

SECTION 20 50 16

UNDERGROUND DUCTWORK AND STRUCTURES FOR FACILITY SERVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Reinforcement steel for ductworks
- B. Conduit
- C. Pre-cast concrete structures
- D. Sand
- E. Cast-in-place concrete ductbank and structures
- F. Frames, covers, gratings, steps and sumps
- G. Cover identification

1.02 RELATED SECTIONS

- A. Electrical conduits and raceways are specified in Section 20 50 13 - Raceways for Facility Services

1.03 MEASUREMENT AND PAYMENT

- A. General: Underground ductwork and structures, as specified herein, will not be measured separately for payment but will be paid for as part of the Contract lump sum price for the related item of work as indicated in the Bid Schedule of the Bid Form.

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM C33 Specification for Concrete Aggregates
 - 2. ASTM F512 Specification for Smooth-Wall Poly Vinyl Chloride (PVC) Conduit and Fittings for Underground Installation

1.05 REGULATORY REQUIREMENTS

- A. California Code of Regulations, Title 24, Part 3, California Electrical Code
- B. State of California Public Utilities Commission (Cal. PUC):
 - 1. Cal. PUC G.O. 128 Rules for Construction of Underground Electric Supply and Communications Systems

- C. Refer to Section 20 70 26 - Common Materials and Methods for Electrical Systems, for additional requirements.

1.06 SUBMITTALS

- A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

- B. Shop Drawings:

- 1. Submit Shop Drawings for fabrication and installation of pre-cast concrete structures, cast-in-place concrete structures, and concrete-encased underground ductwork, including the following:
 - a. Excavation and shoring plans with required structural calculations;
 - b. Cast-in-place and pre-cast detailed steel reinforcement drawings; and
 - c. Cast-in-place and pre-cast manufacturer's concrete mix designs for structures and colored concrete as indicated.
- 2. Shop drawing information may be combined on a single drawing if clarity is not thereby impaired.
- 3. Shop Drawings shall fully demonstrate that the work to be performed and the materials to be provided comply with the provisions of these Specifications.

- C. Product Data: Submit the following:

- 1. Complete materials list of items proposed to be furnished and installed under this Section.
- 2. Manufacturers' specifications and other data required to demonstrate compliance with these Specifications.
- 3. Catalog cuts for the following products:
 - a. Conduits.
 - b. Underground duct system, including manholes, pull boxes, handholes, cable junction boxes, and termination boxes.
 - c. Manhole, pull box, and handhole covers and frames.
 - d. Related miscellaneous hardware and metal items for cable trenches and wireways.
 - e. Trench and wireway covers including composition of FRP materials, divider partition panels, method of joining sections, expansion joint mounting, and support details.

- D. Certificates of Compliance: Provide for all specified products.

1.07 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the California Electrical Code, and Cal. PUC General Order No. 128. In case of conflict between the California Electrical Code and Cal. PUC G.O. 128, the provisions of Cal. PUC G.O. No. 128 shall govern.
- B. Qualification of Manufacturers:
 - 1. Manufacturers of the products specified for work under this Section shall be in the business of manufacturing similar products and shall be able to provide a history of successful production of the specified products.
 - 2. Submit a list of five major projects, where similar products have been supplied, which have been in satisfactory use or operation for the past five years.
- C. Notifications and Inspection: Completed facilities shall be approved by the Engineer before installation of cable and equipment. Corrective work required to obtain approval of underground construction and ductwork shall be performed at no additional cost to the District.

1.08 SITE CONDITIONS

- A. Before beginning construction or installation of a section of underground conduit or ductwork, verify that the site is in suitable condition for installing such conduit or ductwork as indicated.
- B. During non-work hours and at locations where installation of conduits and ducts is temporarily suspended or terminated, close ends of ducts with caps or plugs fitted to prevent entry of water or debris. Use caps or plugs designed for that purpose by the conduit manufacturer.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Reinforcement Steel for Ductbanks:
 - 1. Provide longitudinal reinforcing steel with a minimum total cross sectional area of 0.0018 times the gross area of the ductbank. Maximum spacing of reinforcement bars shall be 18 inches; minimum of one bar in each corner of ductbank.
 - 2. Provide steel tie bars in the transverse direction enclosing the longitudinal bars; minimum size of No. 3 bars; minimum spacing of 12 inches. Minimum clear concrete cover over reinforcement steel shall be 3 inches where concrete is cast directly against earth, and 1.5 inches where concrete is cast directly against formwork.
 - 3. Where ductbank enters rigid underground structures, provide reinforcing steel to tie the ductbank to the structure. Provide details indicating method employed to prevent differential settlement from damaging ductbanks.
- B. Conduit: Conform with ASTM F512. Provide PVC conduit, minimum Schedule 40, and all necessary fittings in sizes as indicated. Provide flared bell ends on conduits and ducts entering manholes, handholes, and pull boxes.

- C. Pre-cast Concrete: Provide pre-cast concrete structures in accordance with requirements of Section 33 05 16 - Utility Structures, and as indicated.
 - 1. Pre-cast concrete electrical boxes, pull boxes, ground rod boxes, manholes, handholes, and vaults shall be provided as indicated. Concrete reinforcement shall be that which is regularly provided in standard products of the manufacturer. Standard manufactured structures that meet project requirements will be acceptable. Provide concrete inserts for mounting cable support brackets as indicated.
 - 2. Pull box tops shall be flush with sidewalks or curbs or placed 1-1/2 inches above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be provided with two lifting eyes and two hold-down bolts. Each box shall have a suitable opening for a ground rod, and a drainage opening.
- D. Sand: Sand for filler material, where indicated, and for bedding of conduit in utility trenches shall be a clean and graded, washed sand, all passing a No. 4 U.S. sieve, and conforming generally to ASTM C33 for fine aggregate.
- E. Cast-In-Place Concrete for Ductbank Encasements, Manholes, Pull Boxes, and Vaults:
 - 1. Concrete shall be Class 3000 in accordance with Section 03 05 15 - Portland Cement Concrete, for ductbank encasements, manholes, pull boxes, and vaults. Concrete for ductbank encasements for conduits carrying circuits rated above 600 volts shall be colored red as specified in Section 03 05 15 - Portland Cement Concrete.
 - 2. Formwork and concrete placement shall conform with applicable requirements of Section 03 11 00 - Concrete Forming, and Section 03 30 00 - Cast-in-Place Concrete.
 - 3. Reinforcing steel, as indicated, shall conform with applicable requirements of Section 03 20 00 - Concrete Reinforcing.
- F. Frames, Covers, Gratings, Steps and Sumps: Provide as indicated and in accordance with Section 33 05 16 - Utility Structures.
- G. Yellow Warning Tape: Poly Thlene Heavy Gauge 4 mil thick tape with "Buried Electrical Line Below."
- H. Cover Identification: Provide covers with embossed or engraved identification as indicated and as specified in Section 33 05 16 - Utility Structures.

PART 3 - EXECUTION

3.01 EXCAVATION, TRENCHING AND BACKFILLING

- A. Perform excavation, bedding, and backfilling for underground conduits and structures in accordance with Section 33 05 28 - Trenching and Backfilling for Utilities, and as indicated.

3.02 INSTALLATION

- A. Underground Duct System: Install as indicated. Conduit, pull boxes, and manholes shall be located as indicated. Comply with applicable requirements of Cal. PUC G.O. 128.
- B. Ducts:
 - 1. Inspect ducts and couplings to ensure that only clean and undamaged pieces are incorporated in the work.
 - 2. Ductbanks or conduits shall interface with building construction 5 feet outside of the building and shall have a minimum slope of 3 inches to each 100 feet away from buildings and towards manholes, pull boxes, and handholes, and shall run in straight lines between indicated changes in direction.
 - 3. Individual conduits that are grouped together to form a ductbank shall conform to the standards and requirements specified herein.
 - 4. Horizontal or vertical changes in direction exceeding ten degrees shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet, except that manufactured bends may be used at ends of short runs of 100 feet or less, and then only at or within 5 feet of the end of the run. Sweep bends may be made up of curved or straight sections, or combinations thereof. Manufactured bends shall have a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.
 - 5. Conduits shall terminate in end-bells where duct lines enter vaults.
 - 6. Spacers or space separators shall be placed not more than 6 feet apart, and shall transmit no vertical load to the conduit.
 - 7. Install ducts, joints, and space separators according to manufacturer's printed instructions and recommendations.
 - 8. During construction, partially completed duct lines shall be protected from the entrance of debris by means of suitable caps or plugs. As each section of a duct line is completed between manholes, handholes, or pull boxes, a testing mandrel not more than 1/4 inch less than the size of the conduit shall be drawn through each conduit, after which a brush with stiff bristles shall be drawn through until the conduit is clear of particles of earth, sand, or gravel. Conduit caps or plugs shall then be immediately installed.
 - 9. Construct the concrete-encased ductbank with 3 inch minimum cover on all sides. The concrete used for the ductbank containing circuits over 600 volts shall be integrally colored with a red mineral coloring pigment as specified in Section 03 05 15 - Portland Cement Concrete.
 - 10. Install 1/8 inch or larger diameter polypropylene pulling cord in ducts including innerducts. Fasten each cord to pull iron anchorage in pull box, manhole, or vault with 2 feet minimum slack.

11. Innerduct placement in communications conduits shall be performed to avoid excessive tension and deformation of the innerduct. Damaged or necked down innerduct shall be replaced. Conform with the manufacturer's installation instructions.
 12. Provide metallic numbering tags indicating the conduit number on both ends of all conduit runs.
- C. Yellow Warning Tape: Tape shall be installed six inches above the top of concrete ductbank and the vertical center line of its cross section
- D. Pre-cast Concrete Structures: Install pre-cast electrical boxes, pull boxes, handholes, manholes, and vaults as indicated. Boxes shall be placed on 4 inches of compacted sand bedding. Manholes shall be placed on 6 inches of compacted aggregate base as specified in Section 32 11 24 - Aggregate Drainage Layer. Conduit, cable, ground rod entrances, and unused openings shall be sealed with cement mortar.
- E. Cast-In-Place Concrete Structures:
1. The location of each pull box, manhole, and vault shall be approved by the Engineer before construction of such structure is started. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction.
 2. Place concrete for pull boxes, manholes, and vaults on well-compacted soil with a minimum of 6 inches of aggregate base as specified in Section 32 11 24 - Aggregate Drainage Layer. Seal all sumps. Frames and covers shall be of gray cast iron. A machine-finished seat shall be provided to ensure a matching joint between the frame and cover.
 3. Where duct lines enter pull boxes, manholes, and vaults, the sections of duct may be either cast in the concrete or may enter through a square or rectangular opening of suitable dimensions provided in the utility structure. A cable-pulling iron anchorage shall be installed in the wall opposite each ductbank entrance.

END OF SECTION 20 50 16