needed.

The following is a list of key personnel that will be involved in this project:

San Manuel Airport Manager	Jim Petty	(520) 866-6545
Engineers	Ryan Toner/Jared Bass	(602) 957-1155
Emergencies		911

**B. Notice to Airmen (NOTAM)**

Construction NOTAM's will be filed by the Airport staff approximately three (3) days prior to construction beginning in the area which the NOTAM references, or prior to any change in airfield conditions which may affect operations or safety. The Contractor will be required to submit pertinent information to the Airport for any construction items that would require the issuance of a NOTAM a minimum of 2-weeks prior to the work being performed.

**C. Emergency Notification Procedures**

Emergencies shall be immediately reported to '911', and then to the San Manuel Airport Manager at (520) 866-6545.

**D. Notification to the FAA and Airport Users**

All proposed construction activities that affect operations at the Airport will be immediately relayed to all Airport Users and the FAA by way of meetings, advisories, NOTAM's and the filing of Form 7460 as appropriate (minimum of 60 days prior to the proposed construction) all issued by one of the Airport's designated staff or Engineer.

This project is phased in order to maintain a fully operating airfield; therefore each phase will likely require additional information to be passed on to the Airport Users as the project progresses. NOTAM's and project advisories will be distributed approximately three (3) days prior to a new construction phase which may include effects to NAVAIDs, temporarily relocated thresholds, approach conditions, lighting, runway and taxiway closures, and other items that may affect normal operating conditions at the Airport. Anticipated night work by the Contractor will need the Airport approval prior to proceeding with the night work.

**E. Coordination with ARFF for Non-Emergency Issues**

This section is not applicable to this project or the San Manuel Airport.

**F. Local ATO/Technical Operations Personnel**

This section is not applicable to this project or the San Manuel Airport.

**G. ATCT Managers on Duty**

This section is not applicable to this project or the San Manuel Airport.

**H. Authorized Representatives to the FAA's Operational Control Center (OCC)**

This section is not applicable to this project or the San Manuel Airport.

**I. OCC Notification About Closed and/or Hazardous Conditions on the Airfield**

This section is not applicable to this project or the San Manuel Airport.

**J. FAA Notification Under CFR Parts 77 and 157**

This section is not applicable to this project or the San Manuel Airport.

**K. FAA Reimbursable Agreements**

A FAA Reimbursable Agreement is not a method of funding for this project.

**L. Affected Instrument Approach Procedures**

This section is not applicable to this project or the San Manuel Airport.

**10. INSPECTION REQUIREMENTS**

**A. Daily (or more frequent) Inspections**

Daily inspections will be required for areas requiring haul routes over active airfield pavements to insure that FOD is minimized. In addition, daily inspections of Contractor access areas will be performed to help insure safety onto the airfield. Daily inspections will be conducted by an Airport Operations employee, a Contractor representative, and a Construction Administration field representative.

Special inspections will be required for airfield pavements that are ready to be re-opened to aircraft traffic after certain phases of the project. Special inspections will also be attended by an Airport Operations employee, a Contractor representative, and a Construction Administration field representative.

All discrepancies noted in the inspection must be corrected to the satisfaction of the Engineer prior to the Contractor leaving the worksite.

Should any inspection reveal any FOD concerns, the Contractor shall have a crew ready to remove any FOD prior to reopening the pavements. Should any inspection reveal work that does not meet Contract requirements or that is deficient in any way, the Contractor shall mobilize a crew as soon as possible to remedy the deficient areas so as to avoid prolonging the continued closure of the areas.

**B. Final Inspections**

Inspections will be required at the Substantial Completion and Final Completion phases of the project. These inspections will be attended by the Contractor, Airport Manager, the FAA, an ADOT Grant Manager, the Engineer, and Construction Administration representatives (whichever applies). A punch list will be developed at the Substantial Completion inspection, and any items placed on the punch list will be required to be completed within 30 days, in time for the Final Inspection.

## **11. UNDERGROUND UTILITIES**

Prior to beginning construction on the airfield, the Contractor will be required to Blue Stake and pothole (if necessary) existing utilities in the project areas. Protection of utilities may include, but is not limited to, flagging utilities, marking lines on pavement, placement of barricades along utility lines and at manholes. A detailed Technical Specification and Special Provision have been provided to the Contractor for additional requirements.

## **12. PENALTIES**

The Contractor will be required to enforce his company's safety policies with the employees working on this project. In addition, the Airport may enforce policies that are in place to protect the safety of the Airport property, its users, and the local Airspace. These policies include, but are not limited to, the following:

- Informal conversations with the subject person or party
- Formal meetings/conversations with the subject person or party and their supervisors/managers
- Formal written notices of non-compliance from the Airport
- Immediate removal from Airport property
- Notification of law enforcement personnel for persons that cause situations posing dangerous threats to property or personal safety

## **13. SPECIAL CONDITIONS**

Special unforeseen conditions or circumstances may require the activation of special procedures by the Airport. In cases involving aircraft emergencies or distressed aircraft the Contractor may be required to temporarily halt construction activities and immediately vacate the area in which he is working. The nearest Airport Operations employee will be expected to notify all Contractor personnel in the vicinity, and promote safe and orderly removal of all Contractor personnel and equipment to an area that is no longer in conflict with the emergency at hand. The Contractor will be expected to immediately comply with all Airport personnel directions, and may not return to the subject work area until given the all clear to do so.

In the event of low-visibility conditions, or other conditions which may signal the need for additional unimpeded space next to runways or taxiways, the Contractor may be required to move to another work area of the project or temporarily stop work. The Contractor will be made aware of the possibility of these situations during the Pre-Construction Conference.

## **14. RUNWAY AND TAXIWAY VISUAL AIDS**

### **A. General**

#### **1) Airport User and FAA Notification Procedures**

Temporary visual aids may be used from time to time as the project progresses to increase safety. Any temporary visual aid, including temporary edge lights or threshold lights for relocated thresholds, will be secured either in-pavement or with heavy items preventing blow-away, while at the same time not obscuring the objects themselves.

#### **2) Frangibility Requirements**

All temporary visual aids must have frangible connections.

### **B. Markings**

Any temporary markings that may be required for this project will meet the requirements of FAA Advisory Circular 150/5340-1L, *Standards for Airport Markings*.

If any existing markings need to be obliterated in this project, obliteration of existing markings will be in accordance with a method approved by the Airport or as directed in the project Technical Specifications.

### **C. Lighting and Visual Aids**

Lighting for all barricades used within the AOA shall be red and shall be a steady-burn or blinking light. All barricading and lighting shall conform to the details in the plans and specifications. Low-profile barricades shall be spaced not more than four feet apart, and shall be placed to prevent ground vehicle traffic from moving onto active airfield pavements (barring a deliberate act), and alert aircraft traffic of closed facilities.

Lighting for any closed facilities will be disconnected or covered and secured with a material that prevents light leakage. Disconnected lighting shall be completed so as to not affect the remaining portion of facilities that may be open to aircraft traffic.

Lighting shall 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*; AC 150/5345-53 *Airport Lighting Certification Program*; AC 150/5345-44, *Specification for Runway and Taxiway Signs*; AC 150/5340-18, *Standards for Airport Sign Systems*; and AC 150/5345-53, *Airport Lighting Certification Program*, as required.

### **D. Signs**

Temporary airfield signing is not anticipated for this project.

## **15. MARKING AND SIGNS FOR ACCESS ROUTES**

Temporary signing used for Contractor access/haul routes, open trenching or other hazards shall be clear, concise, reflective, and large enough so as to minimize safety-related issues. All temporary

signing shall meet the requirements of the most current version of AC 150/5340-18 and, to the extent practicable, with the MUTCD and/or State highway specifications. All temporary signs shall also be properly secured to withstand the site and elemental conditions.

## **16. HAZARD MARKING AND LIGHTING**

### **A. General**

#### **1) Hazard Marking and Lighting**

Hazards, such as open trenches, manholes, and steep embankments shall be barricaded and lighted with Caution Tape or orange fabric construction fencing to prohibit accidental falls. The Contractor's site-specific and company safety plan/guidelines shall address the protection of these areas and the protection of the employees against these hazards. The Contractor shall also assign a Project Safety Officer for the project to monitor and enforce the Contractor's safety guidelines and the provisions of this Construction Safety Plan.

When areas on the Airport are closed or present hazards due to construction activities, they should be marked and lighted according to AC 150/5340-1L, *Standards for Airport Markings*. Marking and lighting must be approved by the Airport.

When construction involves an extended closure of a runway, an illuminated cross ("X") shall be required at each end and shall be serviced and maintained by the Contractor. See Section 14.C for more information.

#### **2) Less Obvious Construction Related Hazards**

Some less obvious construction related hazards include, but are not limited to, the following:

- Loose debris, trash, etc. in the work areas
- Loose debris, trash, etc. on or in the bed of vehicles
- Jet blast
- Jet engine run-up noise

The Contractor shall be vigilant in keeping the work areas in a safe and trash-free condition as much as possible so as to prevent debris from making its way onto active airfield pavements. The Contractor shall also exercise due care when working the vicinity of active aircraft. This can include the use of hearing protection and the securing of clothing and hardhats while working.

### **B. Equipment**

#### **1) Use of Warning Indicators for Construction Areas**

Construction areas will be barricaded with either vertical panel or low-profile barricades on aircraft movement areas. For construction areas that do not include aircraft operating areas, Vertical Panel barricades may be used to prohibit vehicle and pedestrian traffic. All barricades must have flashing red or steady burn lights.

Barricades, temporary markers approved by the Airport, and any other warning equipment placed or left in areas adjacent to any open aircraft movement area, (i.e. runway, taxiway, taxilane, etc.), shall be as low to the ground as possible, and not more than 18-inches in height, (unless otherwise noted on the phasing plans). All barricades and temporary markers shall also be properly secured to withstand the site and elemental conditions.

#### 2) *Hazard Marking and Lighting*

Hazards, such as open trenches, manholes, and steep embankments shall be barricaded and lighted with Caution Tape or orange fabric construction fencing to prohibit accidental falls. The Contractor's site-specific and company safety plan/guidelines shall address the protection of these areas and the protection of the employees against these hazards. The Contractor shall also assign a Project Safety Officer for the project to monitor and enforce the Contractor's safety guidelines and the provisions of this Construction Safety Plan.

When areas on the Airport are closed or present hazards due to construction activities, they should be marked and lighted according to AC 150/5340-1L, *Standards for Airport Markings*. Marking and lighting must be approved by the Airport.

#### 3) *Security Equipment to Prevent Blow-Down*

Barricading and lighting equipment shall be secured to prevent blow-down. This may include the use of water-filled items, the use of sandbags, and/or flat heavy footings. Temporary lighting may be secured to the pavement with nails or screws.

#### 4) *Spacing Barricades*

See barricade detail in **Exhibit B** for barricading requirements.

#### 5) *Requirements of Red Lights*

Red LED lights on low-profile barricades shall be of the omni-directional, flashing or steady-burn type. The rate of flash and illumination, as well as barricade reflectivity, shall meet the requirements of the latest edition of the Manual of Uniform Traffic Control Devices (MUTCD).

#### 6) *Low-Profile Barricades and Markers*

Low-profile barricades shall be used and shall be reflective, have an omni-directional steady-burning or flashing red LED light, and shall be properly secured (screwed-in).

#### 7) *Proper Marking of Barricades*

Barricades shall be properly colored and marked with reflective material according to the plan details for this project and the latest edition of the MUTCD.

#### 8) *Proper Reflectivity and Lighting of Barricades*

Barricades shall be properly colored and marked with reflective material according to the plan details for this project and the latest edition of the MUTCD.

#### 9) *Marking for Temporary Closures*

Temporarily closed taxiways will be outlined with barricades as outlined in this report and identified on the project plans. If determined necessary by the Airport, partially closed taxiways shall have the appropriate markings obliterated (with either sand-blasting or water-blasting) that would indicate a fully-operational facility.

#### 10) *Emergency Maintenance of Airport Hazard Lighting and Barricades*

The Contractor shall designate an employee (or Subcontractor) to be responsible for the regular maintenance of barricades and lighting. In addition, the Contractor shall provide an emergency contact number for the responsible individual to perform any emergency maintenance on any barricades or lighting, and insure functional operation of all hazard lighting and barricades 24 hours per day, 7 days per week. The designated person or sub-contractor shall be able to respond to the Airport within one (1) hour of notification of a non-functioning barricade.

### **17. PROTECTION OF RUNWAY AND TAXIWAY SAFETY AREAS, OFA'S, OFZ'S, AND APPROACH/DEPARTURE SURFACES**

#### **A. *Runway Safety Area (RSA)***

##### 1) *Construction Within Runway Safety Areas*

No construction activities will occur within any Runway Safety Areas.

##### 2) *Adjustment of Runway Safety Areas*

No impact or adjustment to any RSA is anticipated for this project for an active runway.

##### 3) *Requirements for Open Procedures*

No work will be performed within any RSA, therefore, no trenches shall be left open within any RSA.

##### 4) *Appropriate Covering of Excavations Within RSA's*

No major excavations within active RSA's are anticipated on this project.

##### 5) *Marking of Excavations and Open Trenches*

Hazards, such as open trenches, major excavations, manholes, and steep embankments shall be barricaded, lighted, and outlined with appropriate caution tape or orange fabric construction fencing to prohibit accidental falls. The Contractor's site-specific and company safety plan/guidelines shall address the protection of these areas and the protection of the employees against these hazards. See Section 16 *HAZARD MARKING AND LIGHTING* for further information.

##### 6) *Maintenance of RSA's*

No impact or adjustment to any RSA is anticipated for this project for an active runway.

##### 7) *Blast Protection Procedures*

The Contractor's company safety plan/guidelines shall include a provision for jet blast protection. At a minimum, it should address requirements for the securing of clothing and hardhats, as well as any requirements for hearing protection.

**B. Runway Object Free Area (ROFA)**

No construction activities will occur within any Runway Object Free Areas.

Construction equipment not in use shall be returned to the Contractor's Staging Area by the Contractor, where practicable. In no case shall construction equipment be left within any Object Free Areas.

**C. Taxiway Safety Area (TSA)**

1) *Construction Within Taxiway Safety Areas*

No construction activities may occur within the Taxiway Safety Areas without taking the appropriate measures to close or partially close the affected Taxiway. These measures include strict coordination with the Airport and the Engineer.

No trenches shall be left open within the TSA if the taxiway will be re-opened for use. Any trenching within a TSA needing to be left open after the Contractor leaves the work site for the day shall be properly plated and capable of safely supporting aircraft traffic, but it is the intent that this be a unique situation with very limited occurrences. Any requests of this type shall be submitted in writing to the Engineer at least 48 hours prior to the construction. The Engineer will confer with the Airport Manager and the FAA, and any decision related to the particular situation at hand shall be final.

No drops from pavement edges in excess of three (3) inches will be permitted within the Safety Area of an active taxiway. No significant depressions or humps in grades within the Safety Area of an active taxiway will be permitted. Prior to re-opening the taxiway, the Contractor will be responsible for grading to meet these requirements.

No adjustment to the TSA is anticipated with this project.

2) *Adjustment of Taxiway Safety Areas*

Reference section 17.C.1 (above).

3) *Requirements for Open Procedures*

Reference section 17.C.1 (above).

4) *Appropriate Covering of Excavations Within TSA's*

Reference section 17.C.1 (above).

5) *Marking of Excavations and Open Trenches*

Reference section 17.C.1 (above). Hazards, such as open trenches, major excavations, manholes, and steep embankments shall be barricaded, lighted, and outlined with appropriate caution tape or orange fabric construction fencing to prohibit accidental falls. The Contractor's site-specific and company safety plan/guidelines shall address the protection of these areas and the protection of the employees against these hazards. See Section 16 *HAZARD MARKING AND LIGHTING* for further information.

6) *Maintenance of TSA's*

Reference section 17.C.1 (above).

7) *Blast Protection Procedures*

The Contractor's company safety plan/guidelines shall include a provision for jet blast protection. At a minimum, it should address requirements for the securing of clothing and hardhats, as well as any requirements for hearing protection.

**D. *Taxiway Object Free Area (TOFA)***

When construction impacts any TOFA of an active taxiway, the respective taxiway will be closed. Reference Section 2, *PHASING*, for additional information regarding the construction phasing.

Construction equipment not in use shall be returned to the Contractor's Staging Area by the Contractor, where practicable. In no case shall construction equipment be left within any Object Free Areas.

**E. *Obstacle Free Zone (OFZ)***

It is not anticipated that any construction of this project will affect an OFZ.

**F. *Runway Approach & Departure Surfaces***

It is not anticipated that any construction of this project will impact a Runway Approach or Departure Surface or Clearway.

**18. OTHER LIMITATIONS ON CONSTRUCTION**

**A. *Prohibitions***

1) *Use of Flare Pots*

The use of flare pots is not permitted within the AOA at any time.

2) *Use of Electrical Blasting Caps*

The use of electrical blasting caps is not permitted within 1,000 feet of the Airport property.

**B. *Restrictions***

1) *Open Flame Welding and Torches*

Open flame welding and the use of torches shall be approved by the Airport prior to the project commencing. Open flame welding and the use of torches may require a "Hot-Work Permit" by a governing agency, (the City of Mesa), or the Airport's Aircraft Rescue and Fire Fighting (ARFF) department. If this type of work is required on this project, the Contractor shall notify the Airport.

2) *Airfield Lighting Vault Lock-Out/Tag-Out Policy*

The purpose of this procedure is to standardize the lock-out/tag-out procedures between Electrical Contractors, Airport Electricians, and Operations:

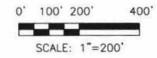
- The Airport electricians responding to a lock-out/tag-out request will coordinate with the Airport through Operations.
- After Operations notifies electricians of closures, the Airport electricians will turn off the closed runways/taxiways using the airfield computer system.
- The Contractor will supply 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 vault in a lock box provided by the Airport.
- The load break elbows and/or S-1 switches will be pulled, locked on the corresponding regulator by the Electrical Contractor, and the S-1 cabinet will be locked by the Contractor.
- The Electrical Contractor and the Airport electricians must fill out lock-out/tag-out forms before leaving the Vault.
- Upon completion of the lock-out, the Contractor will remove all locks and install the load breaks. All circuits must be verified operations in the manual mode on the regulator. Operations will perform a complete check of the lights in the field to verify actual operation.
- When that has been completed, the Airport electricians will notify the Airport Operations when lock-in is complete and regulators are in remove control; Operations will notify the ATCT that they have control of the airfield lighting.
- Complete lock-out/lock-in forms.

This procedural checklist must be followed to the letter.

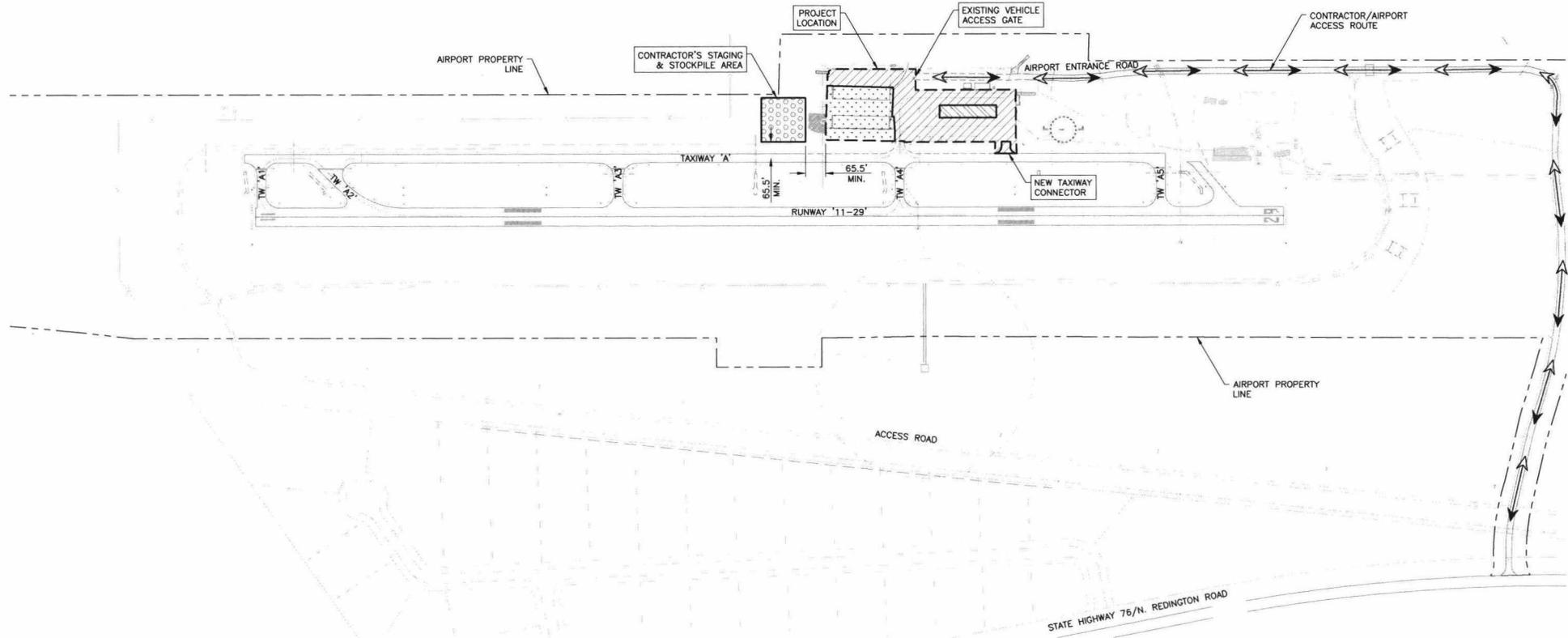
### 3) *Contractor Employee Safety*

The Contractor and its employees shall employ safe practices per the Contractor's safety procedures and industry safety standards. The Contractor's safety procedures will ultimately dictate the use of protective clothing and equipment for its employees, but at a minimum, the Contractor's employees must be equipped with a Type 2 safety vest, and every employee that enters the site must be wearing said vest. The vest must be worn the entire time that the employee is within the AOA.

The Contractor is required to prepare and submit a Construction Safety and Phasing Plan Compliance document for review and approval of the Airport.



AS BUILT DATE
<b>Dibble Engineering</b>
7500 N. Dreamy Draw Drive Suite 200 Phoenix, AZ 85020 P 602.957.1159



**NOTES:**

1. CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF HIS OWN EQUIPMENT. CONTRACTOR MAY INSTALL TEMPORARY FENCING AROUND THE CONTRACTOR'S STAGING AREA AT HIS OWN EXPENSE.
2. CONTRACTOR SHALL PROTECT ALL HAUL ROAD ACCESS POINTS TO THE AIRFIELD FROM UNAUTHORIZED ENTRY; CONTRACTOR IS REQUIRED TO POST GATE GUARD(S) AT AIRFIELD ENTRY GATES DURING CONTRACTOR'S WORKING HOURS (IF LEFT UNLOCKED).
3. CONTRACTOR IS RESPONSIBLE FOR THE REPAIR OF ANY HAUL ROADS USED AND ANY OTHER AREAS DISTURBED BY THE CONTRACTOR THAT ARE OUTSIDE THE PROJECT AREA LIMITS. REPAIRS SHALL BE MADE TO THE SATISFACTION OF THE OWNER/AIRPORT AND/OR ENGINEER, AND SHALL BE AT THE CONTRACTOR'S EXPENSE.
4. THE OWNER MAY, AT HIS DISCRETION, REQUEST THAT THE CONTRACTOR PROVIDE A CROSSING GUARD ON THE AIRFIELD AT ALL ACTIVE CROSSINGS OF TAXIWAYS AND APRONS.
5. THE HAUL ROAD WITHIN THE AIR OPERATIONS AREA (AOA) IS SUBJECT TO CHANGE, AT THE OWNER'S DISCRETION, TO ACCOMMODATE AIRCRAFT MOVEMENTS.

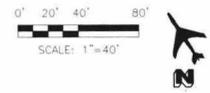
**LEGEND**

- BASE BID WORK/LIMITS
- ADD. ALT NO. 1 WORK/LIMITS
- ADD. ALT NO. 2 WORK/LIMITS
- CONTRACTOR'S STAGING & STORAGE AREA

REVISION	BY	DATE
<b>SAN MANUEL AIRPORT</b>		
DIBBLE PROJECT NO 101133.04		
AIRPORT APRON RECONSTRUCTION & SHADE PORTS		
AIRPORT & PROJECT SITE PLAN		
DRN: DSO	DES: MJB	CK: RWT
DATE: 05.22.14	DATE: 05.22.14	DATE: 05.22.14
SCALE: 1" = 200'		DRAWING
		EXHIBIT A



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AS BUILT DATE

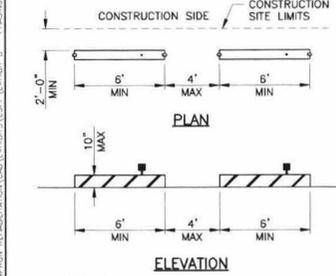
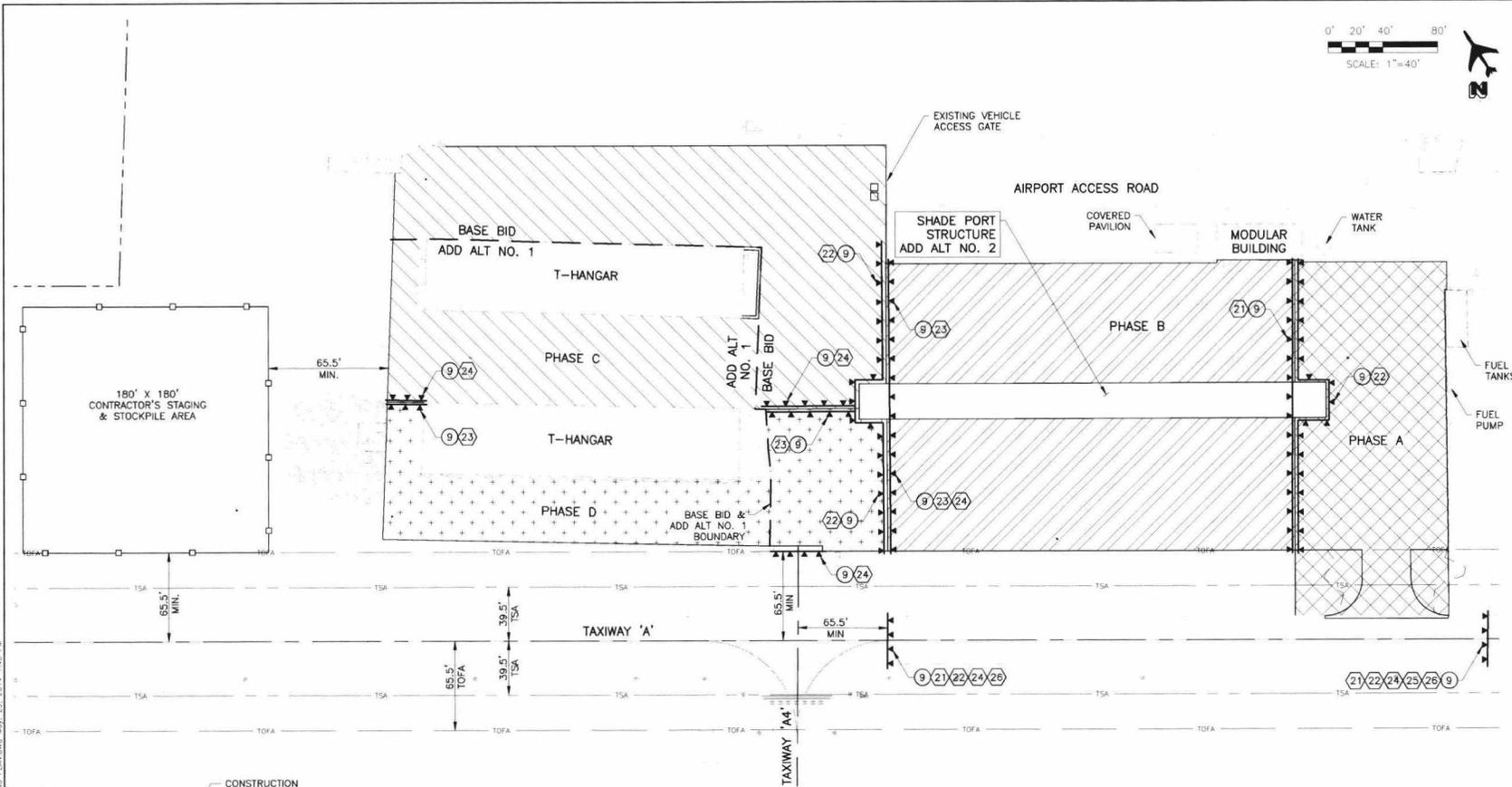
**Dibble Engineering**  
 7500 N. Dreamy Drive  
 Suite 200  
 Phoenix, AZ 85020  
 P 602.957.1155

CONSTRUCTION NOTES

9 LOW-PROFILE BARRICADES NPI

REFERENCE NOTES

- 21 PHASE A LOW-PROFILE BARRICADES
- 22 PHASE B LOW-PROFILE BARRICADES
- 23 PHASE C LOW-PROFILE BARRICADES
- 24 PHASE D LOW-PROFILE BARRICADES
- 25 LOW-PROFILE BARRICADES LOCATED WEST OF TAXIWAY 'A5' TOFA
- 26 TAXIWAY 'A' MUST BE CLOSED WHEN ANY CONSTRUCTION OR EQUIPMENT IMPACTS THE TOFA



**NOTES:**

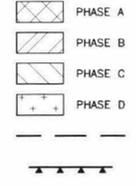
- LOW PROFILE BARRICADES AND LIGHTS SHALL BE PROVIDED AND MAINTAINED (DAY AND NIGHT) BY THE CONTRACTOR (NPI).
- THE OWNER MAY DIRECT THE CONTRACTOR TO RELOCATE ANY BARRICADES AT THEIR DISCRETION.

**LOW PROFILE BARRICADES**  
N.T.S.

**PHASING NOTES:**

- INSTALL 180'X180' TEMPORARY SECURITY FENCE FOR THE CONTRACTORS STAGING & STORAGE AREA; REMOVE UPON COMPLETION OF PROJECT (NPI).
- ALL PHASES MUST BE CONSTRUCTED SEQUENTIALLY.
- PHASE A CONSISTS OF PAVEMENT REMOVAL, TIE-DOWN REMOVAL, PAVEMENT RECONSTRUCTION INCLUDING GRADING & STRIPING.
- PHASE B CONSISTS OF TIE-DOWN REMOVAL, PAVEMENT REMOVAL, PAVEMENT RECONSTRUCTION INCLUDING GRADING, STRIPING & INSTALLATION OF SHADE PORTS, (IF ADDITIVE ALTERNATE NO. 2 IS AWARDED).
- PHASES C & D CONSIST OF PAVEMENT REMOVAL & PAVEMENT RECONSTRUCTION INCLUDING GRADING & STRIPING.
- ALL LOW PROFILE BARRICADES SHALL BE A MAXIMUM OF 4' OUTSIDE CONSTRUCTION LIMITS.
- ADDITIVE ALTERNATE NO. 1 INCLUDES ADDITIONAL PAVEMENT REMOVAL & RECONSTRUCTION WITHIN PHASES C & D. IF ADDITIVE ALTERNATE NO. 1 IS AWARDED, WORK MUST BE DONE CONCURRENTLY WITHIN THE APPROPRIATE PHASE.
- ADDITIVE ALTERNATE NO. 2 INCLUDES THE CONSTRUCTION OF A SHADE PORT STRUCTURE & LIGHTING. IF ALTERNATE NO. 2 IS AWARDED, THE WORK MUST BE DONE CONCURRENTLY WITH THE APPROPRIATE PHASES, INCLUDING UNDERGROUND ELECTRICAL & FOOTING FOUNDATIONS.

**LEGEND**



**CONSTRUCTION DURATION**

- 14 - CALENDAR DAYS
- 21 - CALENDAR DAYS
- 21 - CALENDAR DAYS
- 14 - CALENDAR DAYS
- BASE BID & ADD ALT NO. 1 BOUNDARY
- LOW-PROFILE BARRICADES



DRN: DSO DES: MJB CK: RWT  
 DATE: 05.22.14 DATE: 05.22.14 DATE: 05.22.14  
 SCALE: 1" = 40'

REVISION	BY	DATE

**SAN MANUEL AIRPORT**  
 DIBBLE PROJECT NO 101133.04  
 AIRPORT APRON RECONSTRUCTION & SHADE PORTS  
 CONSTRUCTION PHASING PLAN

DRAWING  
 EXHIBIT B

A:\2011\101133.04 - SAN MANUEL AIRPORT - RECONSTRUCTION\LOAD EXHIBITS\CONSTRUCTION PHASING PLAN.DWG May 23, 2014 1:40 PM