



---

**SECTION 72 – ELECTRICAL MANHOLES AND JUNCTION STRUCTURES  
(FAA L-115)****72-1 GENERAL**

The Contractor shall perform all work required by the plans and specifications for construction of pull boxes, manholes, and miscellaneous underground structures for airfield electrical systems in accordance with the Standard Specifications, except as specified otherwise in FAA Specification Item L-115, as included and modified hereafter, and as shown on the Plans.

It shall also include all trenching, backfilling, removal, and restoration of any paved areas; concrete footings (where required), mandreling installation of pulling irons, cable hooks, ladders, grounding rods and capping, and the testing of the installation as a completed unit ready for installation of cables, to the satisfaction of the Owner and Engineer. The Contractor shall protect the existing pavements from damage by use of any equipment with tracks, stabilization feet, hydraulic fluids, etc., during the construction of this item.

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

***115-1.1*** This item shall consist of electrical manholes and junction structures (handholes, pullboxes, junction cans, etc.) installed in accordance with this specification, at the indicated locations and conforming to the lines, grades and dimensions shown on the plans or as required by the Engineer. This item shall include the installation of each electrical manhole and/or junction structures with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces to the satisfaction of the Engineer.

***EQUIPMENT AND MATERIALS******115-2.1 GENERAL.***

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

***b.*** Manufacturer's certifications shall not relieve the Contractor of the Contractor's responsibility to provide materials in accordance with these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not materially comply with these specifications shall be removed,



when directed by the Engineer and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

*c. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in project accruing directly or indirectly from late submissions or resubmissions of submittals.*

*d. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Contractor's submittals shall be neatly bound. The Engineer reserves the right to reject any and all equipment, materials or procedures, which, in the Engineer's opinion, does not meet the system design and the standards and codes, specified herein.*

*e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.*

### **115-2.2 CONCRETE STRUCTURES.**

*a. Cast-in-place concrete structures shall conform to the details and dimensions shown on the plans.*

*Provide precast concrete structures where shown on the plans. Precast concrete structures shall be an approved standard design of the manufacturer. Precast units shall have mortar or bitumastic sealer placed between all joints to make them watertight. ~~The structure shall be designed to withstand [ZZZ lb aircraft] loads, unless otherwise shown on the plans. Openings or knockouts shall be provided in the structure as detailed on the plans.~~*

*Threaded inserts and pulling eyes shall be cast in as shown.*

*If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by*



*the Engineer shall be submitted by the Contractor to allow for a full evaluation by the Engineer. The Engineer shall review in accordance with the process defined in the General Provisions.*

*Handholes and electrical vaults shall be aircraft load rated for a minimum of 100,000 lbs wheel loading, suitable for use adjacent to airfield taxiways and runways in accordance with the loading requirements in paragraph 115-2.2.1. Precast concrete handholes and electrical vaults, covers, tops, and related assemblies shall conform to ASTM C 478. Concrete for handholes and electrical vaults shall be 4500 psi. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete handholes and electrical vaults. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Covers shall fit frames without undue play. Steel and iron shall be formed to shape with sharp lines and angles. Castings shall be free from warp and blow holes that may impair their strength or appearance. Exposed metal shall have a smooth finish and sharp lines. Provide all necessary lugs and brackets. Door cover section shall be provided with pre-manufactured or welded grounding strap lug, braided electrical grounding strap, tie-down bolts, two recessed pullout lift handles, removable load beams, locking torsion hinges, and appropriately engraved/inscribed identification on top of cover for the intended application. The word "POWER" or "COMM" shall be cast in the top face of all covers. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable. Cable racks, rack arms, and support brackets shall be fiberglass, PVC, or nylon, and shall be rated for 350-pound load, minimum. Support hardware such as screws, nuts, bolts, and anchors shall be 316 Stainless Steel with field applied PVC coating. Handholes and electrical vaults shall have a sump, ground rod knockouts, raceway knockouts, and cast in place galvanized channels for securing cable racks.*

*b. All handholes and electrical vaults shall be provided with a saddle rack on each vertical wall surface where cables are routed. Saddle racks shall be the three-saddle type with 3" saddle throat opening and slip-on lock assembly. Saddle racks shall be constructed of high performance polymer with UV stabilization. Saddle racks shall be constructed of super tough yellow nylon with UV stabilization. Mounting shall be per manufacturer's requirements for "permanent installation". Saddle racks shall be manufactured by Underground Devices Inc., or approved equal.*

#### **115-2.2.1 LOADING.**

*The Contractor shall provide stamped, engineering calculations showing that the surfacing method proposed will withstand aircraft loading not less than 100,000 lbs wheel loading in conformance with the requirements set forth in the Appendices to FAA Advisory Circular 150-5320-6, Pavement Design.*



**115-2.3 JUNCTION CANS.** Junction Cans shall be L-867 Class 1 (non-load bearing for edge lights, signs and other in-field installations) or L-868 Class 1 (load bearing for centerline fixtures and other in pavement installations) cans encased in concrete. The cans shall have a galvanized steel blank cover, gasket, and stainless steel hardware, when no fixture is installed. Covers shall be 3/8" thickness for L-867 and 3/4" thickness for L-868. L-867 and L-868 unless otherwise noted shall be 24 inches deep.

**115-2.4 MORTAR.** The mortar shall be composed of one part of portland cement and two parts of mortar sand, by volume. The portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15 percent of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C 6. The water shall be clean and free of deleterious amounts of acid, alkalies or organic material. If the water is of questionable quality, it shall be tested in accordance with AASHTO T-26.

**115-2.5 CONCRETE.** All concrete used in structures shall conform to the requirements of Section 54 (FAA Item P-610, Structural Portland Cement Concrete).

**115-2.6 FRAMES AND COVERS.** The frames shall conform to one of the following requirements:

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

All castings specified shall withstand the loadings described in paragraph 115-2.2.1.

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



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

*Each pull box frame and cover shall be equipped with spring loaded assisted lifting devices (capable of lifting the cover to within 30% of the total lid weight) and support rods to prevent accidental closures.*

*All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A 123.*

*Each cover shall have the word "ELECTRIC" or "COMM" and the associated pull box or manhole designation number cast on it. No cable notches are required.*

**115-2.7 LADDERS.** *Ladders, installed in all manholes deeper than 5'-0" and where specified, shall be galvanized steel or as shown on the plans, and extend the full length of the manhole including neck, to within 6" of the finish grade.*

**115-2.8 REINFORCING STEEL.** *All reinforcing steel shall be deformed bars of new billet steel meeting the requirements of ASTM A 615, Grade 60.*

**115-2.9 BEDDING/SPECIAL BACKFILL.** *Bedding or special backfill shall be as shown on the plans.*

**115-2.10 FLOWABLE BACKFILL.** *Flowable material used to backfill shall conform to the requirements of Item P-153 "Controlled Low Strength Material".*

**115-2.11 CABLE TRAYS.** *Cable trays shall be of galvanized steel, or plastic, ~~or aluminum~~. Cable trays shall be located as shown on the plans.*

**115-2.12 PLASTIC CONDUIT.** *Plastic conduit shall comply with Specification Section 71 (FAA Item L-110 - Airport Underground Electrical Duct Banks and Conduits).*

**115-2.13 CONDUIT TERMINATORS.** *Conduit terminators shall be bell shaped, pre-manufactured for the specific purpose and sized as required or as shown on the plans.*

**115-2.14 PULLING-IN IRONS.** *Pulling-in irons shall be manufactured with 7/8-inch diameter hot-dipped galvanized steel or stress-relieved carbon steel roping designed for concrete applications (7 strand, 1/2-inch diameter with an ultimate strength of 270,000 psi). Where stress-relieved carbon steel roping is*



*used, a rustproof sleeve shall be installed at the hooking point and all exposed surfaces shall be encapsulated with a polyester coating to prevent corrosion.*

**115-2.15 GROUND RODS.** *Ground rods shall be one piece, copper. The ground rods shall be 10-feet long and no less than 5/8 inch (15 mm) 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 Owner.*

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

*All excavation shall be unclassified and shall be considered incidental to the respective L-115 pay item of which it is a component part. Dewatering necessary for L-115 structure installation, erosion and turbidity control, in accordance with Federal, State, and Local requirements is incidental to its respective pay item as a part of Item L-115. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L-115 Item.*

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

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

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



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

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

**115-3.2 CONCRETE STRUCTURES.** *Concrete structures shall be built on prepared foundations conforming to the dimensions and form indicated on the plans. The concrete and construction methods shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the Engineer before the concrete is placed.*

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

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

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

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

*Pulling-in irons shall be located opposite all conduit entrances into structures to provide a strong, convenient attachment for pulling-in blocks when installing*



cables. Pulling-in irons shall be set directly into the concrete walls of the structure.

**115-3.5 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 six (6) inches of material is placed above the top of the structure and before any bracing is removed. Voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

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

**115-3.7 BACKFILLING.** After a structure has been completed, the area around it shall be backfilled in horizontal layers not to exceed 6 inches in thickness measured after compaction to the density requirements in ~~Item P-152~~ [Section 23 Earthwork](#). 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 permission is given by the Engineer. In the case of concrete, such permission shall not be given until tests made by the laboratory under supervision of the Engineer establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

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

**115-3.8 CONNECTION OF DUCT BANKS.** To relieve stress of joint between concrete-encased duct banks and structure walls, reinforcement rods





*shall be placed in the structure wall and shall be formed and tied into duct bank reinforcement at the time the duct bank is installed.*

**115-3.9 GROUNDING.** *A ground rod shall be installed in the floor of all concrete structures so that the top of rod extends 6 inches above the floor. The ground rod shall be installed within 1 foot of a corner of the concrete structure. Ground rods shall be installed prior to casting the bottom slab, or a ¾" sleeve provided in prefabricated manholes or pull boxes. Where the soil condition does not permit driving the ground rod into the earth without damage to the ground rod, the Contractor shall drill a 4-inch diameter hole into the earth to receive the ground rod. The hole around the ground rod shall be filled throughout its length, below slab, with Portland cement grout. Ground rods shall be installed in precast bottom slab of structures by drilling a hole through bottom slab and installing the ground rod. Bottom slab penetration shall be sealed watertight with Portland cement grout around the ground rod.*

*A grounding bus of 4/0 bare stranded copper shall be exothermically bonded to the ground rod and loop the concrete structure walls. The ground bus shall be a minimum of 1 foot above the floor of the structure and separate from other cables. No. 2 AWG bare copper pigtailed shall bond the grounding bus to all cable trays and other metal hardware within the concrete structure. Connections to the grounding bus shall be exothermic. 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 conforming MIL-P-21035. Surfaces shall be prepared and compound applied in accordance with manufacturer's recommendations.*

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

**115-3.11 RESTORATION.** *After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. The Contractor shall restore all disturbed areas equivalent to or better than their original condition. All sodding, grading and restoration shall be considered incidental to the respective L-115 pay item.*

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

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



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

**115-3.12 INSPECTION.** *Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the plans and this specification. Any indication of defects in materials or workmanship shall be further investigated and corrected. The earth resistance to ground of each ground rod shall not exceed 25 ohms. Each ground rod shall be tested utilizing the fall-of-potential ground impedance test as described by ANSI IEEE Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.*

**115-3.13 MANHOLE ELEVATION ADJUSTMENTS.** *The Contractor shall adjust the tops of existing manholes in areas designated in the Contract Documents to the new elevations shown. The Contractor shall be responsible for determining the exact height adjustment required to raise 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 then 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. Finally, the Contractor shall reinstall the manhole top section or ring and cover on top and check the new top elevation.*

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

**115-3.14 Duct Extension to Existing Ducts.** *Where existing concrete encased ducts are to be extended, the duct extension shall be concrete encased plastic conduit. The fittings to connect the ducts together shall be standard manufactured connectors designed and approved for the purpose. The duct extensions shall be installed according to the concrete encased duct detail and as shown on the plans.*

#### **METHOD OF MEASUREMENT**

~~*115-4.1 See Section 71-2. Electrical manholes and junction structures shall be measured by each unit completed in place and accepted. The following additional items are specifically included in each unit.*~~



~~All Required Excavation, Dewatering~~

~~Sheeting and Bracing~~

~~All Required Backfilling with On Site Materials~~

~~Restoration of All Surfaces and Finished Grading, Sodding~~

~~All Required Connections~~

~~Dewatering If Required~~

~~Temporary Cables and Connections~~

~~Ground Rod Testing~~

~~115-4.2 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 See Section 71-3. The accepted quantity of electrical manholes and junction structures 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 structure.~~

~~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 L-115-5.1 Electrical Manhole [size and type] Per Each~~

~~Item L-115-5.2 Electrical Junction Structure [size and type] Per Each~~

~~Item L-115-5.3 Existing Electrical Manhole/Junction Structure Elevation Adjustment [size and type] Per Each~~

**MATERIAL REQUIREMENTS**

- ANSI/IEEE Std 81                      IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- AC 150/5345-7                        Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
- AC 150/5345-26                        Specification for L-823 Plug and Receptacle Cable Connectors
- FED SPEC J-C-30                      Cable and Wire, Electrical Power, Fixed Installation (cancelled; replaced by AA-59544 Cable and Wire, Electrical (Power, Fixed Installation))





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.

No separate payment will be made for constructing the item under construction sequencing restrictions, including limited access or nighttime work areas.

**END OF SECTION 72**