CITY OF HOUSTON

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July 30, 2025

SUBJECT: **Addendum No. 3**

REFERENCE: Invitation To Bid (ITB) for IAH Runway 9-27 Grind and Groove at George Bush Intercontinental Airport (IAH); Solicitation No. H06-IAHRWY-2025-009; Project No. 1073

To: All Prospective Bidders:

This Addendum is being issued for the following reason:

I. **Add** Project Manual Div02, Volume 3, Technical Specifications.

When issued, Addendum shall automatically become part of the solicitation documents and shall supersede any previous specification(s) and/or provision(s) in conflict with this Addendum. Addenda will be incorporated into the Contract as applicable. It is the responsibility of the bidder(s) to ensure that it has obtained all such Addenda. By submitting a bid on this project, bidder(s) shall be deemed to have received all Addenda.

If further clarification is needed regarding this solicitation, please contact David Martinez, Sr. Procurement Specialist, via email at david.martinez@houstontx.gov.

DS

DocuSigned by:
Cathy Vander Plaats
02232028DE99414...

Cathy Vander Plaats
Aviation Procurement Officer
Houston Airport System

cc: Andre Morrow
Solicitation file

Attachment – Project Manual Div02, Volume 3, Technical Specifications

City of Houston - Department of Aviation – Infrastructure Division

PROJECT MANUAL

IAH RUNWAY 9-27 GRIND AND GROOVE
GEORGE BUSH INTERCONTINENTAL AIRPORT (IAH)

HAS PROJECT No.: PN1073
HAS Contract No.: 715G-041
T.I.P No.: TIP-25-55-IAH
B.S.G. No.: BSG-2025-118

VOLUME NO. 3 OF 3 TOTAL VOLUMES

Division 02

April 1, 2025

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END OF DOCUMENT

Item C-100 Contractor Quality Control Program (CQCP)

100-1 General. Quality is more than test results. Quality is the combination of proper materials, testing, workmanship, equipment, inspection, and documentation of the project. Establishing and maintaining a culture of quality is key to achieving a quality project. The Contractor shall establish, provide, and maintain an effective Contractor Quality Control Program (CQCP) that details the methods and procedures that will be taken to assure that all materials and completed construction required by this contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified here and elsewhere in the contract technical specifications, the Contractor shall assume full responsibility for accomplishing the stated purpose.

The Contractor shall establish a CQCP that will:

a. Provide qualified personnel to develop and implement the CQCP.

b. Provide for the production of acceptable quality materials.

c. Provide sufficient information to assure that the specification requirements can be met.

d. Document the CQCP process.

The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the CQCP has been reviewed and approved by the Resident Project Representative (RPR). No partial payment will be made for materials subject to specific quality control (QC) requirements until the CQCP has been reviewed and approved.

The QC requirements contained in this section and elsewhere in the contract technical specifications are in addition to and separate from the quality assurance (QA) testing requirements. QA testing requirements are the responsibility of the RPR or Contractor as specified in the specifications.

A Quality Control (QC)/Quality Assurance (QA) workshop with the Engineer, Resident Project Representative (RPR), Contractor, subcontractors, testing laboratories, and Owner's representative must be held prior to start of construction. The QC/QA workshop will be facilitated by the Contractor. The Contractor shall coordinate with the Airport and the RPR on time and location of the QC/QA workshop. Items to be addressed, at a minimum, will include:

a. Review of the CQCP including submittals, QC Testing, Action & Suspension Limits for Production, Corrective Action Plans, Distribution of QC reports, and Control Charts.

b. Discussion of the QA program.

c. Discussion of the QC and QA Organization and authority including coordination and information exchange between QC and QA.

d. Establish regular meetings to discuss control of materials, methods and testing.

e. Establishment of the overall QC culture.

100-2 Description of program.

a. General description. The Contractor shall establish a CQCP to perform QC inspection and testing of all items of work required by the technical specifications, including those performed by subcontractors. The CQCP shall ensure conformance to applicable specifications and plans with respect to materials, off-site fabrication, workmanship, construction, finish, and functional performance. The CQCP shall be effective for control of all construction work performed under this Contract and shall specifically include surveillance and tests required by the technical specifications,

in addition to other requirements of this section and any other activities deemed necessary by the Contractor to establish an effective level of QC.

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

The CQCP shall be organized to address, as a minimum, the following:

1. QC organization and resumes of key staff
2. Project progress schedule
3. Submittals schedule
4. Inspection requirements
5. QC testing plan
6. Documentation of QC activities and distribution of QC reports
7. Requirements for corrective action when QC and/or QA acceptance criteria are not met
8. Material quality and construction means and methods. Address all elements applicable to the project that affect the quality of the pavement structure including subgrade, subbase, base, and surface course. Some elements that must be addressed include, but is not limited to mix design, aggregate grading, stockpile management, mixing and transporting, placing and finishing, quality control testing and inspection, smoothness, laydown plan, equipment, and temperature management plan.

The Contractor must add any additional elements to the CQCP that is necessary to adequately control all production and/or construction processes required by this contract.

100-3 CQCP organization. The CQCP shall be implemented by the establishment of a QC organization. An organizational chart shall be developed to show all QC personnel, their authority, and how these personnel integrate with other management/production and construction functions and personnel.

The organizational chart shall identify all QC staff by name and function, and shall indicate the total staff required to implement all elements of the CQCP, including inspection and testing for each item of work. If necessary, different technicians can be used for specific inspection and testing functions for different items of work. If an outside organization or independent testing laboratory is used for implementation of all or part of the CQCP, the personnel assigned shall be subject to the qualification requirements of paragraphs 100-03a and 100-03b. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.

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

a. Program Administrator. The Contractor Quality Control Program Administrator (CQCPA) must be a full-time employee of the Contractor, or a consultant engaged by the Contractor. The CQCPA must have a minimum of five (5) years of experience in QC pavement construction with prior QC experience on a project of comparable size and scope as the contract.

Included in the five (5) years of paving/QC experience, the CQCPA must meet at least one of the following requirements:

(1) Professional Engineer with one (1) year of airport paving experience.

(2) Engineer-in-training with two (2) years of airport paving experience.

(3) National Institute for Certification in Engineering Technologies (NICET) Civil Engineering Technology Level IV with three (3) years of airport paving experience.

(4) An individual with four (4) years of similar airport paving experience, with a Bachelor of Science Degree in Civil Engineering, Civil Engineering Technology or Construction.

The CQCPA must have full authority to institute any and all actions necessary for the successful implementation of the CQCP to ensure compliance with the contract plans and technical specifications. The CQCPA authority must include the ability to immediately stop production until materials and/or processes are in compliance with contract specifications. The CQCPA must report directly to a principal officer of the construction firm. The CQCPA may supervise the Quality Control Program on more than one project provided that person can be at the job site within two (2) hours after being notified of a problem.

b. QC technicians. A sufficient number of QC technicians necessary to adequately implement the CQCP must be provided. These personnel must be either Engineers, engineering technicians, or experienced craftsman with qualifications in the appropriate field equivalent to NICET Level II in Civil Engineering Technology or higher, and shall have a minimum of two (2) years of experience in their area of expertise.

The QC technicians must report directly to the CQCPA and shall perform the following functions:

(1) Inspection of all materials, construction, plant, and equipment for conformance to the technical specifications, and as required by paragraph 100-6.

(2) Performance of all QC tests as required by the technical specifications and paragraph100-8.

(3) Performance of tests for the RPR when required by the technical specifications.

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

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

100-4 Project progress schedule. Critical QC activities must be shown on the project schedule as required by Section 80, paragraph 80-03, *Execution and Progress*.

100-5 Submittals schedule. The Contractor shall submit a detailed listing of all submittals (for example, mix designs, material certifications) and shop drawings required by the technical specifications. The listing can be developed in a spreadsheet format and shall include as a minimum:

a. Specification item number

b. Item description

c. Description of submittal

d. Specification paragraph requiring submittal

e. Scheduled date of submittal

100-6 Inspection requirements. QC inspection functions shall be organized to provide inspections for all definable features of work, as detailed below. All inspections shall be documented by the Contractor as specified by paragraph 100-9.

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

a. During plant operation for material production, QC test results and periodic inspections shall be used to ensure the quality of aggregates and other mix components, and to adjust and control mix proportioning to meet the approved mix design and other requirements of the technical specifications.

All equipment used in proportioning and mixing shall be inspected to ensure its proper operating condition. The CQCP shall detail how these and other QC functions will be accomplished and used.

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

100-7 Contractor QC testing facility.

a. For projects that include Item P-401, Item P-403, and Item P-404, the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following paragraphs of ASTM D3666, *Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials*:

- 8.1.3 Equipment Calibration and Checks;
- 8.1.9 Equipment Calibration, Standardization, and Check Records;
- 8.1.12 Test Methods and Procedures

b. For projects that include P-501, the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following paragraphs of ASTM C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation:

- 7 Test Methods and Procedures
- 8 Facilities, Equipment, and Supplemental Procedures

100-8 QC testing plan. As a part of the overall CQCP, the Contractor shall implement a QC testing plan, as required by the technical specifications. The testing plan shall include the minimum tests and test frequencies required by each technical specification Item, as well as any additional QC tests that the Contractor deems necessary to adequately control production and/or construction processes.

The QC testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

a. Specification item number (e.g., P-401)

b. Item description (e.g., Hot Mix Asphalt Pavements)

c. Test type (e.g., gradation, grade, asphalt content)

d. Test standard (e.g., ASTM or American Association of State Highway and Transportation Officials (AASHTO) test number, as applicable)

e. Test frequency (e.g., as required by technical specifications or minimum frequency when requirements are not stated)

f. Responsibility (e.g., plant technician)

g. Control requirements (e.g., target, permissible deviations)

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

All QC test results shall be documented by the Contractor as required by paragraph 100-9.

100-9 Documentation. The Contractor shall maintain current QC records of all inspections and tests performed. These records shall include factual evidence that the required QC inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, causes for rejection, etc.; proposed remedial action; and corrective actions taken.

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

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

a. Daily inspection reports. Each Contractor QC technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations. These technician's daily reports shall provide factual evidence that continuous QC 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) Summary of any necessary corrective actions
(7) Safety inspection.
(8) Photographs and/or video

The daily inspection reports shall identify all QC inspections and QC tests 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 QC technician and the CQCPA. The RPR shall be provided at least one copy of each daily inspection report on the work day following the day of record. When QC inspection and test results are recorded and transmitted electronically, the results must be archived.

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

(1) Technical specification item number and description
(2) Test designation
(3) Location
(4) Date of test
(5) Control requirements
(6) Test results
(7) Causes for rejection
(8) Recommended remedial actions
(9) Retests

Test results from each day's work period shall be submitted to the RPR prior to the start of the next day's work period. When required by the technical specifications, the Contractor shall maintain statistical QC charts. When QC daily test results are recorded and transmitted electronically, the results must be archived.

100-10 Corrective action requirements. The CQCP shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process into control. The requirements for corrective action shall include both general requirements for operation of the CQCP as a whole, and for individual items of work contained in the technical specifications.

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

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

100-11 Inspection and/or observations by the RPR. All items of material and equipment are subject to inspection and/or observation by the RPR at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate QC system in conformance with the requirements detailed here and the applicable technical specifications and plans. In addition, all items of materials, equipment and work in place shall be subject to inspection and/or observation by the RPR at the site for the same purpose.

Inspection and/or observations by the RPR does not relieve the Contractor of performing QC inspections of either on-site or off-site Contractor's or subcontractor's work.

100-12 Noncompliance.

a. The Resident Project Representative (RPR) will provide written notice to the Contractor of any noncompliance with their CQCP. After receipt of such notice, the Contractor must take corrective action.

b. When QC activities do not comply with either the CQCP or the contract provisions or when the Contractor fails to properly operate and maintain an effective CQCP, and no effective corrective actions have been taken after notification of non-compliance, the RPR will recommend the Owner take the following actions:

(1) Order the Contractor to replace ineffective or unqualified QC personnel or subcontractors and/or

(2) Order the Contractor to stop operations until appropriate corrective actions are taken.

METHOD OF MEASUREMENT

100-13 Basis of measurement and payment. Contractor Quality Control Program (CQCP) is for the personnel, tests, facilities and documentation required to implement the CQCP. The CQCP will be paid as a lump sum with the following schedule of partial payments:

a. With first pay request, 25% with approval of CQCP and completion of the Quality Control (QC)/Quality Assurance (QA) workshop.

b. When 25% or more of the original contract is earned, an additional 25%.

c. When 50% or more of the original contract is earned, an additional 20%.

d. When 75% or more of the original contract is earned, an additional 20%

e. After final inspection and acceptance of project, the final 10%.

BASIS OF PAYMENT

100-14 Payment will be made under:

Item C-100-1 Contractor Quality Control Program (CQCP) – per lump sum

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

National Institute for Certification in Engineering Technologies (NICET)

ASTM International (ASTM)

ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

END OF ITEM C-100

Item C-102 Temporary Air and Water Pollution, Soil Erosion, and Siltation Control

DESCRIPTION

102-1. This item shall consist of temporary control measures as shown on the plans or as ordered by the Resident Project Representative (RPR) during the life of a contract to control pollution of air and water, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

Temporary erosion control shall be in accordance with the approved erosion control plan; the approved Construction Safety and Phasing Plan (CSPP) and AC 150/5370-2, *Operational Safety on Airports During Construction*. The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

Temporary control measures shall be designed, installed and maintained to minimize the creation of wildlife attractants that have the potential to attract hazardous wildlife on or near public-use airports.

Collection and proper disposal of the slurry from milling and grinding operations, saw cutting and pavement marking removal utilizing sediment basins; control dust from milling and grinding operations. Implement control measures on haul routes and in staging areas.

MATERIALS

102-2.1 Grass. Grass that will not compete with the grasses sown later for permanent cover per Item T-901shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover. Selected grass species shall not create a wildlife attractant.

102-2.2 Mulches. Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials per Item T-908. Mulches shall not create a wildlife attractant.

102-2.3 Fertilizer. Fertilizer shall be a standard commercial grade and shall conform to all federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

102-2.4 Slope drains. Slope drains may be constructed of pipe, fiber mats, rubble, concrete, asphalt, or other materials that will adequately control erosion.

102-2.5 Silt fence. Silt fence shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life. Silt fence shall meet the requirements of ASTM D6461.

102-2.6 Other. All other materials shall meet commercial grade standards and shall be approved by the RPR before being incorporated into the project.

102-2.7 Vacuum sweeper truck. As approved by RPR.

CONSTRUCTION REQUIREMENTS

102-3.1 General. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The RPR shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

102-3.2 Schedule. Prior to the start of construction, the Contractor shall submit schedules in accordance with the approved Construction Safety and Phasing Plan (CSPP) and the plans for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the RPR.

102-3.3 Construction details. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the plans and approved CSPP. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion may be a problem, schedule and perform clearing and grubbing operations so that grading operations and permanent erosion control features can follow immediately if project conditions permit. Temporary erosion control measures are required if permanent measures cannot immediately follow grading operations. The RPR shall limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified as directed by the RPR.

The Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the RPR. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the RPR, the work shall be performed by the Contractor and the cost shall be incidental to this item.

The RPR may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

The erosion control features installed by the Contractor shall be maintained by the Contractor during the construction period.

Provide temporary structures whenever construction equipment must cross watercourses at frequent intervals. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

102-3.4 Installation, maintenance and removal of silt fence. Silt fences shall extend a minimum of 16 inches (41 cm) and a maximum of 34 inches (86 cm) above the ground surface. Posts shall be set no more than 10 feet (3 m) on center. Filter fabric shall be cut from a continuous roll to the length required minimizing joints where possible. When joints are necessary, the fabric shall be spliced at a support post with a minimum 12-inch (300-mm) overlap and securely sealed. A trench shall be

excavated approximately 4 inches (100 mm) deep by 4 inches (100 mm) wide on the upslope side of the silt fence. The trench shall be backfilled and the soil compacted over the silt fence fabric. The Contractor shall remove and dispose of silt that accumulates during construction and prior to establishment of permanent erosion control. The fence shall be maintained in good working condition until permanent erosion control is established. Silt fence shall be removed upon approval of the RPR.

METHOD OF MEASUREMENT

102-4.1 Temporary erosion and pollution control work required will be performed as scheduled or directed by the RPR. Completed and accepted work will be measured as follows:

- **a.** Temporary air and water pollution, soil erosion, and siltation controls will be paid on a lump sum basis and will not be measured for payment.
- **b.** Partial payment will be made in accordance with the percentage and schedule specified in 105- 5 Basis of measurement and payment.

102-4.2 Control work performed for protection of construction areas outside the construction limits, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites, will not be measured and paid for directly but shall be considered as a subsidiary obligation of the Contractor.

BASIS OF PAYMENT

102-5.1 Accepted quantities of temporary water pollution, soil erosion, and siltation control work ordered by the RPR and measured as provided in paragraph 102-4.1 will be paid for under:

Item C-102-1 Temporary Air and Water Pollution, Soil Erosion,and Siltation Control – per lump sum.

Where other directed work falls within the specifications for a work item that has a contract price, the units of work shall be measured and paid for at the contract unit price bid for the various items.

Temporary control features not covered by contract items that are ordered by the RPR will be paid for in accordance with Section 90, paragraph 90-05 *Payment for Extra Work*.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5200-33 *Hazardous Wildlife Attractants on or Near Airports*

AC 150/5370-2 *Operational Safety on Airports During Construction*

ASTM International (ASTM)

ASTM D6461 *Standard Specification for Silt Fence Materials*

United States Department of Agriculture (USDA)

FAA/USDA Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF ITEM C-102

Item C-105 Mobilization

105-1 Description. This item of work shall consist of, but is not limited to, work and operations necessary for the movement of personnel, equipment, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items.

105-2 Mobilization limit. Mobilization shall be limited to 10 percent of the total project cost. Mobilization work includes, but is not limited to, establishing haul routes and staging area, and employee security and driver training. Demobilization includes, but is not limited to removal of all temporary facilities and restoration of site.

105-3 Posted notices. Prior to commencement of construction activities, the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster "Equal Employment Opportunity is the Law" in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL "Notice to All Employees" Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.

105-4 Engineer/RPR field office. The Contractor shall provide dedicated space for the use of the field RPR and inspectors, as a field office for the duration of the project. This space shall be located conveniently near the construction and shall be separate from any space used by the Contractor. The Contractor shall furnish water, sanitary facilities, heat, air conditioning, and electricity in accordance with local building codes.

METHOD OF MEASUREMENT

105-5 Basis of measurement and payment. All preparatory work, equipment, and establishment of operations prior to construction, as well as those incurred after construction, shall be included in the lump sum item. Mobilization/ Demobilization costs for subcontracted work shall be considered to be included in the Contract unit price bid items for which it is required. Based upon the contract lump sum price for "Mobilization" partial payments will be allowed as follows:

a. With first pay request, 25%.

b. When 25% or more of the original contract is earned, an additional 25%.

c. When 50% or more of the original contract is earned, an additional 40%.

d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by Section 90, paragraph 90-11, *Contractor Final Project Documentation,* the final 10%.

BASIS OF PAYMENT

105-6 Payment will be made under:

Item C-105-1 Mobilization/ Demobilization – per lump sum

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Office of Federal Contract Compliance Programs (OFCCP)

Executive Order 11246, as amended

EEOC-P/E-1 – Equal Employment Opportunity is the Law Poster

United States Department of Labor, Wage and Hour Division (WHD)

WH 1321 – Employee Rights under the Davis-Bacon Act Poster

END OF ITEM C-105

ITEM P-101 PREPARATION OF EXISTING PAVEMENTS

DESCRIPTION

101-1 This item shall consist of preparation of existing pavement surfaces for regrooving and joint resealing of existing pavement, and other miscellaneous items. The work shall be accomplished in accordance with these specifications and the applicable plans. Preparation of existing pavements includes full depth, full and partial PCC panel replacements as specified in P-501.

EQUIPMENT AND MATERIALS

101-2 All equipment and materials shall be specified here and in the following paragraphs or approved by the Resident Project Representative (RPR). The equipment shall not cause damage to the pavement to remain in place.

CONSTRUCTION

101-3.1 Removal of existing pavement.

The Contractor's removal operation shall be controlled to not damage adjacent pavement structure, and base material, cables, utility ducts, pipelines, or drainage structures which are to remain under the pavement.

a. Concrete pavement removal. Full depth saw cuts shall be made perpendicular to the slab surface. The Contractor shall saw through the full depth of the slab including any dowels at the joint, removing the pavement and installing new dowels as shown on the plans and per the specifications. Where the perimeter of the removal limits is not located on the joint and there are no dowels present, the perimeter shall be saw cut the full depth of the pavement. The pavement inside the saw cut shall be removed by methods which will not cause distress in the pavement which is to remain in place. Concrete slabs that are damaged by under breaking shall be repaired or removed and replaced as directed by the RPR.

The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Spall and underbreak repair shall be in accordance with the plans. Any underlaying material that is to remain in place that is damaged, shall be repaired or replaced as directed by the RPR as the Contractor' expense. Adjacent areas damaged during repair shall be repaired or replaced at the Contractor's expense.

101-3.4 Concrete Repairs.

a. Repair of concrete spalls. The Contractor shall repair all concrete as shown on the plans or as directed by the RPR. Concrete spall repair details are shown on the plans and locations shall be indicated by the RPR prior to commencing demolition. Spall repair material shall one of the products indicated in below. Contractor may submit alternate materials with proving performance for airfield concrete pavement repair. Submit spall repair material, manufacturer's certification of the material's compatibility for the intended application, and manufacturer's instructions a minimum of 14 days prior to commencing the work.

Product Name	Manufacturer
DOTLine	Aquafin Inc.
HD-50 Rapid Set	Dayton Superior Corp.
Pavemend 15	Aquafin Inc.
ProSpec Premium Patch 200	H.B. Fuller
Rapid Set Concrete Mix	CTS Cement Corp.
SikaQuick Set-45	Sika Corp.
Ulti-Pave 3	Buzzi Unicem
SikaQuick 2500	Sika Corp
Pavemend SLQ	Aquafin Inc.
SikaEmaco -1060	Sika Corp.
SikaEmaco -6000	Sika Corp.
CTS Rapid Set Mortar Mix4	CTS Cement Corp.

The first day of spall repairs shall be considered a test section for the purpose of demonstrating to the satisfaction of the RPR that demolition, preparation, and placement of the spall repair is in accordance with the plans and specifications. A representative of the spall repair material manufacturer shall be on-site for the duration of the test section to provide guidance to the Contractor and ensure the installation is in accordance with the manufacturer's instructions. Provide a test section report from the manufacturer's representative for review and approval by the RPR. Full production of spall repairs shall not continue until the test section is approved in writing by the RPR. Spall repairs shall be performed prior to diamond grinding.

101-3.5 Diamond Grinding for Concrete Surface. Grinding shall be performed using diamond blades mounted on a self- propelled machine designed for grinding and texturing pavement. The grinding equipment shall be at a minimum 35,000 pounds including the grinding head, and of a size that will grind a strip at least 4 feet wide. The effective wheelbase of the machine shall be no less than 12 feet. The effective wheelbase is defined as the distance from the front wheel assembly transverse pivot point to the transverse pivot point of the profile/depth control/ ground drive wheels. The equipment shall have a positive means of vacuuming the grinding residue from the pavement surface, leaving the surface in a clean, near-dry condition. Grinding equipment that causes raveling, aggregate fractures or disturbance to the joints shall not be permitted. The equipment shall be maintained to ensure it is in proper working order, with
attention paid to the "roundness" of the match and depth control wheels. Any wheels found to be out of round shall be immediately replaced.

a. Grinding Operation. The grinding operation shall be scheduled and proceed in a manner that produces a neat, uniform finished surface. Grinding shall transition from the runway to shoulder or taxiways as indicated in the plans. Full- and partial-depth concrete repairs, slab stabilization and other concrete repairs shall be completed prior to grinding operations. Joint sealing shall be completed subsequent to the grooving operation.

Grinding shall be accomplished in a manner that eliminates joint or crack faults so there is no more than a 1/16-inch differential between the adjacent sides of the joints and cracks. Grinding shall also substantially remove pavement conditions such as warp and curl.

Lateral drainage shall be achieved by maintaining a constant cross slope between grinding passes.

The finished cross slope shall mirror the pre-grind cross slope and shall have no depressions or misalignment of slope greater than1/4-inch in 12 feet when measured with a 12-foot straightedge placed perpendicular to the centerline. Steps will be taken to ensure that wheel path wear and the existing grooves are removed, and that the grinding operation is simply not texturing depressions or existing grooves. Areas of deviation shall be reground. Straightedge requirements will apply across the entire runway.

Grinding shall begin and end at the project limits indicated in the plans by grinding tapering as indicated in the plans. Passes of the grinding head shall not overlap more than 1-inch. No unground surface area between passes will be permitted.

b. Final Surface Finish. The grinding process shall produce a pavement surface that is true in grade and uniform in appearance with longitudinal line-type texture. The line-type texture shall contain corrugations perpendicular to the runway centerline and present a narrow ridge corduroy type appearance. The saw blades shall be 1/8-inch wide with sufficient number of flush cut blades that create grooves between 0.090 and 0.130 inches wide; and peaks and ridges approximately 1/32 inch higher than the bottom of the grinding cut. The project conditions may dictate that the contractor has to make multiple passes with the equipment to meet the specifications. It is the contractor's responsibility to determine the proper sequence of operations to meet the specification. If multiple passes of the grinding equipment are required, the area will only be considered for payment once.

c. Clean-up. The Contractor shall sweep the ground surface daily and immediately after grinding until all residual materials are removed from the pavement surface. Waste materials shall be collected and removed from the pavement surface and adjacent areas by sweeping or vacuuming. Waste materials shall be removed and disposed in areas in accordance with disposal plan approved by RPR.

d. Profilograph Testing. The contractor shall conduct profilograph testing prior and after grinding for the full length of the project. The Contractor, in the presence of the RPR shall perform a profilograph roughness tests with a profilograph meeting the requirements of ASTM E1274 or a Class I inertial profiler meeting ASTM E950. Data and results shall be provided within 48 hours of profilograph roughness tests.

The pavement shall have an average profile index less than 15 inches per mile per 1/10 mile. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2-inch (5 mm) blanking band. The bump template must span one inch (25 mm) with an offset of 0.4 inches (10 mm). The profilograph must be calibrated prior to use and operated by a factory or State DOT approved, trained operator. Profilographs shall be recorded on a longitudinal scale of one inch equals 25 feet and a vertical scale of one inch equals one inch. Profilograph shall be performed one foot right and left of project centerline and 15 feet right and left of project centerline.

Any areas that indicate "must grind" prior to diamond grinding operations shall be documented and a grinding correction plan submitted to the RPR for approval. Once diamond grinding is completed, a second profilograph run shall be performed to verify that the corrections and the overall grinding process produced an average profile index of 15 inches per mile per 1/10 mile or less.

e. Smoothness for Contractor Quality Control. The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than ¼ inch in 12 feet and identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the grinding process shall be made by the Contractor before grinding continues

The Contractor may use a 12-foot "straightedge, a rolling inclinometer meeting the requirements of ASTM E2133 or rolling external reference device that can simulate a 12-foot straightedge approved by the RPR. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each

successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be

determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two high points. If the rolling inclinometer or external reference device is used, the data may be evaluated using either the FAA profile program, ProFAA, or FHWA profile program ProVal, using the 12-foot straightedge simulation function.

The transition between ground and existing pavement shall be evaluated so the transition produces a variance of less than ¼ inch in 12 feet.

(1) Transverse measurements. Transverse measurements shall be taken for each day's production. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the RPR.

(2) Longitudinal measurements. Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the runway centerline; at the third points of each slab.

Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than 1/4 inch shall be corrected with diamond grinding. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding.

f. Test Section. Prior to full production, the contractor shall demonstrate in the presence of the RPR, that the equipment, grinding process and quality control process meet the requirements of the specification. The test section shall be a half runway width wide by 250 feet long. The test section shall produce a finished surface without existing grooves mirroring the existing slope and meeting the straightedge requirements.

101-3.7 Maintenance. The Contractor shall perform all maintenance work necessary to keep the pavement in a satisfactory condition until the full runway is grooved, joints sealed, and accepted by the RPR. The surface shall be kept clean and free from foreign material. The pavement shall be properly drained at all times. If cleaning is necessary or if the pavement becomes disturbed, any work repairs necessary shall be performed at the Contractor's expense.

101-3.8 Preparation of Joints in Rigid Pavement prior to Resealing. Prior to application of sealant material, clean and dry the joints of all scale, dirt, dust, old sealant, curing compound, moisture and other foreign matter. The Contractor shall demonstrate, in the presence of the RPR, that the method used cleans the joint and does not damage the joint.

101-3.8.1 Removal of Existing Joint Sealant. All existing joint sealants will be removed prior to grinding by plowing or use of hand tools. Any remaining sealant and or debris will be removed by use of wire brushes or other tools as necessary. If resawing is necessary, resaw joints removing no more than 1/16 inch from each joint face. Immediately after sawing, flush out joint with water and other tools as necessary to completely remove the slurry.

101-3.8.2 Cleaning prior to Sealing. Immediately before sealing, joints shall be cleaned by removing any remaining laitance and other foreign material. Allow sufficient time to dry out joints prior to sealing. Joint surfaces will be surface-dry prior to installation of sealant.

101-3.8.3 Joint sealant. Joint material and installation will be in accordance with Item P-605.

101-3.9 Diamond Grinding for Asphalt Surface. Diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive. Diamond grinding shall be performed with the machine for concrete surface or with a machine designed specifically for diamond grinding capable of cutting a path at least 3 feet wide. The saw blades shall be 1/8-inch wide with a sufficient number of blades to create grooves between 0.090 and 0.130 inches wide; and peaks and ridges approximately 1/32 inch higher than the bottom of the grinding cut. The actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Equipment or grinding procedures that cause

ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted. Contractor shall demonstrate to the RPR that the grinding equipment will produce satisfactory results prior to making corrections to surfaces. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. The Contractor shall apply a surface treatment per P-608 to all areas that have been subject to grinding.

METHOD OF MEASUREMENT

101-4.1 Pavement removal. The unit of measurement for pavement removal shall be the number of square yards removed by the Contractor. Any pavement removed outside the limits of removal because the pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment. No direct measurement or payment shall be made for saw cutting. Saw cutting shall be incidental to pavement removal. Dowel bar installation shall be incidental to pavement removal.

101-4.5 Concrete Spall Repair. The unit of measure for concrete spall repair shall be the number of square feet. The location and average depth of the patch shall be determined and agreed upon by the RPR and the Contractor.

101-4.6 Diamond Grinding. The unit of measure for diamond grinding shall be per square yard. The location and average depth of the cold milling shall be as shown on the plans. If the initial cut does not correct the condition, the Contractor shall re-grind the area and will not be paid separately.

BASIS OF PAYMENT

101-5.1 Payment. Payment shall be made at contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

Item P 101-1	Pavement Removal - per square yard
Item P-101-2	Concrete Spall Repair - per square foot
Item P-101-3	PCC Diamond Grinding – per square yard
Item P-101-4	Asphalt Diamond Grinding – per square yard

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5380-6 Guidelines and Procedures for Maintenance of Airport Pavements.

END OF ITEM P-101

ITEM P-501 CEMENT CONCRETE PAVEMENT

DESCRIPTION

501-1.1 This work shall consist of pavement composed of cement concrete with reinforcement for full slab or partial slab replacement as indicated by the RPR and constructed in accordance with these specifications and shall conform to the lines, grades, thickness, and typical cross-sections shown on the plans. The terms cement concrete, hydraulic cement concrete, and concrete are interchangeable in this specification.

MATERIALS

501-2.1 Aggregates.

a. Reactivity. Conduct ASTM C1567 for the proposed mixture design proportions of aggregates, cementitious materials. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined aggregate materials mixture can reduce the expansion to less than 0.10% at 28 days or new aggregates shall be evaluated and tested.

(1) Option 1. Replace 25% of the cement with fly ash meeting the requirements of paragraph 501-2.3.a.

(2) Option 2. Replace 35-45% of the cement with slag cement meeting the requirements of paragraph 501-2.3.b.

b. Fine aggregate. Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33 and the parameters identified in the fine aggregate material requirements below. Fine aggregate material requirements and deleterious limits are shown in the table below.

Fine Aggregate Material Requirements		
Soundness of Aggregates by Use of Sodium Sulfate **or** Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Sand Equivalent	45minimum	ASTM D2419
Fineness Modulus (FM)	$2.50 \leq FM \leq 3.40$	ASTM C136
Limits for Deleterious Substances in Fine Aggregate for Concrete		
Clay lumps and friable particles	1.0% maximum	ASTM C142
Coal and lignite	0.5% using a medium with a density of Sp. Gr. of 2.0	ASTM C123
Total Deleterious Material	1.0% maximum	

c. Coarse aggregate. The maximum size coarse aggregate shall be ASTM C33 No.57 gradation requirements. Contractor may elect to use a blended coarse aggregate gradation consisting of ASTM C33 No.4 and No. 67.

Aggregates delivered to the mixer shall be clean, hard, uncoated aggregates consisting of crushed stone, crushed or uncrushed gravel, air-cooled iron blast furnace slag, crushed recycled concrete pavement, or a combination. The aggregates shall have no known history of detrimental pavement staining. Steel blast furnace slag shall not be permitted. Coarse aggregate material requirements and deleterious limits are shown in the table below; washing may be required to meet aggregate requirements.

Coarse Aggregate Material Requirements

Material Test	Requirement	Standard
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate **or** Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Flat, Elongated, or Flat and Elongated Particles	8% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 for any size group coarser than 3/8 (9.5 mm) sieve [1]	ASTM D4791

[1] A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

The amount of deleterious material in the coarse aggregate shall not exceed the following limits:

Limits for Deleterious Substances in Coarse Aggregate

Deleterious material	AST M	Percentage by Mass
Clay Lumps and friable particles	ASTM C142	1.0
Material finer than No. 200 sieve (75 µm)	ASTM C117	1.0 1
Lightweight particles	ASTM C123 using a medium with a density of Sp. Gr. of 2.0	0.5
Chert[2] (less than 2.40 Sp Gr.)	ASTM C123 using a medium with a density of Sp. Gr. of 2.40)	1.0

[1] The limit for material finer than 75-µm is allowed to be increased to 1.5% for crushed aggregates consisting of dust of fracture that is essentially free from clay or shale. Test results supporting acceptance of increasing limit to 1.5% with statement indicating material is dust of fracture must be submitted with Concrete mix. Acceptable techniques to characterizing these fines include methylene blue adsorption or X-ray diffraction analysis.

[2] Chert and aggregates with less than 2.4 specific gravity.

d. Combined aggregate gradation. Use aggregate gradations that produce concrete mixtures with well-graded or optimized aggregate combinations. The Contractor shall submit complete mixture

information necessary to calculate the volumetric components of the mixture. The combined aggregate grading shall meet the following requirements:

(1) The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in paragraph 501-2.1d(4) below, the point thus determined shall fall within the parallelogram described therein.

(2) The CF shall be determined from the following equation:

CF = (cumulative percent retained on the 3/8 in. (9.5 mm) sieve)(100) / (cumulative percent retained on the No. 8 (2.36 mm) sieve)

(3) The WF is defined as the percent passing the No. 8 (2.36 mm) sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds (42 kg) of cementitious material per cubic meter yard greater than 564 pounds per cubic yard (335 kg per cubic meter).

(4) A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary. The point determined by the plotting of the CF and WF may be adjusted during production ±3 WF and ±5 CF. Adjustments to gradation may not take the point outside of the parallelogram.

e. Contractors combined aggregate gradation. The Contractor shall submit their combined aggregate gradation using the following format:

Contractor's Combined Aggregate Gradation

Sieve Size	**Contractor's Concrete mix Gradation (Percent passing by weight)**
2 inch (50 mm)	*
1-1/2 inch (37.5 mm)	*
1 inch (25.0 mm)	*
3/4 inch (19.0 mm)	*
1/2 inch (12.5 mm)	*
3/8 inch (9.5 mm)	*
No. 4 (4.75 mm)	*
No. 8 (2.36 mm)	*
No. 16 (1.18 mm)	*
No. 30 (600 µm)	*
No. 50 (300 µm)	*
No. 100 (150 µm)	*

501-2.2 Cement. Cement shall conform to the requirements of ASTM C150 Type I/II or ASTM C595 Type IL.

501-2.3 Cementitious materials.

a. Fly ash. Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than 6%. Fly ash shall have a Calcium Oxide (CaO) content of less than 15% and a total alkali content less than 3% per ASTM C311. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the concrete mix, and shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the Resident Project Representative (RPR).

b. Slag cement (ground granulated blast furnace (GGBF)). Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25% and 55% of the total cementitious material by mass.

c. Raw or calcined natural pozzolan. Natural pozzolan shall be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 6%. Class N pozzolan for use in mitigating Alkali-Silica Reactivity shall have a total available alkali content less than 3%.

501-2.4 Joint seal. The joint seal for the joints in the concrete pavement shall meet the requirements of Item P-605 and shall be of the type specified in the plans.

501-2.5 Isolation joint filler. Premolded joint filler for isolation joints shall conform to the requirements of ASTM D1751 or ASTM D1752 and shall be where shown on the plans. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise specified by the RPR. When the use of more than one piece is required for a joint, the abutting ends shall be fastened securely and held accurately to shape by stapling or other positive fastening means satisfactory to the RPR.

501-2.6 Steel reinforcement. Reinforcing shall be as indicated in the plans conforming to the requirements of ASTM A615.

501-2.7 Dowel and tie bars. Dowel bars shall be plain steel bars conforming to ASTM A615 and shall be free from burring or other deformation restricting slippage in the concrete.

a. Dowel Bars. Before delivery to the construction site each dowel bar shall be epoxy coated per ASTM A1078, Type 1, with a coating thickness after curing greater than 10 mils. Patched ends are not required for Type 1 coated dowels. The dowels shall be coated with a bond-breaker recommended by the manufacturer. Dowel sleeves or inserts are not permitted. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the grout hardens.

b. Tie Bars. Tie bars shall be deformed steel bars and conform to the requirements of ASTM A615. Tie bars designated as Grade 60 in ASTM A615 or ASTM A706 shall be used for construction requiring bent bars.

501-2.8 Water. Water used in mixing or curing shall be potable. If water is taken from other sources considered non-potable, it shall meet the requirements of ASTM C1602.

501-2.9 Material for curing concrete. Curing materials shall conform to one of the following specifications:

a. Liquid membrane-forming compounds for curing concrete shall conform to the requirements of ASTM C309, Type 2, Class A, or Class B.

501-2.10 Admixtures. Admixtures shall conform to the following specifications:

a. Air-entraining admixtures. Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entraining agent and any water reducer admixture shall be compatible.

b. Water-reducing admixtures. Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D.

c. Other admixtures. The use of set retarding and set-accelerating admixtures shall be approved by the RPR prior to developing the concrete mix. Retarding admixtures shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating admixtures shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

501-2.11 Epoxy-resin. All epoxy-resin materials shall be two-component materials conforming to the requirements of ASTM C881, Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

b. Material for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.

c. Material for use for injecting cracks shall be Type IV, Grade 1.

d. Material for bonding freshly mixed Portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

501-2.12 Bond Breaker. Fabric shall meet the requirements of AASHTO M 288 Class I fabric with elongation not less than 50% at the specified strengths, with a weight not less than 14.5 oz/sy. A certificate of compliance (COC) shall be provided by the fabric manufacturer that the material may be used as a bond breaker.

CONCRETE MIX

501-3.1. General. No concrete shall be placed until an acceptable concrete mix has been submitted to the RPR for review and the RPR has taken appropriate action. The RPR's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

501-3.2 Concrete Mix Laboratory. The laboratory used to develop the concrete mix shall be accredited in accordance with ASTM C1077. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for developing the concrete mix must be included in the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the RPR prior to start of construction.

501-3.3 Concrete Mix Proportions. Develop the mix using the procedures contained in Portland Cement Association (PCA) publication, "Design and Control of Concrete Mixtures." Concrete shall be proportioned to achieve a 28-day compressive strength that meets or exceeds the acceptance criteria contained in paragraph 501-6.6 for a compressive strength of 5,000 psi per ASTM C39.

The minimum cementitious material shall be adequate to ensure a workable, durable mix. The minimum cementitious material (cement plus fly ash, or slag cement) shall be 470 pounds per cubic yard. The ratio of water to cementitious material, including free surface moisture on the aggregates but not including moisture absorbed by the aggregates shall be between 0.38 – 0.45 by weight.

Compressive strength test specimens shall be prepared in accordance with ASTM C192 and tested in accordance with ASTM C39. At the start of the project, the Contractor shall determine an allowable slump as determined by ASTM C143 not to exceed 4 inches.

The results of the concrete mix shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic yard basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition.

If a change in source(s) is made, or admixtures added or deleted from the mix, a new concrete mix must be submitted to the RPR for approval.

The RPR may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

501-3.4 Concrete Mix submittal. The concrete mix shall be submitted to the RPR at least 30 days prior to the start of operations. The submitted concrete mix shall not be more than 180 days old and must use the materials to be used for production for the project. Production shall not begin until the concrete mix is approved in writing by the RPR.

The submitted concrete mixes shall be stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items and quantities as a minimum:

- Certified material test reports for aggregate in accordance with paragraph 501-2.1. Certified reports must include all tests required; reporting each test, test method, test result, and requirement specified (criteria).
- Combined aggregate gradations and analysis; and including plots of the fine aggregate fineness modulus.
- Reactivity Test Results.
- Coarse aggregate quality test results, including deleterious materials.
- Fine aggregate quality test results, including deleterious materials.
- Mill certificates for cement and supplemental cementitious materials.
- Certified test results for all admixtures.
- Specified flexural strength, slump, and air content.
- Recommended proportions/volumes for proposed mixture and trial water-cementitious materials ratio, including actual slump and air content.
- Compressive strength summaries and plots, including all individual beam and cylinder breaks.
- Correlation ratios for acceptance testing and Contractor QC testing, when applicable.
- Historical record of test results documenting production standard deviation, when applicable.

501-3.5 Cementitious materials.

a. Fly ash. When fly ash is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be 25% by weight of the total cementitious material. If fly ash is used in conjunction with slag cement the maximum replacement rate shall not exceed 10% by weight of total cementitious material.

b. Slag cement (ground granulated blast furnace (GGBF)). Slag cement may be used. The slag cement, or slag cement plus fly ash if both are used, may constitute between 35 to 55% of the total cementitious material by weight.

c. Raw or calcined natural pozzolan. Natural pozzolan may be used in the concrete mix. When pozzolan is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30% by weight of the total cementitious material. If pozzolan is used in conjunction with slag cement the maximum replacement rate shall not exceed 10% by weight of total cementitious material.

501-3.6 Admixtures.

a. Air-entraining admixtures. Air-entraining admixture are to be added in such a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained concrete shall be based upon trial mixes with the materials to be used in the work adjusted to produce concrete of the required plasticity and workability. The percentage of air in the mix shall be 3.0%. Air content shall be determined by testing in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly porous coarse aggregate.

b. Water-reducing admixtures. Water-reducing admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted with the materials to be used in the work, in accordance with ASTM C494.

c. Other admixtures. Set controlling, and other approved admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted with the materials to be used in the work, in accordance with ASTM C494.

CONSTRUCTION METHODS

501-4.1 Control Strip. Not used.

501-4.2 Equipment. The Contractor is responsible for the proper operation and maintenance of all equipment necessary for handling materials and performing all parts of the work to meet this specification.

a. Plant and equipment. The plant and mixing equipment shall conform to the requirements of ASTM C94 and/or ASTM C685. Each truck mixer shall have attached in a prominent place a manufacturer's nameplate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades. The truck mixers shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades. The pickup and throwover blades shall be replaced when they have worn down 3/4 inch or more. The Contractor shall have a copy of the manufacturer's design on hand showing dimensions and arrangement of blades in reference to original height and depth.

b. Finishing equipment. Provide tools for hand screeding and float finishing.

c. Vibrators. Hand held vibrators shall meet the recommendations of ACI 309R, Guide for Consolidation of Concrete. A 2-inch spud vibrator is the minimum size for the project.

d. Concrete saws. The Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions. The Contractor shall provide at least one standby saw in good working order and a supply of saw blades at the site of the work at all times during sawing operations.

e. Fixed forms. If required, straight side fixed forms shall be made of steel and shall be furnished in sections not less than 10 feet (3 m) in length. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the RPR. The top face of the form shall not vary from a true plane more than 1/8 inch in 10 feet , and the upstanding leg shall not vary more than 1/4 inch . The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when approved by the RPR. The forms shall extend the full depth of the pavement section.

501-4.3 Form setting. Forms shall be set to line and grade as shown on the plans, sufficiently in advance of the concrete placement, to ensure continuous paving operation. Forms shall be set to withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms shall be cleaned and oiled prior to the concrete placement.

501-4.4 Base surface preparation prior to placement. Any damage to the underlying base shall be corrected full depth by the Contractor at the Contractor's expense prior to concrete placement. The underlying surface shall be entirely free of water when concrete is placed. The prepared grade shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from concrete. Bond breaker shall be applied in accordance with 501-2.12.

501-4.5 Handling, measuring, and batching material. Aggregate stockpiles shall be constructed and managed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the concrete batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Store and maintain all aggregates at a uniform moisture content prior to use. A continuous supply of materials shall be provided to the work to ensure continuous placement.

501-4.6 Mixing concrete. The concrete may be mixed at the work site, in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials are placed into the drum until the drum is emptied into the truck. All concrete shall be mixed and delivered to the site in accordance with the requirements of ASTM C94 or ASTM C685.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators, or non-agitating trucks. The elapsed time from the addition of cementitious material to the mix until the concrete is discharged from the truck should not exceed 30 minutes when the concrete is hauled in non-agitating trucks, nor 90 minutes when the concrete is hauled in truck mixers or truck agitators. In no case shall the temperature of the concrete when placed exceed 90°F . Retempering concrete by adding water or by other means will not be permitted. With transit mixers additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements provided the addition of water is performed within 45 minutes after the initial mixing operations and provided the water/cementitious ratio specified is not exceeded.

501-4.7 Weather Limitations on mixing and placing. No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

a. Cold weather. Unless authorized in writing by the RPR, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

The aggregate shall be free of ice, snow, and frozen lumps before entering the mixer. The temperature of the mixed concrete shall not be less than 50°F at the time of placement. Concrete shall not be placed on frozen material nor shall frozen aggregates be used in the concrete.

When concreting is authorized during cold weather, water and/or the aggregates may be heated to not more than 150°F. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials.

Curing during cold weather shall be in accordance with paragraph 501-4.13d.

b. Hot weather. During periods of hot weather when the maximum daily air temperature exceeds 85°F , the following precautions shall be taken.

The forms and/or the underlying surface shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 90°F. The aggregates and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not more than the specified maximum.

The concrete placement shall be protected from exceeding an evaporation rate of 0.2 psf per hour. When conditions are such that problems with plastic cracking can be expected, and particularly if any plastic cracking begins to occur, the Contractor shall immediately take such additional measures as necessary to protect the concrete surface. If the Contractor's measures are not effective in preventing plastic cracking, paving operations shall be immediately stopped.

Curing during hot weather shall be in accordance with paragraph 501-4.13e.

c. Temperature management program. Prior to the start of paving operation for each day of paving, the Contractor shall provide the RPR with a Temperature Management Program for the concrete to be placed to assure that uncontrolled cracking is avoided. (Federal Highway Administration HIPERPAV 3 is one example of a temperature management program.) As a minimum, the program shall address the following items:

(1) Anticipated tensile strains in the fresh concrete as related to heating and cooling of the concrete material.

(2) Anticipated weather conditions such as ambient temperatures, wind velocity, and relative humidity; and anticipated evaporation rate using Figure 19-9, PCA, Design and Control of Concrete Mixtures.

(3) Anticipated timing of initial sawing of joint.

(4) Anticipated number and type of saws to be used.

d. Rain. The Contractor shall have available materials for the protection of the concrete during inclement weather. Such protective materials shall consist of rolled polyethylene sheeting at least 4 mils thick of sufficient length and width to cover the plastic concrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic concrete surface. When rain appears imminent, all paving operations shall stop and all available personnel shall begin covering the surface of the unhardened concrete with the protective covering.

501-4.8 Concrete Placement. At any point in concrete conveyance, the free vertical drop of the concrete from one point to another or to the underlying surface shall not exceed 3 feet. The finished concrete product must be dense and homogeneous, without segregation and conforming to the standards in this specification. Backhoes and grading equipment shall not be used to distribute the concrete in front of the paver. Front end loaders will not be used. All concrete shall be consolidated without voids or segregation, including under and around all load-transfer devices, joint assembly units, and other features embedded in the pavement. Hauling equipment or other mechanical equipment can be permitted on adjoining

previously constructed pavement when the concrete strength reaches a compressive strength of 3,100 psi, based on the average of four field cured specimens after 4 days. The Contractor must determine that the above minimum strengths are adequate to protection the pavement from overloads due to the construction equipment proposed for the project.

The Contractor shall have available materials for the protection of the concrete during cold, hot and/or inclement weather in accordance with paragraph 501-4.7.

a. Slip-form construction. Not used.

b. Fixed-form construction. If required, forms shall be drilled in advance of being placed to line and grade to accommodate tie bars / dowel bars where these are specified.

Immediately in advance of placing concrete and after all subbase operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing.

Side forms shall remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms have been removed.

Side forms shall be thoroughly cleaned and coated with a release agent each time they are used and before concrete is placed against them.

Concrete shall be spread, screed, shaped and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement will conform to the required cross-section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery. The equipment must be specifically designed for placement and finishing using stationary side forms. Methods and equipment shall be reviewed and accepted by the RPR.

Concrete for the full paving width shall be effectively consolidated by internal vibrators. The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation, voids, or leaving vibrator trails.

Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

c. Consolidation. Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than 2 inches. Vibrators shall not be used to transport or spread the concrete. For each paving train, at least one additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) or over-consolidation (vibrator trails, segregation, or any other evidence) shall require the immediate stopping of the paving operation and adjustment of the equipment or procedures as approved by the RPR.

If a lack of consolidation of the hardened concrete is suspected by the RPR, referee testing may be required. Referee testing of hardened concrete will be performed by the RPR by cutting cores from the finished pavement after a minimum of 24 hours curing. The RPR shall visually examine the cores for evidence of lack of consolidation. Density determinations will be made by the RPR based on the water content of the core as taken. ASTM C642 shall be used for the determination of core density in the saturated-surface dry condition. When required, referee cores will be taken at the minimum rate of one for

each 500 cubic yards (382 m^2) of pavement, or fraction. The Contractor shall be responsible for all referee testing cost if they fail to meet the required density.

The average density of the cores shall be at least 97% of the original concrete mix density, with no cores having a density of less than 96% of the original concrete mix density. Failure to meet the referee tests will be considered evidence that the minimum requirements for vibration are inadequate for the job conditions. Additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete conforms to the above requirements.

501-4.9 Strike-off of concrete and placement of reinforcement. Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the plans and to an elevation that when the concrete is properly consolidated and finished, the surface of the pavement shall be at the elevation of the surrounded concrete. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete by mechanical or vibratory means after spreading.

Reinforcing steel, at the time concrete is placed, shall be free of mud, oil, or other organic matter that may adversely affect or reduce bond. Reinforcing steel with rust, mill scale or a combination of both will be considered satisfactory, provided the minimum dimensions, weight, and tensile properties of a hand wire-brushed test specimen are not less than the applicable ASTM specification requirements.

501-4.10 Joints. Joints shall be constructed as shown on the plans and in accordance with these requirements. All joints shall be constructed with their faces perpendicular to the surface of the pavement and finished or edged as shown on the plans. Joints shall not vary more than 1/2-inch their designated position and shall be true to line with not more than 1/4-inch variation in 10 feet. The surface across the joints shall be tested with a 12-foot straightedge as the joints are finished and any irregularities in excess of 1/4 inch shall be corrected before the concrete has hardened. All joints shall be so prepared, finished, or cut to provide a groove of uniform width and depth as shown on the plans.

a. Construction. Longitudinal construction joints shall be formed against side forms as shown in the plans.

Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for more than 30 minutes or it appears that the concrete will obtain its initial set before fresh concrete arrives. The installation of the joint shall be located at a planned contraction or expansion joint. If placing of the concrete is stopped, the Contractor shall remove the excess concrete back to the previous planned joint.

b. Contraction. Contraction joints shall be installed at the locations and spacing as shown on the plans. Contraction joints shall be installed to the dimensions required by sawing a groove into the concrete surface after the concrete has hardened. When the groove is formed in plastic concrete the sides of the grooves shall be finished even and smooth with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer's instructions. The groove shall be finished or cut clean so that spalling will be avoided at intersections with other joints. Grooving or sawing shall produce a slot at least 1/8 inch wide and to the depth shown on the plans.

c. Isolation (expansion). Isolation joints shall be installed as shown on the plans or as indicated by the RPR. The premolded filler of the thickness as shown on the plans, shall extend for the full depth and width of the slab at the joint. The filler shall be fastened uniformly along the hardened joint face with no buckling or debris between the filler and the concrete interface, including a temporary filler for the sealant reservoir at the top of the slab. The edges of the joint shall be finished and tooled while the concrete is still plastic

d. Dowels and Tie Bars for Joints

(1) Tie bars. Tie bars shall consist of deformed bars installed in joints as shown on the plans. Tie bars shall be placed at right angles to the centerline of the concrete slab and shall be spaced at intervals shown on the plans. They shall be held in position parallel to the pavement surface and in the middle of the slab depth and within the tolerances in paragraph 501-4.10(f.). When tie bars extend into an unpaved lane, they may be bent against the form at longitudinal construction joints, unless threaded bolt or other assembled tie bars are specified. Tie bars shall not be painted, greased, or enclosed in sleeves. When slip-form operations call for tie bars, two-piece hook bolts can be installed.

(2) Dowel bars. Dowel bars shall be placed across joints in the proper horizontal and vertical alignment as shown on the plans. The dowels shall be coated with a bond-breaker or other lubricant recommended by the manufacturer and approved by the RPR. Dowels bars at longitudinal construction joints shall be bonded in drilled holes.

(3) Placing dowels and tie bars. Horizontal spacing of dowels shall be within a tolerance of ±3/4 inch. The vertical location on the face of the slab shall be within a tolerance of ±1/2 inch. The method used to install dowels shall ensure that the horizontal and vertical alignment will not be greater than 1/4 inch per feet, except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of lubricating oil or light grease before the concrete is placed. Dowels shall be installed as specified in the following subparagraphs.

(a) Contraction joints. Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires.

(b) Construction joints. Install dowels and tie bars by the cast-in- place or the drill-and-dowel method. Installation by removing and replacing in preformed holes will not be permitted. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms.

(c) Joints in hardened concrete. Install dowels in hardened concrete by bonding the dowels into holes drilled into the concrete. The concrete shall have cured for seven (7) days or reached a minimum compressive strength of 3100 psi before drilling begins. Holes 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur. Spalling beyond the limits of the grout retention ring will require modification of the equipment and operation. Depth of dowel hole shall be within a tolerance of ±1/2 inch of the dimension shown on the drawings. On completion of the drilling operation, the dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole by means of a suitable metal or plastic grout retention ring fitted around the dowel.

e. Sawing of joints. Sawing shall commence, without regard to day or night, as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and before uncontrolled shrinkage cracking of the pavement occurs and shall continue without interruption until all joints have been sawn. All slurry and debris produced in the sawing of joints shall be removed by vacuuming and washing. Curing compound or system shall be reapplied in the initial saw-cut and maintained for the remaining cure period.

Joints shall be cut in locations as shown on the plans. The initial joint cut shall be a minimum 1/8 inch wide and to the depth shown on the plans. Prior to placement of joint sealant or seals, the top of the joint shall be widened by sawing as shown on the plans.

501-4.11 Finishing. Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, edging of joints, and then texturing. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made or the equipment replaced. Equipment, mixture, and/or procedures which produce more than 1/4 inch of mortar-rich surface shall be immediately modified as necessary to eliminate this condition or operations shall cease. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way. Fog (mist) sprays or other surface applied finishing aids specified to prevent plastic shrinkage cracking, approved by the RPR, may be used in accordance with the manufacturer's requirements.

a. Machine finishing with slipform pavers. Not used.

b. Machine finishing with fixed forms. Not used.

c. Other types of finishing equipment. Clary screeds, other rotating tube floats, or vibratory-truss finishers or pans are allowed on full slab and partial-slab replacements.

d. Hand finishing. Hand finishing methods is permitted for full-slab and partial-slab replacements.

e. Straightedge testing and surface correction. After the pavement has been struck off and while the concrete is still plastic, it shall be tested for trueness with a 12-foot finishing straightedge swung from handles capable of spanning at least one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the centerline and the whole area gone over from one side of the slab to the other, as necessary. Advancing shall be in successive stages of not more than one-half the length of the straightedge. Any excess water and laitance in excess of 1/8 inch thick shall be removed from the surface of the pavement and wasted. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the smoothness requirements. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and until the slab conforms to the required grade and cross-section. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment.

501-4.12 Surface texture. The surface of the pavement shall be finished as designated below for all newly constructed concrete pavements. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. The texture shall be uniform in appearance and approximately 1/16 inch in depth. Any imperfections resulting from the texturing operation shall be corrected to the satisfaction of the RPR.

a. Brush or broom finish. Shall be applied when the water sheen has practically disappeared. The equipment shall operate transversely across the pavement surface.

b. Burlap drag finish. Burlap, at least 15 ounces per square yard (555 grams per square meter), will typically produce acceptable texture. To obtain a textured surface, the transverse threads of the burlap shall be removed approximately one foot from the trailing edge. A heavy buildup of grout on the burlap threads produces the desired wide sweeping longitudinal striations on the pavement surface.

c. Artificial turf finish. Not used.

501-4.13 Curing. Immediately after finishing operations are completed and bleed water is gone from the surface, all exposed surfaces of the newly placed concrete shall be cured for a 7-day cure period in accordance with one of the methods below. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 hour during the curing period.

When a two-saw-cut method is used to construct the contraction joint, the curing compound shall be applied to the saw-cut immediately after the initial cut has been made. The sealant reservoir shall not be sawed until after the curing period has been completed. When the one cut method is used to construct the contraction joint, the joint shall be cured with wet rope, wet rags, or wet blankets. The rags, ropes, or blankets shall be kept moist for the duration of the curing period.

a. Impervious membrane method. Curing with liquid membrane compounds should not occur until bleed and surface moisture has evaporated. All exposed surfaces of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. The curing compound shall not be applied during rainfall. Curing compound shall be applied by mechanical sprayers under pressure at the rate of one gallon to not more than 150 square feet. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. When hand spraying is approved by the RPR, a double application rate shall be used to ensure coverage. Should the film become damaged from any cause, including sawing operations, within the required curing period, the damaged portions shall be repaired immediately with additional compound or other approved means. Upon removal of side forms, the sides of the exposed slabs shall be protected immediately to provide a curing treatment equal to that provided for the surface.

b. White burlap-polyethylene sheets. The surface of the pavement shall be entirely covered with the sheeting. The sheeting used shall be such length (or width) that it will extend at least twice the thickness of the pavement beyond the edges of the slab. The sheeting shall be placed so that the entire surface and both edges of the slab are completely covered. The sheeting shall be placed and weighted to remain in contact with the surface covered, and the covering shall be maintained fully saturated and in position for seven (7) days after the concrete has been placed.

c. Water method. The entire area shall be covered with burlap or other water absorbing material. The material shall be of sufficient thickness to retain water for adequate curing without excessive runoff. The material shall be kept wet at all times and maintained for seven (7) days. When the forms are stripped, the vertical walls shall also be kept moist. It shall be the responsibility of the Contractor to prevent ponding of the curing water on the subbase.

d. Concrete protection for cold weather. Maintain the concrete at a temperature of at least 50°F for a period of 72 hours after placing and at a temperature above freezing for the remainder of the 7-day curing period. The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather; and any concrete damaged shall be removed and replaced at the Contractor's expense.

e. Concrete protection for hot weather. Concrete should be continuous moisture cured for the entire curing period and shall commence as soon as the surfaces are finished and continue for at least 24 hours. However, if moisture curing is not practical beyond 24 hours, the concrete surface shall be protected from drying with application of a liquid membrane-forming curing compound while the surfaces are still damp. Other curing methods may be approved by the RPR.

501-4.14 Removing forms. Unless otherwise specified, forms shall not be removed from freshly placed concrete until it has hardened sufficiently to permit removal without chipping, spalling, or tearing. After the forms have been removed, the sides of the slab shall be cured in accordance with paragraph 501-4.13.

If honeycombed areas are evident when the forms are removed, materials, placement, and consolidation methods must be reviewed and appropriate adjustments made to assure adequate consolidation at the edges of future concrete placements. Honeycombed areas that extend into the slab less than approximately 1 inch, shall be repaired with an approved grout, as directed by the RPR. Honeycombed areas that extend into the slab greater than a depth of 1 inch shall be considered as defective work and shall be removed and replaced in accordance with paragraph 501-4.19.

501-4.15 Saw-cut grooving. If shown on the plans, grooved surfaces shall be provided in accordance with the requirements of Item P-621.

501-4.16 Sealing joints. The joints in the pavement shall be sealed in accordance with Item P-605.

501-4.17 Protection of pavement. The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents until accepted by the RPR. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, crossovers, and protection of unsealed joints from intrusion of foreign material, etc. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense.

Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least seven (7) days old, or for a longer period if directed by the RPR.

In paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for seven (7) days, the joints are protected, the concrete has attained a minimum field cured compressive strength of 3,500 psi, and the slab edge is protected.

All new and existing pavement carrying construction traffic or equipment shall be kept clean and spillage of concrete and other materials shall be cleaned up immediately.

Damaged pavements shall be removed and replaced at the Contractor's expense. Slabs shall be removed to the full depth, width, and length of the slab.

501-4.18 Opening to construction traffic. The pavement shall not be opened to traffic until test specimens molded and cured in accordance with ASTM C31 have attained a compressive strength of 3,500 psi when tested in accordance with ASTM C39. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to opening the pavement to construction traffic, all joints shall either be sealed or protected from damage to the joint edge and intrusion of foreign materials into the joint. As a minimum, backer rod or tape may be used to protect the joints from foreign matter intrusion.

CONTRACTOR QUALITY CONTROL (CQC)

501-5.1 Quality control plan. The Contractor shall develop a Quality Control Plan to ensure quality of the concrete placement for full-slab and partial slab replacements.

501-5.2 Contractor Quality Control (CQC). The RPR shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The RPR will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

501-5.3 Contractor QC testing. The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to this specification. The testing program shall include, but not necessarily be limited to, tests for aggregate gradation, aggregate moisture content, slump, and air content. A QC Testing Plan shall be developed and approved by the RPR as part of the CQCP.

The RPR may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of concrete mixture which is rendered unfit for use due to contamination, segregation, or improper slump. Such rejection may be based on only visual inspection. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the RPR, and if it can be demonstrated in the laboratory, in the presence of the RPR, that such material was erroneously rejected, payment will be made for the material at the contract unit price**.**

a. Fine aggregate.

(1) Gradation. A sieve analysis shall be made at least once per day's production in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) Moisture content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C70 or ASTM C566.

(3) Deleterious substances. Fine aggregate as delivered to the mixer shall be tested for deleterious substances in fine aggregate for concrete as specified in paragraph 501-2.1b, prior to production, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

b. Coarse Aggregate.

(1) Gradation. A sieve analysis shall be made at least once per day's production for each size of aggregate. Tests shall be made in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) Moisture content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C566.

(3) Deleterious substances. Coarse aggregate as delivered to the mixer shall be tested for deleterious substances in coarse aggregate for concrete as specified in paragraph 501-2.1c, prior to production, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

c. Slump. One test shall be made for each slab or partial-slab replacement. Slump tests shall be performed in accordance with ASTM C143 from material randomly sampled from material discharged from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

d. Air content. One test shall be made for each slab or partial-slab replacement. Air content tests shall be performed in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

e. Unit weight and Yield. One test shall be made for each slab or partial-slab replacement. Unit weight and yield tests shall be in accordance with ASTM C138. The samples shall be taken in accordance with ASTM C172 and at the same time as the air content tests.

f. Temperatures. Temperatures shall be checked at least four times per lot at the job site in accordance with ASTM C1064.

g. Smoothness for Contractor Quality Control.

The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than ¼ inch in 12 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues

h. Grade. Grade will be evaluated prior to and after placement of the concrete surface.

Measurements will be taken at each slab or partial slab replacement. The final surface of the pavement will not vary from the gradeline elevations by more than 1/2 inch vertically. The documentation will be provided by the Contractor to the RPR by the end of the following working day .

Areas with humps or depression that that exceed grade or smoothness and that retain water on the surface must be ground off. If these areas cannot be corrected with grinding then the slabs that are retaining water must be removed and replaced in accordance with paragraph 501-4.19d. Grinding shall be in accordance with Item P-101. All corrections will be at the Contractors expense.

MATERIAL ACCEPTANCE

501-6.1 Quality Assurance (QA) Acceptance sampling and testing. All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Contractor and submitted to the RPR for acceptance. The Contractor shall provide adequate facilities for the initial curing of cylinders. The Contractor shall bear the cost of providing initial curing facilities, per paragraph 501-6.5b(1).

The samples will be transported while in the molds. The curing, except for the initial cure period, will be accomplished using the immersion in saturated lime water method. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60° to 80°F, and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in favorable weather, or in heavyweight closed plastic bags, or using other suitable methods, provided the temperature and moisture loss requirements are met.

501-6.2 Quality Assurance (QA) testing laboratory. Quality assurance testing organizations performing these acceptance tests will be accredited in accordance with ASTM C1077. The quality assurance laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for acceptance sampling and testing must be listed on the lab accreditation. A copy

of the laboratory's current accreditation and accredited test methods will be submitted to the RPR prior to start of construction.

501-6.3 Lot size. Concrete will be accepted for strength on a placement basis for each slab or partial-slab replacement.

501-6.5 Acceptance Sampling and Testing.

a. Strength.

(1) Sampling. One sample will be taken for each slab or partial-slab placement from the concrete delivered to the job site. Sampling locations will be determined by the RPR in accordance with random sampling procedures contained in ASTM D3665. The concrete will be sampled in accordance with ASTM C172.

(2) Test Specimens. The Contractor will be responsible for the casting, initial curing, transportation, and curing of specimens in accordance with ASTM C31. Two (2) specimens will be made from each sample and slump, air content, unit weight, and temperature tests will be conducted for each set of strength specimens. Within 24 to 48 hours, the samples will be transported from the field to the laboratory while in the molds. Samples will be cured in saturated lime water.

The strength of each specimen will be determined in accordance with ASTM C39. The strength for each placement will be computed by averaging the results of the two test specimens representingthat sublot.

(3) Acceptance. Acceptance of pavement for strength will be determined by the RPR in accordance with paragraph 501-6.6b(1). All individual strength tests within a lot will be checked for outliers in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded and the remaining test values will be used to determine acceptance in accordance with paragraph 501-6.5b.

b. Pavement thickness.

Not used.

501-6.6 Acceptance criteria.

a. General. Acceptance will be based on the following characteristics of the completed pavement discussed in paragraph 501-6.5b:

(1) Strength

Acceptance for strength, will be based on the criteria contained in accordance with paragraph 501-6.6b(1).

b. Acceptance criteria.

(1) Strength. If the compressive strength is equal or above 5,000 psi at 28 days, the placement is accepted. If the compressive is below 5,000 psi at 28 days, the placement shall be removed and replaced at the Contractor's expense.

METHOD OF MEASUREMENT

501-7.1 Concrete pavement shall be measured by the number of square yards of reinforced pavement as specified in-place, completed and accepted. Dowels, tie-bars, reinforcing steel, if required for embedded items shall be incidental to the P-501 work and will not be measured separately for payment.

BASIS OF PAYMENT

501-8.1 Payment. Payment for concrete pavement meeting all acceptance criteria as specified in paragraph 501-6.6. Acceptance Criteria shall be based on results of strength.

Payment shall be full compensation for all labor, materials, tools, equipment, and incidentals required to complete the work as specified herein and on the drawings.

e. Payment. Payment shall be made under:

Item P-501-1 Concrete Pavement. per square yard

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A184	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A704	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A884	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A996	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1035	Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A1078	Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement
ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C70	Standard Test Method for Surface Moisture in Fine Aggregate
ASTM C78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C123	Standard Test Method for Lightweight Particles in Aggregate
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C227	Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C295	Standard Guide for Petrographic Examination of Aggregates for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland Cement Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete

ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregates by Drying
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C642	Standard Test Method for Density, Absorption, and Voids in Hardened Concrete
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064	Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1157	Standard Performance Specification for Hydraulic Cement
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1365	Standard Test Method for Determination of the Proportion of Phases in Portland Cement and Portland-Cement Clinker Using X-Ray Powder Diffraction Analysis
ASTM C1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate

ASTM D3665	Standard Practice for Random Sampling of Construction
Materials ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or
Flat and	
	Elongated Particles in Coarse Aggregate
ASTM E178	Standard Practice for Dealing with Outlying Observations
ASTM E1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph
ASTM E2133	Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface

American Concrete Institute (ACI)

ACI 305R	Guide to Hot Weather Concreting
ACI 306R	Guide to Cold Weather Concreting
ACI 309R	Guide for Consolidation of

Concrete Advisory Circulars (AC)

AC 150/5320-6	Airport Pavement Design and

Evaluation Federal Highway Administration (FHWA)

HIPERPAV 3, version

3.2 Portland Concrete

Association (PCA)

PCA	Design and Control of Concrete Mixtures, 16th Edition

U.S. Army Corps of Engineers (USACE) Concrete Research Division (CRD)

CRD C662	Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

United States Air Force Engineering Technical Letter (ETL)

ETL 97-5	Proportioning Concrete Mixtures with Graded Aggregates for Rigid Airfield Pavements

END ITEM P-501

ITEM P-605 JOINT SEALANTS FOR PAVEMENTS

DESCRIPTION

605-1.1 This item shall consist of providing and installing a resilient and adhesive joint sealing material capable of effectively sealing joints in pavement; joints between different types of pavements; and cracks in existing pavement.

MATERIALS

605-2.1 Joint sealants. Joint sealant materials shall meet the requirements of ASTM D5893 Type Non-Sag (SN) for all concrete joints except runway to taxiway joints where type Self-Leveling (SL) is used.

Each lot or batch of sealant shall be delivered to the jobsite in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, the safe heating temperature, and shall be accompanied by the manufacturer's certification stating that the sealant meets the requirements of this specification.

605-2.2 Backer rod. The material furnished shall be a compressible, non-shrinking, non-staining, non-absorbing material that is non-reactive with the joint sealant in accordance with ASTM D5249. The backer-rod material shall be 25% ± 5 % larger in diameter than the nominal width of the joint.

605-2.3 Bond breaking tapes. Not used.

CONSTRUCTION METHODS

605-3.1 Time of application. Joints shall be sealed as soon after completion of the curing period as feasible and before the pavement is opened to traffic, including construction equipment. The pavement temperature shall be 50°F (10°C) and rising at the time of application of the poured joint sealing material. Do not apply sealant if moisture is observed in the joint.

605-3.2 Equipment. Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and maintained in satisfactory condition at all times. Submit a list of proposed equipment to be used in performance of construction work including descriptive data, 30 days prior to use on the project.

a. Tractor-mounted routing tool. Most of the existing joints are sealed with pre-formed compression seals and few joints may be sealed with cold applied sealant. Where required, provide a routing tool, used for removing old sealant from the joints, of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

b. Concrete saw. Provide a self-propelled power saw, with water-cooled diamond or abrasive saw blades, for cutting joints to the depths and widths specified.

c. Sandblasting equipment. The Contractor must demonstrate sandblasting equipment including the air compressor, hose, guide and nozzle size, under job conditions, before approval in accordance with paragraph 605-3.3. The Contractor shall demonstrate, in the presence of the Resident Project Representative (RPR), that the method cleans the joint and does not damage the joint.

d. Waterblasting equipment. The Contractor must demonstrate waterblasting equipment including the pumps, hose, guide and nozzle size, under job conditions, before approval in accordance with paragraph 605-3.3. The Contractor shall demonstrate, in the presence of the RPR, that the method cleans the joint and does not damage the joint.

e. Hand tools. Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces. Hand tools should be carefully evaluated for potential spalling effects prior to approval for use.

f. Hot-poured sealing equipment. Not used.

g. Cold-applied, single-component sealing equipment. The equipment for installing ASTM D5893 single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier's instructions, and unaltered in any way without obtaining prior approval. Small hand-held air-powered equipment (i.e., caulking guns) may be used for small repair areas.

605-3.3 Preparation of joints. Pavement joints for application of material in this specification must be dry, clean of all scale, dirt, dust, curing compound, and other foreign matter. The Contractor shall demonstrate, in the presence of the RPR, that the method cleans the joint and does not damage the joint.

a. Sawing. Joints around repairs areas shall be sawed in accordance with specifications and plan details. Immediately after sawing the joint, the resulting slurry shall be completely removed from joint and adjacent area by flushing with a jet of water, and by use of other tools as necessary.

b. Sealing. Immediately before sealing, the joints shall be thoroughly cleaned of all remaining laitance, curing compound, filler, protrusions of hardened concrete, old sealant and other foreign material from the sides and upper edges of the joint space to be sealed. Cleaning shall be accomplished by sandblasting, tractor-mounted routing equipment, concrete saw or waterblaster as specified in paragraph 605-3.2. The newly exposed concrete joint faces and the pavement surface extending a minimum of 1/2 inch from the joint edge shall be sandblasted clean. Sandblasting shall be accomplished in a minimum of two passes. One pass per joint face with the nozzle held at an angle directly toward the joint face and not more than 3 inches from it. After final cleaning and immediately prior to sealing, blow out the joints with compressed air and leave them completely free of debris and water. The joint faces shall be surface dry when the seal is applied.

c. Backer Rod. When the joint opening is of a greater depth than indicated for the sealant depth, plug or seal off the lower portion of the joint opening using a backer rod in accordance with paragraph 605-2.2 to prevent the entrance of the sealant below the specified depth. Take care to ensure that the backer rod is placed at the specified depth and is not stretched or twisted during installation.

d. Bond-breaking tape. Not used.

605-3.4 Installation of sealants. Joints shall be inspected for proper width, depth, alignment, and preparation, and shall be approved by the RPR before sealing is allowed. Sealants shall be installed in accordance with the following requirements:

Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, perform a final cleaning with compressed air. Fill the joints from the bottom up to 1/4 inch ±1/16 inch below the top of pavement surface; or bottom of groove for grooved pavement. Remove and discard excess or spilled sealant from the pavement by approved methods. Install the sealant in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the RPR. When a primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the manufacturer's instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

605-3.5 Inspection. The Contractor shall inspect the joint sealant for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids.
Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified at no additional cost to the airport.

605-3.6 Clean-up. Upon completion of the project, remove all unused materials from the site and leave the pavement in a clean condition.

METHOD OF MEASUREMENT

605-4.1 Joint sealing material shall be measured by the linear foot of sealant in place, completed, and accepted.

BASIS OF PAYMENT

605-5.1 Payment for joint sealing material shall be made at the contract unit price per linear foot. The price shall be full compensation for furnishing all materials, for all preparation, delivering, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-605-1	Joint Sealing Filler, per linear foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D789	Standard Test Method for Determination of Relative Viscosity of Polyamide (PA)
ASTM D5249	Standard Specification for Backer Material for Use with Cold- and Hot- Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
ASTM D5893	Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

Advisory Circulars (AC)

AC 150/5340-30	Design and Installation Details for Airport Visual Aid

END ITEM P-605

Item P-620 Runway and Taxiway Marking

DESCRIPTION

620-1.1 This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Resident Project Representative (RPR). The terms "paint" and "marking material" as well as "painting" and "application of markings" are interchangeable throughout this specification.

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. This certification along with a copy of the paint manufacturer's surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive; and application requirements must be submitted and approved by the Resident Project Representative (RPR) prior to the initial application of markings. The reports can be used for material acceptance or the RPR may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the RPR upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the RPR.

620-2.2 Marking materials.

Table 1. Marking Materials

Paint[1]					Glass Beads[2]	
Type	**Color**	**Fed Std. 595 Number**	**Permanent Application Rate Maximum**	**Temporary Application Rate Maximum**	**Type**	**Application Rate Minimum**
Waterborne Type II	White	37925	115 ft^2/gal	230 ft^2/gal	III	10 lb./gal. min
Waterborne Type II	Yellow	33538 or 33655	115 ft^2/gal	230 ft^2/gal	III	10 lb./gal. min
Waterborne Type II	Black	37038	115 ft^2/gal	230 ft^2/gal	Not Used	-
Waterborne Type II	Red	31136	115 ft^2/gal	230 ft^2/gal	III	10 lb./gal. min

[1] See paragraph 620-2.2a

[2] See paragraph 620-2.2b

a. Paint. Paint shall be waterborne in accordance with the requirements of this paragraph. Paint colors shall comply with Federal Standard No. 595. Waterborne Paint shall meet the requirements of Federal Specification TT-P-1952F, Type II. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis.

Temporary markings shall be painted at the same rate as final markings.

b. Reflective media. Glass beads for white and yellow paint shall meet the requirements for Federal Specification 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.

Glass beads shall not be used in black and green paint.

CONSTRUCTION METHODS

620-3.1 Weather limitations. Painting shall only be performed when the surface is dry, and the ambient temperature and the pavement surface temperature meet the manufacturer's recommendations in accordance with paragraph 620-2.1. Painting operations shall be discontinued when the ambient or surface temperatures does not meet the manufacturer's recommendations. Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Markings shall not be applied when weather conditions are forecasts to not be within the manufacturers' recommendations for application and dry time.

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 with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. The marking equipment for both paint and beads shall be calibrated daily.

620-3.3 Preparation of surfaces. Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminates that would reduce the bond between the paint and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the RPR. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

a. Preparation of new pavement surfaces. The area to be painted shall be cleaned by broom, blower, water blasting, or by other methods approved by the RPR to remove all contaminants, including PCC curing compounds, minimizing damage to the pavement surface.

b. Preparation of pavement to remove existing markings. Existing pavement markings shall be removed by rotary grinding, water blasting, or by other methods approved by the RPR minimizing damage to the pavement surface. The removal area may need to be larger than the area of the markings to eliminate ghost markings. After removal of markings on asphalt pavements, apply a fog seal or seal coat to 'block out' the removal area to eliminate 'ghost' markings.

c. Preparation of pavement markings prior to remarking. Prior to remarking existing markings, loose existing markings must be removed minimizing damage to the pavement surface, with a method approved by the RPR. After removal, the surface shall be cleaned of all residue or debris.

Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufactures application and surface preparation requirements must be submitted to the RPR prior to the initial application of markings.

620-3.4 Layout of markings. The proposed markings shall be laid out in advance of the paint application.

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 RPR.

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

Marking Dimensions and Spacing Tolerance

Dimension and Spacing	Tolerance
36 inch (910 mm) or less	±1/2 inch (12 mm)
greater than 36 inch 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 inch (50 mm)
greater than 60 feet (18.3 m)	±3 inch (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 shown in Table 1. The addition of thinner will not be permitted.

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment and distribution should be performed.

620-3.6 Application--preformed thermoplastic airport pavement markings.

Preformed thermoplastic pavement markings not used.

620-3.7 Control strip. Prior to the full application of airfield markings, the Contractor shall prepare a control strip in the presence of the RPR. The Contractor shall demonstrate the surface preparation method and all striping equipment to be used on the project. The marking equipment must achieve the prescribed application rate of paint and population of glass beads (per Table 1) that are properly embedded and evenly distributed across the full width of the marking. Prior to acceptance of the control strip, markings must be evaluated during darkness to ensure a uniform appearance.

620-3.8 Retro-reflectance. Reflectance shall be measured with a portable retro-reflectometer meeting ASTM E1710 (or equivalent). A total of 6 reading shall be taken over a 6 square foot area with 3 readings taken from each direction. The average shall be equal to or above the minimum levels of all readings which are within 30% of each other.

Minimum Retro-Reflectance Values

Material	Retro-reflectance mcd/m^2/lux		
	White	**Yellow**	**Red**
Initial Type I	300	175	35
Initial Type III	600	300	35
Initial Thermoplastic	225	100	35
All materials, remark when less than[1]	100	75	10

[1] 'Prior to remarking determine if removal of contaminants on markings will restore retro-reflectance.

620-3.9 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 reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the RPR. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes and regulations.

METHOD OF MEASUREMENT

620-4.1a The quantity of surface preparation shall be measured as a lump sum. All other types of surface preparation specified in paragraph 620-3.3 shall not be measured separately and shall be considered incidental to marking.

620-4.1b The quantity of markings shall be measured by the number of square feet of painting.

620-4.1c The quantity of reflective media shall not be measured separately.

620-4.1d The quantity of temporary markings to be paid for shall be the number of square feet of painting.

BASIS OF PAYMENT

620-5.1 This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item complete in place and accepted by the RPR in accordance with these specifications.

620-5.1a Payment for marking removal shall be made at the contract price for the number of square feet.

620-5.2 Payment for markings shall be made at the contract price for the number of square feet of painting with or without reflective beads per pay item.

620-5.3 Reflective media shall be considered incidental and no separate payment shall be made.

620-5.4 Payment for temporary markings shall be made at the contract price for the number of square feet of painting. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-620-5.1	Surface preparation – per lump sum
Item P-620-5.2a	Taxiway Marking with Reflective Beads (yellow) – per square foot
Item P-620-5.2b	Taxiway Marking with Reflective Beads (red) – per square foot
Item P-620-5.2c	Taxiway Marking without Reflective Beads (black) – per square foot
Item P-620-5.2d	Runway Marking with Reflective Beads (white) – per square foot
Item P-620-5.2e	Runway Marking without Reflective Beads (black) – per square foot
Item P-620-5.3	Not Used.
Item P-620-5.4	Temporary Markings (Install and Removal) – per square foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
ASTM E303	Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

Code of Federal Regulations (CFR)

40 CFR Part 60, Appendix A-7, Method 24
Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings

29 CFR Part 1910.1200 Hazard Communication

Federal Specifications (FED SPEC)

FED SPEC TT-B-1325D	Beads (Glass Spheres) Retro-Reflective
FED SPEC TT-P-1952F	Paint, Traffic and Airfield Marking, Waterborne
FED STD 595	Colors used in Government Procurement

Commercial Item Description

A-A-2886B	Paint, Traffic, Solvent Based

Advisory Circulars (AC)

AC 150/5340-1	Standards for Airport Markings
AC 150/5320-12	Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

END OF ITEM P-620

ITEM P-621 SAW-CUT GROOVES

DESCRIPTION

621-1.1 This item consists of constructing saw-cut grooves to minimize hydroplaning during wet weather, providing a skid resistant surface in accordance with these specifications and at the locations shown on the plans, or as directed by the Resident Project Representative (RPR).

CONSTRUCTION METHODS

621-2.1 Procedures. The Contractor shall submit to the RPR the grooving sequence and method of placing guide lines to control grooving operation. Transverse grooves saw-cut in the pavement must form a 1/4 inch (+1/16 inch, -0 inch) wide by 1/4 inch (±1/16 inch) deep by 1-1/2 inch (-1/8 inch, +0 inch) center-to-center configuration. The grooves must be continuous for the entire runway length. They must be saw-cut transversely (perpendicular to centerline) in the runway and high-speed taxiway pavement to not less than 10 feet from the runway pavement edge to allow adequate space for equipment operation.

The saw-cut grooves must meet the following tolerances. The tolerances apply to each day's production and to each piece of grooving equipment used for production. The Contractor is responsible for all controls and process adjustments necessary to meet these tolerances. The Contractor shall routinely spot check for compliance each time the equipment aligns for a grooving pass.

a. Alignment tolerance. The grooves shall not vary more than ±1-1/2 inch in alignment for 75 feet along the runway length, allowing for realignment every 500 feet along the runway length.

b. Groove tolerance.

(1) Depth. The standard depth is 1/4 inch. At least 90% of the grooves must be at least 3/16 inch, at least 60% of the grooves must be at least 1/4 inch, and not more than 10% of the grooves may exceed 5/16 inch.

(2) Width. The standard width is 1/4 inch. At least 90% of the grooves must be at least 3/16 inch, at least 60% of the grooves must be at least 1/4 inch, and not more than 10% of the grooves may exceed 5/16 inch.

(3) Center-to-center spacing. The standard spacing is 1-1/2 inch. Minimum spacing 1-3/8 inch. Maximum spacing 1-1/2 inch.

Saw-cut grooves must not be closer than 3 inches or more than 9 inches from transverse joints in concrete pavements. Grooves must not be closer than 6 inches and no more than 18 inches from in-pavement light fixtures. Grooves may be continued through longitudinal construction joints. Where lighting cables are installed, grooving through longitudinal or diagonal saw kerfs shall not be allowed.

621-2.2 Environmental requirements. Grooving operations will not be permitted when freezing conditions prevent the immediate removal of debris and/or drainage of water from the grooved area. Discharge and disposal of waste slurry shall be the Contractor's responsibility.

621-2.3 Control strip. Groove a control strip in an area of the pavement outside of the trafficked area, as approved by the RPR. The area shall be 250 feet long by three lanes wide. Demonstrate the setup and alignment process, the grooving operation, and the waste slurry disposal.

621-2.4 Existing pavements. Bumps, depressed areas, bad or faulted joints, and badly cracked and/or spalled areas in the pavement shall not be grooved until such areas are adequately repaired or replaced.

621-2.5 New pavements. Not used.

621-2.6 Grooving machine. Provide a grooving machine that is power driven, self-propelled, specifically designed and manufactured for pavement grooving, and has a self-contained and integrated continuous slurry vacuum system as the primary method for removing waste slurry. The grooving machine shall be equipped with diamond-saw cutting blades, and capable of making at least 48 inches in width of multiple parallel grooves in one pass of the machine. Thickness of the cutting blades shall be capable of making the required width and depth of grooves in one pass of the machine. The cutting head shall not contain a mixture of new and worn blades or blades of unequal wear or diameter. Match the blade type and configuration with the hardness of the existing airfield pavement. The wheels on the grooving machine shall be of a design that will not scar or spall the pavement. Provide the machine with devices to control depth of groove and alignment.

621-2.7 Water supply. Water for the grooving operation shall be provided by the Contractor.

621-2.8 Clean-up. During and after installation of saw-cut grooves, the Contractor must remove from the pavement all debris, waste, and by-products generated by the operations to the satisfaction of the RPR. Cleanup of waste material must be continuous during the grooving operation. Flush debris produced by the machine to the edge of the grooved area or pick it up as it forms. The dust coating remaining shall be picked up or flushed to the edge of the area if the resultant accumulation is not detrimental to the vegetation or storm drainage system. Accomplish all flushing operations in a manner to prevent erosion on the shoulders or damage to vegetation. Waste material must be disposed of in an approved manner. Waste material must not be allowed to enter the airport storm sewer system. The Contractor must dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes and regulations

621-2.9 Repair of damaged pavement. Grooving must be stopped and damaged pavement repaired at the Contractor's expense when directed by the RPR.

621-2.10 Production rate. The Contractor must furnish at least two grooving machines.

ACCEPTANCE

621-3.1 Acceptance testing. Grooves will be accepted based on results of zone testing. All acceptance testing necessary to determine conformance with the groove tolerances specified will be performed by the RPR.

Instruments for measuring groove width and depth must have a range of at least 0.5 inch and a resolution of at least 0.005 inch. Gauge blocks or gauges machined to standard grooves width, depth, and spacing may be used.

Instruments for measuring center-to-center spacing must have a range of at least 3 inches and a resolution of at least 0.02 inch.

The RPR will measure grooves in five zones across the pavement width. Measurements will be made at least three times during each day's production. Measurements in all zones will be made for each cutting head on each piece of grooving equipment used for each day's production.

The five zones are as follows:

Zone 1	Centerline to 5 feet left or right of the centerline.
Zone 2	5 feet to 25 feet left of the centerline.
Zone 3	5 feet 25 feet right of the centerline.
Zone 4	25 feet to edge of grooving left of the centerline.
Zone 5	25 feet to edge of grooving right of the centerline.

At a random location within each zone, five consecutive grooves sawed by each cutting head on each piece of grooving equipment will be measured for width, depth, and spacing. The five consecutive measurements must be located about the middle blade of each cutting head ±4 inches. Measurements will be made along a line perpendicular to the grooves.

- Width or depth measurements less than 0.170 inch shall be considered less than 3/16 inch.
- Width or depth measurements more than 0.330 inch shall be considered more than 5/16 inch.
- Width or depth measurements more than 0.235 inch shall be considered more than 1/4 inch.

Production must be adjusted when more than one groove on a cutting head fails to meet the standard depth, width, or spacing in more than one zone.

METHOD OF MEASUREMENT

621-4.1 The quantity of grooving to be paid for shall be the number of square yards of grooving performed in accordance with the specifications and accepted by the RPR per paragraph 621-3.1.

BASIS OF PAYMENT

621-5.1 Payment for saw-cut grooving. Payment for saw-cut grooving will be made at the contract unit price per square yard for saw-cut grooving. This price shall be full compensation for furnishing all materials, and for all preparation, delivering, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-621-1	Grooving, unit price per square yard

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5320-12	Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

END OF ITEM P-621

Item P-629 Thermoplastic Coal Tar Emulsion Surface Treatments

DESCRIPTION

629-1.1 This item shall consist of an application of a thermoplastic coal tar emulsion Spray Seal Coat, applied to an existing, previously prepared asphalt surface, including airport pavements serving small airplanes roads, and other general applications. Thermoplastic resin coal tar emulsion products provide a fuel-resistant surface where pavements are subjected to fuel spills. Thermoplastic resin coal tar emulsion products assist in pavement preservation through reducing the rate of pavement oxidation. The application of the surface treatment shall be in accordance with these specifications and shall conform to the dimensions shown on the plans or as directed by the Resident Project Representative (RPR).

MATERIALS

629-2.1 Thermoplastic coal tar emulsion. The emulsion material shall be a thermoplastic coal tar emulsion made up of plastic resin and emulsified coal tar pitch. The thermoplastic coal tar emulsion shall be manufactured as a complete product and tested at the manufacturing plant for material certification. The cured thermoplastic coal tar emulsion sample must pass the fuel-resistance test in accordance with ASTM D5727.

629-2.2 Manufacturer's certifications. The Contractor shall furnish the manufacturer's certification of Analysis (COA) that all thermoplastic coal tar emulsion shipped to the project meets the following testing requirements:

Thermoplastic Coal Tar Emulsion Properties

Property	Standard	Requirement
Water content	ASTM D5727, Section 6.1.6	≤58%
Ash of Residue	ASTM D5727, Section 6.1.9	≤ 15%
Flexibility	ASTM D5727, Section 6.1.14	1 rating
Resistance to Kerosene	ASTM D5727, Section 6.1.12	Pass with no loss of adhesion and no softening of film
Softening Point	ASTM D36	>212°F (100°C)

629-2.3 Manufacturer sampling. A sample of undiluted thermoplastic coal tar emulsion shall be obtained at the production facility from each consignment shipped to the job. Manufacturer shall store the samples in containers that are sealed against contamination and retained for a period of six months. Samples shall be stored at room temperature and not be subjected to freezing temperatures.

629-2.4 Water. Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use. The temperature of the water added during mixing shall be at least 50°F (10°C).

629-2.5 Handling and storage. All emulsion stored on-site shall be agitated at least once per day for a minimum of 15 minutes. The distributor or applicator, pumps and all tools shall be maintained in satisfactory working condition. Spray bar nozzles, pumps, or other equipment can be cleaned mechanically or with clean water.

629-2.6 Health, safety, and environment. The Contractor must provide a complete Safety Data Sheet (SDS) in accordance with U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), Regulations (Standards – 29 CFR), 1910.1200 which establishes the

requirement and minimum information for the SDS for hazardous materials. The SDS, Section II, shall include the Chemical Abstracts Service (CAS) registry numbers for all applicable hazardous ingredients in the coal tar emulsion product. The Contractor must provide the manufacturer's certification that the product complies with the Code of Federal Regulation (CFR) Title 40 – Protection of Environment. The manufacturer's certification shall address compliance for Air Programs, Part 59, National Volatile Organic Compound Emission Standards for Consumer and Commercial Products (for the airport location) and Water Programs, Part 116, Designation of Hazardous Substances.

COMPOSITION AND APPLICATION

629–3.0 Thermoplastic coal tar emulsion spray seal coat without **sand aggregate.**

629-3.1 Quantities of materials per square yard. Based on the data in this specification, the Contractor shall submit the proportions of thermoplastic coal tar emulsion and aggregate proposed for use to the RPR for approval prior to the start of operations. A copy of the test data required by this specification shall be submitted to the RPR for approval along with the above information. No thermoplastic coal tar emulsion spray seal coat shall be produced for payment until approved in writing by the RPR.

Application Rate without Aggregate

Composition	Application Rate gal/yd² (L/m²)
75% thermoplastic coal tar emulsion and 25% water (±5%)	0.15-0.25 (0.081-0.136)

Application Rate with Aggregate

Application Coat(s)	Composition [i] lbs/gal (kg/L)	Application Rate [ii] Per Coat gal/yd² (L/m²)	Total Application Rate [ii] gal/yd² (L/m²)
1	6 (0.72)	0.20-0.30 (0.76-1.14)	0.20-0.30 (0.76-1.14)
2	3 (0.36)	0.10-0.15 (0.38-0.57)	0.20-0.30 (0.76-1.14)

i. Aggregate (lbs) shall be mixed with the undiluted thermoplastic coal tar emulsion (gals).
ii. Minimum application rate of uncured thermoplastic coal tar emulsion spray seal coat.

629-3.2 Aggregate. The aggregate material shall be a dry, clean, dust and dirt free, sound, durable, angular shaped manufactured specialty sand, such as that used as an abrasive, with a minimum Mohs hardness of 6. The Contractor shall submit manufacturer's technical data and a manufacturer's certification indicating that the specialty sand meets the requirements of the specification to the RPR prior to bid. The sand must be approved for use by the RPR and shall meet the following gradation limits:

Aggregate Material Gradation Requirements

Sieve Designation (square openings)	Percentage by Weight Retained Sieves
No. 20 (850 µm)	0-2
No. 30 (600 µm)	0-12
No. 40 (425 µm)	2-60
No. 50 (300 µm)	5-60
No. 70 (212 µm)	5-60
No. 100 (150 µm)	5-30
No. 140 (106 µm)	0-10
No. 200 (75 µm)	0-2
Finer than No. 200	0-0.3

The Contractor shall provide a certification showing particle size analysis and properties of the material delivered for use on the project.

629-3.3 Application.

a. Pavement surfaces which have excessive runoff of seal coat due to excessive amount of material being applied or excessive surface grade shall be treated in two or more applications to the specified application rate at no additional cost to the Owner. If multiple coats are specified, each coat shall be allowed to dry and cure initially before applying any subsequent coats. The initial drying shall allow evaporation of water of the applied mixture, resulting in the coating being able to sustain light foot traffic.

If low spots and depressions greater than 1/2 inch (12 mm) in depth in the pavement surface cause ponding or puddling of the applied materials, the pavement surface shall be broomed with a broom drag. Brooming shall continue until the pavement surface is free of any pools of excess material. Ponding and/or puddling shall not cause excessive pavement softening and/or additional distress. The RPR shall inspect and approve areas after brooming.

During all applications, the surfaces of adjacent structures shall be protected to prevent their being spattered or marred. Thermoplastic coal tar emulsion materials shall not be discharged into borrow pits or gutters.

629-3.4 Equipment and tools.

a. Seal coat distributor. The seal coat distributor shall be either a truck-mounted 300 to 3,000-gallon (1136 to 11356 liter) tank or a trailer-mounted unit with a 300 to 1000 gallons (1136 to 3785 liters) containing suitably driven mixing blades to combine predetermined quantities of thermoplastic emulsion, aggregate if specified and if necessary, water into a homogeneous mixture. It shall be equipped with a diaphragm style pump capable of delivering a constant volume of material to a spray wand or spray bar. The device shall have a bottom ball valve capable of delivering material to a squeegee spreader or a drag box.

b. Auxiliary equipment. Other tools or equipment such as power brooms, power blowers, air compressors, hand brooms, hand squeegees, etc., shall be provided as required.

c. Calibration. The Contractor shall furnish all equipment, materials and labor necessary to calibrate the equipment. It shall be calibrated to assure that it will produce and apply a mix that conforms to the job mix formula. Commercial equipment should be provided with a method of calibration by the manufacturer. All calibrations shall be made with the approved job materials prior to applying the seal coat to the pavement. A copy of the calibration test results shall be furnished to the RPR.

629-3.5 Control strip. A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying control areas and/or control strips. The Contractor shall prepare a control

strip at the specified application rate. Separate control strips by a minimum of 200 feet between sections. The area to be tested will be designated by the RPR and will be located on the existing pavement.

The control strip shall determine the quality of the mixture in place as well as the performance of the equipment. The same equipment and method of operations shall be used on the control strip as will be used on the remainder of the work. If the control strip should prove to be unsatisfactory, the necessary adjustments to the mix composition, application rate, placement operations and equipment shall be made. Additional control strips shall be placed and evaluated if required.

a. For taxiway, taxilane and apron surfaces. Prior to full application, the Contractor shall place test area as specified by the manufacturer's representative and RPR. The test area will be located on representative section of the pavement to receive the Thermoplastic coal tar emulsion spray seal coat designated by the RPR.

b. For runway and high-speed taxiway surfaces. Prior to full application, the Contractor shall place a control strip a minimum of 300 feet (90 m) long by 12 feet (3.6 m) wide, or width of anticipated application, whichever is greater, as stipulated by the manufacturer's representative and RPR. The area to be tested will be located on a representative section of the pavement to receive the Thermoplastic coal tar emulsion spray seal coat designated by the RPR. Before beginning the control strip, the skid resistance of the existing pavement shall be determined for each control strip with a continuous friction measuring equipment (CFME). The skid resistance test after application shall be at approximately the same location as the test done on the existing pavement. The Contractor may begin testing the skid resistance of runway and taxiway control strips after application of the Thermoplastic coal tar emulsion spray seal has fully cured. Aircraft shall not be permitted on the runway or taxiway control strips for a minimum of 24 hours and until such time as the Contractor validates that its surface friction meets AC 150/5320-12. The results of the friction evaluation meet or exceed the Maintenance Planning levels provided in Table 3-2, "Friction Level Classification for Runway Pavement Surfaces," in AC 150/5320-12, Measurement, Construction, and Maintenance of Skid-resistant Airport Pavement Surfaces, when tested at speeds of 40 and 60 mph (65 and 95 km/h) wet with approved CFME.

If the control strip should prove to be unsatisfactory, necessary adjustments to the application rate, placement operations, and equipment shall be made. Additional control strips shall be placed and additional skid resistance tests performed and evaluated. Full production shall not begin without the RPR's approval of an appropriate application rate. Acceptable control strips shall be paid for in accordance with paragraph 629-8.1.

629-3.6 Friction characteristics For projects where thermoplastic coal tar emulsion spray seal coat is applied on runway and taxiway surfaces, the Contractor shall submit to the RPR friction tests, from previous airport projects which used the thermoplastic coal tar emulsion spray seal coat in a similar environment, in accordance with AC 150/5320-12, at 40 or 60 mph (65 or 95 km/h) wet, showing, as a minimum; friction value of pavement surface prior to thermoplastic coal tar emulsion spray seal coat application; two values, tested between 24 and 96 hours after application, with a minimum of 24 hours between tests; and one value tested at no less than 180 days or greater than 360 days after the thermoplastic coal tar emulsion spray seal coat application. The results of the two tests between 24 and 96 hours shall indicate friction is increasing at a rate to obtain similar friction value of the pavement surface prior to application, and the long-term test shall indicate no apparent adverse effect with time relative to friction values and existing pavement surface. The Contractor shall submit to the RPR a list of airports which meet the above requirements, as well as technical details on application rates, aggregate rates, and point of contact at these airports to confirm use and success of thermoplastic coal tar emulsion spray seal coat with aggregate. Friction tests shall be submitted from no less than one of the airports on the list and each set of tests described above, must be from one project.

The thermoplastic coal tar emulsion spray seal coat submittal without the required friction performance will not be approved. Friction tests performed on this project cannot be used as a substitute of this requirement.

CONSTRUCTION METHODS

629-4.1 Worker safety. The Contractor shall obtain a SDS for both the thermoplastic coal tar emulsion product and aggregate and require workmen to follow the manufacturer's recommended safety precautions.

629-4.2 Weather limitations. The material shall not be applied when the humidity or impending weather conditions will not allow proper drying or when the atmospheric or pavement temperature is below 50°F (10°C), unless otherwise directed by the RPR.

During application of thermoplastic coal tar emulsion surface treatment, account for wind drift. Cover existing buildings, structures, runway edge lights, taxiway edge lights, informational signs, retro-reflective marking and in-pavement duct markers as necessary to protect against overspray before applying the emulsion. Should thermoplastic coal tar emulsion surface treatment get on any light or marker fixture, promptly clean the fixture. If cleaning is not satisfactory to the RPR, the Contractor shall replace any light, sign or marker with equivalent equipment at no cost to the Owner.

629-4.3 Preparation of asphalt pavement surfaces. Clean pavement surface immediately prior to placing the surface treatment so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease by scrubbing with a detergent, then wash thoroughly with clean water. Any additional surface preparation, such as crack repair, shall be in accordance with P101-3.6.

629-4.4 Application. Application shall be in accordance with paragraph 629-3.3.

629-4.5 Curing. The mixture shall be permitted to dry for a minimum of 24 hours after the application, before opening to traffic or painting, and shall be sufficiently cured to drive over without damage to the installation. Any damage to the uncured mixture caused by the Contractor will be the responsibility of the Contractor to repair.

QUALITY CONTROL (QC)

629-5.1 Field emulsion sampling. All emulsion sampling methods shall be in accordance with ASTM D140. Samples must be taken from the center of an agitated bulk storage tank after a minimum of 15 minutes of continual agitation.

629-5.2 Field composite mix sampling. Composite mix of thermoplastic coal emulsion and aggregate shall be taken directly from the pug mill of the mobile mixing machine for micro-surface and sand slurry installations into a sealed 1-gallon container to be weighed. The minimum weight of composite mix shall be the following:

a. Type A Micro-Surface Composite Mix – Minimum 14 pounds per gallon

b. Type B Micro-Surface Composite Mix – Minimum 13.5 pounds per gallon

c. Sand Slurry Composite Mix – Minimum 13 pounds per gallon

629-5.3 Manufacturer's representation. The manufacturer's representative shall have knowledge of the material, procedures, and equipment described in the specification and shall be responsible for verifying the job mix formula submitted to the RPR and shall oversee the preparation and application of the thermoplastic coal tar emulsion surface treatment. Documentation of the manufacturer representative's experience and knowledge for applying the thermoplastic coal tar emulsion surface treatment shall be furnished to the RPR a minimum of 10 work days prior to placement of the control strips. The cost of the manufacturer's representative shall be included in the bid price.

629-5.4 Contractor qualifications. The Contractor shall provide the RPR Contractor qualifications for applicators, personnel and equipment. The Contractor shall also provide, from the thermoplastic coal tar emulsion Manufacturer, documentation that the Contractor is certified to apply the thermoplastic coal tar emulsion surface treatment. Contractor shall provide documentation for at least three (3) applications similar to this project completed in the past two (2) years.

MATERIAL ACCEPTANCE

629-6.1 Friction tests. Friction Test in accordance with AC 150/5320-12, Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces, shall be accomplished on all runway and taxiways that have received a seal coat. The Contractor shall coordinate testing with the RPR. Each test includes performing friction tests at 40 mph and 60 mph (65 and 95 km/h) both wet, 15 feet (4.5 m) to each side of runway centerline. Friction test shall be run within 30 days prior to application of the seal coat to runway and/or high-speed taxiways and after application of the seal coat. The RPR shall be present for testing. The Contractor shall provide a written report of friction test results.

METHOD OF MEASUREMENT

629-7.1 Measurement. The Thermoplastic Coal Tar Emulsion Spray Seal Coat without Sand Aggregate shall be measured by the square yard (sq m) of the area indicated on the contract drawings or designated by the RPR.

BASIS OF PAYMENT

629-8.1 Payment. Payment shall be made at the contract unit price per square yard (square meter) for the Thermoplastic Coal Tar Emulsion Spray Seal Coat without Sand Aggregate. This price shall fully compensate the Contractor for furnishing all materials and for all labor, equipment tools and incidentals necessary to complete the thermoplastic coal tar emulsion product installation, including mix design and data sheets stipulated in these specifications.

Payments will be made under:

Item P-629-8.1 Thermoplastic coal tar emulsion Spray Seal Coat without Sand Aggregate – per square yard.

Item P-629-8.2 Runway and High Speed Exit Taxiway Friction Testing – per lump sum

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D36	Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D140	Standard Practice for Sampling Bituminous Materials
ASTM D5340	Standard Test Method for Airport Pavement Condition Index Surveys
ASTM D5727	Standard Specification for Emulsified Refined Coal Tar (Mineral Colloid Type)

Advisory Circulars (AC)

AC 150/5320-12	Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces
AC 150/5320-17	Airfield Pavement Surface Evaluation and Rating (PASER) Manuals

Code of Federal Regulations (CFR)

29 CFR Part 1910.1200	Hazard Communication
40 CFR	Protection of the Environment

END OF ITEM P-629

ITEM L-100 GENERAL PROVISIONS – ELECTRICAL

DESCRIPTION

100-1.1 This item is intended to supplement the specifications for the Airfield Electrical, Lighting and Lighting Control requirements of this contract. It is the intent and meaning of the Plans and Specifications that the Contractor shall provide an electrical installation that is operational and complete, including all items and appurtenances necessary, reasonably incidental or customarily included, even though each and every item is not specifically called out or shown.

100-1.2 Installations and construction under these provisions shall be coordinated with the Engineer. Specification requirements for approvals, reviews, or other involvements of the Engineer shall be transmitted by the Contractor to the Engineer.

QUALITY ASSURANCE

100-2.1 APPLICABLE CODES AND STANDARDS.

a. Codes. All electrical work shall conform to the requirements and recommendations of the latest edition of the National Electrical Code. In conflicts among drawings, specifications and codes, the most stringent requirements shall govern.

b. Standards. The specifications and standards of the following organizations are by reference made part of these specifications and all electrical work, unless otherwise indicated, shall comply with their requirements and recommendations wherever applicable.

1. Institute of Electrical and Electronic Engineers (IEEE)

2. American National Standards Institute (ANSI)

3. American Society for Testing and Materials (ASTM)

4. Insulated Power Cable Engineers Association (ICEA)

5. National Bureau of Standards (NBS)

6. National Electrical Contractor's Association (NECA)

7. National Electrical Manufacturer's Association (NEMA)

8. National Fire Protection Association (NFPA)

9. Underwriter's Laboratories, Inc. (UL)

10. National Electrical Safety Code (NESC)

100-2.2 REQUIREMENTS OF REGULATORY AGENCIES

a. Airport lighting equipment and materials covered by FAA specifications shall be certified under the Airport Lighting Equipment Certification Program described in Advisory Circular (AC) 150/5345-53, current edition, and be listed in the current Addendum of the AC. All Advisory Circulars referenced in these specifications shall be the latest edition.

b. All other equipment and materials, covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Engineer.

c. The requirements and recommendations of the latest edition of the Occupational Safety and Health Act are by reference made a part of these specifications and all electrical work shall comply with their requirements and recommendations wherever applicable.

100-2.3 WORKMANSHIP AND PERSONNEL REQUIREMENTS

a. All electrical work shall be performed by workmen skilled in the electrical trade and licensed for the work by the State of Texas. The Engineer will recognize the credentials of Master Electricians with valid current licenses from the State of Texas. Credentials will be recognized of Journeyman Electricians with valid current licenses from the State of Texas or other licensing entities having established reciprocal agreements with this municipality.

b. A licensed Master Electrician will be required for the issuance of a building permit for constructing, installing, altering, maintaining, repairing or replacing any electrical wiring, apparatus, or equipment on any voltage level in the jurisdiction of the Airport.

c. A licensed Master Electrician or a licensed Journeyman Electrician is required to be on the job site whenever any electrical work is performed. Any airfield electrical work or associated electrical installations shall be accomplished under the direct supervision of a licensed Journeyman Electrician.

d. To ensure compliance with Paragraph "c" above, only a documented Electrical work force with a ratio of a maximum of three (3) licensed Apprentices for each licensed Journeyman Electrician shall be allowed to work on the airfield electrical systems.

e. Contractor shall prepare documentation associated with the electrical work force confirming adherence to the requirements of Paragraph "d" above. These documents shall be submitted to the Resident Project Representative for approval. Also, any work force changes or revisions which affect compliance with paragraph "d" above shall also be submitted to the Resident Project Representative for approval.

f. All airfield circuits will be handled throughout the installation process by qualified licensed electrical personnel.

g. Every airfield lighting cable splicer shall be qualified in making airfield cable splices and terminations on cables rated above 1,000 volts A.C. The Contractor shall submit for approval of the Engineer proof of the qualifications of each proposed cable splicer for the cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three (3) years continuous experience in terminating/splice medium voltage cable at airports.

h. At least thirty (30) days prior to performing any cable splicing/terminating, Contractor shall submit to the Engineer a written list of proposed cable splicing/terminating personnel, including written evidence that the proposed personnel have had a minimum of eight (8) hours of technical training by authorized splice/termination kit manufacturer personnel. Approved training shall include a thorough review of kit components and splicing/terminating techniques and procedures. Field splices shall only be installed by technicians approved by the Engineer.

i. In addition, each trained cable splicer shall be required to install a splice and a connector on type and size of the cable to be used under this contract. Sample connections shall be accomplished in accordance with the manufacturer's instructions and in the presence of the Resident Project Representative.

j. The Contractor performing construction on the airfield electrical and/or communication system shall have a minimum of 5 years of experience on construction of projects of similar type of work and of similar size and complexity. The owner will require all Electrical Contractors bidding on this project to submit proof of experience that they have successfully completed at least two projects of comparative size and complexity within the past 5 years.

k. Electrical contractor qualifications shall be based on previous work experience as follows:

1. Provide electrical vault upgrades specifically for 5KV equipment of similar size and capacity.

2. Perform construction activities within an active AOA.

3. Provide airfield lighting, signage and infrastructure installation of similar size and complexity within past 2 years.

100-2.4 EQUIPMENT, MATERIAL AND INSTALLATION REQUIREMENTS

a. The Contractor shall furnish and install all materials, equipment, accessories, connections and incidental items in accordance with the approved recommendations of the manufacturer and the best practices of the trade to provide a complete installation ready for use and operational by the Owner.

b. All equipment and materials shall be new, unless specifically noted otherwise, and shall bear the manufacturer's name, trademark and ASME, UL, and/or other labels in every case where a standard had been established for the particular item.

c. Where applicable, equipment shall be FAA approved design of a standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be supported by a service organization reasonably convenient to the site, as determined by the Engineer.

d. The Contractor shall promptly notify the Engineer in writing of any conflict between any requirements of the Contract Documents and equipment manufacturer's directions and shall obtain written instructions from the Engineer before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's

directions or such written instructions from the Engineer, Contractor shall bear all costs arising in correcting deficiencies.

e. After review of equipment submittals, and instructions by the Engineer to proceed, equipment installations may require arrangements or connections different from those shown on the drawings. It is the responsibility of the Contractor to install the equipment to operate properly. The Contractor shall provide any additional equipment and/or materials required for installations to operate in accordance with the intent of the drawings and specifications.

f. It is the responsibility of the Contractor to insure that items installed fit the space available with adequate room for proper equipment operation and maintenance. Contractor shall make field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation provides a complete and operational system that complies with the requirements of the drawings and specifications.

g. The Contractor shall be responsible for coordinating proper location of roughing in and connections by other trades. Changes associated with coordination requirements shall be made at no increase in the Contract amount or additional costs to other trades.

h. The Contractor shall support work and equipment plumb, rigid and true to line. The Contractor shall determine how equipment, fixtures, conduit, etc., are to be installed, as required by codes, drawings and specifications. Foundations, bolts, inserts, stands, hangers, brackets and accessories required for proper support shall be provided by the Contractor, whether or not specifically indicated on the drawings.

100-2.5 SUBMITTALS. Submit manufacturer's data or shop drawings following Item L-106 – Submittals, Record Documents and Maintenance Manuals.

100-2.6 INSPECTION AND TESTING

a. All work performed by the Contractor shall be subject to periodic inspections by the Engineer, the Owner’s Representative, and the Owner's Resident Project Representative to verify that the installation is in compliance with the applicable requirements of these specifications.

b. System and component testing shall be performed as specified in Item L-111 Airfield Electrical Installation and Testing. Test results shall be evaluated by the Engineer and the Resident Project Representative based upon the criteria indicated.

c. Any installation found which does not conform to the required technical provisions of these specifications or any specimen which does not meet the test criteria defined in Item L-111 Airfield Electrical Installation and Testing, shall be immediately removed by the Contractor and then replaced at his expense. When required, testing shall be performed on the new specimen in place to verify compliance with the criteria defined in Item L-111 Airfield Electrical Installation and Testing.

CONSTRUCTION PROVISIONS

100-3.1 AOA AREA INSTALLATION PROVISIONS. To enhance personnel safety and avoid contractual problems, the Contractor shall comply with the provisions indicated below.

100-3.2 ELECTRICAL WORK PROVISIONS.

a. Existing Underground Utilities. At least forty-eight (48) hours prior to beginning any excavation within the AOA, locations of all utility lines and FAA cables in the construction area will be identified and marked with surveyor flags by appropriate utility and/or FAA personnel. The Contractor shall be responsible for maintaining the location flags. Any flags displaced shall be replaced by the Contractor. The Contractor shall coordinate with Resident Project Representative any additional prior notification time required during weekend and/or holiday work periods.

b. Also at least forty-eight (48) hours prior to beginning any excavation within the AOA, the contractor shall request the airport Resident Project Representative to have airport staff identify circuits in proposed excavation areas. The Contractor shall coordinate with Resident Project Representative any additional prior notification time required during weekend and/or holiday work periods.

c. The above noted line identification information shall not relieve the Contractor of the responsibility of pinpointing underground lines to avoid unplanned disruptions or disturbing of installation or operation of underground lines in construction areas. Contractor shall use cable tracing equipment or other methods approved by the Resident Project Representative at his disposal, to pinpoint line locations. Excavation shall not proceed until all underground lines have been identified to the satisfaction of the Resident Project Representative.

d. Contractor shall hand excavate in areas of Airport underground electrical lines to avoid disturbing circuits such as FAA, telecom and NAVAIDS.

e. Repair of underground lines damaged by the Contractor shall be the sole responsibility of the Contractor.

100-3.3 EXISTING ELECTRICAL EQUIPMENT AND MATERIALS. The Contractor shall remove all existing wiring and electrical equipment made unnecessary by the new installation. All materials removed shall become property of the Contractor and disposed of by the Contractor. The Contractor shall list materials according to type, class and/or size, and store or dispose of materials as directed by the Resident Project Representative.

100-3.4 POWER SERVICE CONTINUITY. Provide labor, materials and supervision required to maintain full capacity power service continuity when connection or modifications are made to existing systems and facilities. Do not interrupt service without prior consent of the Resident Project Representative, with a definite understanding of time and duration of outage. All outages will take place at a time for minimum disruption of facility activity. Coordinate with Owner.

100-3.5 AS-BUILT DRAWINGS

a. The Contractor shall maintain a set of as-built drawings on the job site as required the General Provisions of the Contract. Contractor shall mark on the as-built drawings all work details, alterations installed to meet site conditions and changes made by Change Notices. As-built drawings shall be kept available for inspection by the Resident Project Representative and/or the Engineer at all times. Refer to Item L106 Submittals, Record Documents and Maintenance Manuals for additional requirements.

b. Airfield wiring verification diagrams shall be maintained throughout the project and later submitted to the airport manager upon completion. These field wiring diagrams shall depict the exact routing and number of cables installed in each conduit originating from the airfield lighting vaults and extending to each manhole, handhole, pullbox, sign, and lighting fixture for each new circuit or circuit revision as applicable to the construction documents. Refer to Item L-106 Submittals, Record Documents and Maintenance Manuals for additional requirements.

MEASUREMENT AND PAYMENT

100-4.1 GENERAL. There will be no measurement or payment for this section. All work will be considered incidental for complete installation of the work to which it is related.

END OF ITEM L-100

ITEM L-104 RECOMMENDED LOCKOUT PROCEDURE FOR AIRFIELD LIGHTING CIRCUIT

DESCRIPTION

104-1.1 The Contractor is required to lockout the power source feeding any airfield lighting circuit that he will come in contact with (either by hand or with equipment) during the course of the workday. Coordinate with the RPR. Airfield lighting circuits can be locked out only with the approval of the airport manager. They must be returned to service the same day unless prior arrangements have been made. Cloudy or overcast days may delay or cancel a scheduled lockout.

a. In order to gain access to the circuit power source, the Contractor will contact his RPR at least 48 hours prior to the day and hour when the circuit lockout is required. The Contractor will identify, in writing, his work area and the circuit to be locked out.

b. The RPR will then contact the Airport Manager at least 24 hours in advance, with all the pertinent information, so the work may be scheduled, and verify that the circuit can be turned off as requested. The Airport Manager will determine if the circuit can remain de-energized outside of daylight hours. Request for lockouts that occur on recognized holidays, or Saturdays and Sundays, or after normal working hours, (0530 to 2230), will require special notice. In this case the Airport Manager must be notified a minimum of two regular working days in advance of the lockout occurrence. The Contractor, the RPR, and the Airport Manager, if required, will meet at the vault for the lockout. The Contractor shall provide a 5000-volt, direct current megger. The megger shall be a 120-volt A.C. device, as opposed to a hand crank type, and calibrated within the last three months. The Airport Manager's Authorized Representative will de-energize the circuit. *(See note at the end of the procedure). The Contractor will install his lock on the scissor clip, locking out the disconnect.

c. The Contractor will insulate between the field contact of the S-1 switch of all series circuits to be locked out prior to megging. The insulating piece(s) will remain in place until all circuits are meggered for release of lockout. The Contractor will megger the circuit in the presence of the Airport Manager's Authorized Representative. The megger will be connected to the circuit and allowed to energize the circuit for a full three minutes at 1000 volts, before the reading is taken. The Contractor will record the reading by completely filling out the lockout log form (example attached) on the tablet at the door of the regulator room. The RPR will notify the Airport Manager to report the circuit lockout time and the megger reading.

d. The Contractor will install an appropriate Safety Tag on the locked out disconnect switch. The tag will show the name of the Contractor, and the date.

e. As soon as practical after the work is complete, but no later than the same day unless prior arrangements have been made, the Contractor will notify the RPR, who will in turn notify the Airport Manager that the circuit is ready to be re-energized. The Contractor, the Airport Manager's Authorized Representative and the RPR will meet at the vault to re-test the circuit.

f. The Contractor will megger the circuit for five minutes in the presence of the Airport Manager's Authorized Representative and the RPR and record the reading on the form. He will also, at this time, megger across the field connections of the S-1 switch if present to ensure continuity and correct field connections. If the readings are acceptable to the Airport Manager's Authorized Representative and the RPR, then the Contractor will remove his safety tag and lock. If the readings are not acceptable, then the Contractor must correct the problem immediately or prove that the problem is not in his work area. An acceptable megger reading must be registered before the circuit can be released (acceptance of the circuit at this time does not relieve the Contractor of liability for damage discovered later which results from faulty workmanship). If the circuit is to be left off after dark, the RPR must notify the Airport Manager with detailed information concerning the outage. Some outages will require continued work to re-energize circuits.

g. Under no circumstance will the Circuit Disconnect Switch be turned back on by anyone other than the Airport Manager or their Representative. The RPR will notify the Airport Manager to report the time the circuit was released and the megger reading.

PRODUCTS (NOT USED)

EXECUTION (NOT USED)

MEASUREMENT AND PAYMENT

104-4.1 There will no separate measurement for payment of the work discussed in this section. All work will be considered incidental for the completion of the component of the work to which it is related.

END OF ITEM L-104

ITEM L-106 SUBMITTALS, RECORD DOCUMENTS AND MAINTENANCE MANUALS

DESCRIPTION

106-1.1 GENERAL. The items described in this section are applicable to all electrical work by the Contractor. Where the contract special conditions or general provisions also apply, the stricter of the documents shall apply.

106-1.2 SCOPE. This section includes the requirements for submittals, record documents operation and maintenance (O&M) manuals. All submittals and O & M Manuals shall be submitted in book form as described in this item.

SHOP DRAWINGS AND SAMPLES

106-2.1 REQUIREMENTS FOR SHOP DRAWINGS AND SAMPLES. Shop drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor or any subcontractor, manufacturer, supplier or distributor, and which illustrate some portion of the work.

a. Submittal data for electrical materials and equipment shall consist of shop drawings and/or catalog cuts showing technical data as necessary to evaluate the material or equipment, to include dimensions, wiring diagrams, performance curves, ratings, control sequence and other descriptive data necessary to describe fully the item proposed and its operating characteristics.

b. Samples are physical examples furnished by the Contractor to illustrate materials, equipment or workmanship, and to establish standards by which the work will be judged. Each sample shall be accompanied by the manufacturer's instructions regarding installation, operation and maintenance and shall be identified by item number, and specification.

c. The Contractor shall review, stamp with his approval and submit to the Engineer, one (1) electronic full-size shop drawings, an electronic copy of all submittals and one (1) set of samples (if specifically requested by the engineer) within fifteen (15) days of notice to proceed.

d. If the Contractor desires to deviate from the requirements of the contract documents, the Contractor shall separately submit all deviations from the requirements of the contract documents in shop drawings or samples. The submission shall direct in writing the specific attention of the Engineer to the deviations, and shall contain all required data and supporting documentation necessary for an evaluation of the proposed deviation. Any submission or deviation not identified as heretofore mentioned shall be rejected and require resubmission. Separate written approval of all deviations by the Engineer for all design related deviations and by the RPR for all other deviations is required before the Contractor may perform the work covered by such deviation. By requesting a deviation, the Contractor makes the representations contained in this section.

e. If approval is given, the Contractor will not be excused from producing work in conformity with contract requirements. If a trial use establishes the work does not meet the contract requirements, the Contractor shall take such action as the Engineer determines necessary to meet the contract requirements. No change in contract time will be made as a result of changes made under this subparagraph. By requesting a deviation, the Contractor makes the representations contained in this section.

106-2.2 SUBSTITUTIONS AFTER BID DATE. Substitutions will only be considered after bid date only if the following conditions are met and allowed by other sections of these specifications.

a. Request for substitution is submitted no later than 15 days after notice to proceed for construction is awarded to the Contractor.

b. Request for substitution includes appropriate credit to the project cost. This credit must be submitted with request for substitution in order for substitution to receive any consideration.

c. Samples may be requested to be submitted for all substituted light fixtures, wiring devices and other items deemed necessary by the Engineer to determine that the substituted item meets all specifications and requirements before approval of substitutions can be made.

d. Requested samples shall be submitted within 15 days after the notice to proceed of the contract.

e. Request for substitution shall include the name of the material or equipment for which it is to be substituted, drawings, cuts, performance and that data or any other data or information necessary for the Engineer to determine that the equipment meets all specifications and requirements.

f. Where permitted and approved, the substitution must conform to space requirements. Substitutions that cannot meet space requirements, which is the substitution installer's responsibility whether approved or not, shall be replaced at the Contractor's expense. Any substitution modifications of related systems, as a result of the substitution, shall be made at the Contractor's expense.

g. The Contractor represents that it has personally investigated the proposed substitution and determined that the proposed substitution is equal or superior in all respects to the specified method or equipment.

h. The Contractor represents that it will provide a warranty for the substitution identical in all respects to the warranty for the specified method or equipment.

i. The Contractor represents that it will coordinate the installation of the accepted substitute, making changes as may be required for the work to be complete in all respects at no additional costs to the Airport.

j. The Engineer shall be the sole judge of whether the proposed "or equal" is suitable for use in the work.

106-2.3 SUBSTITUTIONS PRIOR TO BID DATE. Substitutions will be considered prior to bid date only if all the following conditions are met:

a. A written request has been submitted to the Engineer for approval not less than 7 days prior to the bid date.

b. Substitution samples may be requested to be submitted for all substituted light fixtures, wiring devices and other items deemed necessary by the Engineer to determine that the substituted item meets all specifications and requirements before approval of substitutions can be made.

c. Substitution samples shall be submitted not less than 7 days prior to the receipt of bids.

d. Request for substitution shall include the name of the material or equipment for which it is to be substituted, drawings, cuts, performance and that data or any other data or information necessary for the Engineer to determine that the equipment meets all specifications and requirements.

e. Substitution is approved and included in an addendum.

f. By approving and submitting shop drawings and samples, the Contractor thereby represents that he/she has determined and verified all field measurements, field construction criteria, materials, catalog numbers and similar data and that the Contractor, has checked and coordinated each shop drawing and sample with the requirements of the work of the contract documents.

g. Unless otherwise stated in the contract documents, the Engineer will review and approve shop drawings and samples within fifteen (15) days after receipt, but only for conformance with the design concept of the project and with the information given in the contract documents. The Engineer's approval of a separate item shall not indicate approval of an assembly in which the item functions.

h. The Contractor shall make any corrections required by the Engineer and shall resubmit the corrected shop drawings or new samples until approved. The Contractor shall direct specific attention in writing or on resubmitted shop drawings to revisions other than the corrections requested by the Engineer on previous submissions.

i. The Engineer's approval of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the requirements of the contract documents unless the Contractor has informed the Engineer in writing of such deviation at the time of submission and the Engineer has given written approval to the specific deviation. The Engineer's approval shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings or samples.

j. The submittals will be reviewed for design intent and general compliance with the information contained in the drawings and specifications. The Contractor is responsible for dimensions, quantities, fabrication processes and methods of construction, coordination of the Contractor’s work with that of all trades. The Contractor shall be responsible for satisfactory performance of his work and supplying a complete and operational system.

k. No portion of the work requiring a shop drawing or sample submission shall be commenced until the submission has been approved by the Engineer. All such portions of the work shall be in accordance with approved shop drawings and samples.

l. Samples, upon request, shall be submitted after written notice of acceptance and approval has been made of each substitution. The Engineer reserves the right to reject the sample should the sample not meet the requirement of the contract documents.

106-2.4 SUBMITTALS. All submittals shall be submitted electronically and must contain the following:

a. First sheet must contain the following:

1. Project Name/Location

2. Unique identifiable submittal number.

3. Any resubmittal must contain the original submittal number as part of the resubmittal number along with an additional field (numeric or alphabetic) incremented by 1 for each subsequent resubmittal until the entire submittal contents are approved.

4. Date Submitted

5. Submittal Due Date

6. Submittal Description

7. Associated Specification and/or Dwg Sheet number

8. Any other relevant information to aid the reviewer of the submittal

b. The second sheet shall be a table of contents identifying all items to be reviewed in the submittal.

c. Subsequent pages shall consist of readily identifiable marked catalog sheets or shop drawings in proper order. Submittal data shall be presented in a clear and thorough manner. Original catalog cut-sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Markings shall be boldly and clearly made with arrows or circles. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles.

106-2.5 SHOP DRAWINGS: Drawings to include identification of project and name of Engineer, Contractor, subcontractors and suppliers, data, number sequentially and indicate the following:

a. Fabrication and erection dimensions.

b. Arrangements and sectional views.

c. Necessary details, including complete information for making connections with other work.

d. Kinds of materials and finishes.

e. Descriptive names of equipment.

f. Modifications and options to standard equipment required by the work.

g. Leave blank area, size approximately 4-inches x 2-1/2-inches, near title block (Engineer's stamp imprint).

h. Point-to-point wiring diagrams.

i. Conduit/raceway rough-in drawings.

j. See specific sections of specifications for further requirements.

106-2.6 SUBMITTAL PRODUCT DATA. Technical data is required for all items as called for in the specifications regardless if item furnished is as specified.

a. Submit technical data verifying that the item submitted complies with the requirements of the specifications. Technical data shall include manufacturer's name and model number, dimensions, weights, electrical characteristics, and clearances required. Indicate all optional equipment and changes from the standard item as called for in the specifications. Furnish drawings or diagrams, dimensioned and in correct scale, covering equipment, showing arrangement of components and overall coordination.

b. In order to facilitate review of product data, insofar as practicable, they shall be noted, indicating by cross reference the contract drawings, note, and/or specification paragraph numbers where item(s) occur in the contract documents.

c. See specific sections of specifications for further requirements.

106-2.7 PROCESSING SUBMITTALS.

a. The Contractor shall review the submittal before submitting to the Engineer. No request for payment will be considered until the submittal has been reviewed, submitted for approval and approved.

b. Submit under provisions of the Special Conditions, Section 1 and this section of the specifications, whichever is the most strict.

c. Product Data: For standard manufactured materials – submit all data electronically. If submittal is rejected, resubmittal shall be submitted electronically with clear notation that it is a resubmittal with appropriate identifiable submittal number (follow paragraph 2.04.a.2.(a)).

d. Shop Drawings: All shop drawings to be submitted electronically as full-size sheets.

e. Acceptance:

1. When returned to Contractor, the front of each submittal section will be electronically marked with the Engineers stamp. If box marked “Submit Specified Item”, or “Rejected” or “Revise and Resubmit” is checked, submittal is not accepted and Contractor is to correct and resubmit as noted. Contractor is to comply with notation making necessary corrections on submittal and resubmit for final record.

2. If submittal is returned “Approved”, “Approved as Noted”, Contractor may begin construction utilizing the submitted item with corrections made. Contractor is to comply with any notation making necessary corrections on submittal.

3. If the submittal is returned “Approved” the Engineer took no exceptions to the submitted.

4. If the submittal is marked “Approved as Noted”, “Revise and Resubmit” or “Submit Specified Item”, the Contractor shall make or note any corrections or requirements identified in the attached submittal review. Corrections or comments made on the shop drawings during this review do not relieve the Contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for; confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that of all other trades and performing all work in a safe and satisfactory manner.

f. Note that the approval of shop drawings or other information submitted in accordance with the requirements herein before specified, does not assure that the Engineer, or RPR, attests to the dimensional accuracy or dimensional suitability of the material or equipment involved, the ability of the material or equipment involved or the mechanical/electrical performance of equipment. Approval of shop drawings does not invalidate the plans and specifications, if in conflict, unless a letter requesting such a change is submitted and approved on the Engineer's letterhead.

106-2.8 DELAYS. The Contractor is responsible for delays in project time accruing directly or indirectly from late submissions or resubmissions of shop drawings, or product data.

106-2.9 RE-SUBMITTALS. The Engineer shall be reimbursed the cost to review resubmittals subsequent to the second submittal. The cost of review of submittals after the second submittal will be determined and the cost shall be withheld from the Contractor’s earnings each month permanently.

RECORD DOCUMENTS

106-3.1 PROGRESS AND RECORD DRAWINGS

a. Keep one set of blue line prints on the job and neatly markup design drawings each day as components are installed. Different colored pencils shall be used to differentiate each system of electrical work. All items on progress drawings shall be shown in actual location installed. Drawings shall be inspected weekly for compliance and accuracy. Progress payments shall be withheld if the marked-up drawings are not current.

b. All underground ducts, conduits, drains, ground grids, force mains, etc., (all underground utilities) installed by the Contractor or located by the Contractor during the construction of this project shall be surveyed. The data shall be sufficient to accurately relocate the utility at a later date. The data shall include North-South and East-West coordinates and an elevation. This data shall be recorded on the as-built drawings.

c. All manholes and other structures installed by the Contractor shall be surveyed. The center of the structure shall be located by a North-South and East-West coordinate and an elevation. This data shall be recorded on the as-built drawings.

d. Change the equipment schedules to agree with items actually furnished. At the end of the project, all changes shall be transferred to a set of reproducible transparencies of the design drawings marked "As Built" and dated and stamped by the Contractor.

e. Prior to request for final payment, furnish a set of "As Built" electronic dwgs to the Engineer for approval. The prints shall be stamped "As-Built", signed and dated by the electrical contractor.

f. The Contractor's failure to produce representative "As Built" drawings in accordance with requirements specified herein, shall be cause for the Engineer to produce such "As-built" drawings and the Contractor shall reimburse the Engineer for all costs to produce a set of "Record" drawings to the RPR's satisfaction.

g. Complete and sign the Progress and Record Document Certification Form in Appendix A, Figure 5 and submit with the Operation and Maintenance Manuals. Submit one form for each Contractor/Subcontractor providing as-built information and include a copy of each form in the O & M Manuals.

106-3.2 REQUIREMENTS FOR DISPLAY DRAWINGS. An "as built" control and field wiring diagram shall be displayed in the vault. Size D minimum framed and installed. In addition to the wiring diagram (showing actual connections between the system components), a "schematic" diagram shall be provided. A schematic diagram to show the electrical interrelation among the different systems components in the simplest way possible without being cluttered with actual wiring. It should show the path of the signal flow or the power flow. These drawings shall be submitted to the Engineer for approval. The Contractor shall coordinate the requirements with the RPR provide the above at no additional cost to the Airport.

OPERATION AND MAINTENANCE MANUALS

106-4.1 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS. Within each major division of work, each specification section in the contract documents which require submission of O & M information shall be individually identified by a typed index tab. The Contractor shall provide four (4) copies of manufacturer's manuals for all installed equipment. As a minimum, it shall contain the following:

a. Safety precautions used while maintaining the equipment.

b. Theory of circuit and system operation.

c. Complete schematic and interconnecting wiring diagrams

d. Complete parts list with each circuit component keyed to designations assigned on schematics and wiring diagrams. Complete information shall be given for each part to permit ordering for replacement purposes. This information shall include the components rating, name of manufacturer and the manufacturer's part number in addition to the following:

e. Recommended preventive maintenance, including care, cleaning, lubrication, service schedules, etc.

f. Troubleshooting procedures.

g. Physical characteristics (weight, size, mounting dimensions, etc.).

h. Installation instructions.

i. Operating instructions.

j. Recommended spare parts and usage for a 1-year period.

k. Submit for checking purposes a specific set of written operating instructions on each item which requires instructions to operate. After approval, provide one copy for insertion in each Operation and Maintenance Manual.

l. Submit for approval maintenance information consisting of manufacturer's printed instructions and parts list for each major item of equipment. After approval, insert information in each Operations and Maintenance Manual. Detailed schematic diagrams shall be furnished for all electrical/electronic equipment.

m. Bill of materials.

n. Physical layout plans.

o. Equipment supplier list.

p. Panel schedules shall be submitted with the respective panel data.

q. Special instructions.

r. Service maintenance contracts including the name, address and 24-hour phone number and contact of manufacturers authorized repair company.

s. There shall be no "Black Boxes" for which there are no schematic/wiring diagrams.

106-4.2 OPERATION AND MAINTENANCE MANUALS. O & M Manuals shall consist of hard cover, view type, 3-ring binders sized to hold 8-1/2-inch x 11-inch sheets.

a. Each binder is to be adequately sized to comfortably hold required submittals. Minimum spline size to be 1-inch, maximum spline size to be 3-inch (provide additional binders if 3-inch size is not sufficient to properly hold submittals). Each binder shall be adequately sized to hold the submittal information plus an additional 25% of the submittal sheet count.

b. Binder covers to have outer clear vinyl pocket on front and back cover (to hold 8-1/2-inch x 11-inch sheet) and on spline (to hold spline width x 11-inch sheet). Binders shall be Wilson Jones Standard Locking D-Ring View Binders or approved equivalent. Provide correct designation of project in each pocket, see "EXAMPLES" Appendix A, Figures 6 and 7 included at the end of this section. Description sheet is to be white with black letters, maximum sheet height of 11-inch high and full width of pocket. Description is to describe project and match pocket drawing/specification description. Description to include submittal type. One (1) for Airfield Lighting System Materials (black) and one (1) for the Airfield Lighting Control System (blue).

106-4.3 OPERATION AND MAINTENANCE MANUAL CONTENTS. O & M Manuals to include:

a. First sheet in binder shall be a photocopy of the cover sheet see Appendix A, Figure 6.

b. The second sheet shall be a table of contents.

c. The third sheet shall be filled out by the Contractor and shall list project addresses, see Appendix A, Figure 3.

d. The fourth sheet shall also be filled out by the Contractor and list project information for project, see Appendix A, Figure 4.

e. Provide Wilson Jones, reinforced, clear, ring binder indexes, 5-tab No. WJ-54125 or approved equal with the appropriate specification section number, and typed index for each section.

f. Shop Drawings: Shop drawings shall be a copy of the final and approved shop drawings submitted as required in Item L-106-2, Shop Drawings and Samples. These shall be inserted in the binder in proper order. Each catalog sheet shall clearly identify where the product is used and the drawing identification for equipment. Clear vinyl pockets shall be provided for insertion of shop drawings.

g. Product data and/or catalog sheets shall be a copy of the final and approved submittal submitted as required in Item L-106-2, Shop Drawings and Samples. These shall be inserted in the binder proper order. Each catalog sheet shall clearly identify where the product is used and the drawing identification for equipment.

h. Warranty/Guarantee: Provide a copy of the warranty/guarantee and letters of certification, in respective locations in the O & M Manual binder. Original warranty/guarantee is to be incorporated into a separate project warranty book with warranty/guarantees provided for other sections of the specifications and submitted for Engineer approval.

i. Performance Verification and Demonstration to RPR.

j. Tabulated Data (as required in L-111, Airfield Electrical Installation and Testing).

k. Required Check-Out Memos.

l. Progress and Record Drawing Certification.

m. Ground Test Information.

106-4.4 PROCESSING O & M MANUALS

a. Submit one set of O & M Manual. The Contractor shall review the manual before submitting them to the Engineer. An electronic copy of the O&M Manual shall be submitted to the Engineer for review.

106-4.5 DELAYS. The Contractor is responsible for delays in project time accruing directly or indirectly from late submissions or resubmissions of the Operation and Maintenance Manuals.

106-4.6 RE-SUBMITTALS. The Engineer shall be reimbursed the cost to review Operation and Maintenance Manuals, re-submittals subsequent to the second submittal. The cost of review of Operation and Maintenance Manuals after the second submittal will be determined and the cost shall be withheld from the Contractor's earnings each month permanently.

MEASUREMENT AND PAYMENT

106-5.1 The items described in this section are incidental to other sections and not shall be measured for payment. No direct payment shall be made for the work described in this section. The work described in this section is incidental to other items and shall be paid for in the respective bid item of which it is a component part.

END OF ITEM L-106

ITEM L-111- AIRFIELD ELECTRICAL INSTALLATION AND TESTING

DESCRIPTION

111-1.1 SECTION INCLUDES

a. This item shall consist of furnishing all equipment, materials and appliances necessary for testing of airfield lighting circuit installations and associated systems.

b. The Contractor shall provide testing to confirm installations are acceptable for ground rod testing and airfield lighting circuit testing.

c. Requirements under this item shall be coordinated with the Airport Resident Project Representative. Specification requirements for approvals, reviews or other involvement of the Engineer shall be transmitted by the Contractor to the Engineer.

111-1.2 RELATED SECTIONS

a. Item L-108 - Underground Power Cable for Airports

b. Item L-125 – Installation of Airport Lighting Systems

EQUIPMENT AND MATERIALS

111-2.1 GENERAL. Materials and equipment covered by this item shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Engineer.

CONSTRUCTION METHODS

111-3.1 GENERAL. The Contractor shall furnish all necessary equipment and appliances for testing installations as indicated below.

111-3.2 GROUND ROD TESTING.

a. Contractor shall provide equipment and personnel to measure the resistance to earth for all ground rods installed. Earth resistance measurement tests shall adhere to recommendations of IEEE Standard 142, latest edition. Contractor shall submit testing procedure, equipment and report form to the Resident Project Representative for approval.

b. As each rod is installed, tests shall be administered. Any rod that does not have a resistance to ground of 15 ohms or less shall be augmented by an additional rod not less than 10 feet away. No testing of the additional rod is required. Testing results, including confirmation of installation of augmenting ground rods, shall be submitted to the Engineer for approval.

111-3.3 AIRFIELD LIGHTING CIRCUITS TESTING. The Contractor shall notify the Resident Project Representative and Airport Manager 4-hours prior to cable testing. All testing shall be conducted in the presence of the Resident Project Representative and Airport Manager's Authorized Representative. All test results shall be simultaneously recorded by the Contractor and the Airport Manager's Authorized Representative. Contractor shall provide test report information to the Resident Project Representative and the Airport Manager's Authorized Representative for approval. Test procedures for the following required tests, including field test report forms, shall be submitted to the Resident Project Representative for approval prior to testing.

a. Testing Requirements.

1. All Circuits. Prior to commencement of work on any circuit the Low Voltage Tests shall be performed in accordance with procedures below.

2. All Circuits. Upon completion of all rewiring of each circuit, the Low Voltage Tests shall be performed on the completed circuit following paragraph 2 below, to determine if the circuits are free of grounds. Circuits tested shall meet the requirements of paragraph 3 below. Any faults indicated by these tests shall be corrected before proceeding with additional testing. All test results shall be submitted to the Resident Project Representative for approval.

b. Testing Procedures.

1. Low Voltage Tests. Low Voltage Continuity and Insulation-Resistance (Megger) Tests

2. Test Required. As noted in Part A above, circuits and portions of circuits shall be subjected to a low voltage (1000 volt) continuity test and a low voltage (1000 volt) insulation-resistance (megger) test.

3. Test Products. Contractor shall provide a 1000 volt direct current Megger for low voltage testing. Megger tester shall be non-crank type, as manufactured by Associated Research Meg-Check, the James Biddle Megger, General Radio Mega-Ohmmeter or approved equivalent. The Contractor shall be responsible for providing any required 120V AC power source at testing locations remote from available power. Products calibration information shall be readily available for review by the Resident Project Representative, as requested.

4. Test Procedures. Test procedures for the required tests, including field test report forms, shall be submitted to the Resident Project Representative for approval prior to testing.

5. Test Results. Test values not meeting the requirements of paragraph c below shall be considered faulty and shall be corrected accordingly. Refer to paragraph D below for cables not meeting testing requirements.

c. Testing Results.

1. New Circuits and New Portions of Existing Circuits.

2. Low Voltage Tests shall demonstrate to the satisfaction of the Airport Manager's Authorized Representative the following:

3. All circuits are properly connected following the applicable wiring diagrams.

4. All lighting power and control circuits are continuous and free from short circuits.

5. All circuits are free from unspecified grounds.

~~6.~~ The insulation-resistance to ground is equivalent to or greater than 50 mega-ohms for all new non-grounded series circuits.

d. Deficient Testing Results (Circuits Not Meeting Requirements).

1. New Circuits and New Portions of Existing Circuits.

2. Cables not meeting the requirements of sub-paragraph c above shall be considered faulty. Faulty cables shall be corrected, if possible, and re-tested. If acceptable test values cannot be obtained, cables, connectors and isolation transformers shall be removed and replaced with new cable, connectors and isolation transformers at Contractor's expense, as directed by the Resident Project Representative. Required testing of new cable in place shall then be implemented.

e. Submittal of Testing Data.

1. Low Voltage Tests. Contractor shall submit 5 copies of tests reports for approval by the Airport Manager's Authorized Representative and the Engineer-of-Record. Report shall include all measured data including applied voltage, time length of voltage application of cable within a circuit.

DATE CABLE NUMBER	
START TIME	OPERATING VOLTAGE
END TIME	MAX. TEST VOLTAGE
CABLE B/M NO.	FROM PRODUCTS
DESCRIPTION	TO PRODUCTS
TEMP. MEASURE EQUIP. NO.	HUMID. MEASURE
CALIBRATION DUE DATE	EQUIP. NO.
AMBIENT TEMPERATURE	RELATIVE HUMIDITY

111-3.4 SYSTEM TESTS

a. After the airfield lighting systems installation is complete and at such times as the Engineer may direct, the contractor shall conduct airfield lighting systems operating tests for approval.

b. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. The test shall be performed in the presence of the Engineer or his authorized representative. The contractor shall furnish all equipment and personnel required for the test.

c. Each applicable switch in the control tower lighting panels shall be operated so that each switch position is engaged at least ten times. During this process, all lights and associated equipment shall be observed to determine that each control device properly commands the corresponding circuit. Radio communication between the operator and the observers shall be provided by the Contractor.

d. The above tests shall be repeated from the local control switches on the regulators. Each installed or revised lighting circuit shall be tested by operating the lamps throughout the range of applicable steps and shall be operated separately at Step 3 or Step 5 as appropriate for full intensity or as directed by the Engineer, for not less than 1 hour. Visual examination shall be made at the beginning and at the end of this test to determine that the installed airfield light fixtures are illuminating at full intensity.

e. If circuit regulators are installed under project construction, regulator output ampacity shall be adjusted for proper outputs following manufacturer's recommendations and requirements to insure proper circuit operation.

f. Systems tests shall confirm by demonstration in service that all lighting circuits are in good operating condition to the satisfaction of the Engineer if the tests are unsatisfactory, lighting systems installed shall be corrected and systems tests shall again be implemented.

MEASUREMENT AND PAYMENT

111-4.1 There will no separate measurement for payment on the work discussed in this section. All work will be considered incidental for the completion of the component of the work to which it is related.

END OF ITEM L-111

ITEM L-125 INSTALLATION OF AIRPORT LIGHTING SYSTEMS

DESCRIPTION

125-1.1 This item shall consist of airport lighting systems furnished and installed in accordance with this specification, the referenced specifications, and the applicable advisory circulars (ACs). The systems shall be installed at the locations and in accordance with the dimensions, design, and details shown in the plans. This item shall include the furnishing of all equipment, materials, services, and incidentals necessary to place the systems in operation as completed units to the satisfaction of the RPR.

EQUIPMENT AND MATERIALS

125-2.1 GENERAL.

Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified under the Airport Lighting Equipment Certification Program in accordance with AC 150/5345-53, current version. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not performs as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.

Manufacturer's certifications shall not relieve the Contractor of their responsibility to provide materials in accordance with these specifications and acceptable to the RPR. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the RPR and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

All materials and equipment used shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Clearly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be clearly made with arrows or circles (highlighting is not acceptable). The Contractor shall be responsible for delays in the project accruing directly or indirectly from late submissions or resubmissions of submittals.

The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the plans and specifications. The Contractor's submittals shall be submitted in electronic PDF format, tabbed by specification section. The RPR reserves the right to reject any or all equipment, materials or procedures, which, in the RPR’s opinion, does not meet the system design and the standards and codes, specified herein.

All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months

from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

EQUIPMENT AND MATERIALS

125-3.1 CONDUIT/DUCT. Conduit shall conform to Specification Item L-110 Airport Underground Electrical Duct Banks and Conduits.

125-3.2 CABLE AND COUNTERPOISE. Cable and Counterpoise shall conform to Item L-108 Underground Power Cable for Airports.

125-3.3 TAPE. Rubber and plastic electrical tapes shall be Scotch Electrical Tape Numbers 23 and 88 respectively, as manufactured by 3M Company or an approved equal.

125-3.4 CABLE CONNECTIONS. Cable Connections shall conform to Item L-108 Installation of Underground Cable for Airports.

125-3.5 RETROREFLECTIVE MARKERS. Retroreflective markers shall be type L-853 and shall conform to the requirements of AC 150/5345-39.

125-3.6 RUNWAY AND TAXIWAY LIGHTS. Runway and taxiway lights shall conform to the requirements of AC 150/5345-46. Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract. Filters shall be of colors conforming to the specification for the light concerned or to the standard referenced.

a. Refer to the contract documents for type of light, base and transformer including class, mode, style and option as appropriate for project.

b. See engineering FAA Engineering Brief No. 67 “Light Sources other than Incandescent and Xenon for Airport Lighting and Obstruction Lighting Fixtures for additional information on LED fixtures.

c. Refer to plan drawings for fixture installation details.

d. Fixture Hold Down Bolts. Fixture hold down bolts and installations shall adhere to the following requirements.

1. Bolts shall be all-thread, 18-8, Grade 2 Carbon Steel with Fluoropolymer Coating. Bolts shall be colored orange or pink.

2. Bolts information shall be submitted for approval of the Engineer. Submittal shall be specifically identified, at a minimum, the bolt material, dimensions and threading.

3. Bolt material shall be readily identifiable in the field by appropriate ASTM markings on the bolts or by having material identified on bolt packaging, as approved by the Engineer.

4. Normally, bolts are supplied with the bases, not the fixtures. However, the usual bolts supplied with the bases are too short to extend into base can. The Contractor shall install bolts long enough to extend 1 inch inside the rim of the

can after proper installation to hold down fixtures. Bolts of appropriate length and type shall be ordered accordingly.

5. Lock washers shall be installed on each bolt as per fixture base manufacturer's recommendations. Appropriate lock washers are usually provided with bases.

e. Spacer Rings. Install as allowed by the FAA criteria.

f. Concrete. Concrete shall adhere to requirements of Item P-610. Reinforcing steel shall conform to provisions of Item P-610. Precast base cans are not approved for use.

g. Sealer Products. Products used shall conform to applicable requirements for Joint Sealing Filler. Submit materials with satisfactory adhesive and waterproofing qualities for approval of the Owners representative. The joint sealer shall be a 2-component, Polyurethane P-606 compliant sealant similar to Q-Seal 295 or equal.

h. Joints. Use joint sealing material across concrete pavement joints. Where conduit is being installed in saw cut trench in existing pavement, OZ Gedney Type DX Expansion Fitting shall be installed at intersection of conduit installation and existing concrete pavement expansion joints.

125-3.7 RUNWAY AND TAXIWAY SIGNS. Runway and Taxiway Guidance Signs should conform to the requirements of AC 150/5345-44.

a. Refer to the contract documents for sign type, size style class and mode.

b. The nameplate required by 150/5345-44, latest edition, shall be made of metal with the data stamped into the metal nameplate.

c. Provide 6 inch high, die cut labels for each sign, labels shall be reflective film, with pressure-sensitive adhesive backing, suitable for exterior applications. Labels shall be UV resistant. Labels shall be yellow for installation on black surface, black for installation on other surfaces. Text shall be: number and letter style; Helvetica medium, upper case, 6-inch height.

d. The quantity of sign modules is based on two (2) characters per module. Payment shall be made on the basis of a module consisting of two characters, regardless of the manufacturing methods or techniques.

125-3.8 RUNWAY END IDENTIFIER LIGHT (REIL). Not required.

125-3.9 PRECISION APPROACH PATH INDICATOR (PAPI). Not required.

125-3.10 CIRCUIT SELECTOR CABINET. Not required.

125-3.11 LIGHT BASE AND TRANSFORMER HOUSINGS. Light Base and Transformer Housings should conform to the requirements of AC 150/5345-42. Light bases shall be as noted on the contract documents and shall be provided as indicated or as required to accommodate the fixture or device installed thereon. Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures

125-3.12 ISOLATION TRANSFORMERS. Isolation Transformers shall be Type L-830, size as required for each installation. Transformer shall conform to AC 150/5345-47.

INSTALLATION

125-4.1 INSTALLATION. The Contractor shall furnish, install, connect and test all equipment, accessories, conduit, cables, wires, buses, grounds and support items necessary to ensure a complete and operable airport lighting system as specified here and shown in the plans.

The equipment installation and mounting shall comply with the requirements of the National Electrical Code and state and local code agencies having jurisdiction.

The Contractor shall install the specified equipment in accordance with the applicable advisory circulars and the details shown on the plans.

125-4.2 TESTING. All lights shall be fully tested by continuous operation for not less than 24 hours as a completed system prior to acceptance. The test shall include operating the constant current regulator in each step not less than 10 times at the beginning and end of the 24-hour test. The fixtures shall illuminate properly during each portion of the test.

125-4.3 SHIPPING AND STORAGE. Equipment shall be shipped in suitable packing material to prevent damage during shipping. Store and maintain equipment and materials in areas protected from weather and physical damage. Any equipment and materials, in the opinion of the RPR, damaged during construction or storage shall be replaced by the Contractor at no additional cost to the owner. Painted or galvanized surfaces that are damaged shall be repaired in accordance with the manufacturer's recommendations.

125-4.4 ELEVATED AND IN-PAVEMENT LIGHTS. Water, debris, and other foreign substances shall be removed prior to installing fixture base and light.

A jig or holding device shall be used when installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Light fixtures shall be oriented with the light beams parallel to the runway or taxiway centerline and facing in the required direction. The outermost edge of fixture shall be level with the surrounding pavement. Surplus sealant or flexible embedding material shall be removed. The holding device shall remain in place until sealant has reached its initial set.

a. Install and mount the products to comply with the requirements of the National Electric Code, Item L-111 and Item L-108.

b. General Cable Installation Requirements

1. The primary cable shall enter the light base and transformer housing as shown on the plans.

2. Primary cable slack shall be provided inside the light fixture base following Item
L-108. In general, enough slack shall be left in the cable to permit installation aboveground of the connections between the primary cable and the isolation transformer primary leads. A similar length of primary cable slack shall be provided for any unconnected cable installed in a fixture base can.

3. The transformer secondary leads shall be connected to the lamp leads with a disconnecting plug and receptacle. The secondary connection shall not be taped; the cable connections to the insulating transformer's leads shall be made following Item L-108.

4. The connector joints in the primary circuit shall be wrapped with at least 3 layers of synthetic rubber tape and 2 layers of plastic tape, one-half lapped, extending at least 1-1/2 inches on each side of the joint. Refer to section L-108.

5. Ends of cables shall be sealed with heat shrinkable tubing until the splice is made to prevent the entrance of moisture.

c. General Duct and Conduit Installation Requirements. Trenching, installation of ducts and conduits, concrete backfilling, trench backfilling, installation of duct markers and the type of material used shall conform to Item L-110.

d. General Light Fixture Base Installation Requirements.

1. Caution shall be exercised during light base installation to prevent the collection of foreign matter in products and on operating components. All installation residue shall be collected as installation progresses. As directed by Owners Representative, a cover shield shall be used to protect components from foreign matter during installation.

2. Fixture base shall be installed in existing reinforced concrete or asphalt pavements with connecting conduit as shown on the plans. Precast base cans are not approved for use.

3. Light bases shall be set level. Leveling jig shall be required as specified and as directed by the RPR. Turn leveling tool over to owner for spare parts.

4. Where fixtures bases are encased in concrete, use PVC coated rigid galvanized steel conduit for fixture connection through the encasement. Transition to PVC Schedule 40 outside of the encasement.

5. Install reinforcement in the concrete encasement consisting of No. 4 bar tie bar cage. Base can encasement shall be cast-in-place. Pre-cast base cans are not allowed.

6. Flexible, seal tight steel conduit shall not be used unless specifically approved by the RPR. If approved for use, a maximum length of two (2) feet of flexible, sealtight steel conduit can be installed at the connection point to fixture base cans, only where rigid conduit connections cannot be made. Any flexible, sealtight steel conduit bend radius shall meet the cable manufacturer's minimum bend radius requirements or shall meet bend radius requirements for rigid conduit. The more stringent requirement shall govern, as determined by the RPR.

7. Light or bases shall have 1, 2 or more 2-inch threaded metallic hubs for all required conduit entrances, or as indicated on the plans. Grommeted conduit entrances are strictly prohibited. The cable entrance hubs shall be oriented in the proper direction so as to align with the connecting conduit.

8. Stub-in conduit connections into existing light bases shall be Meyers Hub installation, where required on the plans and as noted on plan details.

9. Furnish base with a drain conduit connection as shown in contract drawings.

10. Furnish a light base ground consisting of a #6 AWG bare copper wire jumper bonded to the external ground lug on the base to a ground rod installed adjacent to the base.

11. Furnish a light fixture bonding conductor consisting of a (minimum 6-foot length) #6 AWG stranded copper wire rated for 600V with green XHHW insulation. Connect conductor from internal ground lug on base can to light fixture base plate following light fixture manufacturers recommendations.

12. When existing light fixtures are removed for the purpose of installing new conductors, lockwashers shall be re-installed using new hold down bolts.

13. Breakage of fixture hold down bolts normally and regularly occurs in the field during fixture removal or fixture installation. When breakage occurs, the Contractor shall adhere to the following requirements:

a) The Contractor shall submit a broken bolt removal process for approval of the OAR.

b) Submittal shall include information about the planned broken bolt removal process and jig required to effectively drill and tap broken bolts, when necessary.

c) Whenever encountered, broken bolts shall be removed.

d) Where drilling and tapping is required, a jig approved for use by the RPR shall be used.

e) All broken bolts shall be replaced with new hold down bolts. In the event that light fixture bases are permanently damaged in the course of removing broken bolts, the Contractor shall be held responsible for the immediate repair/replacement of the lighting base. Permanent damage includes drilling of holes which exceed the required 3/8 inch bolt diameter and/or any “off centered” impressions that penetrate the inner lip of the existing bolt holes.

f) Use of "helicoils" shall be strictly prohibited as a method of dealing with stripped bolt holes, unless specifically approved in extreme emergency conditions by the Owners Representative.

g) Light fixture bases to be used as junction boxes shall be installed at the approximate locations indicated in the plans, or as directed by the Owners Representative.

h) For elevated fixtures installed on standard L-867

1) Use 18-8 stainless steel bolts with 2-piece locking washer sets.

2) Provide material submittal of anti-seize compound to Engineer for approval prior to use.

3) Perform Bolt Clamping Force Test as noted in Section X-100 to determine required bolt torque.

i) For fixtures installed on stainless steel base cans or L-868 type galvanized steel base cans:

1) Use ceramic coated “orange” bolts, MCB Industries #L201-2416x1.75 or equal, with 2-piece locking washer sets.

2) Do NOT apply anti-seize compound.

3) Perform Bolt Clamping Force Test as noted in Section X-100 to determine required bolt torque.

j) For new fixtures installed on existing L-868 type base cans:

1) Remove existing bolts and install new ceramic coated “orange” bolts, MCB Industries #L201-2416x1.75 or equal, with 2-piece locking washer sets.

2) Do NOT apply anti-seize compound.

3) Perform Bolt Clamping Force Test as noted in Section X-100 to determine required bolt torque.

4) Provide new fixture ID following contract documents.

e. General Cable Installation Requirements

1. The primary cable shall enter the light base and transformer housing as shown on the plans.

2. Primary cable slack shall be provided inside the light fixture base following Item L-108. In general, enough slack shall be left in the cable to permit installation aboveground of the connections between the primary cable and the isolation transformer primary leads. A similar length of primary cable slack shall be provided for any unconnected cable installed in a fixture base can.

3. The transformer secondary leads shall be connected to the lamp leads with a disconnecting plug and receptacle. The secondary connection shall not be taped; the cable connections to the insulating transformer's leads shall be made following Item L-108.

4. The connector joints in the primary circuit shall be wrapped with at least 1 layer of synthetic rubber tape and 2 layers of plastic tape, one-half lapped, extending at least 1-1/2 inches on each side of the joint.

5. Ends of cables shall be sealed with heat shrinkable tubing until the splice is made to prevent the entrance of moisture.

f. Installing Light Fixtures at Existing Bases

1. At locations indicated on the plans, the Contractor shall install light fixtures at existing fixture bases. This shall include providing the following items, as required and directed by the RPR.

a) Remove and salvage existing base cover plates.

b) Refurbish and prepare the base flange with flange rings or spacer rings, as required and directed by the OAR, in order to properly install the specified light fixture.

c) Clean out and refurbish the interior of the bases, including conduits.

d) If no ground lug exists on the interior, provide new ground lug with ground strap following base manufacturer's recommendations.

e) Install primary airfield lighting circuit cable or verify existing airfield light cable is properly installed.

f) Install fixture isolation transformers of proper specified rating and wattage.

g) Install specified fixtures.

h) Install concrete collar as shown on the contract documents.

g. An identification tag shall be installed with each light or sign as shown in the plans. Circuit identification tags identifying each circuit shall be attached to each circuit as shown in the plans. Refer to section L-108.

h. Dow Corning Compound III valve lubricant non-curing sealant or approved equal shall be used to seal between sections of base cans, spacer rings, adapter rings or fixtures.

i. Demolition and Salvage. At locations noted on plans, the following shall be required:

1. Existing light fixtures, bases, cables and other materials identified as salvageable by the RPR shall be removed. Salvageable materials shall be delivered to the owner's salvage area or disposed of as directed by the RPR.

125-4.5 SIGNS, BASE CANS.

a. All signs, base cans, etc. shall be installed as shown in the plans or approved shop drawings and in accordance with the applicable FAA Advisory Circulars and manufacturers' recommendations. Survey instruments shall be used to position all items to insure precise orientation. Tolerances given in the FAA Advisory Circulars, these specifications, and the plans shall not be exceeded. Where no tolerance is given, no deviation is permitted. Items not installed in accordance with the FAA Advisory Circulars, these specifications and plans shall be removed and replaced by and at the expense of the Contractor.

b. Signs shall be oriented at 90 degrees to the direction of the taxing path from which it is viewed unless noted otherwise.

c. For all signs, the concrete pad shall extend to not less than eighteen (18) inches out from the edge of the sign all around. The concrete pad shall be a minimum of six (6) inches thick. The concrete pad shall be poured in place and rest on undisturbed soil. The pad shall be reinforced with steel bars formed and placed as indicated in the Plans. Exposed concrete surface shall be finished smooth with a steel trowel or rubbed to a smooth finish. All horizontal edges to be chamfered one (1) inch at 45 degrees.

d. During construction of the pad, the transformer base shall be adjusted and firmly held in place so that machined upper surface of base flange will be level within -2 degrees and not more than 1/4 inch above the surface of pad. All other bearing areas for additional flange supports shall be in the same horizontal plane as the transformer base flange.

e. The Contractor shall completely survey and stake out each areas signage layout prior to starting any installation. Should any irregularities occur in the layout, the RPR shall be notified immediately. The bid item price shall include the necessary surveyed layout for each item and the cost for any additional adjustment or resurvey of the location of the items due to the existing geometric conditions. The new signage installation shall be coordinated with and blend into the signage installation.

f. All loose material shall be removed from all excavations for electrical equipment, raceways, manholes, pads, etc. The bottom of the excavation shall be compacted to 95% compaction in accordance with ASTM D 1557 prior to the installation of the electrical item and backfill.

g. Assemble units and connect to the system in accordance with the manufacturer's recommendations and instructions.

h. An identification monument shall be installed with each fixture, sign, etc. as shown in the plans.

i. Provide three feet (3') of slack in each end of each cable in each base can. All connections shall be able to be made above ground.

j. Painted and galvanized surfaces that are damaged shall be repaired according to the manufacturer's recommendations, to the satisfaction of the RPR. Use cold galvanizing compound or to repair galvanized surfaces. Obtain paint and primer, of same batch number, from the equipment manufacturer to repair painted surfaces.

k. All signs shall use an L-867D size Base Can shall be used.

l. Dewatering necessary to construct L-125 Items and related erosion and turbidity control shall be in accordance with federal, state, and local requirements and is incidental to its respective pay item as a part of L-125. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L-125 Item.

METHOD OF MEASUREMENT

125-5.1 This item provides for the removal of an existing top section of an L-868B base can, and the salvaging and protecting of the existing light fixture installed on the can.

This work includes recording the location of the existing light fixture for re-installation after milling and grooving operations have concluded. This item includes all work and labor associated with this item, including coring existing pavement to free the top section. This item additionally includes the installation of a mud plate and all protective measures required to keep the existing bottom can section protected during milling and grooving operations. Measurement for this item will be per each, installed complete and accepted by the OAR.

125-5.2 This item provides for the installation of a salvaged in-pavement light, or a new owner provided LED light fixture on an existing base can. This item includes installation of the salvaged light fixture with all bolts and base can hardware required, cable tags, light ID markers as required, safety ground, testing and all items necessary to complete installation. Incidental to this item is the testing to determine the required bolt torque following section X-100 including, but not limited to, testing for determination of the K factor, mock-up of lighting assembly and all materials and tools necessary to conduct the test following EB-83A. Measurement for this item will be per each, installed complete and accepted by the OAR.

125-5.3 This item provides for the procurement and installation of a new L-868B base can top section on an existing bottom section. This item includes all bolts and hardware required to make the connection, as well as all spacers and incidental equipment required for a complete and accepted system. Measurement for this item will be per each, installed complete and accepted by the OAR.

125-5.4 This item provides for the procurement and installation of a new or salvaged in-pavement light of the type shown with new base can of the type shown in new concrete pavement areas. This item includes installation of the light fixture with, lens, lamps, new L-868B base can with grade 2 carbon steel coated bolting hardware with CEC lock washers, nylon bushing, gasket, spacers, multi-hole adapter ring, connector kit, isolation transformer, heat shrinks, cable tags, light ID marker, concrete encasement with reinforcement, safety ground, stainless steel ground rod including all terminations, testing and all items necessary to complete installation. Incidental to this item, if required, is the special height base can with bricks. Incidental to this item is the testing to determine the required bolt torque following section X-100 including, but not limited to, testing for determination of the K factor, mock-up of lighting assembly and all materials and tools necessary to conduct the test following EB-83A. Also incidental to this item, is the removal of the existing base can in the pavement block-out reconstruction area, including all components. Measurement for this item will be per each, installed complete and accepted by the OAR.

125-5.5 This item provides for the repair or replacement of bolt threads, as identified in the drawings and specifications. This item includes the labor and materials required for the bolt removal and thread repair including multi-hole adapter plate, threaded inserts, bolting hardware and all incidentals required to provide a complete and operational system. Measurement for this item will be per each, installed complete and accepted by the OAR. There is no separate measurement for base can type.

125-5.6 Temporary Electrical Provisions shall be measured by the lump sum for all project phases and scope and shall include installation of temporary L-824C, #8 5KV cables, associated conduit where required by operations, trench where required by operations, temporary sign panels or blanking of sign panels as directed by Operations, blanking out of existing fixtures including both inpavement and elevated as required by Operations, splicing of existing cables, L-823 connectors, removal, site restoration and all incidentals, complete in place. There is no separate measurement for work zone or project phase.

BASIS OF PAYMENT

125-5.7 Payment for this item will be made at the contract unit price per each completed and accepted light assembly, which constitutes full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, supervision, equipment, tools and incidentals necessary to complete this item. Unsuitable materials removed must be disposed of off-site by the Contractor in accordance with local laws and regulations. All other materials removed must be hauled separately to the EMMS, unless otherwise directed by the OAR. The cost of removing and disposing of the material will not constitute a pay item and will be considered incidental to installation.

125-5.8 Payment for this item will be made at the contract unit price per each, which constitutes full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, supervision, equipment, tools and incidentals necessary to complete this item. The quantity of this bid item is an assumed quantity for bidding purposes. These locations and total quantity of this item will need to be verified on site. In each work area, prior to commencing any repair work on existing bolts, the Contractor in the company of the OAR, must inspect and identify the proposed bolt repair locations. Identification of defects approved for repair shall be at the discretion of the OAR. Payment will be made for the actual quantities as completed by the contractor and approved by the OAR.

125-5.9 Payment will be made at the contract price for required temporary electrical provisions. This item includes all materials, labor, transportation, incidentals and services required for the temporary electrical provisions needed to maintain the airfield electrical systems to the satisfaction of the Airport Authority during each noted construction phase shown on the plans. This item includes any temporary wiring, fixtures, sign panels, blanking of fixtures or sign panels, etc. required to maintain the existing airfield lighting systems to the satisfaction of the Owner and RPR. It is the intent of the temporary electrical provisions pay item that all temporary electrical modifications necessary to properly close the work area for construction while maintaining adjacent utilities is complete during construction and removed following construction and set back to proper operation. There is no additional payment for work zones.

Payment will be made under:

Item L-125-1	REMOVE AND SALVAGE EXISTING IN-PAVEMENT LIGHT FIXTURE, REMOVE TOP SECTION OF BASE CAN, PER EACH
Item L-125-2	INSTALL SALVAGED IN-PAVEMENT LIGHT FIXTURE OR OWNER PROVIDED LED FIXTURE ON EXISTING BASE CAN, PER EACH
Item L-125-3	INSTALL NEW L-868B BASE CAN TOP SECTION ON EXISTING L-868B BASE CAN BOTTOM SECTION PER EACH
Item L-125-4	INSTALL SALVAGED IN-PAVEMENT LIGHT FIXTURE OR OWNER PROVIDED LED FIXTURE ON NEW L-868B BASE CAN IN MODIFIED PAVEMENT AREA, PER EACH

Item L-125-5	REPAIR BROKEN BOLTS AND THREADS AT EXISTING BASE CAN, PER EACH
Item L-125-6	TEMPORARY ELECTRICAL PROVISIONS, PER LUMP SUM

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-18	Standards for Airport Sign Systems
AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-28	Precision Approach Path Indicator (PAPI) Systems
AC 150/5345-39	Specification for L-853, Runway and Taxiway Retroreflective Markers
AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5345-44	Specification for Runway and Taxiway Signs
AC 150/5345-46	Specification for Runway and Taxiway Light Fixtures
AC 150/5345-47	Specification for Series to Series Isolation Transformers for Airport Lighting Systems
AC 150/5345-51	Specification for Discharge-Type Flashing Light Equipment
AC 150/5345-53	Airport Lighting Equipment Certification Program

Engineering Brief (EB)

EB No. 67	Light Sources Other than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures

END OF ITEM L-125