

PART 1 GENERAL**1.1 RELATED DOCUMENTS**

- A. The requirements of the General Conditions, Supplementary Conditions and the following specification sections apply to all Work herein:
1. Section 26 00 10 - General Requirements
 2. Section 26 00 20 - Scope of Work
 3. Section 26 05 19 - Electrical Conductors - 600 Volts
 4. Section 26 05 26 - Grounding and Bonding
 5. Section 26 05 33 - Raceways and Boxes
 6. Section 26 08 13 - Testing

1.2 SUMMARY

- A. Furnish and install an underground duct system as specified herein and as required for proper distribution and protection of wire, cable and/or electrical conductors throughout the Project as indicated on the Drawings.

1.3 REFERENCE STANDARDS

- A. Each underground duct system and all components shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:
1. UL Standard 1 - Flexible Metal Electrical Conduit
 2. UL Standard 6 - Rigid Galvanized Conduit
 3. UL Standard 467 - Electrical Grounding and Bonding
 4. UL Standard 651 - Rigid Nonmetallic Electrical Conduit
 5. UL Standard 797 - Electrical Metallic Conduit
 6. UL Standard 1242 - Intermediate Metal Conduit
 7. NFPA 70 - National Electrical Code (NEC)
- B. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the General Conditions and Section 26 00 10 and shall include, but not be limited to:
1. Conduit complete with fittings, materials, connector details, etc.
 2. Installation Drawings: indicating exact routing and location of all raceway and duct, grade elevations, and batter board layout. Include information describing the proposed methods of trenching, compaction, and backfill including backfill material.
- B. The Subcontractor shall submit to the Engineer for review all manufacturers of conduit, fittings, outlets, and boxes that the Subcontractor wishes to be considered, from the acceptable manufacturers listed herein. If approved, the Subcontractor may install conduit, fittings, outlets, and boxes furnished by any manufacturer listed on the approved submittal. See Section 26 00 10 for requirements.
- C. All items or equipment listed above with asterisks (*) shall be certified by the manufacturer using Manufacturer Certification "MCA" as set forth in Section 26 00 10. See Section 16010 for certification requirements.

1.5 WARRANTY

- A. Comply with the requirements of the General Conditions and Section 26 00 10.

PART 2 PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- A. If it complies with these Specifications, conduit and fittings manufactured by one of the following manufacturers will be acceptable:
1. Rigid Nonmetallic (PVC) conduit and fittings:
 - a. Cantex
 - b. Carlon
 - c. JM Manufacturing

2.2 GENERAL

- A. The duct system shall consist of single round bore conduit for the electrical distribution system. The number and size of the duct shall be as indicated. Changes in direction of runs exceeding a total of 10° either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 10', except that manufactured bends may be used at ends of short runs of 100' or less and then only at or close to the end of the run. The long sweep bends may be made up of one or more curved or straight sections and/or combinations thereof. Manufactured bends shall have a minimum radius of 24" for 4" conduit.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. The Subcontractor shall do all trenching, excavation, concrete encasing of ducts and backfill as shown on the Drawings and as specified hereinafter for the complete underground duct system.
- B. Duct lines shall be installed so that the top of the duct lines is not less than 24" below finish grade, unless otherwise specified on the Drawings. Provide orange warning tape capable of being detected by an above grade metal detector at 12" below grade along length of duct bank.
- C. Conduit shall be thoroughly cleaned before using or laying. During construction and after the duct line is completed, the ends of the conduits shall be plugged to prevent water washing mud into the conduits. Particular care shall be taken to keep the conduits clean of concrete, dirt and any other substance during the course of construction. Where it is necessary to cut a tapered end on a piece of conduit at the site, the cut shall be made with a tool or lathe designed to cut a taper to match the taper of the particular conduit being used. After the duct line has been completed, a standard flexible mandrel not less than 12" long, having a diameter approximately 1/2" less than the inside diameter of the conduit, shall be pulled through each conduit, after which a brush with stiff bristles shall be pulled through each conduit to make certain that no particles of earth, sand or gravel have been left in the line. Pneumatic rodding may be used to draw in the lead wire. Where connection is made to an existing duct that is of different material and shape than the duct line being installed, a suitable coupling of a type recommended by the duct manufacturer shall be used. All spare ducts shall be plugged at each end after the ducts are tested and brushed.
- D. Raceways shall be spaced a minimum of 2" apart with interlocking plastic duct spacers wired securely in place on 5' centers.
- E. Rigid metallic galvanized conduit elbow as specified in Section 26 05 33 titled "Raceways and Boxes" shall be installed at locations where horizontal runs are "stubbed up" or changed to vertical runs. Provide suitable connector for transition from polyvinyl chloride electrical duct to steel.
- F. A nylon rope shall be installed in each spare duct. Approximately 2' of wire shall be folded back into the duct at each end. Spare ducts shall be plugged or sealed at each end.
- G. Installation of Duct Banks: Each single conduit of the duct bank shall be completely encased in a minimum of 2" of concrete or as indicated on the Drawings. The thickness of concrete encasement shown is the minimum thickness and may be increased to fit the actual shape of the trench. Separators or spacing block shall be made of plastic, as specified hereinbefore. Joints in the conduits shall be staggered at least 6".

Ducts shall be securely anchored with nonmetallic, nondecaying stacks or blocks to prevent movement during the placement of concrete.

- H. Installation of Couplings: All types of conduit joints shall be made up in accordance with the manufacturer's recommendations using solvent cement joint material and plastic couplings. The tapered ends or joints of PVC shall be swabbed with joint sealing compound before the coupling is applied.
- I. Concrete Work: Concrete Work shall conform to Division 3 - CONCRETE for concrete, reinforcing steel and cement finish. Duct lines shall be of monolithic construction. Where a connection is made to an existing structure, the concrete encasement shall be well bonded or doweled to the existing structure. Underground ducts shall be enclosed in a 28-day, 2500 psi, pea gravel aggregate and concrete envelope. Concrete directly encasing the ductbank shall have two (2) pounds of Sonobrite "Tile Red" per 100 pounds of cement to provide red coloring.
- J. Trench Excavation and Backfill:
1. All underground ducts shall be laid in open trench. All ducts shall be laid and pipe joints made in the presence of Architect/Engineer or Owner. No duct banks shall be backfilled until approved by the Architect/Engineer. Drawings shall be submitted for review by the Architect/Engineer. See Section 26 00 10 for Shop Drawing requirements.
 2. Ducts shall be laid and maintained at required lines and grades to comply with the Drawings with all joints centered and joints complete. Provide stakes and batter boards for locating Work at all times during construction. Batter boards shall have planned parallel pales and spaced not over 25' apart. Use twilled lines of wire for indicating lines and grades. Use suitable plummet and grade poles.
 3. The trench shall be excavated to alignment and depth as required. Trench shall be properly braced and dewatered for maximum safety. Bracing materials and dewatering equipment shall be provided by the Subcontractor, as required, subject to approval of the Architect/Engineer. The trenches shall be kept free from water at all times during installation, testing of pipe and backfilling. The Subcontractor shall provide proper facilities for discharging all pumped water into natural drainage channels. No water shall be discharged onto the street or yard without approval of the Architect/Engineer.
 4. The trench shall be at 9" outside of the duct on each side of the duct bank or as shown on the Drawings. Sides of trench shall be maintained as vertical as possible. The trench shall be excavated to a depth sufficient to provide for pipe cushions as specified hereinafter.
 5. Trench shall be excavated to even grade. If excavation is too deep or must be filled to required grade, use suitable banks and or other suitable bedding material, subject to the approval of the Architect/Engineer.
 6. Sheet pile and brace excavations wherever necessary to prevent caving. Trench width may be increased as required and piling shall be left in place until at least 1' of backfill properly compacted is in place. The Subcontractor shall properly sheet and brace all open trenches to render it secure and shall remove all such sheeting and bracing before completing the backfill. The Subcontractor shall comply with local regulation or in the absence thereof, with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc. Excavation and sheeting shall be done simultaneously. The placing of prefabricated panels after portions of excavation have been completed will not be permitted. Wherever sheeting is necessary, the width of the trench shall be widened beyond the widths stipulated to allow adequate clearance for the proper installation and inspection of the duct bank. Sheeting and bracing shall not be removed until the trench is backfilled sufficiently to protect the duct bank and prevent injurious cave in. It is understood and agreed that the quantity of excavation required to install sheeting and the installation and removal of sheeting and bracing will not be regarded as extra Work and all costs incurred for this excavation and installing sheeting shall be incidental to and included in this Subcontractor's bid proposal.
 7. Trenching may be done with trench digging machinery, unless hand digging is required to avoid damage to existing structures above or below grade. No more than 300 linear feet may be excavated at one time, unless approved by the Architect/Engineer.
 8. Upon completion of excavation and prior to the laying of the ducts, the trench bottom shall be brought up to the required elevation with bank sand. The bank sand shall be deposited in the trench and shall be compacted, leveled off and shaped to obtain a smooth compacted bed along the laying length of the duct.
 9. Duct shall be stored in a suitable location and shall be cleaned and inspected before installation in the trench.
 10. Duct shall be ends abutting and true to line and grade.
 11. Duct shall not be laid in water or when trench condition is unsuitable, except in the event of an emergency.

12. When duct bank section is complete, it shall be temporarily sealed until additional ducts are laid.
13. Trenches shall be backfilled only after concrete encased duct banks have been inspected, tested and approved by the Architect/Engineer. All backfill material shall be placed in the trench either by hand or by approved mechanical methods. The compaction of backfill material shall be done by tamping with hand tools or approved pneumatic tampers, by using vibratory compactors, by puddling or by any combination of the three. The method of compaction shall be approved by the Architect/Engineer and all compaction shall be done to the satisfaction of the Architect/Engineer. The backfill for duct banks shall be select backfill material tamped at intervals of no more than 12" depths. All material to be used as selected backfill material shall be approved by the Architect/Engineer. If in the opinion of the Architect/Engineer the excavated material does not meet the requirements of selected material, the Subcontractor shall be required to screen the material prior to its use as selected material backfill. Material shall not contain stone, rock or other material larger than six (6) inches in its largest dimension. No wood, vegetable matter or other material, which in the opinion of the Architect/Engineer is unsuitable, shall be included in the backfill. Backfill shall be brought up to finish grade as shown on the Drawings, including additional backfill required to offset settlement during consolidation.
14. When removal of unsuitable excavated material creates a shortage of backfill material, the Subcontractor shall, at no cost to the Owner, furnish material as specified in this Section in the amount required to complete backfill.
15. Submit complete installation Drawings (sealed by a registered professional engineer) and test procedures for approval of the Architect/Engineer prior to commencing any Work.

3.2 FIELD TESTING

- A. Refer to Section 26 08 13 for additional testing requirements for underground duct systems.

END OF SECTION