

Item P-101**Preparation/Removal of Existing Pavements****DESCRIPTION**

101-1 This item shall consist of preparation of existing pavement surfaces for overlay, surface treatments, removal of existing pavement, and other miscellaneous items. The work shall be accomplished in accordance with these specifications and the applicable plans.

EQUIPMENT AND MATERIALS

101-2 All equipment and materials shall be specified here and in the following paragraphs or approved by the Program Manager. 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 Program Manager.

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 underlying material that is to remain in place, shall be recompact and/or replaced as shown on the plans. Adjacent areas damaged during repair shall be repaired or replaced at the Contractor's expense.

b. Asphalt pavement removal. Asphalt pavement to be removed shall be cut to the full depth of the asphalt pavement around the perimeter of the area to be removed. The material to be removed shall be milled.

c. Repair or removal of Base, Subbase, and/or Subgrade. All failed material including surface, base course, subbase course, and subgrade shall be removed and repaired as shown on the plans or as directed by the Program Manager. Materials and methods of construction shall comply with the applicable sections of these specifications. Any damage caused by Contractor's removal process shall be repaired at the Contractor's expense.

101-3.2 Preparation of joints and cracks prior to overlay/surface treatment. Remove all vegetation and debris from cracks to a minimum depth of 1 inch (25 mm). If extensive vegetation exists, treat the specific area with a concentrated solution of a water-based herbicide approved by the Program Manager. Fill all cracks greater than 1/4 inch (6 mm) wide) with a crack sealant per ASTM D6690. The crack sealant, preparation, and application shall be compatible with the surface treatment/overlay to be used. To minimize contamination of the asphalt with the crack sealant, underfill the crack sealant a minimum of 1/8 inch, not to exceed 1/4 inch. Any excess joint or crack sealer shall be removed from the pavement surface.

101-3.3 Removal of Foreign Substances/contaminates prior to overlay and/or remarking.

Removal of foreign substances/contaminates from existing pavement that will affect the bond of the new treatment shall consist of removal of rubber, fuel spills, oil, crack sealer, at least 90% of paint, and other foreign substances from the surface of the pavement. Areas that require removal are designated on the plans and as directed by the Program Manager in the field during construction.

High-pressure water or rotary grinding may be used. Removal methods used shall not cause major damage to the pavement, or to any structure or utility within or adjacent to the work area. Major damage is defined as changing the properties of the pavement, removal of asphalt causing the aggregate to ravel, or removing pavement over 1/8 inch (3 mm) deep. If it is deemed by the Program Manager that damage to the existing pavement is caused by operational error, such as permitting the application method to dwell in one location for too long, the Contractor shall repair the damaged area without compensation and as directed by the Program Manager.

Removal of foreign substances shall not proceed until approved by the Program Manager. Water used for high-pressure water equipment shall be provided by the Contractor at the Contractor's expense. No material shall be deposited on the pavement shoulders. All wastes shall be disposed of in areas indicated in this specification or shown on the plans.

101-3.4 Concrete spall or failed asphaltic concrete pavement repair.

a. Repair of concrete spalls in areas to be overlaid with asphalt. The Contractor shall repair all spalled concrete as shown on the plans or as directed by the Program Manager. The perimeter of the repair shall be saw cut a minimum of 2 inches (50 mm) outside the affected area and 2 inches (50 mm) deep. The deteriorated material shall be removed to a depth where the existing material is firm or cannot be easily removed with a geologist pick. The removed area shall be filled with asphalt mixture with aggregate sized appropriately for the depth of the patch. The material shall be compacted with equipment approved by the Program Manager until the material is dense and no movement or marks are visible. The material shall not be placed in lifts over 4 inches in depth. This method of repair applies only to pavement to be overlaid.

b. Asphalt pavement repair. The Contractor shall repair all spalled concrete as shown on the plans or as directed by the Program Manager. The failed areas shall be removed as specified in paragraph 101-3.1b. All failed material including surface, base course, subbase course, and subgrade shall be removed. Materials and methods of construction shall comply with the applicable sections of these specifications.

101-3.5 Cold milling. Milling shall be performed with a power-operated milling machine or grinder, capable of producing a uniform finished surface. The milling machine or grinder shall operate without tearing or gouging the underlying surface. The milling machine or grinder shall be equipped with grade and slope controls, and a positive means of dust control. All millings shall be removed and disposed off Airport property. If the Contractor mills or grinds deeper or wider than the plans specify, the Contractor shall replace the material removed with new material at the Contractor's Expense.

a. Patching. The milling machine shall be capable of cutting a vertical edge without chipping or spalling the edges of the remaining pavement and it shall have a positive method of controlling the depth of cut. The Program Manager shall layout the area to be milled with a straightedge in increments of 1-foot (30 cm) widths. The area to be milled shall cover only the failed area. Any excessive area that is milled because the Contractor doesn't have the appropriate milling machine, or areas that are damaged because of his negligence, shall be repaired by the Contractor at the Contractor's Expense.

b. Profiling, grade correction, or surface correction. The milling machine shall have a minimum width of 7 feet and it shall be equipped with electronic grade control devices that will cut the surface to the grade specified. The tolerances shall be maintained within +0 inch and -1/4 inch of the specified grade. The machine must cut vertical edges and have a positive method of dust control. The machine must have the ability to remove the millings or cuttings from the pavement and load them into a truck. All millings shall be removed and disposed of off the airport in areas designated on the plans.

c. Clean-up. The Contractor shall sweep the milled surface daily and immediately after the milling until all residual materials are removed from the pavement surface. Prior to paving, the Contractor shall wet down the milled pavement and thoroughly sweep and/or blow the surface to remove loose residual

material. 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 off Airport property.

101-3.6. Preparation of asphalt pavement surfaces prior to surface treatment. Existing asphalt pavements to be treated with a surface treatment shall be prepared as follows:

a. Patch asphalt pavement surfaces that have been softened by petroleum derivatives or have failed due to any other cause. Remove damaged pavement to the full depth of the damage and replace with new asphalt pavement similar to that of the existing pavement in accordance with paragraph 101-3.4b.

b. Repair joints and cracks in accordance with paragraph 101-3.2.

c. Remove oil or grease that has not penetrated the asphalt pavement by scrubbing with a detergent and washing thoroughly with clean water. After cleaning, treat these areas with an oil spot primer.

d. 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.

101-3.7 Maintenance. The Contractor shall perform all maintenance work necessary to keep the pavement in a satisfactory condition until the full section is complete and accepted by the Program Manager. 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 Program Manager, 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 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. Resaw joints removing no more than 1/16 inch (2 mm) 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 Preparation of Cracks in Flexible Pavement prior to sealing. 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 Program Manager, that the method used cleans the cracks and does not damage the pavement.

101-3.9.1 Preparation of Crack. Widen crack with router by removing a minimum of 1/16 inch from each side of crack. Immediately before sealing, cracks will be blown out with a hot air lance combined with oil and water-free compressed air.

101-3.9.2 Removal of Existing Crack Sealant. Existing sealants will be removed by routing. Following routing any remaining debris will be removed by use of a hot lance combined with oil and water-free compressed air.

101-3.9.3 Crack Sealant. Crack sealant material and installation will be in accordance with Item P-605.

101-3.9.4 Removal of Pipe and other Buried Structures.

a. Removal of Existing Pipe Material. Remove the types of pipe as indicated on the plans. The pipe material shall be legally disposed of off-site in a timely manner following removal. Trenches shall be backfilled with material equal to or better in quality than adjacent embankment. Trenches under paved areas must be compacted to 95% of ASTM D1557, when outside of paved areas must be compacted to 95% of ASTM D698.

b. Removal of Inlets/Manholes. Where indicated on the plans or as directed by the Program Manager, inlets and/or manholes shall be removed and legally disposed of off-site in a timely fashion

after removal. Excavations after removal shall be backfilled with material equal or better in quality than adjacent embankment. When under paved areas must be compacted to 95% of ASTM D1557, when outside of paved areas must be compacted to 95% of ASTM D698.

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.

101-4.2 Joint and crack repair. The unit of measurement for joint and crack repair shall be the linear foot (meter) of joint.

101-4.3 Removal of Foreign Substances/contaminates. The unit of measurement for foreign Substances/contaminates removal shall be the square foot.

101-4.4 Spalled and failed asphalt pavement repair. The unit of measure for failed asphalt pavement repair shall be square foot.

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 Program Manager and the Contractor.

101-4.6 Removal of Pipe and other Buried Structures. The unit of measurement for removal of pipe and other buried structures will be made at the contract unit price for each completed and accepted item. This price shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with paragraph 101-3.9.4.

101-4.7 Miscellaneous Demolition. The lump sum price for Miscellaneous Demolition shall include all required demolition not specifically covered by other pay items in this section. The pay item shall include, but is not limited to: underdrain pipe, cleanouts and outlet structures; electrical conduit (both DEB and concrete encased), electrical pullboxes and junction cans.

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 excavation, demolition, debris removal and disposal, labor, equipment, tools, and incidentals necessary to complete this item.

- Item P-101-5.01 Miscellaneous Demolition – per lump sum
- Item P-101-5.02 Demolition – Remove Existing Concrete Swale – per linear foot
- Item P-101-5.03 Remove Existing Light Fixture and Transformer and Turn Light Fixture over to Owner– per each
- Item P-101-5.05 Demolition of Electrical Manhole – per each
- Item P-101-5.06 Demolition of Duct Bank – 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.

Advisory Circulars (AC)

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

ASTM International (ASTM)

ASTM D6690 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

END OF ITEM P-101

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ITEM P-153**CONTROLLED LOW-STRENGTH MATERIAL (CLSM)****DESCRIPTION****153-1.1**

This item shall consist of furnishing, transporting, and placing a controlled low-strength material (CLSM) as flowable backfill in trenches or at other locations shown on the plans or as directed by the Program Manager.

MATERIALS**153-2.1 MATERIALS**

- a. **Cement.** Cement shall conform to the requirements of ASTM C150 Type I, II, or V, or ASTM C595 Type IL, IS, or IP.
- b. **Fly ash.** Fly ash shall conform to ASTM C618, Class C or F.
- c. **Fine aggregate (sand).** Fine aggregate shall conform to the requirements of ASTM C33 except for aggregate gradation. Any aggregate gradation which produces the specified performance characteristics of the CLSM and meets the following requirements will be accepted.

<u>Sieve Size</u>	<u>Percent Passing by weight</u>
3/4 inch	100
No. 200	0 – 12

- d. **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.

MIX DESIGN**153-3.1 PROPORTIONS**

The Contractor shall submit, to the Program Manager, a mix design including the proportions and source of aggregate, fly ash, cement, water, and approved admixtures. No CLSM mixture shall be produced until the Program Manager has given written approval of the proportions. The proportions shall be prepared by a laboratory and shall remain in effect for the duration of the project. The proportions shall establish a single percentage or weight for aggregate, fly ash, cement, water, and any admixtures proposed. Laboratory costs are incidental to this item.

- a. **Compressive strength.** CLSM shall be designed to achieve a 28-day compressive strength of 100 to 200 psi when tested in accordance with ASTM D4832, with no significant strength gain after 28 days.
- b. **Consistency.** Design CLSM to achieve a consistency that will produce an approximate 8-inch diameter circular-type spread without segregation. CLSM consistency shall be determined in accordance with ASTM D6103.

CONSTRUCTION METHODS**153-4.1 PLACEMENT**

- a. **Placement.** CLSM may be placed by any reasonable means from the mixing unit into the space to be filled. Agitation is required during transportation and waiting time. Placement shall be performed

so structures or pipes are not displaced from their final position and intrusion of CLSM into unwanted areas is avoided. The material shall be brought up uniformly to the fill line shown on the plans or as directed by the Program Manager. Each placement of CLSM shall be as continuous an operation as possible. If CLSM is placed in more than one lift, the base lift shall be free of surface water and loose foreign material prior to placement of the next lift.

- b. Contractor Quality Control.** The Contractor shall collect all batch tickets to verify the CLSM delivered to the project conforms to the mix design. The Contractor shall verify daily that the CLSM is consistent with 153-3.1a and 153-3.1b. Adjustments shall be made as necessary to the proportions and materials as needed. The Contractor shall provide all batch tickets to the Program Manager.
- c. Limitations of placement.** CLSM shall not be placed on frozen ground. Mixing and placing may begin when the air or ground temperature is at least 35°F and rising. Mixing and placement shall stop when the air temperature is 40°F and falling or when the anticipated air or ground temperature will be 35°F or less in the 24-hour period following proposed placement. At the time of placement, CLSM shall have a temperature of at least 40°F.

153-4.2 CURING AND PROTECTION

- a. Curing.** The air in contact with the CLSM shall be maintained at temperatures above freezing for a minimum of 72 hours. If the CLSM is subjected to temperatures below 32°F, the material may be rejected by the Program Manager if damage to the material is observed.
- b. Protection.** The CLSM shall not be subject to loads and shall remain undisturbed by construction activities for a period of 48 hours or until a compressive strength of 15 psi is obtained. The Contractor shall be responsible for providing evidence to the Program Manager that the material has reached the desired strength. Acceptable evidence shall be based upon compressive tests made in accordance with paragraph 153-3.1a.

153-4.3 QUALITY ASSURANCE (QA) ACCEPTANCE

CLSM QA acceptance shall be based upon batch tickets provided by the Contractor to the Program Manager to confirm that the delivered material conforms to the mix design.

METHOD OF MEASUREMENT

153-5.1

No separate measurement for payment shall be made for controlled low strength material (CLSM). CLSM shall be considered necessary and incidental to the work of this Contract.

BASIS OF PAYMENT

153-6.1

No payment will be made separately or directly for controlled low strength material (CLSM). CLSM shall be considered necessary and incidental to the work of this Contract.

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 C33	Concrete Aggregates
ASTM C150	Portland Cement

ASTM C618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C595	Blended Hydraulic Cements
ASTM C1602	Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D4832	Preparation and Testing of Controlled Low-Strength Material (CLSM) Test Cylinders
ASTM D6103	Flow Consistency of Controlled Low Strength Material (CLSM)

END ITEM P-153

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Item P-407**Asphalt Treated Permeable Base Course (ATPB)****DESCRIPTION****407-1.1**

This item shall consist of an asphalt treated permeable base composed of mineral aggregate, and asphalt cement mixed in a central mixing plant and placed on a prepared subgrade or subbase course in accordance with these specifications and shall conform to the lines, grades, thickness, and typical cross sections shown in the plans.

MATERIALS**407-2.1 Aggregate.**

The aggregate shall consist of clean, sound, hard, durable, angular particles of crushed gravel or crushed stone and shall meet the gradation requirements of ASTM C33 Size 57. Fine aggregate shall consist of natural sand or manufactured sand meeting the requirements of ASTM C33. The aggregate shall meet the material requirements in the table below.

Aggregate Material Requirements

Material Test	Requirement	Standard
Coarse Aggregate		
Resistance to Degradation	Loss: 40% maximum	ASTM C131
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
Fractured Faces	90% by weight of particles with at least 2 fractured faces	ASTM D5821
Flat Particles, Elongated Particles, or Flat and Elongated Particles ¹	10% maximum, by weight, for fraction retained on the 3/8 inch (9.5mm) sieve and 10% maximum, by weight, for the fraction passing the 3/8-inch (9.5 mm) sieve	ASTM D4791
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Fine Aggregate		
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
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

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).

407-2.2 Sampling and testing.

a. Aggregate base materials. The Contractor shall take samples of the aggregate base stockpile in accordance with ASTM D75 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraph 407-2.1. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

407-2.3 Asphalt binder. Asphalt binder shall conform to ASTM D6373 Performance Grade (PG) 67-22.

407-2.4 Anti-stripping agent. Any anti-stripping agent or additive (anti-strip) shall be heat stable and shall not change the asphalt binder grade beyond specifications. Anti-strip shall be an approved material of the Department of Transportation of the State in which the project is located.

407-2.5 Bond Breaker. Choke stone shall be an ASTM C33 Number 89 stone.

407-2.6 Separation Geotextile. Not used.

COMPOSITION OF MIXTURE

407-3.1 Mix design. The Mix Design shall be composed of a mixture of open graded aggregate, a minimum of 0.5% antistrip agent and asphalt binder. An acceptable mix will have between 2 – 3.5% asphalt, sufficient to cover 95% of mixture with a shiny black appearance with minimal draindown at 200°F, and will bind the compacted mix. When the aggregates are blended and mixed with the asphalt cement at 250°F and compacted at 150°F with 35 blows of a standard Marshall hammer, the JMF shall have a permeability of not less than 500 ft/day nor more than 1,500 ft/day when tested with constant head permeability test ASTM D 2434/AASHTO T 215.

407-3.2 Submittals. At least 30 days prior to the placement of the ATPB, the Contractor shall submit certified test reports to the Program Manager for those materials proposed for use during construction, as well as the job mix design information for the material. The submittal package shall include the following:

- a. Sources of materials, including aggregate, asphalt binder, additives, and bond-breaking materials (if used).
- b. Physical properties of the aggregates, asphalt binder, antistrip agent and bond-breaking materials.
- c. Percent of asphalt
- d. Amount of antistrip agent
- e. Permeability of JMF

The job mix tolerances shown in the follow Table shall be applied to the job mix formula to establish a job control grading band. The full tolerances will still apply if application of the job mix tolerances results in a job control grading band outside the master grading band.

Job Mix Formula Tolerances

(Based on a Single Test)

<u>Material</u>	<u>Tolerance - Plus or Minus</u>
Aggregate passing No. 4 sieve or larger	5 percent
Aggregate passing No. 8 and No. 30 sieves	4.0 percent
Aggregate passing No. 20 sieve	2.0 percent
Bitumen	0.40 percent
Temperature of mix	20° F

If a change is made in any component or in the source of the materials of the bituminous mix, a new job mix formula shall be established and approved by the Program Manager before any additional material on the project is produced and placed. When unsatisfactory results or other conditions make it necessary, the Program Manager may establish a new job mix formula.

No drainable ATPB material shall be placed until the submittal is accepted in writing by the Program Manager. During production, the Contractor shall submit batch tickets for each delivered load.

CONSTRUCTION METHODS

407-4.1 Control strip. The contractor shall produce, place and compact a control strip of at least 250 ft. The Contractor shall demonstrate, in the presence of the Program Manager, that the materials, equipment, and construction processes meet the requirements of the specification. Control strips that do not meet specification requirements shall be removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Program Manager. Upon acceptance of the control strip by the Program Manager, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Program Manager.

When additional effort beyond that provided by the paver is required to seat the aggregate, additional compaction shall not be initiated until mixture has cooled to below 175°F (or lower as determined during construction of the test strip). One to two passes of a self-propelled, steel-wheel static roller with weight between 5 and 12 tons (4.5 to 10.9 metric tons) is usually sufficient. The roller shall be in good condition and shall be capable of reversing without backlash and of compacting the ATPB without undue displacement or excessive crushing of the aggregate. The actual rolling pattern and sequence shall be established during placement of the control strip and approved by the Program Manager. In areas inaccessible to the paver and roller, hand operated vibrator-plate compactors may be used to seat the aggregate.

The control strip ATPB layer shall be considered acceptable when aggregate is completely coated with asphalt cement with minimal evidence of crushing; the surface is firm, unyielding and stable under construction traffic; and the layer meets the field permeability per paragraph 407-3.1.

407-4.2 Weather limitations. The ATPB material shall not be mixed or placed while the air temperature is below 40°F. The ATPB shall not be placed on frozen underlying courses or mixed when aggregate is frozen. The ATPB may not be placed when rainfall is occurring or where rain is imminent.

407-4.3 Equipment. All equipment necessary to mix, transport, place, compact, and finish the ATPB material shall be furnished by the Contractor and approved by the Program Manager. The equipment will be inspected by the Program Manager prior to the start of construction operations.

407-4.4 Preparation of the underlying course. The underlying course shall be checked and accepted by the Program Manager before placing operations begin. Prior to placing the material, the final grade should be firm, moist and free of frost. Use of chemicals to eliminate frost will not be permitted.

407-4.5 Mixing. The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the work. Stockpiles shall be constructed in a manner that prevents segregation and intermixing of deleterious materials. Free access to the plant must be provided to the Program Manager at all times for inspection of the plant's equipment and operation and for sampling the ATPB mixture and its components.

407-4.6 Hauling. The ATPB mixture shall be transported from the plant to the job site in trucks or other hauling equipment having beds that are smooth and clean. Truck bed covers shall be provided to protect the ATPB during transport from rain.

407-4.7 Placing. The ATPB material shall be placed using an asphalt paver. The ATPB shall be installed in a single 4 inch lift. The ATPB material shall be placed at a temperature between 175°F and 250°F.

407-4.8 Compaction. Compaction shall be withheld until the mixture has cooled to 150°F to 175°F. The ATPB material shall be compacted using the approved compaction equipment and roller pattern/sequence, as determined in the approved control strip. Sufficient rollers shall be furnished to handle the output of the plant. If the rolling pattern/sequence results in undue displacement of the surface, or causes crushing of the aggregate, work shall be stopped until the cause(s) can be

determined and corrections are made. The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint.

407-4.9 Joints. The formation of all joints shall be made in such a manner as to ensure a continuous bond between old and new sections of the course. All joints shall present the same texture and smoothness as other sections of the course. Transverse joints shall be formed by placement of a bulkhead or by tapering the mixture. Tapered joints shall be cut back full depth and width creating a vertical joint before placing additional mixture against the joint. Joints which are irregular, damaged shall be cut back to expose a clean, sound surface for full depth of course.

407-4.10 Quality Control. The Contractor shall perform tests for smoothness, grade, gradation and asphalt content daily. Asphalt content and gradation must be within job tolerances or appropriate steps taken to maintain production control within tolerances. Any area not meeting smoothness and grade shall be corrected by the Contractor at the Contractor's expense. The Contractor shall provide gradation, asphalt content, smoothness and grade data to the Program Manager on a daily basis.

a. Asphalt Content. Determine asphalt content a minimum of two times per day in accordance with ASTM D6307 or ASTM D2172.

b. Gradation. Determine aggregate gradation a minimum of two times per day from mechanical analysis of extracted aggregate in accordance with ASTM D5444, ASTM C136 and ASTM C117.

c. Smoothness. The finished surface shall not vary more than $\pm 3/8$ -inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline, and moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid. The Contractor shall correct any high spots more than $3/8$ inch in 12-foot with a grinding machine or remove and replace the material at the Contractor's expense.

d. Grade. The grade shall be measured on a 50-foot grid and shall be within ± 0.05 feet of the specified grade. When the surface is more than $1/2$ inch above the grade shown in the plans, the surface shall be corrected at the Contractor's expense to an elevation that falls within a tolerance of $1/4$ inch.

407-4.11 Field Permeability. One test shall be performed by the Contractor in the presence of the Program Manager for 1200 square yards. Test locations will be determined on a random basis in accordance with ASTM D3665. The permeability of the base will be determined in accordance with ASTM C1701. If it can be demonstrated that a 1 gallon container of water will flow through the layer within approximately 1 minute the Program Manager can waive additional permeability testing.

407-4.12 Bond breaker. Prior to placing the overlaying concrete pavement a bond breaker shall be placed on the surface to prevent bonding per 407-2.5.

407-4.13 Maintenance. The completed drainable base shall be maintained by the Contractor in a condition to meet all specification requirements until the pavement has been placed. Placement of the next higher pavement layer shall be made as soon as practicable but no more than thirty (30) calendar days after placement of the drainage layer. The ATPB shall not be opened to traffic until the mixture has cooled to ambient temperature. Traffic on ATPB should be kept to a minimum to avoid rutting or displacement of the ATPB. Limit traffic on ATPB to equipment needed to construct next higher pavement layer.

MATERIAL ACCEPTANCE

407-5.1 Sampling and testing. All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Program Manager for each 1200 square yards. Sampling locations will be determined by the Program Manager on a random basis per ASTM D3665. Only the areas of the ATPB meeting the thickness requirements shall be measured for payment.

a. Thickness. One core shall be drilled by the Program Manager for thickness determination for each 1200 square yards. Thickness will be determined by measuring the depth of core hole. The Contractor shall be responsible for filling the core holes as directed by the Program Manager.

METHOD OF MEASUREMENT

407-6.1 Measurement. The quantity of ATPB to be paid for shall be the number of square yards of material placed, and accepted in the completed base course.

BASIS OF PAYMENT

407-7.1 Payment. Payment will be made at the contract unit price per square yard for ATPB at the specified thickness as measured by Program Manager. This price shall be full compensation for furnishing all materials, for all preparation, mixing, placing, compacting, curing, and placement of overlaying bond breaker; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-407-7.1 Asphalt treated permeable base course (ATPB) (6" thick) - 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 C33	Standard Specification for Concrete Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM D448	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
ASTM D2434	Standard Test Method for Permeability of Granular Soils (Constant Head)
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM C1701	Standard Test Method for Infiltration Rate of In Place Pervious Concrete American Association of State Highway and Transportation Officials (AASHTO)
M288	Standard Specification for Geosynthetic Specification for Highway Applications
T215	Standard Method of Test for Permeability of Granular Soils (Constant Head)

END ITEM P-407

ITEM L-108**UNDERGROUND POWER CABLE FOR AIRPORTS****DESCRIPTION****108-1.1**

This item shall consist of furnishing and installing power or communication cables within conduit or duct banks per these specifications at the locations shown on the plans. It includes excavation and backfill of trench for direct-buried cables only, if applicable. Also included are the installation of counterpoise wires, ground wires, ground rods and connections, cable splicing, cable marking, cable testing, and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the Program Manager. This item shall not include the installation of duct banks or conduit (except as otherwise noted herein for temporary jumper cable), or trenching and backfilling for duct banks or conduit. Furnishing of cables for FAA facilities within the project is included.

EQUIPMENT AND MATERIALS**108-2.1 GENERAL**

- a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program per Advisory Circular (AC) 150/5345-53, current version.
- b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Program Manager.
- c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications and acceptable to the Program Manager. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Program Manager) and replaced with materials that comply with these specifications, at the Contractor's cost.
- d. For FAA owned or FAA-maintained facilities, copper cable shall comply with the plans.
- e. All materials and equipment used to construct this item shall be submitted to the Program Manager for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.
- f. The data submitted shall be sufficient, in the opinion of the Program Manager, to determine compliance with the plans and specifications. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section, or may be electronically submitted in pdf format. The Program Manager reserves the right to reject any and all equipment, materials, or procedures that do not meet the system design and the standards and codes, specified in this document.

- g. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner. The Contractor shall maintain a minimum insulation resistance per paragraph 108-3.10e with isolation transformers connected in new series circuits and new segments of existing series circuits through the end of the contract warranty period when tested in accordance with AC 150/5340-26, Maintenance Airport Visual Aid Facilities, paragraph 5.1.3.1., Insulation Resistance Test.

108-2.2 CABLE

Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall conform to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits latest edition and shall be subject to approval by the MSCAA Airfield Electrical Supervisor. Conductors for use on 6.6 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #8 American wire gauge (AWG), L-824 Type C, 5,000 volts, non-shielded, with cross-linked polyethylene insulation. Conductors for use on 20 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #6 AWG, L-824 Type C, 5,000 volts, non-shielded, with cross-linked polyethylene insulation. L-824 conductors for use on the L-830 secondary airfield lighting series circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

Wire for electrical circuits up to 600 volts shall comply with Specification L-824 and/or Commercial Item Description A-A-59544A and shall be type THWN-2, 75 degree C for installation in conduit and RHW-2, 75 degree C for direct burial installations. Conductors for parallel (voltage) circuits shall be type and size and installed in accordance with NFPA-70, National Electric Code.

Unless noted otherwise, all 600-volt and less non-airfield lighting conductor sizes are based on a 75 degree C, THWN-2, 600 volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600 volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG.

Replaced or new FAA facility control cables shall be as indicated on the plans. Copper cables shall be No. 19 AWG, filled solid copper-bearing, gopher resistant, shielded cables manufactured by General Cable and available through Interstate Wire Co., telephone 1-800-527-0010, by Almo Wire & Cable, telephone 1-800-922-7335, or approved equivalent. Control cable furnished by the Contractor shall conform to the latest edition of FAA-E-2042, specification for use in electrical control applications. Replaced or new fiber optic cables shall be single mode; see paragraph below.

Replaced or new FAA facility single mode fire optic cables shall meet the following requirements: All fibers shall be color coded to facilitate individual fiber identification.

Max Attenuation	0.4 dB/km @ 1310 nm 0.3 dB/km @ 1550 nm
Cladding Diameter	125.0 ± 1.0 µm
Core Diameter	8.3 µm

MSCAA airfield lighting control system (ALCS) fiber optic cables shall meet the following requirements:

- 1.) Provide 8.3 micron/125 micron (core/clad) fiber optic cables with a maximum attenuation of 0.45 dB/km at 1310 nm and 0.35 dB/km at 1550 nm. All dielectric shall meet IBM 3044 Channel Extender and FDDI optical specifications. Each fiber optic cable shall contain 6 or 12 strands of optic fiber, as necessary to replace/relocate the existing fiber optic cables.
- 2.) Provide non-riser and non-plenum cables with an outer polyethylene jacket, single-mode OS2 (ITU-T G.652.D, 6 strand and 12 strand).

Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the Contract Documents. All conductors, pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental to the respective pay items provided.

Cable type, size, number of conductors, strand and service voltage shall be as specified in the Contract Document.

108-2.3 BARE COPPER WIRE (COUNTERPOISE, BARE COPPER WIRE GROUND AND GROUND RODS)

Wire for counterpoise or ground installations for airfield lighting systems shall be No. 6 AWG bare solid copper wire for counterpoise and/or No. 6 AWG insulated stranded for grounding bond wire per ASTM B3 and ASTM B8 and shall be bare copper wire. For voltage powered circuits, the equipment grounding conductor shall comply with NEC Article 250.

Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than 8 feet long and 5/8 inch in diameter.

108-2.4 CABLE CONNECTIONS

In-line connections or splices of underground primary cables shall be of the type called for on the plans, and shall be one of the types listed below. No separate payment will be made for cable connections.

- a. **The Cast Splice.** A cast splice, employing a plastic mold and using epoxy resin equivalent to that manufactured by 3M Company, "Scotchcast" Kit No. 82-B, or an approved equivalent, used for potting the splice is acceptable. The cast splice shall not be used for L-824 Type C cable.
- b. **The Field-Attached Plug-In Splice.** Field attached plug-in splices shall be installed as shown on the plans. The Contractor shall determine the outside diameter of the cable to be spliced and furnish appropriately sized connector kits and/or adapters. Tape or heat shrink tubing with integral sealant shall be in accordance with the manufacturer's requirements. Primary Connector Kits manufactured by Amerace, "Super Kit", Integro "Complete Kit", or approved equal is acceptable.
- c. **The Factory-Molded Plug-In Splice.** Specification for L-823 Connectors, Factory-Molded to Individual Conductors, is acceptable.
- d. **The Taped or Heat-Shrink Splice.** Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or Commercial Item Description A-A-55809.

Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation

of the wire being spliced forming a moisture-proof and dirt-proof seal. Additionally, heat shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory kits that are designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent.

- f. **Fiber Optic Cable Splices.** Fiber optic cable splices shall be fusion splices. See paragraph 108-3.3.

In all the above cases, connections of power cable conductors shall be made using crimp connectors using a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made per the manufacturer's recommendations and listings.

All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except that a light base ground clamp connector shall be used for attachment to the light base. All exothermic connections shall be made per the manufacturer's recommendations and listings.

108-2.5 SPLICER QUALIFICATIONS

Every airfield lighting cable splicer shall be qualified in making airport cable splices and terminations on cables rated at or above 5,000 volts AC. The Contractor shall submit to the Program Manager proof of the qualifications of each proposed cable splicer for the airport cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three (3) years continuous experience in terminating/splicing medium voltage cable.

108-2.6 CONCRETE

Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures.

108-2.7 FLOWABLE BACKFILL

Flowable material used to backfill trenches for power cable trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material.

108-2.8 CABLE IDENTIFICATION TAGS

Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed on the plans.

108-2.9 TAPE

Electrical tapes shall be Scotch Electrical Tapes – Scotch 88 (1-1/2 inch wide) and Scotch 130C linerless rubber splicing tape (2 inch wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M), or an approved equivalent.

108-2.10 ELECTRICAL COATING

Electrical coating shall be Scotchkote as manufactured by 3M Company, or an approved equivalent.

108-2.11 EXISTING CIRCUITS

Whenever the scope of work requires connection to an existing circuit, the existing circuit's insulation resistance shall be tested in the presence of the Program Manager. The test shall be performed per this item and prior to any activity that will affect the respective circuit. The Contractor shall record the results on forms acceptable to the Program Manager. When the work affecting the circuit is complete, the circuit's insulation resistance shall be checked again, in the presence of the Program Manager.

The Contractor shall record the results on forms acceptable to the Program Manager. The second reading shall be equal to or greater than the first reading, or the Contractor shall make the necessary repairs to the existing circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

108-2.12 DETECTABLE WARNING TAPE

Plastic, detectable, American Public Works Association (APWA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend magnetic tape shall be polyethylene film with a metalized foil core and shall be 3 – 6 inches wide. Detectable tape is incidental to the respective bid item. Detectable marking tape for communication cables shall be orange. Detectable warning tape color code shall comply with the APWA Uniform Color Code.

CONSTRUCTION METHODS

108-3.1 GENERAL

The Contractor shall install the specified cable at the approximate locations indicated on the plans. Unless otherwise shown on the plans, all cable required to cross under pavements expected to carry aircraft loads shall be installed in concrete encased duct banks. Cable shall be run without splices, from fixture to fixture.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers. The Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the Program Manager or shown on the plans.

In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for maintenance and test points shall be installed at locations shown on the plans. Cable circuit identification markers shall be installed on both sides of the L-823 connectors installed and on both sides of slack loops where a future connector would be installed.

Provide not less than 3 feet of cable slack on each side of all connections, isolation transformers, light units, and at points where cable is connected to field equipment. Where provisions must be made for testing or for future above grade connections, provide enough slack to allow the cable to be extended at least one foot vertically above the top of the access structure. This requirement also applies where primary cable passes through empty light bases, junction boxes, and access structures to allow for future connections, or as designated by the Program Manager.

Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as manholes, hand holes, pull boxes, junction boxes, etc. Markers shall be of sufficient length for imprinting the cable circuit identification legend on one line, using letters not less than 1/4 inch in size. The cable circuit identification shall match the circuits noted on the construction plans.

For installation of cable for FAA-owned facilities, see also FAA specification SO-STD-71. In the event of conflict, the most stringent requirement applies.

Temporary jumper cable installation shall be protected. Temporary jumper cable and its installation through the existing conduit system or through temporary conduit, shall all be furnished, installed, and removed by the Contractor. Temporary jumper cable shall not be used in the permanent installation. Temporary conduit shall be provided where cable will remain longer than 45 days; otherwise, temporary cable shall be buried in turf areas. **Other methods may be used for short term or emergency situations only if approved by the MSCAA Airfield Electrical Supervisor.** Where cable in conduit is approved for temporary placement on the surface, the conduit shall be held in place

in a manner approved by the Program Manager, and the Contractor shall provide temporary traffic protection for the cable and/or conduit. **Temporary jumper cable locations shall be marked sufficiently to prevent damage from construction equipment.**

108-3.2 INSTALLATION IN DUCT BANKS OR CONDUITS

This item includes the installation of the cable in duct banks or conduit per the following paragraphs. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be per the latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

The Contractor shall make no connections or splices of any kind in cables installed in conduits or duct banks.

Unless otherwise designated in the plans, where ducts are in tiers, use the lowest ducts to receive the cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and that any potential interference is avoided.

Duct banks or conduits shall be installed as a separate item per Item L-110, Airport Underground Electrical Duct Banks and Conduit. The Contractor shall run a mandrel through duct banks or conduit prior to installation of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall be compatible with the conduit size. The Contractor shall swab out all conduits/ducts and clean light bases, manholes, etc. interiors IMMEDIATELY prior to pulling cable. Once cleaned and swabbed the light bases and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, light bases, manholes, etc. is incidental to the pay item of the item being cleaned. All raceway systems left open after initial cleaning for any reason shall be re-cleaned at the Contractor's expense. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Program Manager of any blockage in the existing ducts.

The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture seal tape providing moisture tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing immediately after cutting and before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum pulling-tensions shall not exceed the cable manufacturer's recommendations. A non-hardening cable-pulling lubricant recommended for the type of cable being installed shall be used where required.

The Contractor shall submit the recommended pulling tension values to the Program Manager prior to any cable installation. If required by the Program Manager, pulling tension values for cable pulls shall be monitored by a dynamometer in the presence of the Program Manager. Cable pull tensions shall be recorded by the Contractor and reviewed by the Program Manager. Cables exceeding the maximum allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor's expense.

The manufacturer's minimum bend radius or NEC requirements (whichever is more restrictive) shall apply. Cable installation, handling and storage shall be per manufacturer's recommendations. During cold weather, particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be installed when the temperature is at or below the manufacturer's minimum installation temperature. At the Contractor's option, the Contractor may submit a plan, for review by the Program Manager, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer's minimum cable installation temperature.

Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.

Home run cables shall not be pulled continuously for distances greater than 600 foot at any one time unless otherwise indicated on the plans. The following procedure shall be used to pull cables. First, pull 600 foot of a continuous cable and coil. Secondly, pull the 600 foot section of cable through the next 600 foot segment of system. Then pull 600 foot more of cable at the first location and coil and repeat second step. The procedure is altered in length only where a greater continuous pull is indicated on the plans. These steps will be repeated until cable is in place continuously in system without splices or connections, unless otherwise authorized in writing by the Program Manager or as indicated on the plans. Alternate methods may be detailed and submitted to the Program Manager for consideration.

Not less than five (5) foot of cable slack shall be left on each side of all connections in manholes, handholes, pullboxes, light bases (transformer housings), or junction cans so that a minimum of three (3) foot on each side of all connections may be extended above finish grade for maintenance purposes. The exception is cable in light bases of taxiway centerline lights containing two interleaved circuits; only the circuit that is attached to the transformer in the light base shall have the extra cable slack to allow three (3) foot of cable extension above finish grade.

108-3.2.1 FIBER OPTIC CABLE INSTALLATION

The Contractor shall install all fiber optic cable through an innerduct system per manufacturer's recommendations and using locally accepted practices. At each manhole/pullbox the Contractor shall coil cable in one or more "figure-eight" loops. For FAA fiber optic cables, one hundred (100) foot of cable shall be stored at each manhole/handhole/pullbox location. One- and one-half loops of cable shall be stored at each facility enclosure. Cable shall be installed using a combination of Kellums grip and an adjustable tension release "pulling-eye" which can be set to release at 400 pounds.

All cables shall be clearly labeled at every manhole/handhole and at each facility demarcation point. Markings shall identify fiber type, fiber count, and the facility served.

Fiber optic cable splices are allowed only in manholes, handholes (pullboxes), or buildings. Maximum 0.2 dB loss per splice will be allowed; however, the total transmission losses including cable and splices shall not exceed 25 percent of the capability of the transceivers. Install all fiber optic cable, terminations, and splices per manufacturer's recommendations by a person with at least 3 years' experience in the installation of fiber optic cables and terminations of the type, size, and ratings of the products to be installed. Do not exceed the minimum bend radius of the fiber cable specified by the manufacturer.

Perform cable-pulling calculations based on the actual field routing of the cables prior to installation. Demonstrate through the calculations that the cable pulling tension and sidewall pressure loading are within Manufacturer's limitations. Submit calculations for approval.

Provide fiber optic terminations made with "LC" duplex style connectors; install in accordance with the manufacturer's instructions. Provide UPC polish type fiber connectors. Crimp and cleave terminations will not be accepted. Terminate all unused fibers with epoxy/polish or fusion splice-on connectors; seal to make watertight. Neatly train and lace fiber optic cables within junction boxes and patch panels.

Fiber optic patch panel configurations are dependent on project needs.

Splices in manholes and handholes (pullboxes) shall be fusion splices performed by a person with at least three years' experience in the installation and splicing of fiber optic cables. Fusion splices shall be performed in accordance with manufacturer's recommendations for type of cable being spliced. Splice enclosures shall be watertight, rated for underground use, and sized for full fiber count with slack storage.

All terminations and splices of FAA facility fiber optic cable shall be performed by FAA Southern Region approved contractor for this type work, under this project's Contractor, or by a qualified technician as noted above and shall be approved by the FAA prior to start of work.

108-3.3 INSTALLATION OF DIRECT-BURIED CABLE IN TRENCHES – Not used.

108-3.4 CABLE MARKERS FOR DIRECT-BURIED CABLE – Not used.

108-3.5 SPLICING

Connections of the type shown on the plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

- a. **Cast Splices.** These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured per manufacturer's instructions and to the satisfaction of the Program Manager.
- b. **Field-attached Plug-in Splices.** These shall be assembled per the manufacturer's instructions. These splices shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one of the following methods: (1) wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches on each side of the joint (2) covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches on each side of the joint or (3) on connector kits equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.
- c. **Factory-Molded Plug-in Splices.** These shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one of the following methods: (1) wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches on each side of the joint (2) covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches on each side of the joint or (3) on connector kits equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.
- d. **Taped or Heat-Shrink Splices.** A taped splice shall be made in the following manner:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch (6 mm) of bare conductor on each side of the connector. Prior to splicing, the two ends of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus 3 inches on each end) is clean. After scraping wipe the entire area with a clean lint-free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. The manufacturer's recommendation for stretching tape during splicing shall be followed. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a

distance of approximately one inch over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

Heat shrinkable tubing shall be installed following manufacturer's instructions. Direct flame heating shall not be permitted unless recommended by the manufacturer. Cable surfaces within the limits of the heat-shrink application shall be clean and free of contaminants prior to application.

- e. **Assembly.** Surfaces of equipment or conductors being terminated or connected shall be prepared in accordance with industry standard practice and manufacturer's recommendations. All surfaces to be connected shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other nonconductive coatings shall be removed to expose base metal. Clean all surfaces at least 1/4 inch beyond all sides of the larger bonded area on all mating surfaces. Use a joint compound suitable for the materials used in the connection. Repair painted/coated surface to original condition after completing the connection.

108-3.6 BARE COUNTERPOISE WIRE INSTALLATION FOR LIGHTNING PROTECTION AND GROUNDING

If shown on the plans or included in the job specifications, bare solid #6 AWG copper counterpoise wire shall be installed for lightning protection of the underground cables. The Engineer shall select one of two methods of lightning protection for the airfield lighting circuit based upon sound engineering practice and lightning strike density:

- a. **Equipotential.** The counterpoise size is as shown on the plans. The equipotential method is applicable to all airfield lighting systems; i.e. runway, taxiway, apron – touchdown zone, centerline, edge, threshold and approach lighting systems. The equipotential method is also successfully applied to provide lightning protection for power, signal and communication systems. The light bases, counterpoise, etc – all components – are bonded together and bonded to the vault power system ground loop/electrode.

Counterpoise wire shall be installed in the same trench for the entire length of buried cable, conduits and duct banks that are installed to contain airfield cables. The counterpoise conductor is centered over the cable/conduit/duct to be protected.

The counterpoise conductor shall be installed no less than 8 inches minimum or 12 inches maximum above the raceway or cable to be protected, except as permitted below:

- (1) The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.
- (2) The counterpoise conductor height above the protected raceway(s) or cable(s) shall be calculated to ensure that the raceway or cable is within a 45-degree area of protection; (45 degrees on each side of vertical creating a 90 degree angle).

The counterpoise conductor shall be bonded to each metallic light base, mounting stake, and metallic airfield lighting component.

All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

All components rise and fall at the same potential; with no potential difference, no damaging arcing and no damaging current flow.

See AC 150/5340-30, Design and Installation Details for Airport Visual Aids and NFPA 780, Standard for the Installation of Lightning Protection Systems, Chapter 11, for a detailed description of the Equipotential Method of lightning protection.

Reference FAA STD-019E, Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment, Part 4.1.1.7.

- b. Isolation.** Not used.
- c. Common Installation Requirements.** When a metallic light base is used, the grounding electrode shall be bonded to the metallic light base or mounting stake with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

Grounding electrodes may be rods, ground dissipation plates, radials, or other electrodes listed in the NFPA 70 (NEC) or NFPA 780.

Where raceway is installed by the directional bore, jack and bore, or other drilling method, the counterpoise conductor shall be permitted to be installed concurrently with the directional bore, jack and bore, or other drilling method raceway, external to the raceway or sleeve.

The counterpoise wire shall also be exothermically welded to ground rods installed as shown on the plans but not more than 500 feet apart around the entire circuit. The counterpoise system shall be continuous and terminate at the transformer vault or at the power source. It shall be securely attached to the vault or equipment external ground ring or other made electrode grounding system. The connections shall be made as shown on the plans and in the specifications.

Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

- d. Parallel Voltage Systems.** Provide grounding and bonding in accordance with NFPA 70, National Electrical Code.

108-3.7 COUNTERPOISE INSTALLATION ABOVE MULTIPLE CONDUITS AND DUCT BANKS

Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise wires above the conduits shall be adequate to provide a complete area of protection measured 45 degrees each side of vertical.

Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above the duct bank. Reference details on the construction plans.

108-3.8 COUNTERPOISE INSTALLATION AT EXISTING DUCT BANKS

When airfield lighting cables are indicated on the plans to be routed through existing duct banks, the new counterpoise wiring shall be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and exit the duct bank. The new counterpoise conductor shall be bonded to the existing counterpoise system.

108-3.9 EXOTHERMIC BONDING

Bonding of counterpoise wire shall be by the exothermic welding process or equivalent method accepted by the Program Manager. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

Contractor shall demonstrate to the satisfaction of the Program Manager the welding kits, materials, and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations and the following:

- a. All slag shall be removed from welds.
- b. Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not recommended unless the base has been specially modified. Consult the manufacturer's installation directions for proper methods of bonding copper wire to the light base. See also AC 150/5340-30 for galvanized light base exception.
- c. If called for in the plans, all buried copper and weld material at weld connections shall be thoroughly coated with 6 mm of 3M "Scotchkote," or approved equivalent, or coated with coal tar Bitumastic material to prevent surface exposure to corrosive soil or moisture.

108-3.10 TESTING

Testing shall be per Item L-111, Airfield Electrical Installation Testing. The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the Program Manager. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the Program Manager. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

- a. Earth resistance testing procedures shall be submitted to the Program Manager for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the Program Manager. All such testing shall be at the sole expense of the Contractor.
- b. Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The Program Manager shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

After installation, the Contractor shall test and demonstrate to the satisfaction of the Program Manager the following:

- c. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.
- d. That all affected circuits (existing and new) are free from unspecified grounds.
- e. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than 500 megohms. Verify continuity of all series airfield lighting circuits prior to energization.
- f. That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.

- g.** That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.
- h.** That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.
- i.** That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Program Managers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the Program Manager prior to performing the testing.

Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the Program Manager. Where connecting new cable to existing cable, ground insulation tests shall be performed on the new cable prior to connection to the existing circuit.

There are no approved "repair" procedures for items that have failed testing other than complete replacement.

METHOD OF MEASUREMENT

108-4.1

Cable or counterpoise wire installed in trench, duct bank or conduit shall be measured by the number of linear feet installed and grounding connectors, and trench marking tape ready for operation, and accepted as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in trench, duct bank or conduit. The measurement for this item shall not include additional quantities required for slack.

Cable and counterpoise slack is considered incidental to this item and is included in the Contractor's unit price. No separate measurement or payment will be made for cable or counterpoise slack.

108-4.2

Ground rods shall be measured by each installed complete.

108-4.3

Temporary jumper cable shall be measured by the number of linear feet, as measured in place from center-to-center of light, sign, junction can, etc. along the cable path, excluding cable slack and loops, ready for operation, and accepted as satisfactory. Separate measurement shall be made for each cable installed, by various installation types, along the cable path.

BASIS OF PAYMENT

108-5.1

Payment will be made at the contract unit price for cable and bare counterpoise wire installed in trench, duct bank, or conduit, in place by the Contractor and accepted by the Program Manager. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, testing, documentation, and incidentals, including ground connectors and trench marking tape, necessary to complete the item.

108-5.2

Payment will be made at the contract unit price for temporary jumper cable installed, regardless of type of installation, in place by the Contractor and accepted by the Program Manager. This price shall include material and labor necessary for temporary jumper installation buried in turf, in temporary buried conduit, existing conduit, temporary surface mounted conduit or other method approved by the Program Manager. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, including trench and backfill, all L-823 connectors, conduit or other protection allowed by the Program Manager, counterpoise where directed, ground rods, and other incidentals necessary to complete this item. Temporary anchor methods and protection, removal of all temporary materials and restoration are also included. Temporary jumper cable for fiber optic shall include extraction of cable from existing duct in addition to rerouting as temporary jumper, splices, and conduit or other protection allowed by the Program Manager, and regardless of size or type of fiber optic cable.

Payment will be made under:

Item L-108-5.1	No. 8 AWG, 5 kV, L-824, Type C Cable, Installed in Duct or Conduit – per linear foot
Item L-108-5.2	No. 6 AWG, Solid, Bare Copper Counterpoise Wire, Installed Above Duct Bank or Conduit, Including Connections/Terminations – per linear foot
Item L-108-5.3	Furnish & Install 8-foot Ground Rod – per each
Item L-108-5.4	Furnish & Install 10-foot Ground Rod – per each
Item L-108-5.5	Temporary Jumper Cable, No. 8 AWG, 5 kV, L-824, Type C, Including Material and Labor for Approved Method of Temporary Services Installed & Removed – per linear foot
Item L-108-5.6	6-Strand, Multimode Fiber Optic Cable, Installed in Duct or Conduit – per linear foot
Item L-108-5.7	12-Strand, Single Mode Fiber Optic Cable, Installed in Duct or Conduit – per linear foot
Item L-108-5.8	12 Pair #19 Shielded Control Cable, Installed in Duct or Conduit – per linear foot
Item L-108-5.9	Temporary Jumper Cable, Fiber Optic, Including Material and Labor for Approved Method of Temporary Services Installed & Removed – 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.

Advisory Circulars (AC)

AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-7	L-824 Underground Electrical Cable for Airport Lighting Circuits

AC 150/5345-26	L-823 Plug and Receptacle Cable Connectors
AC 150/5345-53	Airport Lighting Equipment Certification Program
Commercial Item Description	
A-A-59544A	Cable and Wire, Electrical (Power, Fixed Installation)
A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic
ASTM International (ASTM)	
ASTM B3	Soft or Annealed Copper Wire
ASTM B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
ASTM D4388	Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes
Mil Spec	
MIL-PRF-23586F	Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive
National Fire Protection Association (NFPA)	
NFPA-70	National Electrical Code (NEC)
NFPA-780	Installation of Lightning Protection Systems
American National Standards Institute (ANSI)/Institute of Electrical and Electronics Program Managers (IEEE)	
ANSI/IEEE Std 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
Federal Aviation Administration Standard	
FAA STD-019E	Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment

END OF ITEM L-108

ITEM L-115**ELECTRICAL MANHOLES AND JUNCTION STRUCTURES****DESCRIPTION****115-1.1**

This item shall consist of electrical manholes and junction structures (hand holes, pull boxes, junction cans, etc.) installed per this specification, at the indicated locations and conforming to the lines, grades and dimensions shown on the plans or as required by the Program Manager. This item shall include the installation of each electrical manhole and/or junction structures with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces to the satisfaction of the Program Manager including removal of existing manholes and junction structures as shown on the plans.

EQUIPMENT AND MATERIALS**115-2.1 GENERAL**

- a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the Program Manager.
- b. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Program Manager) and replaced with materials that comply with these specifications at the Contractor's cost.
- c. All materials and equipment used to construct this item shall be submitted to the Program Manager for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.
- d. The data submitted shall be sufficient, in the opinion of the Program Manager, to determine compliance with the plans and specifications. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section, or may be electronically submitted in pdf format. The Program Manager reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes specified in this document.
- e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

115-2.2 CONCRETE STRUCTURES

Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures. Cast-in-place concrete structures shall be as shown on the plans.

115-2.3 PRECAST CONCRETE STRUCTURES

Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program. Provide precast concrete structures where shown on the plans.

Precast concrete structures shall be an approved standard design of the manufacturer. Precast units shall have mortar or bitumastic sealer placed between all joints to make them watertight. The structure shall be designed to withstand 100,000 lb wheel load per FAA AC 150/5320-6, unless otherwise shown on the plans. Openings or knockouts shall be provided in the structure as detailed on the plans.

Threaded inserts and pulling eyes shall be cast in as shown on the plans.

If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by the Program Manager shall be submitted by the Contractor to allow for a full evaluation by the Program Manager. The Program Manager shall review per the process defined in the General Provisions.

115-2.4 JUNCTION BOXES

Junction boxes shall be L-867 Class 1 (non-load bearing) or L-868 Class 1 (load bearing) airport light bases that are encased in concrete. The light bases shall have a L-894 blank cover, gasket, and stainless steel hardware. All bolts, studs, nuts, lock washers, and other similar fasteners used for the light fixture assemblies must be fabricated from 316L (equivalent to EN 1.4404), 18-8, 410, or 416 stainless steel. If 18-8, 410, or 416 stainless steel is utilized it shall be passivated and be free from any discoloration. Covers shall be 3/8-inch thickness for L-867 and 3/4-inch thickness for L-868. All junction boxes shall be provided with both internal and external ground lugs.

115-2.5 MORTAR

The mortar shall be composed of one part of cement and two parts of mortar sand, by volume. The cement shall be per the requirements in ASTM C150, Type I. The sand shall be per the requirements in ASTM C144. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15% of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C206. Water shall be potable, reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.

115-2.6 CONCRETE

Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures.

115-2.7 FRAMES AND COVERS

The frames shall conform to one of the following requirements:

- | | | |
|----|--------------------|--|
| a. | ASTM A48 | Gray iron castings |
| b. | ASTM A47 | Malleable iron castings |
| c. | ASTM A27 | Steel castings |
| d. | ASTM A283, Grade D | Structural steel for grates and frames |
| e. | ASTM A536 | Ductile iron castings |
| f. | ASTM A897 | Austempered ductile iron castings |

All castings specified shall withstand a maximum tire pressure of 250 psi and maximum load of 100,000 lbs.

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings specified.

Each frame and cover unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

Each cover shall have the word "ELECTRIC" or other approved designation cast on it. Each frame and cover shall be as shown on the plans or approved equivalent. No cable notches are required.

Each manhole shall be provided with a "DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" safety warning sign as detailed in the Contract Documents and in accordance with OSHA 1910.146 (c)(2).

115-2.8 LADDERS

Ladders, if specified, shall be galvanized steel or as shown on the plans.

115-2.9 REINFORCING STEEL

All reinforcing steel shall be deformed bars of new billet steel meeting the requirements of ASTM A615, Grade 60.

115-2.10 BEDDING/SPECIAL BACKFILL

Bedding or special backfill shall be as shown on the plans.

115-2.11 FLOWABLE BACKFILL

Flowable material used to backfill shall conform to the requirements of Item P-153, Controlled Low Strength Material.

115-2.12 CABLE TRAYS

Cable trays shall be of galvanized steel. Cable trays shall be located as shown on the plans.

115-2.13 PLASTIC CONDUIT

Plastic conduit shall comply with Item L-110, Airport Underground Electrical Duct Banks and Conduits.

115-2.14 CONDUIT TERMINATORS

Conduit terminators shall be pre-manufactured for the specific purpose and sized as required or as shown on the plans.

115-2.15 PULLING-IN IRONS

Pulling-in irons shall be manufactured with 7/8-inch diameter hot-dipped galvanized steel or stress-relieved carbon steel roping designed for concrete applications (7 strand, 1/2-inch diameter with an ultimate strength of 270,000 psi). Where stress-relieved carbon steel roping is used, a rustproof sleeve shall be installed at the hooking point and all exposed surfaces shall be encapsulated with a polyester coating to prevent corrosion.

115-2.16 GROUND RODS

Ground rods shall be one piece, copper clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case shall they be less than 8 feet long nor less than 5/8 inch in diameter.

CONSTRUCTION METHODS**115-3.1 UNCLASSIFIED EXCAVATION**

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Damage to utility lines, through lack of care in excavating, shall be repaired or replaced to the satisfaction of the Program Manager without additional expense to the Owner.

The Contractor shall perform excavation for structures and structure footings to the lines and grades or elevations shown on the plans or as staked by the Program Manager. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

All excavation shall be unclassified and shall be considered incidental to Item L-115. Dewatering necessary for structure installation and erosion per federal, state, and local requirements is incidental to Item L-115.

Boulders, logs and all other objectionable material encountered in excavation shall be removed. All rock and other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped or serrated, as directed by the Program Manager. All seams, crevices, disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

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

Unless otherwise provided, bracing, sheeting and shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner that will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.

After each excavation is completed, the Contractor shall notify the Program Manager. Structures shall be placed after the Program Manager has approved the depth of the excavation and the suitability of the foundation material.

Prior to installation the Contractor shall provide a minimum of 6 inches of sand or a material approved by the Program Manager as a suitable base to receive the structure. The base material shall be compacted and graded level and at proper elevation to receive the structure in proper relation to the conduit grade or ground cover requirements, as indicated on the plans.

115-3.2 CONCRETE STRUCTURES

Concrete structures shall be built on prepared foundations conforming to the dimensions and form indicated on the plans. The concrete and construction methods shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the Program Manager before the concrete is placed.

115-3.3 PRECAST UNIT INSTALLATIONS

Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of manhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed.

115-3.4 PLACEMENT AND TREATMENT OF CASTINGS, FRAMES AND FITTINGS

All castings, frames and fittings shall be placed in the positions indicated on the Plans or as directed by the Program Manager and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

Field connections shall be made with bolts, unless indicated otherwise. Welding will not be permitted unless shown otherwise on the approved shop drawings and written approval is granted by the casting manufacturer. Erection equipment shall be suitable and safe for the workman. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the Program Manager and approval of the method of correction shall be obtained. Approved corrections shall be made at Contractor's expense.

Anchor bolts and anchors shall be properly located and built into connection work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

Pulling-in irons shall be located opposite all conduit entrances into structures to provide a strong, convenient attachment for pulling-in blocks when installing cables. Pulling-in irons shall be set directly into the concrete walls of the structure.

115-3.5 INSTALLATION OF LADDERS

Ladders shall be installed such that they may be removed if necessary. Mounting brackets shall be supplied top and bottom and shall be cast in place during fabrication of the structure or drilled and grouted in place after erection of the structure.

115-3.6 REMOVAL OF SHEETING AND BRACING

In general, all sheeting and bracing used to support the sides of trenches or other open excavations shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a structure shall be withdrawn, unless otherwise directed, before more than 6 inches of material is placed above the top of the structure and before any bracing is removed. Voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

The Program Manager may direct the Contractor to delay the removal of sheeting and bracing if, in his judgement, the installed work has not attained the necessary strength to permit placing of backfill.

115-3.7 BACKFILLING

After a structure has been completed, the area around it shall be backfilled in horizontal layers not to exceed 6 inches in thickness measured after compaction to the density requirements in Item P-152. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the Program Manager.

Backfill shall not be placed against any structure until approval is given by the Program Manager. In the case of concrete, such approval shall not be given until tests made by the laboratory under supervision of the Program Manager establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

Where required, the Program Manager may direct the Contractor to add, at his own expense, sufficient water during compaction to assure a complete consolidation of the backfill. The Contractor shall be responsible for all damage or injury done to conduits, duct banks, structures, property or persons due to improper placing or compacting of backfill.

115-3.8 CONNECTION OF DUCT BANKS

To relieve stress of joint between concrete-encased duct banks and structure walls, reinforcement rods shall be placed in the structure wall and shall be formed and tied into duct bank reinforcement at the time the duct bank is installed.

115-3.9 GROUNDING

A ground rod shall be installed in the floor of all concrete structures so that the top of rod extends 6 inches above the floor. The ground rod shall be installed within one foot of a corner of the concrete structure. Ground rods shall be installed prior to casting the bottom slab. Where the soil condition does not permit driving the ground rod into the earth without damage to the ground rod, the Contractor shall drill a 4-inch diameter hole into the earth to receive the ground rod. The hole around the ground rod shall be filled throughout its length, below slab, with Portland cement grout. Ground rods shall be installed in precast bottom slab of structures by drilling a hole through bottom slab and installing the ground rod. Bottom slab penetration shall be sealed watertight with Portland cement grout around the ground rod.

A grounding bus of 4/0 bare stranded copper shall be exothermically bonded to the ground rod and loop the concrete structure walls. The ground bus shall be a minimum of one foot above the floor of the structure and separate from other cables. No. 2 American wire gauge (AWG) bare copper pigtailed shall bond the grounding bus to all cable trays and other metal hardware within the concrete structure. Connections to the grounding bus shall be exothermic. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete per UL 467. Hardware connections may be mechanical, using a lug designed for that purpose.

115-3.10 CLEANUP AND REPAIR

After erection of all galvanized items, damaged areas shall be repaired by applying a liquid cold-galvanizing compound per MIL-P-21035. Surfaces shall be prepared and compound applied per the manufacturer's recommendations.

Prior to acceptance, the entire structure shall be cleaned of all dirt and debris.

115-3.11 RESTORATION

After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. The Contractor shall restore all disturbed areas equivalent to or better than their original condition. All sodding, grading and restoration shall be considered incidental to the respective Item L-115 pay item.

The Contractor shall grade around structures as required to provide positive drainage away from the structure.

Areas with special surface treatment, such as roads, sidewalks, or other paved areas shall have backfill compacted to match surrounding areas, and surfaces shall be repaired using materials comparable to original materials.

Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD) and remove any such FOD that is found. This

FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

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

115-3.12 INSPECTION

Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the plans and this specification. Any indication of defects in materials or workmanship shall be further investigated and corrected. The earth resistance to ground of each ground rod shall not exceed 25 ohms. Each ground rod shall be tested using the fall-of-potential ground impedance test per American National Standards Institute / Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.

115-3.13 MANHOLE ELEVATION ADJUSTMENTS

The Contractor shall adjust the tops of existing manholes in areas designated in the Contract Documents to the new elevations shown. The Contractor shall be responsible for determining the exact height adjustment required to raise or lower the top of each manhole to the new elevations. The existing top elevation of each manhole to be adjusted shall be determined in the field and subtracted/added from the proposed top elevation.

The Contractor shall remove/extend the existing top section or ring and cover on the manhole structure or manhole access. The Contractor shall install precast concrete sections or grade rings of the required dimensions to adjust the manhole top to the new proposed elevation or shall cut the existing manhole walls to shorten the existing structure, as required by final grades. The Contractor shall reinstall the manhole top section or ring and cover on top and check the new top elevation.

The Contractor shall construct a concrete slab around the top of adjusted structures located in graded areas that are not to be paved. The concrete slab shall conform to the dimensions shown on the plans.

115-3.14 DUCT EXTENSION TO EXISTING DUCTS

Where existing concrete encased ducts are to be extended, the duct extension shall be concrete encased plastic conduit. The fittings to connect the ducts together shall be standard manufactured connectors designed and approved for the purpose. The duct extensions shall be installed according to the concrete encased duct detail and as shown on the plans.

METHOD OF MEASUREMENT

115-4.1

Electrical manholes and junction structures shall be measured by each unit completed in place and accepted.

BASIS OF PAYMENT

115-5.1

The accepted quantity of electrical manholes and junction structures will be paid for at the Contract unit price per each, complete and in place. The following items shall be included in the price of each unit: All required excavation and dewatering; sheeting and bracing; all required backfilling with on-site materials; restoration of all surfaces and finished grading and turving; all required connections; temporary cables and connections; and ground rod testing. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials,

furnishing and installation of appurtenances and connections to duct banks and other structures as may be required to complete the item as shown on the plans and for all labor, equipment, tools and incidentals necessary to complete the structure.

Payment will be made under:

Item L-115-5.1	Aircraft-Rated Pullbox — per each
Item L-115-5.2	L-867D Junction Can Installed in Turf – per each
Item L-115-5.3	Aircraft-Rated Electrical Manhole (FAA) – per each

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.

American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)

ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
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Advisory Circular (AC)

AC 150/5345-7	L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-42	Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description (CID)

A-A 59544	Cable and Wire, Electrical (Power, Fixed Installation)
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ASTM International (ASTM)

ASTM A27	Steel Castings, Carbon, for General Application
ASTM A47	Ferritic Malleable Iron Castings
ASTM A48	Gray Iron Castings
ASTM A123	Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Ductile Iron Castings
ASTM A615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A897	Austempered Ductile Iron Castings
ASTM C144	Aggregate for Masonry Mortar

ASTM C150 Portland Cement

ASTM C206 Finishing Hydrated Lime

FAA Engineering Brief (EB)

EB #83 National Electric Code (NEC)

Mil Spec

MIL-P-21035 Paint High Zinc Dust Content, Galvanizing Repair

National Fire Protection Association (NFPA)

NFPA-70 National Electric Code (NEC)

END OF ITEM L-115

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ITEM L-125**INSTALLATION OF AIRPORT LIGHTING SYSTEMS****DESCRIPTION****125-1.1 REQUIREMENTS**

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 PROGRAM MANAGER.

EQUIPMENT AND MATERIALS**125-2.1 GENERAL**

- a. 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 perform as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.
- b. Manufacturer's certifications shall not relieve the Contractor of their responsibility to provide materials in accordance with these specifications and acceptable to the PROGRAM MANAGER, Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Program Manager and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.
- c. All materials and equipment used shall be submitted to the Program Manager 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.
- d. The data submitted shall be sufficient, in the opinion of the Program Manager, to determine compliance with the plans and specifications. The Contractor's submittals shall be submitted in electronic PDF format, tabbed by specification section. The Program Manager reserves the right to reject any or all equipment, materials or procedures, which, in the Program Manager's opinion, does not meet the system design and the standards and codes, specified herein.
- e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. In addition, all LED light fixtures, inclusive of all electronics, shall be guaranteed for a period of at least four (4) years from final acceptance. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

125-2.2 CONDUIT/DUCT

Conduit shall conform to Specification Item L-110 Airport Underground Electrical Duct Banks and Conduits.

125-2.3 CABLE AND COUNTERPOISE

Cable and Counterpoise shall conform to Item L-108 Underground Power Cable for Airports.

125-2.4 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.

125-2.5 CABLE CONNECTIONS

Cable Connections shall conform to Item L-108 Installation of Underground Cable for Airports.

125-2.6 RETROREFLECTIVE MARKERS – Not required.**125-2.7 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. Light fixtures shall be Class 2, Mode 1, and for semiflush shall be Style 3.

LIGHTS

DESCRIPTION	TYPE	BASE	FILTER	XFORMER	OPTIONS
Runway Combination Guard/Stop Bar, Wide Beam	L-852G/S (L)	L-868	Yellow/Red	65W	Fixture shall be dual lamp with addressable circuit switching and monitoring.
Runway Stop Bar, Unidirectional, Elevated	L-862S(L)	L-867	Red	45W	Provide with addressable circuit switching and monitoring.
Runway Guard, Unidirectional, 2 Light Alternately Flashing, Elevated	L-804(L)	L-867	Yellow	45W	Provide with monitoring.
Taxiway Centerline, Bidirectional	L-852C(L)	L-868	Green/Green	20/25W	
Taxiway Centerline, Bidirectional	L-852C(L)	L-868	Green/Yellow	20/25W	Fixture shall be dual lamp with addressable circuit switching and monitoring.
Taxiway Clearance Bar	L-852C(L)	L-868	Yellow	10/15W	
Taxiway Centerline, Bidirectional, Wide Beam	L-852D(L)	L-868	Green/Green	30/45W	
Taxiway Centerline Lead-on/off, Bidirectional, Wide Beam	L-852D(L)	L-868	Green/Green or Green/Yellow	30/45W	Fixture shall be dual lamp with addressable circuit switching and monitoring.
Taxiway Centerline, Omnidirectional	L-852F(L)	L-868	Yellow	200W	
Taxiway Edge, Elevated	L-861T(L)	L-868 or L-867	Blue	10/15W	Mounting hardware to be compatible with L-868 base, where designated on drawings.

125-2.8 RUNWAY AND TAXIWAY SIGNS

Runway and Taxiway Guidance Signs should conform to the requirements of AC 150/5345-44.

SIGNS

TYPE	SIZE	STYLE	CLASS	MODE	NOTES
L-858R	3	5	1	2	Mandatory instruction sign, white legend on red background
L-858Y	3	5	1	2	Direction sign, black legend on yellow background
L-858L	3	5	1	2	Taxiway location sign, yellow legend on black background

125-2.9 RUNWAY END IDENTIFIER LIGHT (REIL) – Not required.

125-2.10 PRECISION APPROACH PATH INDICATOR (PAPI) – Not required.

125-2.11 CIRCUIT SELECTOR CABINET – Not required.

125-2.12 LIGHT BASE AND TRANSFORMER HOUSINGS

Light base and transformer housings should conform to the requirements of AC 150/5345-42. Light bases Type L-867 or L-868, Class 1A, Size B 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.

125-2.13 ISOLATION TRANSFORMERS

Isolation transformers shall be Type L-830, size as required for each installation. Transformers shall conform to AC 150/5345-47.

125-2.14 HIGH-PERFORMANCE GROUT

The encapsulation of cans and conduit install in existing taxiway or runway concrete pavements shall be accomplished, as detailed on the drawings, with a high-performance grout that is an elastomeric. This product shall be Delcrete Elastomeric Concrete by D.S. Brown, North Baltimore, Ohio, Telephone No. 419-257-3561, WaboCrete II by Watson Bowman Acme, Amherst, New York, Telephone No. 800-677-4922, or an approved equivalent. An equivalent, in order to be considered for approval, must meet or exceed the tensile strength, tensile stress, elongation, and hardness properties specifications of the products listed above under equivalent test conditions.

125-2.15 BLOCKOUT

Blockout of light base, installed where base is less than 2-foot from a pavement joint, shall be formed using a cylindrical fiber form material (Round Concrete Form by Masco, Sonotube by Sonoco, or an approved equivalent), reinforcing, dowels, sand, plywood cover, and all incidentals. This blockout shall only be used when the centerline of a base can will be located closer than two and one-half (2.5) feet to a concrete pavement joint.

INSTALLATION**125-3.1 GENERAL**

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.

a. General Light Base (Transformer Housing) Requirements

Stub-in conduit connections at existing light bases shall be Meyers Hub installation where required on the drawings and as noted on plan details.

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:

- (1) The Contractor shall submit a broken bolt removal procedure for approval of the PROGRAM MANAGER, Submittal shall include information about the planned broken bolt removal process and jig required to effectively drill and tap broken bolts, when necessary.
- (2) Whenever encountered, broken bolts shall be removed. Where drilling and tapping is required, a jig approved for use by the Program Manager shall be used. All broken bolts shall be replaced with 3/8"-16 stainless steel bolts. In the event that light bases are permanently damaged in the course of removing broken bolts, the Contractor shall be responsible for the immediate repair/replacement of the damaged light base. Permanent damage includes drilling of holes which exceed the required 3/8" bolt diameter and/or any "off centered" impressions that penetrate the inner lip of the existing bolt holes.
- (3) Use of "helicoils" is prohibited as a method of dealing with stripped bolt holes, unless specifically approved in extreme emergency conditions by the Program Manager.

All existing light bases shall be cleaned prior to the installation of replacement equipment for their final use. Cleaning shall include compressed air cleansing of the top flange prior to mounting either light fixtures, blank covers, or base plates on bases (transformer housings) at signs.

b. General Cable Installation Requirements. The primary cable shall enter the light base and transformer housing as shown on the drawings.

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

When more than one (1) circuit is installed within the lighting base, each cable shall bear its appropriate circuit identification marker.

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 isolating transformer's leads shall be made as specified in Item L-108.

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 and as shown on the drawings.

- d. General Base and Light Fixture Toe-In Requirements.** On curved sections of taxiway, Contractor shall orient the axis of a unidirectional centerline light beam to intersect the taxiway true centerline path at a point equal to four times the light spacing on the curve. Measure this spacing along the chord of the curve. Orient the axis of bi-directional centerline light beams parallel to the tangent of the nearest point of the curve designated as the taxiway true centerline path. On straight sections of taxiway centerlines, the axis of the light beam shall be parallel to the centerline of the taxiway centerline path. The Contractor shall submit their written installation method to the Engineer for approval prior to installation to assure the proper alignment as the bases are being set.
- e. General Light Fixture Bolt Installation.** Bolts for securing in-pavement light fixtures shall be tightened to the torque specified by the fixture manufacturer's specifications. All bolt holes shall be cleaned using compressed air immediately prior to installation of bolts. Threads on all bolts shall be coated with anti-seize compound approved for use on stainless steel. Bolts shall not extend past the threaded adapter ring or into the light base housing. Final tightening of bolts shall be performed with a properly calibrated torque wrench of the required range and verified by the PROGRAM MANAGER, Electrically or pneumatically operated wrenches shall not be used to achieve the final torque.
- f. Installing Light Fixtures at Existing Bases.** At locations indicated on the drawings, the Contractor shall install light fixtures on existing fixture bases. This shall include providing the following items, as required and directed by the PROGRAM MANAGER,
- (1) Remove and salvage existing base cover plates.
 - (2) Refurbish and prepare the base flange with flange rings or spacer rings, as required and directed by the Program Manager, in order to properly install the specified light fixture.
 - (3) Clean out and refurbish the interior of the bases, including conduits.
 - (4) Install primary airfield lighting circuit cable.
 - (5) Install fixture isolation transformers of specified rating and wattage.
 - (6) Furnish the correct size and number of new stainless steel bolts and install specified fixtures.
- g. Light Fixture and Base Installation in New Rigid Pavement Areas.**
- (1) Install light fixture base in accordance with the general requirements of paragraph 125-3.1 a. and d., as shown on the plans, and as noted below.

Conduit and base trench shall be filled with a concrete slurry of well-graded aggregate mix with a maximum ASTM C33 No. 8 size coarse aggregate. This concrete shall have a minimum 28-day compressive strength of 4,000 psi and may have a slump of up to 4 inches. The aggregate (except gradation) and other material shall meet the requirements of Item P-610, Structural Portland Cement Concrete. See Light Base Installation in Rigid Pavement details shown in the plans.

Light base setting and leveling jig shall not be removed for 24 hours after placing the encapsulation or until a hard set has occurred when using a high-performance grout encapsulation.

After installation of the light fixture, the azimuth of the light beam shall not vary more than $\pm 1/2$ degree from the required direction. The elevation of the light fixture outside edge shall be flush with the surrounding surface elevation such that the

elevation of the fixture is not more than +0 inches higher than or -1/16 inch lower than the elevation of the pavement on the low side. If this tolerance is not met, the Contractor shall, at its own expense, remove and replace the light base extension (top section) to the satisfaction of the Engineer.

In concrete light bases shall have one, two, or more 2-inch threaded metallic hubs for all required conduit entrances, as indicated on the plans. Grommets and conduit entrances are strictly prohibited except where shown on the plans.

- (2) Assemble the light fixture in accordance with the manufacturer's instructions. Connect the secondary leads of the transformer to the fixture leads with a disconnecting plug and receptacle conforming to AC 150/5345-26, latest revision, without taping the joint. Install a lamp of the proper rating in the fixture. Level each fixture as recommended by the manufacturer.
- (3) Install cable, duct and conduit in accordance with the general requirements noted in paragraph 125-3.1 b. and c.

h. Light Fixture and Base Installation in New Flexible Pavement Shoulder Areas.

- (1) Install light fixture base in accordance with the general requirements noted in paragraph 125-3.1 a., as shown on the plans, and as noted below.

Following placement of compacted aggregate base course conduit and bottom base section shall be placed. Conduit trench shall be filled to the top of compacted base with a concrete slurry of well graded aggregate mix with a maximum ASTM C33 No. 8 size coarse aggregate. The concrete shall have a minimum cement content of five (5) sacks per cubic yard, a slump up to 4 inches, and shall have a minimum 28-day compressive strength of 3,000 psi. The aggregate and other material shall meet the requirements of Item P-610, Structural Portland Cement Concrete. Concrete shall be placed under and around the outside of the base as shown on the plans. After hardening of the concrete to the satisfaction of the PROGRAM MANAGER, the asphalt course layers shall be placed in accordance with their specification. After installation of the surface course, Contractor shall core to the light base bottom section and install the top extension with band ring using spacer rings between the bottom and top extension to set proper elevation. Contractor shall then place the final high performance nonshrink grout shown on the plans to complete the light base installation.

The Contractor may use alternate methods of installations, only if approved in writing by the Engineer. The placement of conduit prior to subgrade and base completion and setting of bases after placement of bituminous courses will not be allowed.

Submit planned installation process for approval of the Engineer.

- (2) Assemble the light fixture in accordance with the manufacturer's instructions. Connect the secondary leads of the transformer to the fixture leads with a disconnecting plug and receptacle conforming to AC 150/5345-26, latest revision, without taping the joint. Install a lamp of the proper rating in the fixture.
- (3) Install cable, duct and conduit in accordance with the general requirements noted in paragraph 125-3.1 b. and c.

- i. **Guidance Signs.** Existing internally lighted L-858 signs shall be removed from the project site and stored by the Contractor until reused or shall be furnished complete with legend, as identified on the drawings. Install modular sign base, transformer, transformer base plate, conduit and cable entrances. Provide supports and tie devices for blast resistance.

Provide each lighted sign with an identification number in accordance with the plans by 1) affixing a retroreflective, self-adhesive vinyl label with 4-inch high characters on the sign end toward the associated pavement, and 2) provide, imbedded in the concrete encasement adjacent to each L-867 base for the sign, a 2 inch domed bronze identification marker disk with ¼-inch minimum height characters.

Bagging of signs and removal of bagging, as necessary during the progress of work, shall be incidental to sign installations and no separate payment shall be made.

125-3.2 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.

125-3.3 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 Program Manager, 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.

125-3.4 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.

METHOD OF MEASUREMENT

125-4.1

The number of fixtures furnished, including transformers, to be paid for shall be measured per each for each type of fixture with transformer furnished, and accepted by the Program Manager.

The number of fixtures, with transformers, installed to be paid for shall be measured per each for every fixture with transformer installed, and accepted by the Program Manager.

The number of blank covers furnished and installed to be paid for shall be measured per each for the type and size of blank cover furnished, installed, and accepted by the Program Manager.

The number of fixture bases furnished and installed, with safety ground, to be paid for shall be measured per each for each type of fixture base furnished, installed, and accepted by the Program Manager.

The number of light base blockouts constructed to be paid for shall be measured per each installed, complete, and accepted by the Program Manager.

The number of existing sign panels replaced shall be the number per each sign panel furnished and installed.

The measurement of existing L-858 signs relocated or removed, stored, and reinstalled shall be the number per each sign, including modular base, removed from the existing location, stored by the Contractor if necessary, and reinstalled at the new location, complete, and accepted by the Program Manager.

BASIS OF PAYMENT

125.5.1

Payment will be made at the contract unit price for each complete unit furnished, installed, or furnished and installed by the Contractor, and accepted by the Project Manager. This payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made at the contract unit price for each light base blackout completed with fiber form as detailed on the drawings. This payment will be full compensation for furnishing fiber form blackout cylinder, dowels, and all other materials, and for all labor, equipment and all incidentals necessary to construct the blackout, and following paving to remove the plywood cover and sand, to prepare the blackout for installation of the light base, to install the flexible conduit connection, and to place the concrete backfill, for a complete installation.

Payment will be made at the contract unit price for each existing guidance sign relocated or removed to storage and reinstalled at new location, complete and accepted by the Program Manager. Existing guidance signs include lighted sign, transformer, and modular precast base. This payment will be full compensation for furnishing all materials, seals, connectors, heat shrink kits, ground rod, aggregate base, and other incidentals, for disassembly and reassembly of lighted sign, and modular base, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

- L-125-5.1 Furnish and Install L-868B Blank Cover – per each
- L-125-5.2 Furnish and Install L-867B Blank Cover – per each
- L-125-5.3 Furnish L-852C LED Bidirectional Taxiway Centerline Fixture & Transformer – per each
- L-125-5.4 Furnish L-852C LED Unidirectional Taxiway Clearance Bar Fixture & Transformer – per each
- L-125-5.5 Furnish L-852D LED Bidirectional Taxiway Centerline Fixture & Transformer – per each
- L-125-5.6 Furnish L-852D LED Bidirectional Taxiway Centerline Fixture, & Transformer, with Programmable Unit – per each
- L-125-5.7 Furnish L-852F LED Omnidirectional Taxiway Intersection Fixture & Transformer – per each
- L-125-5.8 Furnish L-852GS LED Combo Runway Guard/Stop Bar Fixture & Transformer, with Programmable Unit – per each
- L-125-5.9 Furnish L-862S LED Elevated Stop Bar Fixture & Transformer, with Programmable Unit – per each
- L-125-5.10 Furnish L-804 LED Elevated Runway Guard Fixture & Transformer – per each
- L-125-5.11 Furnish L-861T LED Elevated Taxiway Edge Fixture & Transformer – per each
- L-125-5.12 Furnish L-868B 2-Piece Light Base with Multihole Adapter Ring for In-Pavement Light – per each
- L-125-5.13 Furnish L-868B 2-Piece Light Base with Multihole Adapter Ring for Edge Light – per each

- L-125-5.14 Furnish L-868B 1-Piece, 27" Deep Light Base with Multihole Adapter Ring– per each
- L-125-5.15 Furnish L-868B 1-Piece, 12" Deep Light Base with Multihole Adapter Ring– per each
- L-125-5.16 Furnish L-867B 1-Piece, 12" Deep Light Base – per each
- L-125-5.17 Furnish L-867B 1-Piece, 27" Deep Light Base – per each
- L-125-5.18 Install In-Pavement Light, Complete – per each
- L-125-5.19 Install Elevated Light, Complete – per each
- L-125-5.20 Install Light Base in New Rigid Pavement – per each
- L-125-5.21 Install Light Base in New Flexible Pavement – per each
- L-125-5.22 Install Shallow Light Base in Existing Rigid Pavement – per each
- L-125-5.23 Install 27" Deep Light Base in Existing Rigid Pavement – per each
- L-125-5.24 Install Shallow Light Base in Existing Flexible Pavement – per each
- L-125-5.25 Install 27" Deep Light Base in Existing Flexible Pavement – per each
- L-125-5.26 Furnish Materials and Construct Light Base Blockout, Complete – per each
- L-125-5.27 Replace Sign Panel in Existing Guidance Sign – per each
- L-125-5.28 Relocate 3 Mod L-858 Sign and Modular Base, Complete – per each
- L-125-5.29 Relocate 4 Mod L-858 Sign and Modular Base, Complete – per each
- L-125-5.30 Remove, Store, & Reinstall 3 Mod L-858 Sign and Modular Base, Complete – per each
- L-125-5.31 Remove, Store, & Reinstall 4 Mod L-858 Sign and Modular Base, Complete – per each
- L-125-5.32 Furnish & Install 2 Mod L-858 Sign with Transformer, Base Can, and Foundation, Complete – per each

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 150/5345-42	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 150/5345-53	Airport Lighting Equipment Certification Program

Engineering Brief (EB)

EB No. 67	Light Sources Other than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures
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END OF ITEM L-125