

SECTION 02500

UNDERGROUND DUCTWORK AND STRUCTURES

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Section includes requirements for conduits, precast concrete structures, cast-in-place concrete ductbank and structures, including frames, covers, gratings, steps and sumps, and cover identification.

1.02 REFERENCE STANDARDS

- A. American Society of Testing and Materials (ASTM International):
 - 1. A48 Specification for Gray Iron Castings
 - 2. A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 3. A536 Specifications for Ductile Iron Castings
 - 4. B26/B26M Specification for Aluminum-Alloy Sand Castings
 - 5. C33 Specification for Concrete Aggregates
 - 6. F512 Specification for Smooth-Wall Poly Vinyl Chloride (PVC) Conduit and Fittings for Underground Installation
- B. California Code of Regulations:
 - 1. Title 24, Part 3 State Electrical Code
- C. State of California Public Utilities Commission (CPUC) General Orders (GO):
 - 1. 128 Rules for Construction of Underground Electric Supply and Communications Systems

1.03 SUBMITTALS

- A. Submit shop drawings for fabrication and installation of precast concrete structures, cast-in-place concrete structures, and concrete-encased underground ductwork, including the following:
 - 1. Cast-in-place and precast detailed steel reinforcement drawings; and precast manufacturer's concrete mix designs for structures and colored concrete as indicated.
- B. Submit product data including 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, duct spacers, 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.
- C. Submit concrete mix designs for cast-in-place concrete under Section 03300, Cast-in-Place Concrete. Submit concrete sample showing proposed concrete color for approval.
- D. Qualifications: Submit manufacturers' qualifications.
- E. Submit certificates of compliance for all specified products.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the State Electrical Code, and CPUC General Order No. 128. In case of conflict between the State Electrical Code and CPUC G.O. 128, the provisions of CPUC 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.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Conduit and Pull Cord: Provide PVC conduit, minimum Schedule 40, and all necessary fittings, in sizes as indicated, and pull cord as specified in Section 16130, Conduit and Fittings. Provide flared bell ends on conduits and ducts entering manholes, handholes, and pull boxes.

- B. Precast Concrete: Provide precast concrete structures in accordance with requirements as indicated in this Section.
 - 1. Precast 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. Provide covers with two lifting eyes and two hold-down bolts. Each box shall have a suitable opening for a ground rod, and a drainage opening.
- C. Sand: Sand for filler material, where indicated, and for bedding of conduit shall be bedding material specified in Section 02300, Earthwork.
- D. Aggregate Base: As specified in Section 02310, Aggregate Base Courses.
- E. Cast-In-Place Concrete for Ductbank Encasements, Manholes, Pull Boxes, and Vaults:
 - 1. Concrete shall be Class 3000 in accordance with Section 03300, Cast-in-Place Concrete, for ductbank encasements, manholes, pull boxes, and vaults. Concrete for ductbank encasements shall be colored with a red mineral coloring pigment as specified in Section 03160, Colored Concrete. Color: Red.
 - 2. Formwork and concrete placement shall conform with applicable requirements of Section 03100, Concrete Forming, and Section 03300, Cast-in-Place Concrete.
 - 3. Reinforcing steel, as indicated, shall conform with applicable requirements of Section 03200, Concrete Reinforcing.

2.02 FRAMES, COVERS, STEPS, AND SUMPS

- A. Ferrous Castings:
 - 1. Metal used in manufacture of castings shall conform to ASTM A48, Class 35B for Gray Iron, or ASTM A536, Grade 65-45-12 for Ductile Iron.
 - 2. Castings shall be of uniform quality, free from blowholes, shrinkage, distortion or other defects. Castings shall be smooth and cleaned by shotblasting.
 - 3. Minimum tensile strength shall be 35,000 psi.
 - 4. Castings shall be manufactured true to pattern; component parts shall fit together in a satisfactory manner. Round frames and covers shall have continuously machined bearing surfaces to prevent rocking and rattling.
 - 5. Where castings will be subjected to loads of H20 or greater, provide ductile iron castings.

- B. Aluminum Castings: Where required to reduce weights of larger covers for ease of handling, such covers may be manufactured of aluminum castings conforming to ASTM B26/B26M, Alloy No. 713.0. Minimum tensile strength shall be 32,000 psi.
- C. Manhole Covers: Provide cast, manufactured manhole covers and frames with heavy-duty solid cover (lid) or vented cover (lid). Covers shall be embossed or engraved with nonslip diamond or square cross-hatched pattern.
 - 1. Provide metal covers with embossed or engraved word identification for the enclosed or underground utility.
- D. Precast Covers: Precast covers shall have the utility identification stamped into the cover.
- E. Cast Iron Manhole Steps: Provide cast, manufactured manhole steps with cross-hatched treads and with anchor configuration appropriate for cast-in-place concrete or precast concrete. Provide steps for installation 12 inches on center in vertical alignment.
- F. Ladders: Provide standard-manufactured or custom-fabricated steel ladders as required to meet the conditions indicated. Steel ladders shall be hot-dip galvanized after fabrication.
- G. Galvanizing: All ferrous metal items shall be galvanized after fabrication by the hot-dip process in accordance with ASTM A123. Weight of the zinc coating shall conform with the requirements specified under "Weight of Coating" in ASTM A123.

2.03 REINFORCED PLASTIC MORTAR SPACERS (RPM)

- A. Duct spacers shall be made from high density polyethylene (not less than 0.96 specific gravity), as manufactured by Formex Manufacturing, Inc., Underground Devices Inc. make, or equal.
- B. Duct Spacers:
 - 1. Duct spacers shall be double wall construction. Spacers shall consist of interlocking modules, i.e. bases, intermediates, and caps, designed to provide independent support for each duct.
 - 2. When spacer modules are locked together, openings shall provide approximately 1/16 inch clearance over the outside diameter of the duct. The interior surface of the duct spacer opening shall be convex to prevent kinking of the duct.
 - 3. Configure spacer module openings to ensure the horizontal and vertical separations for each duct as indicated on the Contract Drawings.

PART 3 – EXECUTION

3.01 VERIFICATION

- 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.

3.02 EXAMINATION AND EXCAVATION, TRENCHING AND BACKFILLING

- A. Perform excavation, bedding, and backfilling for underground conduits and structures in accordance with Section 02300, Earthwork, or as indicated.

3.03 INSTALLATION

- A. Underground Duct System: Locate duct system, conduit, pull boxes, and manholes as indicated on the Contract Drawings. Comply with applicable requirements of CPUC GO 128.
- B. Ductbank Reinforcing Detail:
 - 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 1-1/2 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.
- C. Ducts:
 - 1. Inspect ducts and couplings to ensure that only clean and undamaged pieces are incorporated in the work.
 - 2. Ductbanks or conduits 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. Accomplish horizontal or vertical changes in direction exceeding ten degrees 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. Terminate conduits in end-bells where duct lines enter vaults.
 6. Place spacers or space separators not more than 6 feet apart.
 7. Install ducts, joints, and space separators according to manufacturer's printed instructions and recommendations.
 8. 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.
 9. During construction, protect partially completed duct lines 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, draw a mandrel through each conduit as specified in Section 16130, Conduits and Fittings, after which draw a brush with stiff bristles through until the conduit is clear of particles of earth, sand, or gravel. Immediately install conduit caps or plugs.
 10. Construct the concrete-encased ductbank with 3 inch minimum cover on all sides.
 11. Install 1/8 inch or larger diameter pulling cord in ducts including inner ducts. Fasten each cord to pull iron anchorage in pull box, manhole, or vault with 2 feet minimum slack.
 12. Place innerduct in communications conduits avoiding excessive tension and deformation of the innerduct. Replace damaged or necked down innerduct. Conform to the manufacturer's installation instructions.
 13. Provide metallic numbering tags indicating the conduit number on both ends of all conduit runs.
- D. Concrete Structures, General: Install pull box tops flush with sidewalks or curbs. Install 1-1/2 inches above surrounding grades when remote from curbed roadways or sidewalks.
- E. Precast Concrete Structures: Install precast electrical boxes, pull boxes, handholes, manholes, and vaults as indicated. Place boxes on 4 inches of compacted sand bedding. Place manholes on 6 inches of compacted aggregate base. Seal conduit, cable, ground rod entrances, and unused openings with cement mortar.
- F. Cast-In-Place Concrete Structures:
1. Obtain Engineer's approval of the location of each pull box, manhole, and vault before construction of such structure is started. Construct top,

walls, and bottom of reinforced concrete. Construct walls and bottom of monolithic concrete.

2. Place concrete for pull boxes, manholes, and vaults on well-compacted soil with a minimum of 6 inches of aggregate base. Seal all sumps.
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. Install cable-pulling iron anchorage in the wall opposite each ductbank entrance.

3.04 REINFORCED PLASTIC MORTAR SPACERS (RPM)

- A. Use base pads to ensure specified dimensions between trench floor and bottom of first tier of ducts. Assemble and anchor ducts and duct spacers using reinforcing bars or trench jack and adjusting wedges in accordance with duct spacer manufacturer's written instructions. Ensure that duct spacing is maintained and that ducts do not float as a result of concrete pour.
- B. For each 20 feet length of duct, provide a minimum of four spacer locations. Place duct spacers not more than six feet apart; transmit no vertical load to conduit.
- C. For bore spacers where ductwork is installed in casings, refer to Section 16130, Conduits and Fittings.

3.05 FIELD QUALITY CONTROL

- A. Notify the Engineer for inspection and sign-off of the following installations:
 1. Completed underground installations: Obtain the Engineer's inspection and acceptance before installation of cable and equipment.
- B. Perform corrective work required to obtain approval of underground construction and ductwork.

END OF SECTION