Add the following:

ITEM L-101 AIRPORT ROTATING BEACONS

DESCRIPTION

101-1.1 This item shall consist of removal and disposal of existing beacons and furnishing and installing new airport rotating beacons. The work shall include mounting, leveling, wiring, conduit, painting, maintaining, and testing of the beacon. In addition, this item also includes all materials and incidentals necessary to place the beacon in a serviceable condition, as a completed unit, to the satisfaction of the Engineer. This item shall include a mounting platform if specified on the Plans.

EQUIPMENT AND MATERIALS

101-2.1 GENERAL.

a. Airport lighting equipment and materials covered by advisory circulars (ACs) shall be certified in *AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. The AC 150/5345-53, the latest certified equipment list, and the address list of certified airport lighting equipment manufacturers are available on the FAA Airport Engineering, Design, & Construction web page: https://www.faa.gov/airports/engineering/.

101-2.2 BEACON. The beacon shall be type L-801A, or L-802A, Class II, with metal-halide lamp(s), meeting the requirements of *AC 150/5345-12, Specification for Airport and Heliport Beacons.*

a. The beacon shall be supplied with an arctic kit to provide supplemental heating to the beacon mechanisms and bearings for operations in extreme weather. If the manufacturer does not offer an optional arctic kit, the beacon shall be modified as specified in this subsection. The beacon shall, at a minimum, be equipped with a 400 watts (W) strip heater installed to keep the motor and beacon housing warm during extreme cold weather conditions. An air-sensing thermostat shall be supplied with contacts rated for 16 amperes (A), 120 volts (V). The thermostat shall be constructed so that contacts close on descending temperatures adjustable between 0 °F and 30 °F, +/- 4 °F. The contacts shall open on rising temperatures at 15 °F above closing temperature.

b. The internal heater and internal thermostatic control kit shall be field wired separate from the beacon lights and motor, as shown in the beacon wiring diagram on the Plans.

c. The beacon contactor shall be 2-pole, 30 A, with an operating coil designed for 120 V, 60 Hz., and shall be mounted in the control panel with its operating coil circuit connected through an on-off-auto switch as shown on the Plans.

101-2.3 BEACON INSTALLATION. Installation shall be as shown on the Plans and in compliance with *AC 150/5340-30, Design and Installation Details for Airport Visual Aids*.

101-2.4 PANEL BOARDS AND BREAKERS. Panel boards and breakers shall conform to the requirements of Federal Specification W-P-115, Panel, Power Distribution.

101-2.5 WEATHERPROOF CABINETS. The weatherproof cabinets shall conform to National Electrical Manufacturers Association Standards (NEMA) and shall be constructed of steel not less than No. 16 United States Standard (USS) gauge.

101-2.6 ELECTRICAL WIRE. For ratings up to 600 V, thermoset wire conforming to Commercial Item Description A-A-59544A, Type XHHW-2, shall be used. The wires shall be the type, size, number of conductors, and voltage shown in the Plans or in these Specifications.

101-2.7 CONDUIT. Rigid steel conduit and fittings shall be per Underwriters Laboratories (UL) Standards 6 and 514B.

101-2.8 PAINT.

a. Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.

b. Priming paint for galvanized metal surfaces shall be a zinc-rich epoxy primer paint per MIL-DTL-24441C/19C, Formula 159, Type III. Use MIL-24441 thinner per paint manufacturer's recommendations.

c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint meeting the requirements of Master Painter's Institute (MPI) Reference #9 (gloss). The color shall be per Federal Standard 595, International Orange Number 12197.

d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint per the Master Painter's Institute, Reference #9, Exterior Alkyd, Gloss, volatile organic content (VOC) Range E2.

e. Priming paint for wood surfaces shall be mixed on the job by thinning the above-specified orange or white paint with 1/2 pint of raw linseed oil to each gallon.

f. Factory-applied paint shall be manufacturer's standard prime and finish coats or powder-coated finish.

101-2.9 DISCONNECT SWITCH. Switch shall be a 600V AC, 30A minimum, heavy-duty motor-rated, multi-pole switch as indicated on the Plans. Provide switch in a NEMA type 4X metal enclosure.

CONSTRUCTION METHODS

101-3.1. PLACING THE BEACON. The beacon shall be mounted as shown in the Plans.

101-3.2 HOISTING AND MOUNTING. The beacon shall be hoisted to the mounting platform by using suitable slings and hoisting tackle. Before fastening the beacon to the mounting platform, the mounting holes shall be checked for correct spacing. Beacon base or mounting legs shall not be strained or forced out of position to fit incorrect spacing of mounting holes. The beacon base shall be raised first, set in position, and bolted in place. The drum shall then be raised and assembled to the base.

101-3.3 LEVELING. After the beacon has been mounted, it shall be accurately leveled following the manufacturer's instructions. The leveling shall be checked in the presence of the Engineer and shall be to the Engineer's satisfaction.

101-3.4 SERVICING. Before placing the beacon in operation, the Contractor shall check the manufacturer's manual for proper servicing requirements. Follow the manufacturer's servicing instructions for each size of beacon. If not included in the manufacturer's instructions, the Contractor must also:

a. Clean and polish all glassware, both inside and outside, using a type of cleaner which will not scratch the lens, and clean the interior of the beacon.

b. Clean interior of beacon base and check for alignment of parts.

c. Clean and lubricate all mechanical systems according to manufacturer's recommendations. Assure that all sub-assemblies are properly aligned and working properly.

d. Secure lamps properly in the sockets.

101-3.5 BEAM ADJUSTMENT. After the beacon has been mounted and leveled, the elevation of the beam shall be adjusted. The final beam adjustments shall be made at night so that results can be readily observed. The beams shall be adjusted to the elevation directed by the Engineer or as shown in the Plans. See AC 150/5340-30 for additional information about airport beacon beam adjustment.

101-3.6 BEACON MOUNTING PLATFORM. Where the beacon is to be mounted at a location other than the beacon tower and where a special mounting platform is required, the construction of the mounting platform and any necessary lightning protection equipment shall be per the details shown in the Plans.

101-3.7 WIRING. The Contractor shall furnish all necessary labor and materials and shall make complete above ground electrical connections per the wiring diagram furnished with the project Plans. The electrical installation shall conform to the requirements of the latest edition of National Fire Protection Association, NFPA-70, National Electrical Code (NEC).

If underground cable for the power feed from the transformer vault to the beacon site and duct for this cable installation is required, the cable, ground rods and duct shall be installed as shown on the Plans.

If shown on the Plans, the Contractor shall connect the tell-tale relay mechanism in the beacon to energize the tower obstruction light circuit when failure of the beacon service (primary) lamp occurs.

If lightning protection is specified in the Plans, it shall be installed per L-103, Airport Beacon Towers, Subsection 103-2.3.

101-3.8 PANEL AND CABINET. If shown on the plans, the Contractor shall furnish and install at the top of the beacon tower or mounting platform a circuit-breaker panel consisting of four 15-ampere breakers mounted in a weather-proof cabinet to provide separate protection for the circuits to the beacon lamps, motor, obstruction lights, and other equipment. The cabinet shall be located on the side of the beacon platform as shown on the plans or as directed by the Engineer.

101-3.9 CONDUIT. All exposed wiring shall be run in not less than 3/4-inch galvanized rigid steel conduit. Outdoor rated, liquid-tight, flexible metal conduit may be used for final connection at the beacon equipment. No conduit shall be installed on top of a beacon platform floor. All conduits shall be installed to provide for drainage. If mounted on a fixed steel beacon tower, the conduit shall be fastened to the tower members with Wraplock® straps (or equivalent), clamps, or approved fasteners, spaced approximately 5 feet apart.

The conduit shall be fastened to wooden structures with galvanized pipe straps and with galvanized wood screws not less than No. 8 or less than 1-1/4 inches long. There shall be at least two fastenings for each 10 feet length.

101-3.10 BOOSTER TRANSFORMER. If shown on the Plans and described in these Specifications, a booster transformer, used to compensate for a voltage drop to the beacon, shall be installed in a suitable weatherproof housing under or on the tower platform, at the base of the tower, in the transformer vault, or at the power source.

Install booster transformer as shown on the Plans and as described in these Specifications. If the booster transformer is required for installation in the transformer vault, it shall be installed according to L-109 Airport Transformer Vault and Vault Equipment.

101-3.11 PHOTOELECTRIC CONTROL. If shown on the Plans or specified in these Specifications, the Contractor shall furnish and install an automatic control switch at the location indicated in the Plans. The switch shall be a photoelectric type, standard commercially available unit complying with UL 773, with supply voltage rating of 120-277V AC, integral surge protection, -40°F deg F to 140°F temperature range, and EEI-NEMA standard twist-lock mounting base with matching receptacle. The photoelectric switch shall be installed, connected, and adjusted per the manufacturer's instructions.

101-3.12 OBSTRUCTION LIGHTS. Unless otherwise specified, the Contractor shall install on the top of the beacon tower or mounting platform two L-810 obstruction lights on opposite corners. These lights shall be mounted on conduit extensions to a height of not less than 4 inches above the top of the beacon.

101-3.13 PAINTING. If construction of a wooden mounting platform is required as part of the Plans or these Specifications, all wooden parts of the platform shall be given one priming coat of white or international-orange paint after fabrication but before erection and one body and one finish coat of international-orange paint after erection. Steel mounting platforms shall be given one priming coat of corrosion-inhibiting primer before erection and one body and one finish coat of international-orange paint after erection. All equipment installed under this contract and exposed to the weather shall be given one body and one finish coat of international-orange (per Federal Standard 595, Number 12197) or white paint as required. This shall include the beacon (except glass surfaces), beacon base, breaker cabinet, all conduit, and transformer cases. It shall not include lightning protection system air terminals or obstruction light globes.

Apply the paint uniformly at the proper consistency. The finished paint shall be free from sags, holidays, and smears. Each coat of paint shall be given ample time to dry and harden before the next coat of paint is applied. A minimum of three (3) days shall be allowed for drying on wood surfaces, and a minimum of four (4) days shall be allowed for drying on metal surfaces. Painting shall not be performed in cold, damp, foggy, dusty, or frosty atmospheres, or when the air temperature is below 40°F, or started when the weather forecast indicates such conditions for the day.

All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt. All knots in wood surfaces shall be covered with shellac immediately before applying the priming coat of paint. Nail holes and permissible imperfections shall be filled with putty. The ready-mixed paint shall be thinned for the priming and body coats per the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

a. Body coats (for both wood and steel surfaces) - add 1/2 pint of turpentine to each gallon of ready-mixed paint for body coats.

b. Finish coats (for both wood and steel surfaces) the ready-mixed paint shall be used as it comes from the container for finish coats.

101-3.14 TESTING. The beacon installation shall be fully tested for proper operation as a completed unit prior to acceptance. These tests shall include operation of the lamp-changer and performing insulation resistance and voltage readings. The insulation resistance to ground of the beacon power supply circuit shall be not less than 1,000 megohms when measured ungrounded. The Contractor must furnish testing equipment. Tests shall be conducted in the presence of the Engineer and shall be to the Engineer's satisfaction.

101-3.15 SPARE PARTS. Provide a quantity of spare parts, according to subsection L-125-3.10, including two spare lamps. Deliver spare parts to airport maintenance as directed by the Engineer.

METHOD OF MEASUREMENT

101-4.1 The quantity to be paid for shall be the number of beacons installed as completed units in place, accepted, and ready for operation.

BASIS OF PAYMENT

101-5.1 Payment will be made at the contract unit price for each completed and accepted beacon. This price shall be full compensation for removal of existing beacon, furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item. Removal of existing rotating beacons shall be subsidiary to installation of new rotating beacons.

101-5.2 Spare parts are paid for under L125.170.0000 Spare Parts. Spare parts to be paid by actual invoiced material and delivery cost, according to subsection L-125-4.4, plus 15% markup.

Payment will be made under:

Item L101.010.0000	Rotating Beacon, High Intensity, L-802A - per each
Item L101.020.0000	Rotating Beacon, Medium Intensity, L-801A - 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 150/5345-12	Specification for Airport and Heliport Beacons
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description

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

Federal Specification (FED SPEC)

FED SPEC W-P-115	Panel, Power Distribution

Federal Standard (FED STD)

FED STD 595	Colors Used in Government Procurement

Master Painter Institute (MPI)

MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Mil Spec

MIL-DTL-24441C/19C	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

National Fire Protection Association (NFPA)

NFPA-70	National Electric Code (NEC)

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit – Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 773	Plug-In Locking Type Photocontrols for Use with Area Lighting

ITEM L-103 AIRPORT BEACON TOWERS

DESCRIPTION

103-1.1 This item shall consist of removal and disposal of existing beacon tower; furnishing and installing an airport beacon tower as shown on the Plans and according to these Specifications. This work shall include the clearing of the site, erection of the tower, installation of lightning protection, painting, and all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the Engineer. See advisory circular *(AC) 150/5340-30 Design and Installation Details for Airport Visual Aids* for additional installation information about airport beacon towers.

EQUIPMENT AND MATERIALS

103-2.1 GENERAL. All equipment and materials covered by referenced specifications shall be subject to acceptance through the manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

103-2.2 TOWER. The beacon tower shall conform to the requirements of AC 150/5340-30, Chapter 6. The tower and foundation shall be designed according to the International Building Code. Structural design loads shall be determined using the American Society of Civil Engineers, "Minimum Design Loads for Buildings and other Structures" (ASCE 7) for the site. The minimum basic wind speed shall be based on exposure category C (use D if the beacon is within 1/4-mile from large bodies of open water or a coastal area), and Risk Category III. Design the supporting structure for the combined effects of self-weight, wind, snow and earthquake loads as prescribed by ASCE 7. A professional engineer registered in the State of Alaska shall stamp the design and calculations, and submit them to the Department for review.

The beacon tower shall be either of the following:

a. Fixed Tubular Steel Tower. The tubular steel tower shall be formed of 60,000 pounds per square inch, psi (Grade 60) ASTM A572 steel, with galvanized prime and painted finish.

b. Hinged Pole Tower. The beacon tower shall be a galvanized hinged steel pole with painted finish. Provide a pole formed of high strength 50,000 psi (Grade 50) ASTM A572 steel. The pole shall be self-supporting without the use of guy wires, of the height specified in the bid schedule, and have a winch with an automatic brake and a removable hand crank or other approved mechanism to lower the top of the beacon pole to ground level. Provide a counterweighted top section with a tall, sturdy mounting platform for the rotating beacon. Ensure that the beacon pole tower components and assemblies, are designed and rated to meet design loads.

103-2.3 LIGHTNING PROTECTION. Lightning protection shall comply with NFPA-780, Standard for the Installation of Lightning Protection Systems. All materials shall comply with NFPA-780 Class II material requirements regardless of the tower height.

a. Air Terminal. The air terminal shall consist of a galvanized steel, copper, or copper-clad rod with the upper end drawn to a point and of sufficient length as required by the equipment being protected.

b. Down Conductor. The down conductor cable for lightning protection shall consist of No. 2/0 AWG or larger bare stranded copper wire.

c. Ground Rod. The ground rod shall be 3/4-inch diameter by 10 feet long, made of copper or copper - clad metal. The tower shall be grounded at the base as shown in the Plans and as specified.

103-2.4 PAINT.

a. Priming paint for galvanized steel towers shall be zinc dust-zinc oxide primer paint per MIL-DTL-24441C/19C. Use MIL-24441 thinner per paint manufacturer's recommendations.

b. Priming paint for non-galvanized steel towers shall be a high solids alkyd primer per the Master Painter's Institute (MPI), Reference #9, Exterior Alkyd, Gloss.

c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint MPI Reference #9 (gloss). The color shall be per Federal Standards 595, International Orange Number 12197.

d. White paint for a steel tower shall be ready-mixed paint per MPI #8.

103-2.5 FOUNDATION. Construct foundation as shown on the Plans. Foundation to pole base connections must be adjustable by tightening or loosening bolts with a wrench and adjusts within a minimum 5-degree tolerance without compromising the wind rating.

a. Contractor Designed Foundation. If a foundation design is not included in the Plans, the Contractor will design the foundation based on the soil bearing capacity of the soils located at the poles site, using a factor of safety of 3 or more, and design loads on the rotating beacon.

Design the foundation as necessary to resist pole lateral, uplift, and overturning forces. A professional engineer registered in the State of Alaska shall stamp the design and calculations, and shall demonstrate the foundation design is adequate to support the specified loads and resist forces. Submit the design and calculations to the Department for review.

CONSTRUCTION METHODS

103-3.1 CLEARING AND GRADING. The site on which the beacon tower is to be erected shall be cleared and leveled. All trees and brush shall be removed from the area within a distance of 25 feet from the tower or as called for in the Plans. Stumps shall be removed to a depth of 18 inches below finished grade and the excavation filled with earth and tamped. If a transformer vault or other structure is included as part of the installation, the area shall be cleared to a distance of 25 feet from these structures. The ground near the tower shall be leveled to permit the operation of mowing machines. The leveling shall extend at least 2 feet outside the tower legs. All debris removed from the tower site shall be disposed of by the Contractor to the satisfaction of the Engineer and per federal, state, or local regulations.

103-3.2 EXCAVATION AND FILL. Excavation for the tower footings shall be carried to a minimum of 4 inches below the footing depth. The excess excavation below the footing depth shall then be backfilled with gravel or crushed stone meeting the requirements of P-154, P-209, or P-299. The footing plates shall be installed, and a thickness of not less than 18 inches of the same gravel or crushed stone shall be placed immediately above the footing plates in layers of not over 6 inches. Each layer above the footing plates shall be thoroughly tamped in place. The remainder of the backfill may be of excavated earth placed in layers not to exceed 6 inches. Each layer shall be thoroughly compacted by tamping.

Where solid rock is encountered, which prevents the carrying of the foundation legs to the required depth but which is of sufficient strength to use hold-down bolts, the tower anchor posts shall be cut off at the required length and the hold-down bolts shall be installed as indicated in the plans with the approval of the Engineer. Each tower leg shall be anchored to the rock by means of two 7/8-inch diameter by 3 feet long expansion or split bolts and shall be grouted with neat Portland cement into holes drilled into the natural rock. Except as required for rock foundations, the footing members shall not be cut off or shortened. If excavated material is of such consistency that it will not readily compact when backfilled, the Engineer may order the excavation backfilled with concrete or other suitable material.

The concrete footing for tubular beacon towers shall be installed per the manufacturer's recommendations. Portions of the footing in the topsoil layer shall not be included in the footing height.

Concrete foundation for hinged pole shall be in accordance with these Specifications and the manufacturer's drawings and recommendations. Concrete shall meet the requirements of P-610. Notify the Engineer at least 24 hours prior to placement of concrete. Allow concrete bases to cure for 7 days after pouring before installing the pole.

Do not grout between the base plate and the foundation to allow air to circulate through the pole to prevent moisture accumulation.

103-3.3 ERECTION. Fixed tower erection as shown on the Plans and detailed erection drawings furnished by the manufacturer shall be strictly followed during construction. All towers shall be erected in sections from the ground up unless otherwise specified. For final assembly, all bolts and fastenings shall be installed, and the structure shall be plumb, true, square, and level. Nuts shall be taken up to a firm bearing after which the bolts shall, if necessary, be cut to proper length to protrude three full threads.

Approved locknuts shall be placed on each bolt over the regular nut. Ladder bolts shall be inserted with the head to the outer face of the tower. Diagonal, leg, and handrail bolts shall be installed with nuts on the outer face of the tower, unless otherwise specified. Bent parts shall be straightened before erection without damage to the protective coating. Surfaces abraded or bared of protective coating shall be painted with the proper priming paint per these Specifications.

The Contractor shall install the ladder on the side of the tower adjacent to the driveway or most accessible approach to the tower. Tubular beacon towers shall be erected per the manufacturer's recommendations. The safety cable shall be located on the side of the tower adjacent to the driveway or most accessible approach to the tower.

103-3.4 LIGHTNING PROTECTION. The Contractor shall furnish and install a Class II lightning protection system in accordance with NFPA 780, consisting of an air terminal, down conductor, and at least one ground plate or rod for each beacon tower. The air terminal shall be installed at the top of the tower with the tip of the air terminal extending not less than 10 inches above the highest equipment being protected. Ground rods and underground cables shall be installed in accordance with the Plans.

Down-conductor cables shall be securely fastened to the surface of the tower leg at 5-foot intervals with suitable bronze fasteners having bronze or noncorrosive metal bolts. Sharp turns or bends in the down conductor will not be permitted. Down conductors in hinged poles shall be routed inside the pole and connected to ground clamps or lugs at the top and bottom of the pole.

All connections of cable to cable and cable to air terminals, shall be made with solder-less connectors of noncorrosive metal approved by the Engineer and shall be of substantial construction.

The down-conductor cable shall be securely attached to ground rods or plates placed at least 2 feet away from the tower foundations. The ground rod shall be driven into the ground so that the top is at least 6 inches below grade. The down-conductor shall be firmly attached to the ground plate or rod by means of exothermic welding only. Plates shall be embedded in an area of permanent moisture.

The complete lightning protection installation shall be accomplished to the satisfaction of the Engineer. The resistance to ground of any part of the lightning protection system shall not exceed 25 ohms. If a single rod grounding electrode has a resistance to earth of over 25 ohms, then install one supplemental rod not less than 10 feet from the first rod. If desired resistance to ground levels are still not achieved, see FAA-STD-019 for guidance on the application of coke breeze.

103-3.5 PAINTING. The Contractor shall furnish all materials and labor for painting the beacon tower. The color scheme for the steel tower shall be five equal spaces of alternating orange and white paint.

a. Parts to be Painted. Tower parts (except those parts to be exposed to earth) shall be treated or primed before erection. All tower parts placed below ground level or within 12 inches above ground level shall be given two coats of approved asphalt paint.

Apply the proper consistency of paint uniformly. The finished paint shall be free from sags, holidays, and smears. Division lines between colors shall be sharply defined. Each coat of paint shall be given ample time to dry and harden before the next coat is applied. A minimum of four (4) days shall be allowed for drying on metal surfaces. Painting shall not be done in cold, damp, foggy, or dusty

atmospheres, or when air temperature is below 40 °F, or started when the weather forecast indicates such conditions for the day.

All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt when paint is applied. Paint finishes damaged during shipping or erection shall be repaired in accordance with these Specifications or the manufacturer's recommendations as applicable.

The number of coats of paint applied shall be per the following instructions:

b. Steel Towers, Galvanized. One priming coat of zinc dust-zinc oxide primer after erection and one body and one finish of white or orange paint (as required by the color scheme).

c. Steel Towers, Not Galvanized. One priming coat of corrosion-inhibiting primer and one body and one finish coat of white or orange paint (as required by the color scheme).

The above specified orange and white ready-mixed paints shall be thinned for the body coats per the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

d. Body Coats. Add not more than 1/2-pint of turpentine to each gallon of ready-mixed paint for body coats.

e. Finish Coats. The ready-mixed paint shall be used as it comes from the container for finish coats.

METHOD OF MEASUREMENT

103-4.1 The quantity to be paid for under this item shall be the number of airport beacon towers installed as completed units in place, accepted, and ready for operation.

103-4.2 Refer to P-610 for requirements regarding all work and materials to place Portland cement concrete.

BASIS OF PAYMENT

103 5.1 Payment will be made at the contract unit price for each completed and accepted beacon tower. This price shall be full compensation for removal of existing beacon tower; furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Portland cement concrete is subsidiary to L-103 items requiring its use.

Removal of existing beacon towers and foundations shall be subsidiary to the installation of beacon towers and no separate payment will be made.

Payment will be made under:

Item L103.010.0030 30-feet Hinged Pole Beacon Tower - per each

Item L103.020.0000 Fixed Tubular Steel Beacon Tower - 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 150/5340-30 Installation and Design Details for Airport Visual Aids

Master Painter's Institute (MPI)

MPI Reference #8	Alkyd, Exterior, Flat (MPI Gloss Level 1)
MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Federal Standard (FED STD)

FED STD 595	Colors Used in Government Procurement

Mil Standard

MIL-DTL-24441C/19C	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

National Fire Protection Association (NFPA)

NFPA-780	Standard for the Installation of Lightning Protection Systems

ITEM L-107 AIRPORT WIND CONES

DESCRIPTION

107-1.1 This item shall consist of the removal of existing airport wind cones; furnishing and installing lighted and unlighted airport wind cones per these Specifications and per the dimensions, design, and details shown on the Plans.

The work shall include the furnishing and installation of a support for mounting the wind cone, the specified interconnecting wire, and a concrete foundation. The item shall also include all cable connections, conduit and conduit fittings, the furnishing and installation of all lamps, ground rod and ground connection, the testing of the installation, and all incidentals necessary to place the wind cone in operation (as a completed unit) to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

107-2.1 GENERAL.

a. Airport lighting equipment and materials covered by advisory circulars (ACs) shall be certified in *AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. The AC 150/5345-53, the latest certified equipment list, and the address list of certified airport lighting equipment manufacturers are available on the FAA Airport Engineering, Design, & Construction web page: https://www.faa.gov/airports/engineering/.

107-2.2 WIND CONES. The 8-foot and 12-foot wind cone assemblies shall conform to the requirements in *AC 150/5345-27, Specification for Wind Cone Assemblie*s, and be a type listed below:

a. Type L-807, Style I-A, Size 1, externally lighted wind cone.

b. Type L-807, Style I-B, Size 1, internally lighted wind cone.

c. Type L-807, Style I-A, Size 2, externally lighted wind cone.

d. Type L-807, Style I-B, Size 2, internally lighted wind cone.

e. Type L-806, Style I-B, Size 1, internally lighted wind cone.

f. Type L-807, Style II, Size 1, unlighted wind cone.

g. Type L-807, Style II, Size 2, unlighted wind cone.

h. Type L-806, Style II, Size 1, unlighted wind cone.

107-2.3 ELECTRICAL WIRE AND CABLE. Cable rated up to 5,000 volts (V) in conduit shall conform to *AC 150/5345-7 Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits*. For ratings up to 600 V, cross-linked polyethylene insulated wire conforming to Commercial Item Description A-A-59544A Type XHHW-2 shall be used. The wires shall be of the type, size, number of conductors, and voltage shown on the Plans or in these Specifications.

107-2.4 CONDUIT. Rigid steel conduit and fittings shall conform to the requirements of Underwriters Laboratories Standards 6 and 514B.

107-2.5 PLASTIC CONDUIT (FOR USE BELOW GRADE ONLY). (Subsection Not Used)

107-2.6 CONCRETE. The concrete for foundations shall be proportioned, placed, and cured per P-610 Concrete for Miscellaneous Structures.

a. Foundation. Construct foundation as shown on the Plans. Foundation to pole base connections must be adjustable by tightening or loosening bolts with a wrench to adjust within a minimum 5-degree tolerance without compromising the wind rating. If a foundation design is not included in the Plans, design the foundation based on the soil bearing capacity of the soils located at the pole site, using a factor of safety of 3 or more, and design loads on the wind cone.

Design the foundation as necessary to resist pole lateral, uplift, and overturning forces. A professional engineer registered in the State of Alaska shall stamp the design and calculations, and shall demonstrate the foundation design is adequate to support the specified loads and resist forces. Submit the design and calculations to the Department for review.

107-2.7 PAINT.

a. Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.

b. Priming paint for galvanized metal surfaces shall be zinc dust-zinc oxide primer paint conforming to MIL-DTL-24441C/19C. Use MIL-24441 thinner per paint manufacturer's recommendations.

c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint per Master Painter's Institute (MPI) Reference #9 (gloss). The color shall be per Federal Standards 595, International Orange, Number 12197.

d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the MPI, Reference #9, Exterior Alkyd, Gloss.

e. Priming paint for wood surfaces shall be mixed on the job by thinning the above specified aviation-orange or white paint by adding 1/2-pint of raw linseed oil to each gallon.

f. Factory-applied paint shall be manufacturer's standard prime and finish coats or powder-coated finish.

107-2.8 WINDSOCK. The windsock fabric shall be standard international orange.

CONSTRUCTION METHODS

107-3.1 INSTALLATION. The hinged support or hinged pole shall be installed on a concrete foundation in accordance with these Specifications and the manufacturer's drawings. Do not grout between the base plate and the foundation to allow for air circulation and to inhibit corrosion inside the pole.

a. Notification. Notify the Engineer at least 24 hours prior to placement of concrete. Allow concrete bases to cure for 7 days after pouring before installing the pole.

b. Backfill. Use gravel or crushed stone meeting the requirements of P-154, P-209, or P-299 for material used as backfill around the footing of the wind cone foundation. All materials must be free of frozen lumps and clay particles.

107-3.2 SUPPORT POLE ERECTION. The Contractor shall erect the pole on the foundation following the manufacturer's requirements and erection details. The pole shall be level and secure.

107-3.3 ELECTRICAL CONNECTION. The Contractor shall furnish all labor and materials and shall make complete electrical connections per the wiring diagram furnished with the Plans and the manufacturer's instructions. The electrical installation shall conform to the requirements in the latest edition of National Fire Protection Association, NFPA-70, National Electrical Code (NEC).

Underground cable from the transformer vault to the wind cone site and duct for this cable installation shall be installed in accordance with L-108 Underground Power Cables for Airports, and L-110 Airport Underground Electrical Duct Banks and Conduits in locations as shown on the Plans.

107-3.4 BOOSTER TRANSFORMER. If shown in the Plans, a booster transformer shall be installed in a suitable weatherproof housing to compensate for voltage drop to the lamps. The booster transformer shall be installed as shown on the Plans and described in the Specifications.

107-3.5 GROUND CONNECTION AND GROUND ROD. The Contractor shall furnish and install a ground rod, grounding cable, and ground clamps for grounding the “A” frame of the 12-foot assembly or pipe support of the 8-foot support near the base. The ground rod shall be 3/4-inch diameter by 10-foot long and shall be copper or copper clad. The ground rod shall be driven into the ground adjacent to the concrete foundation (minimum distance from foundation of 2 feet) so that the top is at least 6 inches below grade. The grounding cable shall consist of No. 6 American wire gauge (AWG) minimum bare stranded copper wire or larger and shall be firmly attached to the ground rod by exothermic welding.

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. The other end of the grounding cable shall be securely attached to a leg of the “A” frame or to the base of the pipe support with non-corrosive metal and shall be of substantial construction. The resistance to ground shall not exceed 25 ohms. If a single rod grounding electrode has a resistance to earth of over 25 ohms, then install one supplemental rod not less than 10 feet from the first rod. If desired resistance to ground levels are still not achieved, see FAA-STD-019 for guidance on the application of coke breeze. No ground rod is required at the unlighted wind cone.

107-3.6 PAINTING. Three coats of paint shall be applied (one prime, one body, and one finish) to all exposed material installed under this item except the fabric cone, obstruction light globe, and lamp reflectors. The paint shall be per MPI Reference #9 (gloss). The color shall be per Federal Standard 595, International Orange, Number 12197.

107-3.7 LIGHT SOURCES. The Contractor shall furnish and install light sources per the manufacturer’s instruction book for the source type designated on the Plans.

107-3.8 WINCH AND PADLOCK. The Contractor shall furnish and install a suitable locking ratchet winch for lowering and raising the hinged top section.

A padlock shall also be furnished by the Contractor for securing the hinged top section to the fixed lower section. The padlock shall be keyed to match the padlock on the electrical equipment enclosure where present. Three keys for the padlock shall be delivered to the Engineer.

107-3.9 SEGMENTED CIRCLE. The segmented circle shall be constructed as shown on the Plans. Segmented circles shall conform to the requirements in *AC 150/5340-5, Segmented Circle Airport Marker System* and P-640 Segmented Circle.

107-3.10 TESTING. The wind cone installation shall be fully tested for proper operation as a completed unit prior to acceptance. These tests shall include performing insulation resistance and voltage readings. The Contractor must furnish testing equipment. Conduct tests in the presence of the Engineer and to the Engineer’s satisfaction.

No work will be accepted until all applicable tests have been performed. Tests shall not begin until the work has been approved by the Engineer. All tests shall be neatly tabulated on a reproducible "Test Sheet" which shall be signed and dated by the Contractor upon completion of the test. Test and demonstrate to the Engineer the following:

a. That all lighting, power, and control circuits are continuous, and free from short circuits.

b. That all circuits are free from unspecified grounds.

c. The insulation resistance to ground of the wind cone power supply circuit shall be 1,000 megohms, minimum, for 600 V circuits when measured ungrounded. Test cables according to L-108-3.10 when 5,000 V circuits are utilized to serve the wind cone.

d. That all circuits are properly connected according to applicable wiring diagrams.

e. That all circuits are operable.

107-3.11 GUARANTEE. Furnish a written guarantee that any materials or workmanship found defective within one year of final acceptance shall be replaced at the Contractor's expense, promptly upon notification and to the satisfaction of the Engineer, and in conformance with subsection GCP 90-10.

107-3.12 SPARE PARTS. Provide a quantity of spare parts, according to subsection L-125-3.10, including one wind cone sock and lamp or LED illuminator of each type and size installed. Deliver spare parts to airport maintenance as directed by the Engineer.

METHOD OF MEASUREMENT

107-4.1 WIND CONES. The quantity to be paid shall be the number of wind cones installed as completed units in place, accepted, and ready for operation, including wind cone, foundation, excavation and backfill, conduit and conductors to first handhole, incidental materials, and testing required for a complete and operational installation.

107-4.2 SEGMENTED CIRCLE. The quantity of segmented circle airport marker systems to be paid for shall be the number of systems installed as completed units in place, accepted, and ready for operation.

107-4.3 PORTLAND CEMENT CONCRETE. Refer to P-610 for requirements regarding work and materials to place Portland cement concrete. Portland cement concrete is subsidiary to L-107 items requiring its use.

107-4.4 REMOVAL OF EXISTING WIND CONES AND FOUNDATIONS. Removal of existing wind cones and foundations shall be subsidiary to the installation of new wind cones and no separate payment will be made.

107-4.5 BOOSTER TRANSFORMERS. Booster transformers are subsidiary to wind cones if the booster transformer is required for installation remotely from the wind cone.

BASIS OF PAYMENT

107-5.1 Payment will be made at the contract unit price for each completed and accepted wind cone. This price shall be full compensation for removal of existing airport wind cones; furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

107-5.2 Segmented circle is paid for under P640.010.0000 Segmented Circle.

107-5.3 Spare parts are paid for under L125.170.0000 Spare Parts. Spare parts to be paid by actual invoiced material and delivery cost, according to subsection L-125-4.4, plus 15% markup.

Payment will be made under:

Item L107.010.0008	8-feet Lighted Wind Cone, In Place - per each
Item L107.020.0012	12-feet Lighted Wind Cone, In Place - per each
Item L107.030.0008	8-feet Unlighted Wind Cone, In Place - per each
Item L107.040.0012	12-feet Unlighted Wind Cone, In Place - 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 150/5340-5	Segmented Circle Airport Marker System
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-27	Specification for Wind Cone Assemblies
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description

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

Federal Standard (FED STD)

FED STD 595	Colors Used in Government Procurement

Master Painter's Institute (MPI)

MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Mil Standard

MIL-DTL-24441C/19C	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit – Steel
UL Standard 467	Grounding and Bonding Equipment
UL Standard 514B	Conduit, Tubing, and Cable Fittings

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)

ITEM L-109 AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT

DESCRIPTION

109-1.1 This item shall consist of removing an existing airport transformer vault and equipment, and constructing an airport transformer vault or a prefabricated metal housing per these specifications and per the design and dimensions shown in the Plans. This work shall also include the installation of conduits in the floor and foundation, painting and lighting of the vault or metal housing, and the furnishing of all incidentals that are necessary to produce a completed unit. Included as a separate part under this item or as a separate item where an existing structure (vault, metal housing, enclosure or building) is to be utilized shall be the furnishing of all vault equipment, wiring, electrical buses, cable, conduit, and grounding systems. This work shall also include the painting of equipment and conduit; the marking and labeling of equipment and the labeling or tagging of wires; the testing of the installation; and the furnishing of all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

109-2.1 GENERAL. Obtain approval of all materials and equipment proposed for the work. Submit to the Engineer five (5) complete listings of materials and equipment as indicated in the Specifications and shown on the Plans. Prepare the list to clearly identify the material or equipment by item, name, or designation used on the Plans or Specifications and indicate where specified. The submittals will be neatly bound, clearly indexed, and include applicable catalog number, cuts, wiring diagrams, performance data, operation and maintenance manuals, etc., for all material or equipment listed in this subsection, or elsewhere in these Specifications.

In addition, wherever called for in these Specifications, include in the submittal certificates of compliance, manufacturer's instructions and/or shop drawings, or proposed construction, or installation procedures. All materials of similar class or service will be from one manufacturer. Unless otherwise indicated, the capacities, sizes, and dimensions provided will be considered minimum values.

Deliver and store all manufactured materials in their original containers, with the manufacturer's name, brand, and identifying number clearly indicated on the container.

a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be certified in *AC 150/5345-53, Airport Lighting Equipment Certification Program* (AC 150/5345-53) and listed in the AC 150/5345-53 Addendum. AC 150/5345-53, the latest certified equipment list, and the address list of certified airport lighting equipment manufacturers are available on the FAA Airport Engineering, Design, & Construction web page: https://www.faa.gov/airports/engineering/

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

c. Equipment and materials shall meet the Buy American requirements contained in GCP Section 60.

CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

109-3.1 ELECTRICAL VAULT BUILDING. (Not Used).

109-3.2 CONCRETE. The concrete for the vault or electrical enclosure shall be proportioned, placed, and cured per P-610 Concrete for Miscellaneous Structures.

109-3.3 PRECAST CONCRETE STRUCTURES. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another third party certification program approved by the Engineer.

109-3.4 REINFORCING STEEL. Reinforcing steel bars shall be intermediate or structural grade deformed-type bars and shall be per ASTM A615.

109-3.5 BRICK. Brick shall be per ASTM C62, Grade SW.

109-3.6 STEEL CONDUIT. Rigid steel conduit and fittings shall be per Underwriters Laboratories Standards (UL) 6 and 514B. They shall be galvanized on the outside. All fittings shall conform to the same specification as the conduit.

a. Electrical Metallic Tubing (EMT). EMT shall be according to UL Standard 797. All fittings shall be steel, compression type with insulated throats. EMT shall only be used in dry interior locations.

109-3.7 PLASTIC CONDUIT AND FITTINGS. Plastic conduit and fittings shall conform to the requirements of UL-651 schedule 40 polyvinyl chloride (PVC) suitable for use above or below ground.

109-3.8 LIGHTING. Vault, metal-housing or electrical enclosure light fixtures shall be of a vapor-proof type. Indoor lighting fixtures for metal-housing or electrical enclosures shall be LED type with frosted lens, surface mounted, approximately 4000 lumen output, 4000K color temperature.

Emergency lights shall include two LED lamp heads with battery backup and integral charging and transfer electronics with self-testing features and diagnostic indicators.

109-3.9 OUTLETS. Convenience outlets shall be heavy-duty duplex units designed for industrial service. Outlets shall be grounding-type, AC rated 20 amperes, 125 volts, 2-pole, 3-wire NEMA 5-20R, housed in device boxes with cover plates.

109- 3.10 SWITCHES. Vault, metal-housing or electrical enclosure light switches shall be single-pole switches. Switches shall be heavy-duty grade, 277 volts of Alternating Current (AC), rated for inductive and fluorescent lamp loads up to 20 amperes. Switches shall be of the type indicated by symbol on the Plans. Where more than 1 switch is shown at a point, they shall be set under 1 plate, unless otherwise noted.

109-3.11 PAINT.

a. Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.

b. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the Master Painter's Institute (MPI), Reference #9, Exterior Alkyd, Gloss.

c. Priming paint for wood surfaces shall be mixed on the job by thinning the specified white paint by adding 1/2-pint of raw linseed oil to each gallon.

d. Paint for the floor, ceiling, and inside walls shall be a urethane-modified alkyd floor enamel. Walls and ceiling shall be light gray and the floor shall be medium gray.

e. The roof coating shall be hot asphalt material per ASTM D2823. Asbestos-free roof coating per ASTM D4479 may be substituted if required by local codes.

109-3.12 GROUND BUS. Ground bus shall be 1/8 $\times$ 3/4-inch minimum copper bus bar.

109-3.13 SQUARE DUCT. Duct shall be square, factory finished steel with NEMA 1 or 3R rating for interior and exterior use, respectively. The entire front of the duct on each section shall consist of hinged or removable cover for ready access to the interior. The cross-section of the duct shall be not less than 4 $\times$ 4 inches except where otherwise shown in the Plans.

109-3.14 GROUND RODS. Ground rods shall be copper-clad steel, 3/4-inch x 10 feet.

109-3.15 VAULT PREFABRICATED METAL HOUSING. The prefabricated metal housing shall be a commercially available unit.

109-3.16 FAA-APPROVED EQUIPMENT. Certain items of airport lighting equipment installed in vaults are covered by individual FAA equipment specifications in ACs listed below.

AC 150/5345-3	Specification for L-821, Panels for Remote Control of Airport Lighting
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors
AC 150/5345-13	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits.
AC 150/5345-49	Specification for L-854, Radio Control Equipment

The L-821 control panel shall be a custom-fabricated FAA-certified panel with controls for lighting systems as shown on the Plans. The control panel shall be wall-mounted with a NEMA 4 or 12 enclosure and shall include all components necessary for FAA certification and to accomplish the sequence of operations as described and depicted on the Plans.

109-3.17 OTHER ELECTRICAL EQUIPMENT. Distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and all other regularly used commercial items of electrical equipment not covered by FAA equipment specifications and ACs shall conform to the applicable rulings and standards of the Institute of Electrical and Electronic Engineers (IEEE) or the National Electrical Manufacturers Association (NEMA). When specified, test reports from a testing laboratory indicating that the equipment meets the specifications shall be supplied. In all cases, equipment shall be new and a first-grade product. This equipment shall be supplied in the quantities required for the specific project and shall incorporate the electrical and mechanical characteristics specified in the proposal and Plans. Equipment selected and installed by the Contractor shall maintain the short circuit current bracing rating and interrupting current rating of the existing systems or specified rating whichever is greater.

109-3.18 WIRE. Wire in conduit rated up to 5,000 volts shall be per AC 150/5345-7, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits. For ratings up to 600 volts, thermoset wire conforming to Fed. Spec. A-A-59544, Type XHHW-2 shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the Plans or in the proposal.

a. Control Circuits. Unless otherwise indicated on the plans, wire shall be not less than #12 American wire gauge (AWG) and shall be insulated for 600 volts. If telephone control cable is specified, #19 AWG telephone cable per ANSI/Insulated Cable Engineers Association (ICEA) S-85-625 specifications shall be used.

b. Power Circuits.

(1) 600 volts maximum – Wire shall be #12 AWG or larger and insulated for at least 600 volts.

(2) 3,000 volts maximum – Wire shall be #8 AWG or larger and insulated for at least 3,000 volts.

(3) Over 3,000 volts-Wire shall be #8 AWG or larger and insulated for at least the circuit voltage.

109-3.19 SHORT CIRCUIT / COORDINATION / DEVICE EVALUATION / ARC FLASH ANALYSIS. The Engineer shall ensure calculations and analysis are performed to ensure that all equipment bracing and overcurrent protection device interrupting ratings exceed the calculated available short circuit current.

The Engineer shall ensure the arc flash incident energy has been calculated at all electrical equipment that is likely to be accessed while energized and shall provide the information required to produce arc flash labels containing at a minimum, equipment name, voltage/current rating, available incident energy and flash protection boundary. The Engineer shall ensure overcurrent protection devices are adequately coordinated. The analysis shall comply with NFPA 70E and IEEE 1584.

Provide supporting data on new and existing electrical equipment to allow the performance of the arc-flash calculations, as facilitated by the Engineer. The data shall include size of the utility transformer and impedance, if available; size, length, and material of feeder conductors; and make, model, trip rating, and AIC rating of circuit breakers.

109-3.20 WOOD PLATFORM FOUNDATION. If a wood platform foundation is specified, the Contractor shall construct the platform as shown on the Plans. The floor system shall consist of urethane foam core insulated panels with interior and exterior surfaces or similar manufacturer to the building structure. The panels shall be constructed on grade beams of the size shown. Grade beams may be of timber or steel. Timber shall be Douglas Fir-Larch. Timbers shall be pressure treated according to the American Wood Preservers Bureau (AWPB) FDN Standard and shall bear AWPB Quality Mark of an approved inspection agency as described in the AWPB Standard. Preservative salt retention shall be not less than 0.6-pound per cubic foot (lb/ft^3). Wood shall be kiln dried after impregnation. Steel grade beams shall be hot-dipped galvanized according to ASTM A123. The building shall be anchored with soil anchors meeting the requirements of P-650 Aircraft Tie-Down, or as shown on the Plans.

109-3.21 ELECTRICAL ENCLOSURE. The electrical enclosure shall be a pre-engineered structure with minimum dimensions shown on the Plans. The enclosure shall be installed on either a concrete slab or wood platform floor/foundation as shown on the Plans.

The enclosure shall meet the following requirements:

a. Panels and Facings.

(1) The enclosure may be constructed with separate interlocking panels forming the walls and roof or as a single unit. The enclosure exterior walls shall be foamed in place polyurethane core with 3/4- inch plywood on the interior surface. The exterior surface shall be 1/2-inch plywood with either a 26 gauge galvanized steel exterior skin or, fiberglass reinforced polyester. The exterior color shall be a factory applied and shall be white.

(2) The side of the facings which contact the insulation core shall have a coating that will allow core-to-facing bond to be equal or greater than the cohesive strength of the core.

b. Insulation Core.

(1) Factory foamed-in-place polyurethane between facings. Insulating value of the composite roof and floor systems shall be equal to or greater than R-38, and the wall system equal to or greater than R-19. No voids are allowed in the core.

(2) Polyurethane shall have a minimum 2 lbs/ft^3 density.

(3) Polyurethane shall be certified UL flame spread 25 or less per ASTM E84.

c. The panel joints shall have tongue and groove or ship lap interlock with continuous silicone sealant tape at interior and exterior faces.

d. Panels shall be full length in single piece where practical.

e. Panels shall have State Fire Marshal's approval if floor area exceeds 300 square feet.

f. Metal flashing and trim at corners, intersections, openings, eaves and ridges shall be of the same finish and 24 gauge thickness to effect a neat appearing, weather tight joint and closure. Provide wrap-around door jamb trim-flashing.

g. Enclosure shall have two 12-inch x 12-inch vent openings installed in two end or side walls. Each opening shall include a 90-degree weather hood with galvanized bird screen. One opening shall be provided with a manually adjustable damper and replaceable dust filter. One opening shall be provided with an exhaust fan and backdraft damper.

h. A refrigerator style door(s) of the dimensions shown shall be provided for the enclosure. The door(s) shall be of similar construction to the enclosure. Mounting hardware shall be of stainless steel or of forged brass with chrome plating, or approved equal. Provide neoprene weather-stripping. The door(s) shall be provided with a refrigerator safety lock with pushrod from interior, cast zinc with chrome plating. Provide lock(s) consisting of a brass, 6-pin E keyway padlock with a shackle that is 3/8-inch in diameter having a closed clearance of 2-1/4 inches. The lock shall have a control key removable core and shall have one separate replacement core. Provide 4 keys and 1 core removal key.

i. Enclosure construction shall meet the following or those indicated in the currently adopted version of the International Building Code for the project location, whichever is more stringent:

(1) Live Snow Load 70 pounds per square foot (psf)

(2) Live Floor Load 200 psf

(3) Wind Load 110 miles per hour (mph) basic wind speed, applied according to the International Building Code, Exposure Category D, Risk Category III

Enclosure shall be an Equipment Enclosure for Runway Lighting Systems as manufactured by ALCHEM, Inc., of Anchorage, Alaska; Plaschem Shelter as manufactured by Plaschem Supply & Consulting, of Anchorage Alaska; or approved equal.

j. Provide Metal Storage Cabinet and Wall Mounted Shop Desk. Provide 30-inch wide x 12-inch deep x 26-inch high wall mounted locking metal storage cabinet, and 24-inch wide x 23-inch deep x 12-inch high wall mounted shop desk securely fastened to the wall at the location and elevation shown on the drawings. Set bottom of desk surface 36 inches above floor surface.

109-3.22 LIQUID-TIGHT FLEXIBLE METAL CONDUIT. Liquid-tight flexible metal conduit – Type LFMC shall be water-tight, listed for exposed or direct bury per UL-360, as an equipment grounding conductor per NEC 350.60, and rated for temperatures between -67 °F and +220 °F. Conduit fittings shall have an insulated throat.

109-3.23 TAPES.

a. Pipe sealing tape: "Scotch" No. 48, Teflon pipe sealing or approved equal.

b. Corrosion preventive tape: "Scotch" No. 50 or approved equal.

c. Electrical insulating tape: "Scotch" No. 88 or approved equal.

109-3.24 RADIO CONTROL EQUIPMENT, L-854. Radio Control Equipment, shall be L-854, Type 1, Style A, with a field-adjustable receiver frequency set to the Common Traffic Advisory Frequency (CTAF) for the project airport as found in the Alaska Supplement of the U.S. Government Flight Publication.

109-3.25 ANTENNA FOR THE RECEIVER-CONTROLLER. Antenna shall be a heavy-duty omni-directional, tunable, ground plane antenna with vertical polarization in the 118 to 136 megahertz band, designed for 100 mph winds. The antenna shall be tuned for the correct system frequency as assigned

with a bandwidth of 2 megahertz. The antenna shall be of 50 ohms nominal impedance and have an operating VSWR of less than 2:1 at system frequency. The antenna shall be equipped with an integral gap-type lightning arrester. The coaxial cable shall be 50-ohm, type RG-8. Antenna shall be designed to mount on 1-inch pipe support. The antenna ground planes shall be a minimum of 4 feet above the top of the adjacent roof or structure. Antenna mountings shall be fabricated as shown and noted.

109-3.26 APRON FLOODLIGHT. Apron floodlight shall be LED, 4000K color temperature, full-cutoff fixture, with light output and accessories as indicated on the Plans.

109-3.27 PHOTOELECTRIC CONTROL. Photoelectric control shall be a standard commercially available unit complying with UL 773, with supply voltage rating of 120-277 volts AC, integral surge protection, -40°F to 140°F operating temperature range, and EEI-NEMA standard twist-lock mounting base with matching receptacle. The photoelectric switch shall be installed, connected, and adjusted according to the manufacturer's instructions.

109-3.28 PANELBOARDS. Panelboards shall be single phase, 3-wire, of sizes to provide all circuit breakers and spares indicated. The branch breakers shall be bolt-on type. The enclosure shall be NEMA 1 with lockable flush door front, provided with a circuit index card under plastic on the interior side of the panel door; and the enclosure shall have an engraved phenolic label, lettered to indicate the voltage and current rating of the panel, attached to the panel front exterior.

The panelboard circuit breakers shall be bolt-on molded case type, 120/240 volts, 10,000 amperes interrupting capacity minimum, with an insulation temperature rating of 60/75 °C or 75 °C to operate with conductors with insulation rated up to 75 °C per NEC Table 310.15(B)(16). 1- and 2-pole type with current ratings as shown on the Plans. Each pole of the breaker shall provide inverse time delay and instantaneous circuit protection. Breakers shall be operated by toggle type handle and have a quick-make, quick-break over center switching mechanism that is mechanically trip free so that contacts cannot be held closed against short circuits and abnormal currents. Tripping shall be clearly indicated. Non-interchangeable trip breakers shall have sealed covers and interchangeable trip units shall have sealed trip units. Ampere ratings shall be clearly visible.

Panelboard circuit breakers shall be UL listed (where procedures exist), and conform to the applicable requirements of the latest NEMA Standard. Breakers shall be standard thermal-magnetic type unless otherwise noted. Circuit breakers for the duplex receptacles shall incorporate overload, short circuit, and UL Class A ground fault circuit interruption.

109-3.29 TRANSFER SWITCH. Transfer switch shall be heavy-duty, 2-pole, 3-wire, solid neutral, double-throw, non-fusible type in a NEMA 1 enclosure.

109-3.30 IDENTIFICATION TIES. Identification ties shall be self-locking, heavy duty nylon ties and shall be labeled by heat stamp.

109-3.31 SERVICE ENTRANCE EQUIPMENT. The meter/main breaker combination service entrance unit for the Electrical Equipment Enclosure shall be an overhead source or an underground source as shown on the Plans, bottom (underground) load type, 125 A, 120/240 volts, single phase, with 2-pole, 100 amperes, main breaker and 4-jaw kilowatt-hour (kWh) meter. The service entrance enclosure shall be rain tight NEMA 3R rated with a conduit entry hub fitting on top.

The service entrance disconnect switch shall be mounted as shown on the Plans. Disconnect switch shall be 100 amperes, 240 volts, 3-wire (third blade not used), with NEMA 3R enclosure, non-fused, with field installation kit, or as shown on the Plans

109-3.32 PLUG CUTOUT. The plug cutout shall be a lockable, 2-pole type rated 20-ampere at 5,000 volts, 60 hertz. The plug shall be insertable in three positions for normal operations, maintenance, and testing. The plug cutout shall be mounted in a NEMA-1 enclosure with a hinged and lockable door sized to allow the plug and key to be operable by a worker standing in front of the enclosure.

109-3.33 SUPPORTS FOR WALL-MOUNTED PANELS, PANELBOARDS, AND FIXTURES. Supports for wall mounted panels, panelboards and fixtures shall be metal channels with accessory nuts and fittings; Unistrut or approved equal, or 3/4-inch plywood panels.

109-3.34 PUSH-BUTTON STATIONS. Push-button stations shall be off-on, momentary-contact types in water/dust-tight boxes. Provide metal labels identifying the function of each section.

109-3.35 ELECTRIC HEATER. The electric heater shall be surface mounted and rated 2,000 watts at 240 volts, with mounting kit as required. Thermostat shall be wall mounted on a suitable junction box and be of the line voltage type with an off position and a temperature range of 40 °F to 90 °F. Thermostat current rating shall be suitable to control the specified heater.

109-3.36 HARDWARE. All miscellaneous hardware items, nails, bolts, and screws shall be galvanized steel.

109-3.37 EXHAUST FAN. The exhaust fan shall be sidewall propeller fan rated for a minimum of 150 cubic feet per minute (CFM) at 0.20 in water gauge (WG). The fan shall include wire guards on the interior and a backdraft damper at the exterior wall. The fan shall be controlled by a wall-mounted thermostat, adjustable 40-85 °F minimum.

CONSTRUCTION METHODS

CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

109-4.1 GENERAL. The Contractor shall construct the transformer vault or prefabricated metal housing at the location indicated in the Plans. Vault construction shall be reinforced concrete, concrete masonry, or brick wall as specified. The metal housing shall be prefabricated equipment enclosure to be supplied in the size specified. The electrical enclosure shall be a pre-engineered building placed on either a poured concrete foundation or a wood platform as specified. The mounting pad or floor details, installation methods, and equipment placement are shown in the Plans.

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. If the vault, metal housing or electrical enclosure are to be placed on a site not prepared for that purpose under other items of work, the Contractor shall clear, grade, and seed the area around the vault or metal housing for a minimum distance of 10 feet on all sides. The slope shall be not less than 4% away from the vault, metal housing or electrical enclosure in all directions. Cost for site work will be considered incidental to this item and no separate payment will be made.

109-4.2 FOUNDATION AND WALLS.

a. **Reinforced Concrete Construction.** The Contractor shall construct the foundation and walls per the details shown in the plans. Unless otherwise specified, internal ties shall be of the mechanical type so that when the forms are removed the ends of the ties shall be at least 1 inch beneath the concrete surface; the holes shall be plugged and finished to prevent discoloration. Reinforcing steel shall be placed, as shown in the drawings, and secured in position to prevent displacement during the concrete placement.

   The external surfaces of the concrete shall be thoroughly worked during the placing operation to force all coarse aggregate from the surface. Thoroughly work the mortar against the forms to produce a smooth finish free from air pockets and honeycomb.

   The surface film of all pointed surfaces shall be removed before setting occurs. As soon as the pointing has set sufficiently, the entire surface inside and outside of the vault shall be thoroughly wet with water and rubbed with a No. 16 carborundum stone, or equivalent quality abrasive, bringing the surface to a paste. All form marks and projections shall be removed. The surface produced shall be smooth and dense without pits or irregularities. The materials which have been

ground into a paste during the rubbing process shall be spread or brushed uniformly over the entire surface, except the interior surfaces that are to be painted shall have all paste removed by washing before painting, and permitted to reset. Final exterior finish shall be obtained by rubbing with No. 30 carborundum stone, or an equivalent quality abrasive. The surface shall be rubbed until the entire surface is smooth and uniform in color.

b. **Brick and Concrete Construction.** When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The outer edge of the foundation at the floor level shall be beveled 1-1/2 inches at 45 degrees. Brick walls shall be 8 inches thick, laid in running bond with every sixth course a header course. Brick shall be laid in cement mortar (1 part masonry cement and 3 parts sand) with full mortar bed and shoved joints.

   All joints shall be completely filled with mortar, and facing brick shall be back-parged with mortar as work progresses. All joints shall be 3/8-inch thick, exterior joints tooled concave, and interior joints struck flush. Both interior and exterior brick surfaces shall be cleaned and nail holes, cracks and other defects filled with mortar. When specified, a nonfading mineral pigment mortar coloring shall be added to the mortar. Steel reinforcing bars, 3/8-inch in diameter and 12 inches long, shall be set vertically in the center of the brick wall on not more than 2 feet centers to project 2-1/2 inches into the concrete roof slab.

   Lintels for supporting the brickwork over doors, windows, and louvers shall consist of two $4 \times 3 \times$ 3/8-inch steel angles. Lintels shall be painted with one coat of corrosion-inhibiting primer before installation, and all exposed parts shall be painted similar to doors and window sash after installation.

   Window sills may be concrete poured in place or precast concrete as indicated in the plans. All exposed surfaces shall have a rubbed finish as specified under reinforced concrete construction. After completion, all interior and exterior faces of walls shall be scrubbed with a solution of muriatic acid and water in the proportions of not less than 1 part acid to 10 parts of water. All traces of efflorescence, loose mortar, and mortar stain shall be removed, and the walls washed down with clear water.

c. **Concrete Masonry Construction.** When this type of construction is specified, the foundation shall be concrete conforming to the details shown on the Plans. The concrete masonry units shall be standard sizes and shapes and shall conform to ASTM C90 and shall include the closures, jambs, and other shapes required by the construction as shown in the plans. Standard construction practice shall be followed for this type of work including mortar, joints, reinforcing steel for extensions into roof slab, etc. Plaster for interior walls, if specified, shall be Portland cement plaster.

109-4.3 ROOF. The roof shall be reinforced concrete as shown in the plans. Reinforcing steel shall be placed as shown in the drawing and secured in position to prevent displacement during the pouring of the concrete. The concrete shall be poured monolithically and shall be free of honeycombs and voids. The surface shall have a steel-troweled finish and shall be sloped as shown in the drawing. The underside of the roof slab shall be finished in the same manner as specified for walls.

One brush or mop coat of hot asphalt roof coating shall be applied to the top surface of the roof slab. The asphalt material shall be heated to within the range specified by the manufacturer and immediately applied to the roof. The finished coat shall be continuous over the roof surface and free from holidays and blisters. Smears and dribbles of asphalt on the roof edges and building walls shall be removed.

109-4.4 REINFORCED CONCRETE FLOOR. The floor shall be reinforced concrete as shown on the Plans. When present, all sod, roots, refuse, and other perishable material shall be removed from the area under the floor to a depth of 8 inches, unless a greater depth is specified. This area shall be backfilled with materials consisting of sand, cinders, gravel, or stone. Fill shall be placed in layers not to exceed 4 inches and shall be thoroughly compacted by tamping or rolling. A layer of building paper shall be placed over the fill prior to placing concrete. The floor surfaces shall have a steel-troweled finish. The floor shall

be level unless a drain is specified, in which case the floor shall be pitched 1/4-inch per foot downward toward the drain. A 1/4-inch asphalt felt expansion joint shall be placed between floor and foundation walls. The floor shall be poured monolithically and shall be free of honeycombs and voids.

109-4.5 FLOOR DRAIN. If shown in the Plans, a floor drain and dry well shall be installed in the center of the floor of the equipment room. The dry well shall be excavated 4 × 4 feet square and to a depth of 4 feet below the finished floor elevation and shall be backfilled to the elevation of the underside of the floor with gravel - which shall all pass a 2-inch mesh sieve and shall all be retained on a 1/4-inch mesh sieve. The gravel backfill shall be placed in 6-inch maximum layers, and the entire surface of each layer shall be tamped either with a mechanical tamper or with a hand tamper weighing not less than 25 pounds and having a face area of not more than 36 square inches nor less than 16 square inches. The drain inlet shall be set flush in the concrete floor. The drain shall have a clear opening of not less than 8 inches in diameter.

109-4.6 CONDUITS IN FLOOR AND FOUNDATION. Conduits shall be installed in the floor and through the foundation walls per the details shown in the plans. All underground conduit shall be painted with an asphalt compound. Conduit shall be installed with a coupling or metal conduit adapter flush with the top of the floor. All incoming conduit shall be closed with a pipe plug to prevent the entrance of foreign material during construction. Space conduit entrances shall be left closed.

109-4.7 DOORS. Doors shall be metal-clad fireproof Class A (three (3) hour rated) doors conforming to requirements of the National Electrical Code (NEC) and local electrical codes. Panic bar exit hardware shall be installed per NEC requirements. Refer to the new electrical vault detail plan sheets for construction requirements.

109-4.8 PAINTING. The floor, ceiling, and inside walls of concrete construction shall first be given a hardening treatment, after which the Contractor shall apply two coats of paint as specified below, except that interior face brick walls need not be painted. The hardening treatment shall consist of applying two coats of either a commercial floor hardener or a solution made by dissolving 2 pounds of magnesium fluorosilicate or zinc sulfate crystals in one gallon of water.

Each coat shall be allowed to dry at least 48 hours before the next application. After the second treating coat has dried, the surfaces shall be brushed clean of all crystals and thoroughly washed with clear water. Paint for walls and ceiling shall be a light gray color approved by the Engineer. The floor paint shall be a medium gray color approved by the Engineer. Before painting, the surfaces shall be dry and clean. The first coat shall be thinned by adding 2/3-quarts of spar varnish and 1/3-quarts of turpentine to each gallon of paint. The second coat shall be applied without thinning. All doors, lintels, and windows shall be cleaned to remove any rust or foreign material and shall be given one body and one finish coat of white paint. Bare metal surfaces shall be given a prime coat of corrosion-inhibiting primer prior to the body and finish coats.

109-4.9 LIGHTS AND SWITCHES. The Contractor shall furnish and install a minimum of two duplex convenience outlets in the vault room. Where a control room is specified, at least two duplex outlets shall be installed.

INSTALLATION OF EQUIPMENT IN VAULT, PREFABRICATED METAL HOUSING, ENCLOSURE OR BUILDING

109-5.1 GENERAL. The Contractor shall furnish, install, and connect all equipment, equipment accessories, conduit, cables, wires, buses, grounds, and support necessary to ensure a complete and operable electrical distribution center for the airport lighting system as specified herein and shown in the Plans. When specified, an emergency power supply and transfer switch shall be provided and installed.

The equipment installation and mounting shall comply with the requirements of the NEC and local authority having jurisdiction.

109-5.2 POWER SUPPLY EQUIPMENT. Transformers, regulators, booster transformers, and other power supply equipment items shall be furnished and installed at the location shown in the plans or as directed by the Engineer. The power supply equipment shall be set on steel “H” sections, “I” beams, channels, or concrete blocks to provide a minimum space of 1-1/2-inch between the equipment and the floor. The equipment shall be placed so as not to obstruct the oil-sampling plugs of the oil-filled units; and name-plates shall, so far as possible, not be obscured. All equipment shall be securely anchored to the floor.

If specified in the Plans and specifications, equipment for an alternate power source or an emergency power generator shall be furnished and installed. The alternate power supply installation shall include all equipment, accessories, an automatic changeover switch, and all necessary wiring and connections. The emergency power generator set shall be the size and type specified.

109-5.3 SWITCHGEAR AND PANELS. Oil switches, fused cutouts, relays, transfer switches, panels, panelboards, and other similar items shall be furnished and installed at the location shown in the plans or as directed by the Engineer. Wall or ceiling mounted items shall be attached to the wall or ceiling with galvanized bolts of not less than 3/8-inch diameter engaging metal expansion shields or anchors in masonry or concrete vaults.

109-5.4 DUCT AND CONDUIT. The Contractor shall furnish and install square-type exposed metallic ducts with hinged covers for the control circuits in the vault. These shall be mounted along the walls behind all floor-mounted equipment and immediately below all wall-mounted equipment. The hinged covers shall be placed to open from the front side with the hinges at the front bottom.

Wall brackets for square ducts shall be installed at all joints 2 feet or more apart with intermediate brackets as specified. Conduit shall be used between square ducts and equipment or between different items of equipment when the equipment is designed for conduit connection. When the equipment is not designed for conduit connection, conductors shall enter the square-type control duct through insulating bushings in the duct or on the conduit risers.

109-5.5 WIRING AND CONNECTIONS. The Contractor shall make all necessary electrical connections in the vault per the wiring diagrams furnished and as directed by the Engineer. In wiring to the terminal blocks, the Contractor shall leave sufficient extra length on each control lead to make future changes in connections at the terminal block. This shall be accomplished by running each control lead the longest way around the box to the proper terminal. Leads shall be neatly laced in place. Wiring shall be installed according to the Plans and L-108. Circuits rated 60 or greater amperes shall be tested in accordance with L-108.

109-5.6 MARKING AND LABELING. All equipment, control wires, terminal blocks, etc., shall be tagged, marked, or labeled as specified below:

a. **Wire identification.** The Contractor shall furnish and install self-sticking wire labels or identifying tags on all control wires at the point where they connect to the control equipment or to the terminal blocks. Wire labels, if used, shall be of the self-sticking preprinted type and of the manufacturer’s recommended size for the wire involved. Identification -markings designated in the plans shall be followed. Tags, if used, shall be of fiber not less than 3/4-inch in diameter and not less than 1/32-inch thick. Identification markings designated in the plans shall be stamped on tags by means of small tool dies. Each tag shall be securely tied to the proper wire by a nonmetallic cord.

b. **Labels.** The Contractor shall stencil identifying labels on the cases of regulators, breakers, and distribution and control relay cases with white oil paint as designated by the Engineer. The letters and numerals shall be not less than one inch in height and shall be of proportionate width. The Contractor shall also mark the correct circuit designations per the wiring diagram on the terminal marking strips, which are a part of each terminal block.

c. Warning Labels. The Contractor shall install self-adhesive arc-flash warning labels on service disconnects, panelboards, and transfer switches. Arc-flash data for the labels will be provided by the Engineer.

METHOD OF MEASUREMENT

109-6.1 VAULTS. The quantity of vaults to be paid for under this item shall consist of the number of vaults constructed in place and accepted as a complete unit.

109-6.2 PREFABRICATED METAL HOUSINGS. The quantity of prefabricated metal housings to be paid for under this item shall consist of the number of housings constructed in place and accepted as a complete unit.

109-6.3 ELECTRICAL ENCLOSURES. The quantity of electrical enclosures to be paid for under this item shall consist of the number of enclosures constructed in place and accepted as a complete unit. Removal of existing electrical enclosures shall be subsidiary to installation of new enclosures.

109-6.4 INSTALLATION OF ELECTRICAL EQUIPMENT IN NEW OR EXISTING STRUCTURE. The quantity of electrical equipment installed in a new or existing structure (vault, prefabricated metal housing, electrical enclosure or building) to be paid for under this item shall consist of all equipment installed, connected, and accepted as a complete unit ready for operation. Removal of existing electrical equipment from existing structures shall be subsidiary to installation of new electrical equipment.

BASIS OF PAYMENT

109-7.1 Payment will be made at the contract unit price for each completed and accepted vault or prefabricated metal housing equipment installation. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work.

a. Work Items Paid in this Subsection. Completed and accepted work paid at the contract unit price for each.

(1) L109.010.0000 Transformer Vault in Place Pay Item. This pay item includes all work required to construct, or install, the complete transformer vault in place.

(2) L109.020.0000 Prefabricated Metal Housing and Foundation Pay Item. This pay item includes all work required to construct and install the complete prefabricated metal housing and foundation.

(3) L109.030.0000 Electrical Enclosure and Foundation in Place Pay Item. This pay item includes all work required to construct the electrical enclosure and foundation in place.

(4) L109.040.0000 Installation of Electrical Equipment in New or Existing Structure Pay Item. This pay item includes all work required to install electrical equipment in new or existing structure.

b. Work Items Paid in other Subsections.

(1) Lighting Regulators. Lighting regulators are paid for under L-125 pay items.

Payment will be made under:

Item L109.010.0000	Transformer Vault in Place - per each
Item L109.020.0000	Prefabricated Metal Housing and Foundation in Place - per each
Item L109.030.0000	Electrical Enclosure and Foundation in Place - per each

Item L109.040.0000 Installation of Electrical Equipment in New or Existing Structure - 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 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-3	Specification for L-821, Panels for Remote Control of Airport Lighting
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors
AC 150/5345-13	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits
AC 150/5345-49	Specification L-854, Radio Control Equipment
AC 150/5345-53	Airport Lighting Equipment Certification Program

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

ANSI/ICEA S-85-625	Standard for Telecommunications Cable Aircore, Polyolefin Insulated, Copper Conductor Technical Requirements

ASTM International (ASTM)

ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C62	Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C90	Standard Specification for Loadbearing Concrete Masonry Units
ASTM D2823	Standard Specification for Asphalt Roof Coatings, Asbestos Containing
ASTM D4479	Standard Specification for Asphalt Roof Coatings – Asbestos-Free

Commercial Item Description (CID)

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

Institute of Electrical and Electronic Engineers (IEEE)

IEEE 1584	Guide for Performing Arc-Flash Hazard Calculations

Master Painter's Institute (MPI)

MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit – Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)
NFPA-70E	Standard for Electrical Safety in the Workplace

ITEM L-110 AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS

DESCRIPTION

110-1.1 This item shall consist of underground electrical conduits and duct banks, single or multiple conduits encased in concrete, installed per this Specification at the locations and per the dimensions, designs, and details shown on the Plans. This item shall include furnishing and installing of all underground electrical duct banks and individual and multiple underground conduits and removal of existing duct banks. It shall also include all turfing, trenching, backfilling, removal, and restoration of any paved or turfed areas; concrete encasement, mandrelling, pulling lines, duct markers, plugging of conduits, and the testing of the installation as a completed system ready for installation of cables per the Plans and Specifications. This item shall also include furnishing and installing, drain conduits, drywells, and all incidentals for providing positive drainage of the system as shown on the Plans.

EQUIPMENT AND MATERIALS

110-2.1 GENERAL. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

110-2.2 STEEL CONDUIT. Use rigid galvanized steel (RGS) conduit and fittings, hot-dipped galvanized inside and out, and conform to the requirements of Underwriters Laboratories (UL) Standards 6, and 514B.

110-2.3 PLASTIC CONDUIT. Use polyvinyl chloride (PVC) and high density polyethylene (HDPE) underground plastic duct, listed by an OSHA- and a State of Alaska-approved nationally recognized testing laboratory (NRTL), installed per and in compliance with NEC Articles 352 and 353 as applicable, and conforming to one of the following plastic conduit and fittings requirements:

a. **PVC Plastic Duct.** Use rigid, non-metallic, conduit, Schedule 40 or Schedule 80 PVC conforming to UL Standard 651 and NEMA TC-2, nominal size as indicated on the Plans. Use Schedule 40 or Schedule 80 PVC conforming to UL Standard 514B and NEMA TC-3 for all fittings such as elbows, couplings, connectors, expansion joints, adapters, etc., used in the installation.

b. **HDPE Plastic Duct.** Use rigid, HDPE conduit conforming to UL Standard 651A, with a cell classification of 334420C or better according to ASTM D3350. Use the nominal size indicated on the Plans. Use HDPE for all fittings such as saddle fittings, couplings, connectors, adapters, etc., used in the installation. Use fittings that are third-party listed, watertight, and do not rely on gaskets alone for conduit pull-out resistance. Electrofusion couplings or other welded HDPE fittings may be used, but if not third-party listed, Contractor will obtain approval for their use from the authority having jurisdiction prior to ordering materials and include approval with the product submittals.

The type of solvent cement shall be as recommended by the conduit/fitting manufacturer.

110-2.4 SPLIT CONDUIT. Split conduit shall be pre-manufactured for the intended purpose and shall be made of steel or plastic.

110-2.5 CONDUIT SPACERS. Conduit spacers shall be prefabricated interlocking units manufactured for the intended purpose. They shall be of double wall construction made of high grade, high density polyethylene complete with interlocking cap and base pads. They shall be designed to accept No. 4 reinforcing bars installed vertically.

110-2.6 CONCRETE. Concrete shall be proportioned, placed, and cured per P-610 Concrete for Miscellaneous Structures.

110-2.7 PRECAST CONCRETE STRUCTURES. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another third party certification program approved by the Engineer. Precast concrete structures shall conform to ASTM C478.

110-2.8 FLOWABLE BACKFILL. Flowable material used to back fill conduit and duct bank trenches shall conform to the requirements of P-153 Controlled Low Strength Material.

110-2.9 DETECTABLE WARNING TAPE. Detectable warning tape shall be plastic, detectable, American Public Works Association (APWA) red (electrical power lines, cables, conduit and lighting cable), orange (telephone/fiber optic cabling), aluminum-backed, polyethylene film 6 inches wide by 5 mils thick continuous legend “Caution – Buried Electrical Line Below”.

110-2.10 CONDUIT THREAD SEALING AND CORROSION PREVENTION. Conduit corrosion inhibitor and thread sealant shall be electrically conductive. Corrosion inhibitor, thread sealant, and corrosion preventative tape shall be NRTL-listed for the applications in which they are used. The installations shall comply with NEC 300.6.

110-2.11 LIQUIDTIGHT FLEXIBLE METAL CONDUIT. Liquidtight Flexible Metal Conduit – Type LFMC shall be water-tight, listed for exposed or direct bury per UL 360, and rated for temperatures between -67°F and +220°F.

110-2.12 ELECTRICAL MANHOLES. Refer to L-115 for requirements regarding all work and materials to install electrical manholes.

110-2.13 DRYWELLS. Drywells shall consist of buried drain rock surrounded by filter fabric installed at the ends of drain conduits to provide free drainage of excess water in the conduit system. Filter fabric shall conform to the requirements of AASHTO M 288 for Subsurface Drainage, except provide a minimum permittivity of 0.5 sec^{-1}, and meet Class 2 Strength Property Requirements. Meet drain rock gradation in Table 110-1, or as otherwise approved by the Engineer.

TABLE 110-1. GRADATION OF DRYWELL DRAIN ROCK

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
2 in.	100
1-1/2 in.	95-100
3/4 in.	0-20
3/8 in.	0-5

CONSTRUCTION METHODS

110-3.1 GENERAL. The Contractor shall install underground duct banks and conduits at the approximate locations shown on the Plans. The Engineer shall indicate specific locations as the work progresses, if required to differ from the Plans. Duct banks and conduits shall be of the size, material, and type shown on the Plans or indicated in the Specifications. Where no size is indicated on the Plans or in the Specifications, conduits shall not be less than 2 inches inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger.

All duct bank and conduit lines shall be laid so as to grade toward access points and duct or conduit ends for drainage. Unless otherwise shown on the Plans, grades shall be at least 3 inches per 100 feet. On runs where it is not practicable to maintain the grade all one way, the duct bank and conduit lines shall be

graded from the center in both directions toward access points or conduit ends, with a drain into the storm drainage system or drywell. Pockets or traps where moisture may accumulate shall be avoided. Under pavement, the top of the duct bank shall not be less than 18 inches below the subgrade; in other locations, the top of the duct bank or underground conduit shall be not less than 18 inches below finished grade.

Seal all joints in the rigid steel conduit runs with conductive corrosion inhibitor/thread sealant applied to the threaded couplings. Wrap the completed joint with 2 layers of corrosion preventative tape, 1/2-lapped and extending 1-1/2 inches on both sides of the joints. The Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct bank. An iron-shod mandrel, not more than 1/4-inch smaller than the bore of the conduit, shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The Contractor shall swab out all conduits/ducts and clean base can, manhole, pull boxes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed the light bases, manholes, pull boxes, etc., and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of any blockage in the existing ducts.

For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a duct bank, shall be provided with a 200-pound test polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as shown on the Plans, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminants from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed 5 feet.

Unless otherwise shown on the Plans, concrete encased duct banks shall be used when crossing under pavements expected to carry aircraft loads, such as runways, taxiways, taxilanes, ramps and aprons.

All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

Trenches for burial of duct or conduit shall be of sufficient width to provide a minimum of 2 inches of lateral clearance between the duct or conduit and trench walls on both sides. Trenches for burial of duct or conduit shall be of sufficient depth as to assure 1.5-feet minimum duct or conduit burial depth below finished grade, plus 4 inches minimum of below duct or conduit bedding, plus adequate over excavation depth as required to slope and grade all duct or conduit installations to drain toward light bases or handholes.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches below the required conduit or duct bank depth and it shall be replaced with concrete or bedding material of earth or sand

containing no mineral aggregate particles that would be retained on a 1/4-inch sieve. Flowable backfill may alternatively be used.

Detectable underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks and conduits. If not shown on the Plans, the warning tape shall be located 6 inches above the duct/conduit or the counterpoise wire if present.

Joints in plastic conduit shall be prepared per the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 feet.

Changes in direction of runs exceeding 10 degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the Engineer, the unsuitable material shall be removed per P-152 and replaced with suitable material. Additional duct bank supports shall be installed, as approved by the Engineer.

All excavation shall be unclassified. Unless otherwise specified, excavated materials that are deemed by the Engineer to be unsuitable for use in backfill or embankments shall be removed and disposed of offsite as directed by the Engineer.

Any excess excavation shall be filled with suitable material approved by the Engineer and compacted per P-152.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as shown on the Plans. Installation of new cable where such crossings must occur shall proceed as follows:

a. Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred

b. Trenching, etc., in cable areas shall then proceed with approval of the RPR, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair.

Excavate foundations, footings, slabs, pads, handholes, ducts and/or duct banks, or light base assemblies so as to permit the placing or construction of the full width, length, and depth of the structure or object and the layer of bedding material, whenever bedding is required.

110-3.2 DUCT BANKS. Unless otherwise shown in the Plans, duct banks shall be installed so that the top of the concrete envelope is not less than 18 inches below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches below finished grade where installed in unpaved areas.

Unless otherwise shown on the Plans, duct banks under paved areas shall extend at least 3 feet beyond the edges of the pavement or 3 feet beyond any under drains that may be installed alongside the paved area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any obstructions are encountered, provisions can be made to avoid them.

Unless otherwise shown on the Plans, all duct banks shall be placed on a layer of concrete not less than 3 inches thick prior to its initial set. The Contractor shall space the conduits not less than 3 inches apart, measured from outside wall to outside wall. All such multiple conduits shall be placed using conduit spacers applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than 3 inches thick unless otherwise shown on the Plans. All conduits shall terminate with female ends for ease of access in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where shown on the plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 5-foot intervals.

All pavement surfaces that are to have ducts installed shall be neatly saw cut to form a vertical face.

Install a plastic, detectable, color as noted, minimum 6 inches wide tape, 8 inches minimum below grade above all underground conduit or duct lines not installed under pavement. For duct banks equal to or greater than 24 inches in width, utilize more than one tape for sufficient coverage and identification of the duct bank as required.

When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and exposed by hand tools. Prior to being placed in duct, the Engineer shall be notified so that he may inspect the cable and determine that it is in good condition. Where required, split duct shall be installed as shown on the Plans or as required by the Engineer.

110-3.3 CONDUITS WITHOUT CONCRETE ENCASEMENT. Trenches for single-conduit lines shall be not less than 6 inches nor more than 12 inches wide. The trench for 2 or more conduits installed at the same level shall be proportionately wider. Trench bottoms for conduits without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit along its entire length.

Where HDPE or steel conduit is specified, place a layer of bedding material, at least 4-inches thick (loose measurement) in the bottom of the trench to bed the duct. Use bedding material that meets the requirements for the applicable lift of material (P-152, P-154, P-209, and P-299) except that 100% of the bedding material will pass a 1-inch sieve.

Where conduit other than HDPE or steel is specified, a layer of sand, at least 4 inches thick (loose measurement) shall be placed in the bottom of the trench as bedding for the duct. The bedding material shall consist of sand, and it shall contain no particles that would be retained on a 1/4-inch sieve. The bedding material shall be tamped until firm.

Unless otherwise shown on Plans, conduits shall be installed so that the tops of all conduits within the Airport's secured area where trespassing is prohibited are at least 18 inches below the finished grade. Conduits outside the airport's secured area shall be installed so that the tops of the conduits are at least 24 inches below the finished grade per National Electrical Code (NEC), Table 300.5.

When two or more individual conduits intended to carry conductors of equivalent voltage insulation rating are installed in the same trench without concrete encasement, they shall be spaced not less than 3 inches apart (measured from outside wall to outside wall) in a horizontal direction and not less than 6

inches apart in a vertical direction. Where two or more individual conduits intended to carry conductors of differing voltage insulation rating are installed in the same trench without concrete encasement, they shall be placed not less than 3 inches apart (measured from outside wall to outside wall) in a horizontal direction and lot less than 6 inches apart in a vertical direction.

Trenches shall be opened the complete length between normal termination points before conduit is installed so that if any unforeseen obstructions are encountered, proper provisions can be made to avoid them.

Conduits shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches to anchor the assembly into the earth while backfilling. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

110-3.4 MARKERS. When shown on the Plans, the location of each end and of each change of direction of conduits and duct banks shall be marked by a concrete slab marker 2 feet square and 4 - 6 inches thick extending approximately one inch above the surface. The markers shall also be located directly above the ends of all conduits or duct banks, except where they terminate in a junction/access structure or building. Each cable or duct run from a line of lights and signs to the equipment vault must be marked at approximately every 200 feet along the cable or duct run, with an additional marker at each change of direction of cable or duct run.

The Contractor shall impress the word “DUCT” or “CONDUIT” on each marker slab. Impression of letters shall be done in a manner, approved by the Engineer, for a neat, professional appearance. All letters and words must be neatly stenciled. After placement, all markers shall be given one coat of high-visibility orange paint, as approved by the Engineer. The Contractor shall also impress on the slab the number and size of conduits beneath the marker along with all other necessary information as determined by the Engineer. The letters shall be 4 inches high and 3 inches wide with width of stroke 1/2-inch and 1/4-inch deep or as large as the available space permits. Furnishing and installation of duct markers is incidental to the respective duct pay item.

110-3.5 BACKFILLING FOR CONDUITS. For conduits, bedding material that conforms to the requirements specified in subsection 110-3.3 for the conduit that is used shall be placed around the conduits ducts and carefully tamped around and over them with hand tampers. The remaining trench shall then be backfilled and compacted per P-152 except that material used for back fill shall be select material not larger than 4 inches in diameter. If duct is placed in the structural section of a pavement such as for a runway or taxiway, the Contractor shall construct the backfill according to the specifications (P-154, P-209, and P-299) for the material in which the duct is placed.

Flowable backfill may alternatively be used. Trenches shall not contain pools of water during back filling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the Engineer.

110-3.6 BACKFILLING FOR DUCT BANKS. After the concrete has cured, the remaining trench shall be backfilled and compacted per P-152 except that the material used for backfill shall be select material not larger than 4 inches in diameter. If duct bank is placed in the structural section of a pavement such as for a runway or taxiway, the Contractor shall construct the backfill according to the specifications (P-154, P-209, and P-299) for the material in which the duct bank is placed.

Flowable backfill may alternatively be used. Trenches shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of as directed by the Engineer.

110-3.7 RESTORATION. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall include any necessary seeding, sprigging, topsoiling, mulching, or installing vegetative mat according to T-901, T-903, T-905, T-908, and T-920, respectively, as shown on the Plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. 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.

110-3.8 OWNERSHIP OF REMOVED CABLE. (Not Used)

110-3.9 PVC CONDUIT. Install PVC conduit where indicated on the Plans.

Fabricate the conduit runs as recommended by the conduit manufacturer. Make all joints square, tight, and leakproof. Do not allow bends or breaks in the joints. Use only solvents and cements, which are specifically recommended by the conduit manufacturer. Join together the complete run between each light base alongside the trench. Place in the trench and connect to the base assembly after the minimum cure time of the joint cement has elapsed and after inspection and approval is granted by the Engineer.

Make field cuts of the conduit true and square with a tool or lathe designed for the purpose. Deburr and ream the conduit as required.

Bend PVC conduit at the job site only with a "Hot Box" or as recommended by the conduit manufacturer. Heat the conduit uniformly to obtain smooth bends without overheating. Conduit with a brown appearance shall not be used. Conduit with extremely sharp bends, kinks in the bends or which exhibits a significant visual defect shall not be used.

Install expansion fittings in each run of conduit between light base assemblies, at spacing not exceeding 60 feet. The expansion fitting shall be of the same manufacturer as the conduit and shall be installed according to the manufacturer's instruction. Expansion joints shall be installed a maximum of 10-feet from the edge light bases or hand holes and shall be installed with joints 1/4-inch expanded, resulting in a minimum requirement of four expansion joints per 190-foot run of conduit.

110-3.10 HDPE CONDUIT. Assemble high-density polyethylene conduit into runs on the surface and install in trenches after coupling of the section. Butt-weld the duct using the manufacturer's recommended procedures and equipment. Assure that the conduit is open, continuous and free of water and debris prior to installing cable. In underground conduit, pull a flexible mandrel and swab through the entire length of the conduit run immediately prior to the cable being installed.

Make changes in direction, other than long sweeping curves, and stub-ups to equipment using rigid steel conduit elbows. HDPE conduit splices and fittings shall be watertight. Where electrofusion couplings are used to join HDPE to rigid steel conduit, the rigid steel conduit shall be threaded. Where gasketed fittings are used to connect to rigid steel conduit, the rigid steel conduit shall not be threaded to ensure a proper seal at the gasket.

Continuous HDPE conduit shall be removed from the reel using a conduit straightening mechanism to remove the reel memory from the conduit.

110-3.11 DRYWELLS. Drywells shall be excavated to a minimum depth of 24-inches below the drain conduit. The excavated hole shall be lined with filter fabric and filled with drain rock. The drain rock shall be hand tamped, the fabric wrapped over the top of the drain rock, and the hole backfilled. In areas within the project limits, backfill shall be in accordance with the material sections shown in the Plans. In other areas, backfill shall consist of the removed material, unless deemed unsuitable by the Engineer.

METHOD OF MEASUREMENT

110-4.1 UNDERGROUND CONDUITS. Underground conduits and duct banks shall be measured by the linear feet of conduits and duct banks installed, including encasement, locator tape, trenching and backfill with designated material, and restoration, and for drain lines, the termination at the drainage structure, all measured in place, completed, and accepted. Separate measurement shall be made for the various types and sizes.

110-4.2 DRYWELLS. The quantity of drywells to be paid for will be the number of units in place, completed, ready for operation, and accepted by the Engineer.

110-4.3 LUMP SUM. Pay items shown as lump sum will not be measured for payment per GCP section 90.

BASIS OF PAYMENT

110-5.1 Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for removal and disposal of existing duct banks and conduits as shown on the Plans, 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 work.

a. Subsidiary Work. Work listed is subsidiary to the respective L-110 pay items requiring its use.

(1) Installing detectable warning tape.

(2) Cleaning ducts, base cans, manholes, etc., and verifying existing ducts.

(3) Furnishing and installing duct markers.

(4) Dewatering necessary for duct installation and erosion protection per federal, state, and local requirements.

(5) All unclassified excavation, subgrade and embankment work.

(6) FOD inspection and removal.

(7) All Portland cement concrete work.

b. Other Subsidiary Work.

(1) Removing underground ducts is subsidiary to removing associated equipment served by the duct as shown and described in the Plans, unless otherwise indicated.

(2) Removing old and abandoned cables from existing conduit is subsidiary to removing associated equipment serviced by the cable as shown and described in the Plans, unless otherwise indicated.

Payment will be made under:

Item L110.030.1002 Rigid Steel Conduit, 2-inch – per linear foot

Item L110.070.1002 PVC Conduit, 2-inch – per linear foot

Item L110.080.1002 HDPE Conduit, 2-inch – per linear foot

Item L110.115.1002 PE Conduit, 2-inch, Concrete Encased – per linear foot

REFERENCES

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

ASTM International (ASTM)

ASTM C478	Circular Precast Reinforced Concrete Manhole Sections
ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials

National Electrical Manufacturers Association (NEMA)

NEMA TC-2	Electrical Polyvinyl Chloride (PVC) Conduit

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit - Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

ITEM L-115 ELECTRICAL MANHOLES

DESCRIPTION

115-1.1 This item shall consist of electrical manholes installed per this Specification, at the indicated locations and conforming to the lines, grades and dimensions shown on the Plans or as required by the Engineer. This item shall include the installation of each electrical manhole with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces to the satisfaction of the Engineer**,** including removal of existing manholes as shown on the Plans.

EQUIPMENT AND MATERIALS

115-2.1 GENERAL. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through the manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

115-2.2 CONCRETE STRUCTURES. Concrete shall be proportioned, placed, and cured per P-610 Concrete for Miscellaneous Structures. Cast-in-place concrete structures shall be as shown on the Plans.

If the Contractor chooses to propose a different structural design, the Contractor shall submit signed and sealed shop drawings, design load ratings, and other information requested by the Engineer for evaluation by the Engineer, per review process defined in GCP subsection 60-08.

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 third party certification program approved by the Engineer. Provide precast concrete structures where shown on the Plans. Precast concrete structures shall conform to ASTM C478, where applicable.

Precast concrete structures shall be designed by 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 the loadings specified or shown on the Plans . Openings or knockouts for conduit entries, drains, and ground rods shall be provided in the structure as shown on the Plans.

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

Submit signed and sealed shop drawings, design load ratings, and other information requested by the Engineer for evaluation by the Engineer per the process defined in the GCP subsection 60-08.

115-2.4 JUNCTION BOXES. Refer to L-125 for requirements regarding all work and materials to install junction boxes and handholes.

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 PORTLAND CEMENT CONCRETE. Refer to P-610 for requirements regarding work and materials to place Portland cement concrete.

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 or structural steel units shall conform to the dimensions shown on the Plans and shall be designed to support the loadings specified or shown on the Plans for the associated manhole.

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. Unless otherwise indicated, frames and covers shall be hinged. Cast iron covers shall be provided with a spring-assist mechanism for opening.

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.

Where 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 P-153 Controlled Low Strength Material.

115-2.12 CABLE TRAYS AND RACKS. Cable trays and racks shall be non-metallic and located as shown on the Plans.

115-2.13 CONDUIT. Conduit shall comply with 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 pounds per square inch (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 10 feet long or less than 3/4-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 Engineer without additional expense to the Department.

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

All excavation shall be unclassified.

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

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

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

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

Prior to installation the Contractor shall provide a minimum of 6 inches of sand or a material approved by the Engineer as a suitable base to receive the structure. The base material shall be compacted and graded level and at proper elevation to receive the structure in proper relation to the conduit grade or ground cover requirements, as shown 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 P-610. Any reinforcement required shall be placed as indicated on the Plans and shall be approved by the Engineer before the concrete is placed.

115-3.3 PRECAST UNIT INSTALLATIONS. Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of manhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed.

115-3.4 PLACEMENT AND TREATMENT OF CASTINGS, FRAMES AND FITTINGS. All castings, frames and fittings shall be placed in the positions indicated on the Plans or as directed by the Engineer and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

Field connections shall be made with bolts, unless indicated otherwise. Welding will not be permitted unless shown otherwise on the approved shop drawings and written 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 Engineer and approval of the method of correction shall be obtained. Approved corrections shall be made at Contractor's expense.

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

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

115-3.5 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 Engineer may direct the Contractor to delay the removal of sheeting and bracing if, in his judgment, the installed work has not attained the necessary strength to permit placing of backfill.

115-3.7 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 P-152. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the Plans or as directed by the Engineer.

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

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

115-3.8 CONNECTION OF DUCT BANKS. Duct bank and conduit openings shall be grounded solid with non-shrink grout after installation of conduits but prior to backfilling. 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. Manhole grounding shall be as shown on the Plans. Where shown, 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. Where shown, ground rods shall be installed outside the manhole with a ground wire extended into the manhole through a conduit sleeve. The sleeve shall be sealed watertight.

Where shown, a grounding bus of 4/0 bare stranded copper shall be exothermically bonded to the ground rod and loop the concrete structure walls or a copper ground bar shall be mounted to the structure wall.

The ground bus shall be a minimum of one foot above the floor of the structure and separate from other cables. #6 American wire gauge (AWG) bare copper pigtails shall bond the grounding bus to all covers, frames, metallic cable trays and other metal hardware within the concrete structure. Connections to the cable-type grounding bus shall be exothermic. If an exothermic weld is not possible, connections to the grounding bus shall be made by using compression connectors approved for direct burial in soil or concrete per UL 467. Connections to a ground bar shall be two-hole lugs. 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.

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 constructed and 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.

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.

115-3.13 MANHOLE ELEVATION ADJUSTMENTS. The Contractor shall adjust the tops of existing manholes in areas designated on the Plans 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 existing manhole top section or ring and cover on top or install a new top section and cover and check the new top elevation. All new cast in place or precast manhole sections, covers, or other components required for elevation adjustment shall meet the requirements of this Specification for new manholes and shall be designed to support the loadings indicated in the Specifications, or shown on the Plans.

Where shown, 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 MANHOLE. Electrical manholes shall be measured by each unit completed in place and accepted. 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 turfing; all required connections; temporary cables and connections; and grounding.

115-4.2 ADJUST ELECTRICAL MANHOLE. Manhole elevation adjustments shall be measured by the completed unit installed, in place, completed, and accepted. Separate measurement shall not be made for the various types and sizes.

BASIS OF PAYMENT

115-5.1 The accepted quantity of electrical manholes will be paid for at the Contract unit price per each, complete and in place. 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 work.

a. Subsidiary Work. Work listed is subsidiary to the respective L-115 pay items requiring its use.

(1) All unclassified excavation, subgrade and embankment work.

(2) Dewatering necessary for structure installation and erosion protection per federal, state, and local requirements.

(3) All sodding, grading and restoration work.

(4) FOD inspection and removal.

115-5.2 Payment shall be made at the contract unit price for manhole elevation adjustments. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary, including but not limited to, spacers, concrete, rebar, dewatering, excavating, backfill, topsoil, sodding and pavement restoration, where required, to complete this item as shown in the Plans and to the satisfaction of the Engineer.

Payment will be made under:

Item L115.010.0000	Electrical Manhole – per each
Item L115.020.0000	Adjust Electrical Manhole – 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.

ASTM International (ASTM)

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings

ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C206	Standard Specification for Finishing Hydrated Lime

Mil Spec

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

ITEM L-125 INSTALLATION OF AIRPORT LIGHTING SYSTEMS

DESCRIPTION

125-1.1 This item shall consist of airport lighting systems furnished and installed in accordance with this specification, the referenced specifications, and the applicable advisory circulars (ACs). This item includes removal and disposal of existing lighting equipment as shown on the Plans and indicated in these Specifications. 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 Engineer. This item shall also include furnishing, installing, maintaining, and removing temporary runway lighting as specified and shown in the Plans.

EQUIPMENT AND MATERIALS

125-2.1 GENERAL.

a. Airport lighting equipment and materials covered by the Federal Aviation Administration (FAA) advisory circulars (ACs) shall be certified under *AC 150/5345-53 Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not performs as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly. The AC 150/5345-53, the latest certified equipment list, and the address list of certified airport lighting equipment manufacturers are available on the FAA Airport Engineering, Design, & Construction web page: https://ww.faa.gov/airports/engineering/.

b. Lighted airport signs shall be guaranteed for a period of two (2) years, and LED light fixtures shall be guaranteed for a period of four (4) years. All other 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 Department, according to GCP section 90. The defective materials and/or equipment shall be repaired or replaced, at the Department's discretion, with no additional cost to the Department.

125-2.2 CONDUIT/DUCT. Conduit shall conform to L-110 Airport Underground Electrical Duct Banks and Conduits.

125-2.3 CABLE AND COUNTERPOISE. Cable and Counterpoise shall conform to L-108Underground Power Cable for Airports.

125-2.4 TAPE. Rubber and plastic electrical tapes shall be Scotch Electrical Tape Numbers 130C and 88 respectively, as manufactured by 3M Company or an approved equal.

125-2.5 CABLE CONNECTIONS. Cable Connections shall conform to L-108 Installation of Underground Cable for Airports.

125-2.6 RETROREFLECTIVE MARKERS. Retroreflective markers shall be type L-853 and shall conform to the requirements of AC 150/5345-39 and P-660 Retroreflective Markers and Cones. Provide the type and style shown on the Plans.

125-2.7 RUNWAY AND TAXIWAY LIGHTS. Runway and taxiway lights shall conform to the requirements of AC 150/5345-46. Provide the type of light fixture as shown on the Plans and in Table 125-1. 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.

TABLE 125-1. LIGHTS

	ITEM	DESCRIPTION	FAA AC 150 /
a.	Runway Edge and Threshold Light, Bi-directional High-Intensity	L-862 and L-862E, with 6.6 amperes (A) halogen lamp or LED, support column, metal frangible coupling with stainless steel hex head set screws, upper plug and cord assembly with separable connector, and stainless steel lens encircling clamp band. Complete with lens coloration, lamp wattage, and specified support column height. Fixtures shall be left and right toe-in as required.	5345-46
b.	Runway Edge and Threshold Light, Medium Intensity	L-861 and L-861E, with 6.6 A halogen lamp or LED and glass lens, support column, metal frangible coupling with stainless steel hex head set screws, upper plug and cord assembly with separable connector, and stainless steel lens encircling clamp band. Complete with lens coloration, lamp wattage, and specified support column height.	5345-46
c.	Taxiway Edge Light, Medium Intensity	L-861T, with 6.6 A halogen lamp or LED and glass lens, support column, metal frangible coupling with stainless steel hex head set screws, upper plug and cord assembly with separable connector, and stainless steel lens encircling clamp band. Complete with lamp wattage and specified support column height.	5345-46
d.	Flush Taxiway Centerline Light Fixture	Uni or Bi-Directional, Type L-852C, L-852D, or L-852K, Class 2, Mode 1, Style 3, a flat fixture with 1/4-inch or less clearance above finish surface, with halogen or LED lamps, plug and cord assembly, 1/2-inch watertight connector, fixture bolts, 2-piece cam-lock washers, "Dry" system with replaceable lens in the optical assembly sealed above and below with "O" rings, and without optional arctic heater for LED fixtures.	5345-46
e.	Flush Runway Light Fixture	Uni or Bi-Directional, Type L-850A or L-850B, Class 2, Mode 1, Style 3, as indicated, with 1/4-inch or less clearance above finish surface, with halogen or LED lamps, plug and cord assembly, 1/2-inch watertight connector, fixture bolts, 2-piece cam-lock washers, "Dry" system with replaceable lens in the optical assembly sealed above and below with "O" rings.	5345-46
f.	Elevated Runway Guard Light	L-804, with LED lamps, support column with adjustable fitting for fixture aiming, metal frangible coupling with stainless steel hex head set screws, heavy baseplate, internal flasher circuitry, and upper plug and cord assembly with separable connector.	5345-46

	ITEM	DESCRIPTION	FAA AC 150 /
g.	Flush Guard Light Fixture	Uni Directional, Type L-852G, Class 2, Mode 1, Style 3, a flat fixture with 1/4-inch or less clearance above finished surface, with LED lamps, internal flasher circuitry, plug and cord assembly, 1/2-inch watertight connector, fixture bolts, 2-piece cam-lock washers, “Dry” system with replaceable lens in the optical assembly sealed above and below with “O” rings, and without optional arctic heater.	5345-46
h.	Flush Runway Edge Light Fixture	Bi-Directional, Type L-850C, Class 2, Mode 1, Style 3, as indicated, with 1/4-inch or less clearance above finish surface with halogen or LED lamps, color filters, plug and cord assembly, 1/2-inch watertight connector, fixture bolts, 2-piece cam-lock washers, “Dry” system with replaceable lens in the optical assembly sealed above and below the “O” rings. Fixtures shall be left or right toe-in as required.	5345-46
i.	Flush Taxiway Edge Light Fixture	Omni-Directional, Type L-852T, Class 2, Mode 1, Style 3, a flat fixture with 1/4-inch or less clearance above finish surface, with LED lamps, plug and cord assembly, 1/2-inch watertight connector, fixture bolts, 2-piece cam-lock washers, "Dry" system with replaceable lens in the optical assembly sealed above and below with "O" rings, and without optional arctic heater.	5345-46
j.	Flush Taxiway Intersection Light Fixture	Omni-Directional, Type L-852F, Class 2, Mode 1, Style 1, a flat fixture with 1/2-inch or less clearance above finish surface, with halogen lamp, plug and cord assembly, 1/2-inch watertight connector, fixture bolts, 2-piece cam-lock washers, "Dry" system with replaceable lens in the optical assembly sealed above and below with "O" rings, and high-strength ductile iron top housing.	5345-46

125-2.8 RUNWAY AND TAXIWAY SIGNS. Runway and Taxiway Guidance Signs should conform to the requirements of AC 150/5345-44. Provide type, size, style, class, and mode of signs as shown on the Plans and in Table 125-2.

TABLE 125-2. SIGNS

	ITEM	DESCRIPTION	FAA AC 150 /
a.	Airport Signs	L-858, internally lighted, Class 2, size, style, and mode as indicated on the Plans, with acrylic panels, LED lamps, and on/off switch with protective cover. Panels shall be smooth and free from aberration with the exception of	5345-44

	ITEM	DESCRIPTION	FAA AC 150 /
		the panel joints in modular signs. Panel joints shall not interfere with the legibility of the sign.	
b.	Airport Signs	L-858, unlighted.	5345-44

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

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

125-2.11 CIRCUIT SELECTOR CABINET. The circuit selector cabinet shall meet the requirements of AC 150/5345-5. Provide the type, number of circuits controlled, class, and rating as shown on the Plans.

125-2.12 LIGHT BASE AND TRANSFORMER HOUSINGS. Light Base and Transformer Housings shall conform to the requirements of AC 150/5345-42. Provide the type, class, and size shown on the Plans and in Table 125-3. Provide all base plates, cover plates, and adapter plates to accommodate various sizes of fixtures.

TABLE 125-3. LIGHT BASE AND TRANSFORMER HOUSINGS

	ITEM	DESCRIPTION	FAA AC 150 /
a.	Airport Light Base	L-867, transformer housing, Class I, Size B or D, 12 or 16 inches diameter by 24 inches deep, galvanized steel one piece light base with internal grounding lug, gasket, steel cover, base extension (where required), drain opening and conduit hubs or openings as indicated.	5345-42
b.	Airport Light Base	L-867, watertight, transformer housing, Class II, Size B, 12 inches diameter by 24 inches deep, non-metallic one piece light base made from Type III, ultra-high molecular weight, heavy-wall, high-density polyethylene pipe having a cell classification of 345434C or better according to ASTM D3350. Conduit stubs made of the same material as the light bases shall be sidewall fused to the bases using saddle fittings, or other approved method for a watertight connection.	5345-42
c.	Airport Light Base	L-868, transformer housing, Class I, Size B, 12 inches diameter by depth as indicated on the Plans, galvanized steel two section light base assembly with grooved and "O" ringed flange ring with concrete ring. Step the top flange of the light base bottom section to fit outside a standard top section. Complete with any necessary spacer rings, internal grounding lug, mud plate, anti-rotational fins and conduit hubs. Light base and cover shall be suitable for vehicle and aircraft wheel loading.	5345-42

	ITEM	DESCRIPTION	FAA AC 150 /
d.	Primary Handhole	L-868, Class I, Size B, 12 inches diameter by 24 inches deep, galvanized steel, one piece with conduit hubs or openings and drain hole as indicated, steel cover and gasket, internal ground lug with connector, and other items as indicated. Handhole and cover shall be suitable for vehicle and aircraft wheel loading.	5345-42
e.	Handhole	L-867, watertight, transformer housing, Class II, Size B, 12 inches diameter by 24 inches deep, non-metallic one piece light base made from Type III, ultra-high molecular weight, heavy wall, high density polyethylene pipe having a cell classification of 345434C or better according to ASTM D3350. A conduit stub made of the same material as the light bases shall be sidewall to ASTM D3350. Conduit stubs made of the same material as the light bases shall be sidewall fused to the bases using saddle fittings, or other approved method for a watertight connection. Complete with 1/2-inch galvanized steel cover and gasket.	5345-42
f.	Spacer Ring	L-867 or L-868, galvanized steel spacer ring with bolt hole pattern to match light base.	5345-42
g.	Light Base Extension	L-867, Class I, Size B or D, depth as required or indicated, galvanized steel light base extension with bolt hole pattern to match light base.	5345-42

125-2.13 ISOLATION TRANSFORMERS. Isolation Transformers shall conform to AC 150/5345-47. Provide the type, rating, and size as shown on the Plans and in Table 125-4.

TABLE 125-4. ISOLATION TRANSFORMERS

	ITEM	DESCRIPTION	FAA AC 150 /
a.	Isolation Transformer	L-830, individual lamp type, series-to-series, 5000 V, 6.6 A to 6.6 A.	5345-47
b.	Isolation Transformer	L-830, individual lamp type, series-to-series, 5000 V, 20 A to 6.6 A.	5345-47

125-2.14 CONSTANT CURRENT REGULATOR. Constant Current Regulators shall conform to AC 150/5345-10. Provide the type, class, style, and rating as shown on the Plans and in Table 125-5.

TABLE 125-5. CONSTANT CURRENT REGULATORS

	ITEM	DESCRIPTION	FAA AC 150 /
a.	Constant Current Regulator	L-828, class, style, and size as indicated on	5345-10

		Plans, 60 hertz (Hz) input, with brightness control for remote operation. Regulator shall be ferroresonant, dry-type with 6.6 A output current and front-mounted digital meter.	

125-2.15 RADIO CONTROLS. Radio Control Equipment shall conform to AC 150/5345-49. Provide the type and style as shown on the Plans and in Table 125-6.

TABLE 125-6. RADIO CONTROL EQUIPMENT

	ITEM	DESCRIPTION	FAA AC 150 /
a.	Radio Control Equipment	L-854, Type I, Style A, with enclosure for surface mounting, antenna and feedline and field-adjustable frequency set to the Common Traffic Advisory Frequency (CTAF) for the project airport as found in the Alaska Supplement of the U.S. Government Flight Publication.	5345-49

125-2.16 SEALER.

a. Adhesive Sealant. Adhesive sealant shall be a self-leveling silicone sealer.

b. Conduit Sealant. Conduit sealant shall be a two-part, high expansion polyurethane foam duct sealant that is fast setting, easily installed, easily removed and re-enterable. Sealant shall be dispensed with a multi-use, single plunger caulking tube package that automatically mixes the sealant in a correct ratio. Sealant shall create a strong, resilient, chemically resistant seal that is compatible with cable and wire jackets, and will expand, cure, and seal even with water present. Sealant shall be American Polywater Corporation AFT or FST Foam Sealant, Chemque Q-Pak 2000, or approved equal product.

125-2.17 TRANSFORMER SUPPORT PLATFORM. When called for on the Plans, light bases equipped with L-830 type isolating transformers shall, in addition to the other specified items, be provided with 12 inch high non-metallic, fixed height or folding type, transformer support platforms as shown on the Plans.

125-2.18 POWER ADAPTER. Power adapter, when called for in the Plans shall be a series primary to 120 V regulated-voltage power supply suitable for use with a 3- or 5-step constant current regulator source. The power adapter shall be oil filled and include two replaceable internal fuses. Power adapter ratings shall be 670 VA at 120 V alternating current (ac) with ± 3% regulation at 2.8 to 6.6 A primary current.

125-2.19 REGULARLY USED COMMERCIAL ITEMS. All regularly used commercial items of electrical equipment not covered by FAA equipment specifications shall conform to the applicable NEMA rulings and standards for equipment of its type, be listed and labeled as defined in NFPA 70, Article 100, by an OSHA and State of Alaska-approved nationally recognized testing laboratory agency acceptable to the Department, and be marked for the intended use.

125-2.20 LOCK WASHERS. Lock washers shall be two piece cam-type lock washer.

125-2.21 FREE FLOWING INSULATING MATERIAL. Insulating material for filling of light bases shall be an inorganic, non-flammable, free-flowing granular material. The material shall be chemically treated to be hydrophobic. It shall be free of asbestos. The material shall have a density of 40 to 42 pounds per cubic feet (lb/cf), and a load bearing strength of 83 pounds per square inch (psi).

125-2.22 LUBRICANT AND SEALANT. Lubricant and sealant shall be a general purpose "O"-ring and valve lubricant. Temperature range shall be -40 °F to +400 °F. Anti-seize for use on fixture bolts shall be a marine-grade, metal-free anti-seize compound for wet, corrosive environments and shall be compatible with steel, stainless steel, and aluminum.

125-2.23 SOFT GASKET. Gaskets to be installed between the base plate and base shall be soft neoprene.

125-2.24 PEDESTALS. The power and communications pedestals shall be fiberglass enclosures constructed to meet the requirements of ANCI C 57.12.28 Standard for Pad-mounted Equipment Enclosure Integrity, an attachment to ANSI C 37.72. Construction details and overall dimensions shall be according to the Plans.

125-2.25 JUNCTION BOX, TYPE II. Junction boxes shall be pre-cast reinforced concrete boxes of the size and details shown on the Plans. Junction boxes shall have metal covers. The covers shall be effectively grounded with a 3-foot copper braid.

125-2.26 CONCRETE. Concrete shall be proportioned, placed, and cured per P-610 Concrete for Miscellaneous Structures.

125-2.27 FIXTURE BOLTS. Bolts for securing flush-mounted light fixtures shall be fluoropolymer-coated, SAE J429 Grade 5 carbon steel, and fully threaded. Bolts shall extend a minimum of 1/4-inch beyond the underside of the light base top flange and shall be a maximum of 3-1/2 inches long unless otherwise approved by the engineer.

125-2.28 TEMPORARY RUNWAY LIGHTING SYSTEM. Temporary lighting shall be portable lighting units meeting the requirements of AC 150/5345-50 or equipment meeting the requirements of this Specifications installed in a manner to facilitate temporary use. When cabling is required, use L-824 cabling and L-823 connectors in minimum 1-inch schedule 40 HDPE conduit unless otherwise indicated.

125-2.29 DRAIN ROCK. Drain rock shall meet gradation requirements in Table 125-7, or as otherwise approved by the Engineer.

TABLE 125-7. GRADATION OF DRAIN ROCK

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
2-inch	100
1-1/2-inch	95-100
3/4-inch	0-20
3/8-inch	0-5

INSTALLATION

125-3.1 INSTALLATION. The Contractor shall furnish, install, connect and test all equipment, accessories, conduit, cables, wires, buses, grounds and support items necessary to ensure a complete and operable airport lighting system as specified here and shown in the plans.

All work in connection with the airport lighting system shall be according to the applicable provisions of the current edition of NFPA 70 (National Electrical Code) and all State and local codes. Location of all new fixtures, conduit, cables, etc., shall be as shown on the Plans.

The Contractor shall install the specified equipment in accordance with the applicable advisory circulars and the details shown on the Plans, and in this subsection.

Level and align light fixtures according to manufacturer’s instructions. Level to within 1 degree. Align to within 1/2-inch at right angles to centerline and to within 1-inch parallel to centerline. Light fixtures shall be

oriented with the light beams parallel to the runway or taxiway centerline and facing in the required direction.

Where electrical cable or duct is required, such work will be covered under L-108 or L-110, as applicable.

Where remote relay assembly and/or remote control panel is required, such work will be covered under L-109.

Refer to P-610 for requirements regarding all work and materials to place concrete.

Special requirements for providing and maintaining temporary lighting include the following:

a. Install runway, threshold, and taxiway lighting as required with spacing in accordance with AC 150/5340-30.

b. Test temporary lights and system connections prior to their use being required to ensure no delays or service interruptions.

c. Install temporary light units using black sand bags and/or stakes to hold fixtures and conduit in place.

d. On completion of work, remove temporary equipment, repair any damaged light units and turn over all units to the Department.

e. Where hardwired lighting equipment is utilized:

(1) Connect temporary lighting to existing and/or new lighting circuits served from the existing or new regulator and lighting controls.

(2) Use HDPE conduit to provide appropriate physical cable protection. Conduit is not required for short term cable installations that will be removed within 2 days of installation.

(3) Remove HDPE conduit from around cable and dispose of upon completion of use.

(4) Reinstall used cabling on metallic cable drums and turn over to the Department for future use.

(5) At the Contractor's option, cabling may be assembled in the field or by the manufacturer. Each section along the runway edges shall be 200 feet minimum in length.

f. Maintain temporary lighting system and existing lights used as part of the temporary lighting system in good repair to keep the system in working condition. Relocate temporary lights and circuits and adjust circuit connections and configuration as required as construction progresses.

Provide all labor, materials, systems, equipment, facilities, and other incidental items as may be required to provide temporary electrical power for construction and testing of all contract work.

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 Engineer, damaged during

construction or storage shall be replaced by the Contractor at no additional cost to the Department. 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.

125-3.5 INSTALLATION OF IN-PAVEMENT LIGHTS. 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. Surplus Portland Cement Concrete (PCC) shall be removed. The holding device shall remain in place until PCC has reached its initial set.

Install flush runway and taxiway light fixtures in existing pavement after the old pavement has been cold planed, and before the new asphalt is placed. Install flush taxiway and runway light fixtures on new runways or taxiways before the first asphalt lift.

Core remaining asphalt or base course at the light base locations a minimum diameter of 36 inches and remove the base course material to the depth shown. Compact the bottom of the cored hole before pouring concrete.

Use a setting jig to install the bottom section of the light base assembly, as shown in the Plans. The bottom of the light base shall be at least 12 inches above the bottom of the excavation. Provide no more than 4 threaded hubs for the bottom section of the light base, as shown on the Plans. Connect the bottom section of the light bases to the conduit system, using rubber grommets or waterproof nipples and couplings.

Call for inspection of the light base assembly prior to the backfilling of the excavations. Backfill with poured PCC meeting the requirements of P-610. Fill the excavation only to the level shown.

After the PCC has cured at least 72 hours or as approved by the Engineer, apply tack coat and overlay with Asphalt Concrete Pavement.

Plug the conduit ends during the course of construction to prevent accumulation of water or debris in the conduit.

When ready to install the inset lights, determine the location of the light base and drill a small diameter core hole to locate the center of the mud plate. Next, drill a 16 inch diameter core hole over the center of the mud plate (± 1/4 inch tolerance). Use a coring machine of adequate stability to prevent "wobble". After removing the core, mud plate, plywood cover, and any water or debris that has accumulated, apply a thin layer of self-leveling silicone sealer between the bottom flange of the top section and the top flange of the bottom section and bolt the top section using 18-8, 410, or 416 stainless steel all-thread bolts. Coat the bolts with a suitable corrosion inhibitor prior to installing. Use two-piece cam-type lock washers and torque the bolts to 180 inch-pounds or as recommended by the manufacturer.

Make a "dry system" light fixture installation, using a grooved flange ring, "O" ring, and concrete ring. If the actual elevation of the pavement overlay does not equal the estimated elevation, provide spacer rings or flange rings of different thickness. Bolt the fixture to the top section using fluoropolymer-coated Grade 5 bolts. Do not use anti-seize corrosion inhibitor on coated bolts. Use two piece cam-type lock washers, and torque the bolts to 336 - 360 inch-pounds, or as recommended by the manufacturer. Set the outboard edge of the fixture 1/8 inch (+/- 1/16 inch tolerance) below the adjacent finished pavement measured at the downslope side.

Install the light fixtures per the Plans and the Specifications and the manufacturer's recommended procedure. Do not deviate from these procedures, or the materials shown or specified, without the prior approval of the Engineer.

Install isolating transformers and cable connectors as described for non-watertight edge lights.

125-3.6 INSTALLATION OF NON-WATERTIGHT EDGE LIGHTS. The light base shall be placed on a layer of bedding material of minus 1/4-inch material that is not less than 6 inches in depth. Bedding material shall be, sand, gravel, crushed aggregate, or other suitable material containing no organic, frozen, or other deleterious material. Where called for on the Plans, install drain rock below light base in lieu of bedding material. Compact drain rock to the satisfaction of the Engineer. If the light base is placed in the structural section (P-154, P-209, P-299) of a pavement such as for a runway or taxiway, the Contractor shall construct the backfill according to the Specifications for the material in which the light base is placed. The material shall be compacted to the requirements of the material into which it is placed. The light base shall be placed at an elevation that will place the frangible break point below finished grade as indicated on the Plans. The base shall be level to within ±1/4-inch tolerance.

Connect the isolating transformer with L-823 connector kits and heat shrink tubing as shown on Plans. Ensure that all field installed primary cable connectors have the plug pin connectors and receptacle socket connectors properly positioned within their respective connector bodies, as detailed by the connector manufacturer, prior to the shrinking of heat shrink tubing, where required at the cable-connector interface.

Install isolating transformers in the light bases as shown on the Plans. Where called for on the Plans, install isolating transformers in all light bases by placing on top of an approved transformer supporting platform as specified. Train all connections to the isolating transformer to lay in the upper section of the light base, above the transformer platform and below the cover flange, as shown on the Plans. Provide adequate primary and secondary cable slack in each light base to assure that all connectors can be grouped and trained in the upper section of the light base without subjecting the connector to tension.

Install the light fixtures with stainless steel hardware and coat the bolts and frangible couplings with a suitable corrosion inhibitor prior to being installed. Install the light fixtures with lamp, clean the lenses, align and adjust each optical system according to the manufacturer's instructions.

125-3.7 INSTALLATION OF WATERTIGHT EDGE LIGHTS. Place the light base on a layer of bedding material that is not less than 6 inches in depth and backfill around the lighting base with bedding material, Use bedding material that meets requirements for the applicable lift of material (P-152, P-154, P-209, P-299) except that 100% of the bedding material will pass a 1-inch sieve.

Test the base assemblies, saddle fittings, and plastic duct as a complete system or in sections to insure that it is watertight. If a pneumatic test is performed to meet this requirement, the minimum pressure shall be 5 pounds per square inch (psi) for a minimum of 10 minutes.

Base assemblies shall be sealed watertight and conduit openings and any holes shall be caulked with approved sealant to prevent any water from entering the base assemblies. When called for on the Plans, after the connection of the isolating transformer with L-823 connector kits the light bases shall be completely filled with free flowing insulating material.

The light base assemblies shall be sealed watertight using the following method and materials or approved equal:

- **a.** Spot weld the weep hole in the bottom of the base plate hub, if present.
- **b.** Apply conduit sealant to all conduit openings, with the sealant applied on all sides and between cables to fully seal annular and interstitial spaces.

c. To insure that no water leaks into the can, use a soft neoprene gasket under the base plate. The gasket shall be covered on both sides with a generous coating of lubricant and sealant to prevent water seepage during freeze-thaw cycles.

d. Install seal washers with stainless steel cups under the bolt heads. The torque on the six bolts should be approximately 25 inch-pounds, ±5 inch-pounds tolerance. A torque wrench must be used.

e. After installation of the base plate, plug in the edge light. Using clear adhesive sealant, coat the threads of the frangible coupling and screw into place. Plug the weep hole with adhesive sealant. Put adhesive sealant around the bottom of the frangible coupling at the junction with the base plate.

f. Install the edge light stem securely. Then, using more adhesive sealant, fill the space between the edge light stem and the inside diameter of the frangible coupling. Install the light fixtures with lamp, clean the lenses, align and adjust each optical system according to the manufacturer's instructions.

125-3.8 INSPECTION. Notify the Engineer in writing and request inspection at least 48 hours prior to installing lighting fixtures, making any splices, or covering any buried or concealed work. Immediately correct any deficiencies found during the inspection.

125-3.9 RECORD DOCUMENTS. Maintain at the project site a complete set of contract Plans, Specifications and approved changes thereto. In addition to the above, 2 complete sets of electrical plans shall be maintained for as-built purposes upon which all changes, connections, part numbers and conductor routings shall be legibly shown and noted. Where changes to Plans are involved, make notations to show the dates and authorities approving the changes. Permanently store one set of annotated electrical plans in a dry, secure location at the project site. Deliver the second set to the Engineer.

As-built plans shall show locations of all buried items such as conduit, including any existing active lines encountered. All dimensions shall be from runway and taxiway centerlines or other permanent objects. As-built plans shall include complete wiring diagrams, (both power and control), identifying terminals, cables, and connections. As-built plans shall be kept current as the work progresses.

125-3.10 SPARE PARTS. Provide a quantity of spare light fixtures, transformers, and other components equal to 10%, rounded down, of the installed quantity of each piece of equipment or component in the following list. Deliver spare parts to airport maintenance as directed by the Engineer. Spare parts shall be divided into airport visual aid categories as follows:

a. Constant Current Regulators. Fuses, contactors, and other maintenance components as recommended by the regulator manufacturer

b. Runway and Taxiway Elevated Edge Lighting System. Each type and size of fixture and transformer

c. Runway and Taxiway In-Pavement Lighting System. Each type and size of fixture and transformer

d. Runway Elevated and In-Pavement Guard Lighting System. Each type and size of fixture and transformer

e. Illuminated Runway and Taxiway Signs. LED light bar, power supply, and transformer

f. Rotating Beacons. See L-101 for specification of spare parts where applicable

g. Wind Cones. See L-107 for specification of spare parts where applicable

h. Obstruction Lights. See L-119 for specification of spare parts where applicable

METHOD OF MEASUREMENT

125-4.1 (Not Used)

125-4.2 LUMP SUM. Lump sum quantities will not be measured for payment per GCP section 90.

125-4.3 UNIT PRICES. The quantity to be paid will be the number of units installed, complete, in place, accepted by the Engineer, and ready for operation, or the number of units acceptably removed.

125-4.4 CONTINGENT SUM. For spare parts, the total cost of spare parts for each airport visual aid category listed above shall not exceed $10,000 or 10% of the cost of the visual aid, per FAA Order 5100.38 AIP Handbook. If necessary, reduce the quantity of each spare part within a category equally until the costs are at or below the $10,000 or 10% limit. Maintain a minimum of one of each size and type of spare part.

BASIS OF PAYMENT

125-5.1 Payment will be made at the Contract unit price for completed work listed in this subsection installed by the Contractor and accepted by the Engineer, according to GCP section 90. 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 this item.

a. Items of Work Paid in This Subsection. Completed and accepted work paid at the contract lump sum, contingent sum, or unit prices.

(1) L125.010.0000 Airport Lighting Pay Item. This pay item includes all work required under this item to provide the complete airport lighting system, except work listed below which is paid for under other items.

(2) L125.020.0000 Regulator, L-828 Pay Item. This pay item includes mounting and electrical connections, with all input control and output circuits.

(3) L125.025.0000 High Intensity Runway Edge and Threshold Light, L-862 and L-862E Pay Item. This pay item includes L-867 base assembly, grounding lug and connector, baseplate with ground lug, gasket, support column, frangible coupling, L-830 isolating transformer, transformer mounting platform (when shown on Plans), and L-823 cable connectors.

(4) L125.030.0000 Medium Intensity Runway Edge and Threshold Light, L-861 and L-861E Pay Item. This pay item includes L-867 base assembly, grounding lug and connector, baseplate with ground lug, gasket, support column, frangible coupling, L-830 isolating transformer, transformer mounting platform, when shown on Plans, and L-823 cable connectors.

(5) L125.040.0000 Taxiway Edge Light, L-861T Pay Item. This pay item includes L-867 base assembly, spacer rings, grounding lug and connector, baseplate with ground lug, gasket, support column, frangible coupling, L-830 isolating transformer, transformer mounting platform (when shown on Plans), and L-823 cable connectors.

(6) L125.050.0000 Wind Cone Handhole, L-867, Size D Pay Item. This pay item includes steel cover and gasket, grounding lug and connector, L-823 primary and secondary cable connectors, and PA-4 power adapter, when shown on the Plans and indicated in these Specifications.

(7) L125.060.0000, Primary Handhole, L-868, Size B Pay Item. This pay item includes traffic rated steel cover and gasket, grounding lug and connector.

(8) **L125.070.0000 Remove Runway and Taxiway Light Pay Item.** This pay item includes removal of fixtures, transformers, bases, and other associated materials as shown or directed in the Plans.

(9) **L125.080.0000 Flush Runway Centerline Light, L-850A or L-850B Pay Item.** This pay item includes L-868 base assembly, spacer rings, flange ring, L-830 isolating transformer, L-823 cable connectors, concrete work, asphalt patching and sealing.

(10) **L125.095.0000 Flush Taxiway Light, L-852C, L-852D, L-852F, L-852G, L-852K, or L-852T Pay Item.** This pay item includes L-868 base assembly, spacer rings, flange ring, L-830 isolating transformer, L-823 cable connectors, concrete work, asphalt patching and sealing.

(11) **L125.100.0000 Flush Runway Edge Light, L-850C Pay Item.** This pay item includes L-868 base assembly, spacer rings, flange ring, L-830 isolating transformer, L-823 cable connectors, concrete work, asphalt patching and sealing.

(12) **L125.110.0000 Relocate Airport Sign, Type L-858 Pay Item.** This pay item includes L-867 base, frangible couplings, transformer, concrete base, sign faces as shown on the Plans, and removal of existing sign foundation.

(13) **L125.120.0000 Runway Guard Light, L-804 Pay Item.** This pay item includes L-867 base assembly, spacer rings, grounding lug, gasket, support column, frangible coupling, heavy baseplate with ground lug, L-830 isolating transformer, and L-823 cable connectors.

(14) **L125.130.0000 Airport Sign, Type L-858 Pay Item.** This pay item includes sign, L-867 base, frangible couplings, transformer, concrete base, sign faces as shown. Where required, removal of existing sign and foundation is subsidiary to this pay item.

(15) **L125.140.0000 Power or Communications Pedestal Pay Item.** This pay item includes anchor stake and conduits as shown on the Plans.

(16) **L125.150.0000 Handhole, L-867, Size B Pay Item.** This pay item includes grounding lug, steel cover, and gasket.

(17) **L125.160.0000 Junction Box, Type II Pay Item.** This pay item includes junction box, cover, and grounding as shown on the Plans.

(18) **L125.170.0000 Spare Parts Pay Item.** This pay item includes spare light fixtures, transformers, and and other components specified paid by actual invoiced material and delivery cost, plus 15% markup. Where applicable, include rotating beacon, wind cone, and obstruction light spare parts specified in sections L-101, L-107, and L-119.

(19) **L125.180.0000, Temporary Runway Lighting System.** Includes temporary lights, all HDPE conduit, assemblies, adapters, couplings, transformers, L-823 cable connectors, cables, and all necessary incidentals to provide and maintain a complete, operable, and acceptable temporary lighting system installation. Includes installation, ongoing maintenance and relocations as required, and removal of temporary equipment.

b. Items of Work Paid in Other Sections.

(1) **L-108 and L-110 Pay Items.** All work and materials required to install cable, conduit, and ground rods is paid for under L-108 and L-110 pay items.

(2) **L-109 Pay Items.** All work and materials required to install remote relay assembly and remote control panel are paid for under L-109 pay items.

(3) **P-660 Pay Items.** All work and materials required to install retroreflective markers and cones are paid for under item P-660 unless otherwise indicated.

c. Subsidiary Work.

(1) Portland Cement Concrete. Portand cement concrete is subsidiary to L-125 items requiring its use. Refer to P-610 for requirements regarding all work and materials to place Portland cement concrete.

(2) Bedding, Backfill, and Drain Rock. All bedding, backfill, and drain rock around and below light bases and handholes is subsidiary to the light fixture or handhole installation and no separate measurement or payment will be made.

Payment will be made under:

Item L125.010.0000 Airport Lighting – per lump sum

Item L125.020.0000 Regulator, L-828 – per each

Item L125.025.0000 High Intensity Runway Edge and Threshold Light, L-862 and L-862E – per each

Item L125.030.0000 Medium Intensity Runway Edge and Threshold Light, L-861 and L-861E – per each

REFERENCES

The publications listed below form a part of these Specifications 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 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-39	Specification for L-853, Runway and Taxiway Retroreflective Markers
AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5345-44	Specification for Runway and Taxiway Signs
AC 150/5345-46	Specification for Runway and Taxiway Light Fixtures
AC 150/5345-47	Specification for Series to Series Isolation Transformers for Airport Lighting Systems
AC 150/5345-53	Airport Lighting Equipment Certification Program

ITEM P-648 ARCHAEOLOGICAL MONITORING

DESCRIPTION

648-1.1 Provide an Archaeological Monitor meeting qualifications standards as stated in this specification. Conduct the work activities anticipated on the project to monitor and document construction activities in areas specifically identified in an approved Archaeological Monitoring Plan.

GENERAL REQUIREMENTS

648-2.1 QUALIFICATIONS AND RESPONSIBILITIES. The Archaeological Monitor and any subordinate monitoring personnel shall work directly for the Contractor. Submit names and qualifications of the Archaeological Monitor and monitoring personnel to the Engineer. The Archaeological Monitor and monitoring personnel shall not begin work until approved by the Engineer.

a. Archaeological Monitor. An Archaeological Monitor must meet the Secretary of the Interior (SOI) Professional Qualifications Standards for an Archaeologist as defined in 36 CFR Part 61, Appendix A, and be familiar with inadvertent discovery procedures and protocols in Alaska.

b. Archaeological Monitoring Plan. The Archaeological Monitor shall comply with the project-specific archaeological monitoring plan approved by the appropriate permitting authorities and the Engineer.

(1) If an archaeological monitoring plan is provided by the Department, the Archaeological Monitor shall implement the Department's plan.

(2) If a plan is not provided, the Archaeological Monitor will prepare a project-specific archaeological monitoring plan describing the scope of the project, qualifications, procedures, reporting, and protocols for discovery of cultural resources (i.e., historic, prehistoric, and archaeological resources) or human remains, and meeting, at a minimum, the guidelines of "Historic Preservation Series 15 – Monitoring Guidelines", published by the Office of History and Archaeology (OHA), Alaska Department of Natural Resources.

c. Permitting. Prior to any monitoring activities, the Archaeological Monitor shall acquire any permits necessary for conducting monitoring activities from the appropriate land managing agency. For monitoring on state lands the Archaeological Monitor shall obtain a State Cultural Resources Investigation Permit (SCRIP) from the Office of History and Archaeology (OHA), Alaska Department of Natural Resources.

The Archaeological Monitor shall consult with the Department's Regional Cultural Resources Specialist before applying for any permits.

d. Authority of the Archaeological Monitor. The Contractor authorizes the Archaeological Monitor to stop construction work at the discovery site immediately if cultural resources or human remains are discovered.

648-2.2 PRECONSTRUCTION MEETING. Before work begins on the project, the Engineer and the Department's Regional Cultural Resources Specialist (Professionally Qualified Individual) will conduct a preconstruction meeting with the Archaeological Monitor to discuss the procedures to follow if cultural resources or human remains are encountered during the work, as well as the role of the Archaeological Monitor.

MONITORING AND REPORTING

648-3.1 MONITORING. The Archaeological Monitor shall be on site during all ground disturbing activities at the locations designated for archaeological monitoring as identified in the archaeological monitoring plan.

a. No ground disturbing activities in these areas may take place until the Archaeological Monitor is present and has approved the start of activities. Archaeological monitoring is required in areas specifically identified in the archaeological monitoring plan.

b. Activities performed by the Archaeological Monitor shall adhere to the permit and the project's archaeological monitoring plan.

c. If cultural resources or human remains are encountered during construction in any area where the Archaeological Monitor is not present, the Contractor shall stop construction work at the discovery site immediately in accordance with GCP Section 70-07. The Archaeological Monitor is also authorized to stop construction if present at the discovery site.

After work is stopped, the Archaeological Monitor shall:

(1) Initiate the notification process outlined in the project's archaeological monitoring plan.

(2) Establish a boundary delineating the discovery site in coordination with the Engineer, and with law enforcement as applicable in the case of human remains.

(3) Assist the Engineer and the Department's Regional Cultural Resources Specialist to determine when construction work inside the discovery site boundary may resume, according to the project's archaeological monitoring plan, state law, and federal regulations.

The Contractor shall not resume construction work within the discovery site boundary until approved by the Engineer.

648-3.2 REPORTING DELIVERABLES. Prepare monitoring reports.

A. Monitoring Reports. Submit monitoring reports to the Engineer as specified in the archaeological monitoring plan. At a minimum, reports shall include:

(1) Date

(2) Start time, end time, and total hours of contractor activity observed

(3) Approximate location(s) of contractor activity (project station range)

(4) Type(s) of contractor activity

(5) Description of notable findings and observations

B. Discovery Incident Reports. If a discovery is made, the Archaeological Monitor shall submit a written incident report directly to the Engineer separate from the monitoring report. At a minimum, the incident report shall include:

(1) Date

(2) Time discovery occurred

(3) Location information

(4) Type of contractor activity

(5) Description of discovery

C. Final Report. After completion of project monitoring work, the Archaeological Monitor shall prepare a final report which shall be consistent with the SOI Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716). The final report, prepared in accordance with the permit and the archaeological monitoring plan, shall be submitted to the Engineer, and at a minimum include:

(1) Management summary

(2) Introduction

(3) Background/ research design

(4) Monitoring methods and results

(5) Inadvertent discoveries and results

(6) Summary and recommendations

(7) References

(8) Appendices

(9) Figures

METHOD OF MEASUREMENT

648-4.1 The work will be measured according to GCP Section 90, as directed by the Engineer, and as follows:

a. Lump Sum. No measurement of quantities will be made.

b. Contingent Sum. This quantity will be specified in the directive authorizing the work.

c. Hour. This quantity will be measured by the number of field hours of monitoring performed, based on filed monitoring reports as certified by the Engineer.

BASIS OF PAYMENT

648-5.1 ITEMS OF WORK PAID IN THIS SECTION. Payment will be made at the contract unit price for the completed work in this subsection. This price shall be full compensation for furnishing all materials and for labor, equipment, tools, and incidentals necessary to complete the work.

a. Work Items Paid in this Subsection. Completed and accepted work paid at the contract unit price for each.

(1) P648.010.0000 Archaeological Monitoring Pay Item, per Lump Sum. A percentage of the lump sum amount, to be determined by the Engineer, will be paid after satisfying General Requirements, listed above, and initiating monitoring activities at the site.

The balance of the lump sum amount will be prorated over the anticipated archaeological monitoring period with a portion included as part of each interim payment. The final increment will be held until acceptance of the final report.

(2) P648.020.0000 Archaeological Monitoring Pay Item, per Contingent Sum. Payment will be made in accordance with GCP subsection 90-05 to furnish all labor, equipment, and materials necessary for archaeological monitoring.

(3) P648.030.0000 Archaeological Monitoring Pay Item, per Hour. The accepted quantity of field hours will be paid for at the contract unit price. Payment includes all costs associated with furnishing an Archaeological Monitor, including travel and vehicles, lodging and meals, reports, work required outside of the reported field hours, and all other incidentals.

Discovery of cultural resources or human remains may result in a Change Order in accordance with GCP Section 70-07.

Payment will be made under:

Item P648.010.0000	Archaeological Monitoring – per lump sum
Item P648.020.0000	Archaeological Monitoring – per contingent sum
Item P648.030.0000	Archaeological Monitoring – per hour