**MICHIGAN DEPARTMENT OF TRANSPORTATION**
**BUREAU OF AERONAUTICS - STANDARD SPECIFICATION**
**Item L-110**
**Installation of Airport Underground Electrical Duct**

## DESCRIPTION

**1.1** This item shall consist of underground electrical ducts installed in accordance with this specification at the locations and in accordance with the dimensions, designs, and details shown in the plans. This item shall include the installation of all underground electrical ducts or underground conduits. It shall also include all trenching, backfilling, removal, and restoration of any paved areas, manholes, concrete encasement, mandreling installation of steel drag wires and duct markers, capping, and the testing of the installation as a completed duct system ready for installation of cables, to the satisfaction of the Engineer.

## EQUIPMENT AND MATERIALS

**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 so requested by the Engineer.

**2.2** **Bituminous Fiber Duct.** Bituminous fiber duct and fittings shall conform to the requirements of Fed. Spec. W-C-581 or W-C-575 and shall be one of the following, as specified in the proposal:

(a) Type I, for concrete encasement

(b) Type II, for direct burial

**2.3** **Asbestos Cement Duct.** Asbestos cement duct and fittings shall conform to the requirements of Fed. Spec. W-C-571 and shall be one of the following, as specified in the proposal:

(a) Type I, for concrete encasement

(b) Type II, for direct burial

**2.4** **Steel Conduit.** Steel conduit and fittings shall conform to the requirements of Fed. Spec. WW-C-581 and shall be Class 1-Rigid metal steel unless otherwise specified on the plans. If Class 2-Intermediate steel conduit is specified, it shall be encased in concrete.

**2.5** **Concrete.** Concrete shall conform to Item P-610, Structural Portland Cement Concrete, using 25 mm maximum size coarse aggregate.

**2.6** **Plastic Conduit.** Plastic conduit and fittings shall conform to the requirements of Fed. Spec. W-C-1094 and shall be one of the following, as specified in the proposal:

(a) Type I - Suitable for underground use either directly in the earth or encased in concrete.

(b) Type II - Suitable for either above ground or underground use.

**2.7** **Poly (Vinyl Chloride) (PVC).** PVC conduit and fittings shall meet the requirements of ASTM F 512 or UL 651. Any of the types listed in ASTM F 512 or UL 651 may be used for concrete encased burial. Either Type DB 60, DB 120, Schedule 40 or Schedule 80 may be used for direct burial.

## CONSTRUCTION METHODS

**3.1** **General.** The Contractor shall install underground ducts at the approximate locations indicated in the airport layout plans. The Engineer shall indicate specific locations as the work progresses. Ducts shall be of the size, material, and type indicated in the plans or specifications. Where no size is indicated in the plans or specifications, the duct shall not be less than 3 inches inside diameter. All duct lines shall be laid so as to grade toward handholes, manholes, and duct ends for drainage. 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 lines shall be graded from the center in both directions toward manholes, handholes, or duct ends. Pockets or traps where

moisture may accumulate shall be avoided.

The Contractor shall mandrel each duct. An iron-shod mandrel, not more than 1/4 inch smaller than the bore of the duct shall be pushed through each duct by means of jointed conduit rods. The mandrel shall have a leather or rubber gasket slightly larger than the duct hole.

All ducts installed shall be provided with a No. 10 gauge galvanized iron or steel drag wire for pulling the permanent wiring. Sufficient length shall be left in manholes or handholes to bend the drag wire back to prevent it from slipping back into the duct. Where spare ducts are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs, designed by the duct manufacturers, or with hardwood plugs conforming accurately to the shape of the duct and having the larger end of the plug at least 1/4-inch greater in diameter than the duct.

All ducts shall be securely fastened in place during construction and progress of the work and shall be plugged to prevent seepage of grout, water, or dirt. Any duct section having a defective joint shall not be installed.

All ducts, except Class 1-Rigid metal steel conduit and PVC Type DB 60, DB 120, Schedule 40 and Schedule 80, installed under runways, taxiways, aprons, and other paved areas shall be encased in a concrete envelope.

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

Trenches for ducts may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of road patrols or graders shall not be used to excavated the trench. The Contractor shall ascertain the types of soil or rock to be excavated before bidding. All excavation shall be unclassified.

**3.2 Ducts Encased To Concrete.** Unless otherwise shown in the plans, concrete-encased ducts shall be installed so that the top of the concrete envelope is not less than 18 inches below finished grade where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches below finished grade where installed in unpaved areas. Ducts under paved areas shall extend at least 3 feet beyond the edges of the pavement or 3 feet beyond any underdrains which may be installed alongside the paved area. Trenches for concrete-encased ducts shall be opened the complete length before concrete is laid so that if any obstructions are encountered, proper provisions can be made to avoid them. All ducts for concrete encasements shall be placed on a layer of concrete not less than 3 inches thick prior to its initial set. Where two or more ducts are encased in concrete, the Contractor shall space them not less than 1-1/2 inches apart (measured form outside wall to outside wall) using spacers applicable to the type of duct. As the duct laying progresses, concrete not less than 3 inches thick shall be placed around the sides and top of the duct bank. End bells or couplings shall be installed flush with the concrete encasement where required.

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 otherwise shown on the plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 1.5 m intervals.

When clay or soapstone ducts are specified, they shall be installed with concrete encasement as described above. Clay conduit shall be of the single-bore type. Where the self-centering socket-joint type of single clay duct is used, conduit shall be built up, tier by tier, and separated only by sufficient mortar or fine aggregate concrete to bed the ducts evenly and fill all voids between ducts. Single ducts shall be jointed together and the joints grouted with portland cement mortar. A suitable gasket (of rubber or other approved material) shall first be placed in the receptacle end of the duct, prior to the joining operation, in order to exclude all mortar from the duct.

Where the square bore butt-joint type of clay duct, single or multicell, is used, sections shall be aligned with at least four steel dowel pins and joints wrapped with duct tape 6 inches wide and lapped 6

inches. All joints in a bank of single-bore ducts shall be staggered, beginning evenly from the manhole or handhole, by means of short lengths 6, 8, 9, 12, and 15 inches long. Cement mortar shall be troweled around each and every joint. Voids in the duct bank, caused by the external shape of the corners of the conduit, shall also be filled with mortar. The joining and joints of soapstone duct shall be done in accordance with the manufacturer's recommendations.

**3.3 Ducts Without Concrete Encasement.** Trenches for single-duct lines shall not be less than 6 inches nor more than 12 inches wide, and the trench for two or more ducts installed at the same level shall be proportionately wider. Trench bottoms for ducts without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the duct along its entire length.

A layer of fine earth material, 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 soft dirt, sand or other fine fill, 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 in plans, ducts for direct burial shall be installed so that the tops of all ducts are at least 18 inches below the finished grade.

When two or more ducts are installed in the same trench without concrete encasement, they shall be spaced not less than 2 inches apart (measured form outside wall to outside wall) in a horizontal direction and not less than 6 inches apart in a vertical direction.

Trenches shall be opened the complete length before duct is installed so that if any obstructions are encountered, proper provisions can be made to avoid them.

**3.4 Duct Markers.** The location of the ends of all ducts shall be marked by a concrete slab marker 2 feet square and 4 inches thick extending approximately 1 inch above the surface. The markers shall be located above the ends of all ducts or duct banks, except where ducts terminate in a handhole, manhole, or building. The Contractor shall impress the word "DUCT" on each marker slab. He or she shall also impress on the slab the number and size of ducts beneath the marker. 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.

**3.5 Backfilling.** After concrete-encased ducts have been properly installed and the concrete has had time to set, the trench shall be backfilled in at least two layers with excavated material not larger than 4 inches in diameter and thoroughly tamped and compacted to at least the density of the surrounding undisturbed soil. If necessary to obtain the desired compaction, the backfill material shall be moistened or aerated as required.

Trenches shall not be excessively wet and shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, when 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 in accordance with instructions issued by the Engineer.

For ducts without concrete envelope, 8 inches of sand, soft earth, or other fine fill (loose measurement) shall be placed around the ducts and carefully tamped around and over them with hand tampers. The remaining trench may be filled with regular run of excavated material and thoroughly tamped as specified above.

**3.6 Restoration.** Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the trenching, storing of dirt, cable laying, pad construction, and other work shall be restored to its original condition. The restoration shall include any necessary topsoiling, fertilizing, liming, seeding, sprigging, or mulching. All such work shall be performed in accordance with the FAA Standard Turfing Specifications. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance.

## METHOD OF MEASUREMENT

**4.1** The quantity of underground duct to be paid for under this item shall be the number of linear feet of duct installed, measured in place, completed, and accepted. Separate measurement shall be made for the various types and sizes.

## BASIS OF PAYMENT

**5.1** Payment will be made at the contract unit price for each type and size of single-way or multi-way duct completed and accepted. 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, an incidentals necessary to complete this item.

Payment will be made under the nomenclature and seven digit item number specified in the plans and proposal for each type and size of single-way or multi-way duct completed and accepted.

The first three digits of any item number for work included under this specification shall be 110, i.e. 110 XXXX.

## FEDERAL SPECIFICATIONS REQUIRED

| Number | Title |
|---|---|
| W-C-571 | Conduit and Fittings, Nonmetal, rigid; (Asbestos-Cement or Fire-Clay Cement), (for Electrical Purposes) |
| W-C-575 | Conduit and Fittings; Nonmetallic, Rigid, Bituminized Fiber; Laminated Wall |
| W-C-581 | Conduit and Fittings; Nonmetallic, Rigid, (Bituminized Homogeneous Fiber) |
| W-C-1094 | Conduit and Fittings; Nonmetallic, Rigid, (Plastic) |
| WW-C-581 | Conduit, Metal, Rigid and Intermediate; and Coupling, Elbow; and Nipple, Electrical Conduit; Zinc-Coated Steel |

## OTHER SPECIFICATIONS REQUIRED

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|---|---|
| UL 651 | Schedule 40 and Schedule 80 PVC Conduit |
| ASTM F 512 | Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation |