

## **SECTION 26 05 43 – UNDERGROUND DUCTS AND RACEWAYS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Metal conduits and fittings, including GRC.
  - 2. Rigid nonmetallic duct.
  - 3. Duct accessories.
  - 4. Precast concrete handholes.
  - 5. Utility structure accessories.

#### **1.3 DEFINITIONS**

- A. Duct: Single duct or multiple ducts. Duct may be either installed singly or as component of duct bank.
- B. Duct Bank:
  - 1. Two or more ducts installed in parallel, with or without additional casing materials.
  - 2. Multiple duct banks.
- C. GRC: Galvanized rigid (steel) conduit.
- D. Trafficways: Locations where vehicular or pedestrian traffic is normal course of events.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include duct-bank materials, including spacers and miscellaneous components.
  - 2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  - 3. Include accessories for handholes and boxes.
  - 4. Include underground-line warning tape.
- B. Shop Drawings:
  - 1. Precast or Factory-Fabricated Underground Utility Structures:

- a. Include plans, elevations, sections, details, attachments to other work, and accessories.
- b. Include duct entry provisions, including locations and duct sizes.
- c. Include reinforcement details.
- d. Include grounding details.
- e. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
- f. Include joint details.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C858.
- B. Source quality-control reports.
- C. Field quality-control reports.

#### **1.6 MAINTENANCE MATERIALS SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Furnish cable-support arms and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

#### **1.7 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Qualified per ASTM E329 for testing indicated.

#### **1.8 FIELD CONDITIONS**

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under following conditions, and then only after arranging to provide temporary electrical service per requirements indicated:
  - 1. Notify Construction Manager and Owner no fewer than 14 days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Construction Manager's and Owner's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless lower water table is noted on Drawings.

## **PART 2 - PRODUCTS**

### **2.1 METAL CONDUIT AND FITTINGS**

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. Listed and labeled as defined in NFPA 70, by nationally recognized testing laboratory, and marked for intended location and application.

### **2.2 RIGID NONMETALLIC DUCT**

- A. Underground Plastic Utilities Duct: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Listed and labeled as defined in NFPA 70, by nationally recognized testing laboratory, and marked for intended location and application.
- C. Solvents and Adhesives: As recommended by conduit manufacturer.

### **2.3 DUCT ACCESSORIES**

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification."

### **2.4 PRECAST CONCRETE HANDHOLES AND BOXES**

- A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
- B. Comply with ASTM C858 for design and manufacturing processes.
- C. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- D. Cover Finish: Nonskid finish shall have minimum coefficient of friction of 0.50.
- E. Cover Legend: Molded lettering, "ELECTRIC."
- F. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- G. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
  - 1. Extension shall provide increased depth of 12 inches.
  - 2. Slab: Same dimensions as bottom of enclosure and arranged to provide closure.

- H. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at installation location with ground-water level at grade.
- I. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus additional 12 inches vertically and horizontally to accommodate alignment variations.
  - 1. Splayed location.
  - 2. Knockout panels shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
  - 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie into concrete envelopes of duct.
  - 4. Knockout panels shall be framed with at least 2 additional No. 3 steel reinforcing bars in concrete around each opening.
  - 5. Knockout panels shall be 1-1/2 to 2 inches thick.
- J. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

## **2.5 UTILITY STRUCTURE ACCESSORIES**

- A. Accessories for Utility Structures: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application.
- B. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-diameter eye, and one-by-4-inch bolt.
  - 1. Working Load Embedded in 6-inch, 4000-psi Concrete: 13,000-pound-foot minimum tension.
- C. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
  - 1. Tested Ultimate Pullout Strength: 12,000-pound-foot minimum.
- D. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 degrees F. Capable of withstanding temperature of 300 degrees F without slump and adhering to clean surfaces of plastic ducts, metallic conduit, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- E. Cover Hooks: Heavy duty, designed for lifts 60-pound-foot and greater. Two required.

## **2.6 SOURCE QUALITY CONTROL**

- A. Test and inspect precast concrete utility structures per ASTM C1037.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Coordinate layout and installation of duct, duct bank, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Architect if there is conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed and protect vegetation to remain per Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication per Section 311000 "Site Clearing."

### **3.2 UNDERGROUND DUCT APPLICATION**

- A. Duct for Electrical Cables More Than 600V and for Electrical Feeders and Branch Circuits 600V and Less: Type EPC-40-PVC RNC, concrete-encased unless otherwise indicated.
- B. Stub-ups: Concrete-encased RNC.

### **3.3 UNDERGROUND ENCLOSURE APPLICATION**

- A. Handholes and Boxes for 600V and Less:
  - 1. Units in Roadways and Other Deliberate Traffic Paths and in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
  - 2. Units in Sidewalk and Similar Applications with Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
  - 3. Cover design load shall not exceed design load of handhole or box.

### **3.4 EARTHWORK**

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."

- E. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures per "Cutting and Patching" Article in Section 017300 "Execution."

### **3.5 DUCT AND DUCT-BANK INSTALLATION**

- A. Where indicated on Drawings, install duct, spacers, and accessories into duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct per NEMA TCB 2.
- C. Slope: Pitch duct minimum slope of 1:300 down toward handholes and away from buildings and equipment.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
  - 1. Duct shall have maximum of three 90-degree bends or total of bends shall be no more 270 degrees between pull points.
- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight per manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- F. Terminator Entrances to Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches on center for 4-inch duct and vary proportionately for other duct sizes.
  - 1. Begin change from regular spacing to terminator spacing 10 feet from terminator, without reducing duct line slope and without forming trap in line.
  - 2. Expansion and Deflection Fittings: Install expansion and deflection fitting in each duct in area of disturbed earth adjacent to handhole. Install expansion fitting near center of straight-line duct with calculated expansion of more than 3/4-inch.
- G. Building Wall Penetrations: Make transition from underground duct to GRC at least 10 feet outside building wall, without reducing duct line slope away from building and without forming trap in line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Raceways and Cabling."
- H. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- I. Pulling Cord: Install 200-pound-foot-test nylon cord in empty ducts.
- J. Concrete-Encased Ducts and Duct Bank:
  - 1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches in nominal diameter.
  - 2. Width: Excavate trench 12 inches wider than duct on each side.

3. Depth: Install so top of duct envelope is at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
  4. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  5. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than 5 spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  6. Minimum Space between Duct: 3 inches between edge of duct and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and communications ducts.
  7. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
  8. Reinforcement: Reinforce concrete-encased duct. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  9. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
  10. Concrete Cover: Install minimum of 3 inches of concrete cover between edge of duct to exterior envelope wall, 2 inches between duct of like services, and 4 inches between power and communications ducts.
  11. Concreting Sequence: Pour each run of envelope between terminations in one continuous operation.
    - a. Start at one end and finish at other, allowing for expansion and contraction of duct as its temperature changes during and after pour. Use expansion fittings installed per manufacturer's written instructions or use other specific measures to prevent expansion-contraction damage.
    - b. If more than one pour is necessary, terminate each pour in vertical plane and install 3/4-inch reinforcing-rod dowels extending minimum of 18 inches into concrete on both sides of joint near corners of envelope.
  12. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise in middle, uniformly filling open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.
  13. Concrete Color: Red dye added during batching.
- K. Underground-Line Warning Tape: Bury conducting underground line specified in Section 260553 "Identification" no less than 12 inches above concrete-encased duct and duct banks and approximately 12 inches below grade. Align tape parallel to and within 3 inches of centerline of duct bank. Provide additional warning tape for each 12-inch increment of duct bank width over nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

### **3.6 INSTALLATION OF CONCRETE HANDHOLES AND BOXES**

- A. Precast Concrete Handhole Installation:
  - 1. Comply with ASTM C891 unless otherwise indicated.
  - 2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
  - 3. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from one-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- B. Elevations:
  - 1. Install handholes with bottom below frost line.
  - 2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes one inch above finished grade.
  - 3. Where indicated, cast handhole cover frame integrally with handhole structure.
- C. Waterproofing: Apply waterproofing to exterior surfaces of handholes after concrete has cured at least 3 days. Waterproofing materials and installation are specified in Section 071353 "Elastomeric Sheet Waterproofing." After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars.
- D. Hardware: Install removable hardware, including pulling eyes, and cable arms as required for installation and support of cables and conductors and as indicated.
- E. Field-Installed Bolting Anchors in Concrete Handholes: Do not drill deeper than 2 inches for anchor bolts installed in field. Use minimum of 2 anchors for each cable stanchion.

### **3.7 GROUNDING**

- A. Ground underground ducts and utility structures per Section 260526 "Grounding and Bonding."

### **3.8 FIELD QUALITY CONTROL**

- A. Perform following tests and inspections:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
  - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum 12-inch-long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
  - 3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.



### **3.9      CLEANING**

- A.    Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

### **END OF SECTION**