

SECTION 337119 – ELECTRICAL UNDERGROUND DUCTS AND MANHOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. This Section specifies the underground electrical and communication utility duct bank systems for buildings and structures.
2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein for a complete operating system.
3. The Contractor shall furnish and install complete underground electrical and communication duct bank system with all necessary components for a complete system.

- B. Related Sections:

1. Applicable sections of Division 26 - Electrical

1.3 SUBMITTALS

- A. Shop Drawings

1. Duct bank conduit
2. Manholes and all hardware and components

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70, “National Electrical Code”
- C. The underground electrical and communication duct bank shall be in accordance with ANSI C2 National Electrical Safety Code and NFPA 70 National Electrical Code.

D. Guarantee

1. Furnish full parts and labor warranty to cover the duct bank and manhole system for one year from date of installation.

1.5 DESIGN REQUIREMENTS

In general, four 5" plastic feeder ducts are required for each building for electrical and four 5" plastic feeder ducts are required for communications. These feeder ducts should have no pull boxes or short radius bends. All bends shall be designed as long radius sweeps. The electrical ducts shall terminate in the transformer vault. The communication ducts shall terminate, two in the Broadband Utility Room and two in the Telephone Utility Room. The communication duct should not pass through the transformer vault.

Electric and communication manholes shall be constructed of reinforced concrete with sufficient interior space for all cable ways, pulling equipment, and work space. Electric and communication manholes are generally constructed in pairs with a common sump. Tops of manholes will be pitched 1/4"/ft. to the side to allow ground water to drain off. Floors will be pitched 1/8"/ft. to drain. Sizes of manholes will generally be as shown on the standard drawings in Division 17. If precast concrete manholes are used, the next larger size over the sizes shown in Division 17 shall be used.

Manhole openings will be centered in the ceiling of each manhole.

See Standard Drawings for construction details. The applicable details shall be included in the construction documents.

- A. In general, the electrical and communication underground duct bank system is composed of concrete encased conduit terminating at electrical and communication manholes. The duct bank shall be as straight as possible between manholes with the elevation varying to create a slope toward the manholes to drain any water that may enter the duct bank.

PART 2 - PRODUCTS

2.1 ELECTRICAL AND COMMUNICATION MANHOLES

A. Manholes

1. Manholes shall be either reinforced precast concrete or cast-in-place concrete.
2. Manhole walls, base and roof shall all have a minimum thickness of 6". Reinforcement will be Grade 60 rebar conforming to ASTM A706 and rebar cage shall be designed to meet AASHTO HS-20 loading conditions.
3. Reinforced precast concrete manholes shall be in accordance with the standard manhole details as shown. Concrete shall be mixed to produce a 28-day minimum compressive strength of 4500 psi. Manholes shall be transported in such a manner so as to prevent

cracking, chipping, or other damage. Manholes shall be installed under the manufacturer's supervision or by installers having a minimum of five years of experience installing this manufacturer's manholes. They shall be assembled in accordance with manufacturer's recommendations.

4. Reinforced precast concrete manholes shall have integral floor-to-wall construction and integral roof-to-wall construction. The two-piece precast concrete manholes joints shall be sealed with two rows of 1" butyl rope mastic per manufacturer's instructions.
5. Manholes shall be manufactured by Advance Concrete Products Co. or approved equal.
6. Cast-in-place manholes shall be constructed in accordance with the standard manhole detail as shown. Concrete shall be ready-mixed conforming to the standard specifications for ready-mixed concrete ASTM C-94 and mixed to produce a 28-day minimum compressive strength of 3000 psi.
7. In general, electric manholes shall have interior dimensions of 10 feet long x 8 feet wide x 7 feet tall. Communication manholes shall have interior dimensions of 8 feet long x 6 feet wide x 7 feet tall. Openings for duct shall be beveled.
8. Manholes shall have a 30" diameter clear opening. Manhole covers shall be heavy duty type with machined bearing surfaces and shall be lettered with words "ELECTRIC" or "COMMUNICATION". Covers shall have 1" diameter pick holes a minimum of three inches in from outside edge of cover. Ring and cover shall be Neenah No. R-1640-C or East Jordan Iron Works no. 1825 heavy duty cast iron frame and no. 1810 cover.
9. Manhole ring will set on two courses of brick or equivalent in precast concrete rings to allow for future grade adjustments.
10. Covers on electric and communication manholes will be secured by the Owner, only as required.
11. Beveled duct terminators shall be cast in the walls for conduit. Knockout windows or clear windows shall be provided as specified or shown on drawings for future conduit.

B. Cable Racks

1. Cable racks shall be installed in all manholes to properly support cables.
2. 1/2 inch threaded inserts shall be cast-in walls for cable rack connections with a horizontal spacing no greater than 24 inches on-center.
3. Concrete inserts for cable rack bolts will be hot-dipped galvanized.
4. In existing manholes plated steel expansion shield equal to "Phillips," or "A & J" may be used in lieu of inserts.
5. Manhole hardware shall be hot-dipped galvanized manufactured by Inwesco or approved equal. Cable racks shall #10A22, corner brackets shall be #10A50, sidewall brackets

shall be #10A40, and cable support arms shall be #10A37 (10 inch long). Provide a 3I-3600 series 8 foot hooked ladder for each manhole.

C. Pull-in Irons

1. Each wall of each manhole will have at least one 1" hot-dipped galvanized pull-in iron. A pull-in iron shall be installed directly across from each set of duct bank terminators, and new and future duct bank openings. Pull-in irons will be by Advance Concrete or approved equal.

D. Ground Rods

1. All electric and communication manholes shall have a minimum of two (2) 5/8" x 8'0" copper-clad steel ground rods, installed outside and adjacent to the manhole, one each where the duct banks enter the manholes. The top of the ground rods shall be at the same elevation as the duct banks.
2. A 4/0 THW ground cable shall be connected to each ground rod and brought into the manhole along with the ground cable from the adjacent duct bank.
3. Inside the manholes, all the ground cables shall be connected together along with the ground cables in the adjacent manhole (when an Electrical and Communication manhole are installed adjacent to each other) with a 4/0 THW ground cable.
4. Ground cables shall be neatly trained vertical and horizontal, and clamped to the manhole walls.
5. All connections shall be made using the exothermic weld method or the Burndy Hyground compression method.

E. Waterproofing

1. All cast-in-place manholes will be waterproofed with a modified asphalt membrane waterproofing or Bituthene waterproofing. Acceptable Products and Manufacturers: Bituthene by Grace Construction Products Division, Polyguard No. 650 by Polyguard Products, Inc.
2. All precast manholes shall be waterproofed with factory applied exterior waterproofing membrane on the top, bottom, and all four sides.
3. All cast-in-place and precast manholes shall have fanfold DOW Protection Board III applied over the waterproofing to protect the waterproof membrane during backfill.
4. All joints where the duct enters manholes shall have Durajoint PVC, Type 4 waterstop or equal. Waterstop shall be continuous, all joints shall be welded together as recommended by the manufacturer.

F. Drainage

1. All manholes will have foundation drains covered with peastone. Drains will connect to a sump at each manhole or pair of manholes. Sumps will have gravity drain to the storm sewer as shown. Sumps will be centered under the manhole opening above to be accessible for maintenance, and covered with a grating to serve as a floor drain.
2. Foundation tile will be 4" corrugated polyethylene with drainage slits, ADS, Inc. or equal. Drain pipe from any extra floor drains and from sump to catch basins, shall be vitrified clay. (See Section 02630 Storm Drainage).
3. Manholes With Sump Pits
 - a. Manholes with sump pits shall have PVC or cast iron, equal to James B Clow & Sons, Inc., No. F-4216 with No. F4230 extension as required.
 - b. The sump pit shall be located in the center of the manhole floor.
 - c. Slope the floor to the sump pit.
4. Manholes With Floor Drains
 - a. Electric/communication manholes shall be provided with floor drains as shown. Manholes with drains shall be provided with Wade no. W-1744-SO floor drain or approved equal, side outlet pipe size 4 inch, hinged cast iron grate and cast iron sediment bucket, to be furnished with cleanout, connected to ductile iron pipe when under manhole floor, then connected to ASTM C-278-60T Vitrachem extra strength clay pipe with premium joints when outside of manhole perimeter. Use 4 inch to 6 inch adapter between floor drain and drain pipe. Lay drain pipe to sewer at minimum 1 percent grade and install in accordance with section 02630 Storm Drainage.
 - b. Drains in manholes with floor elevations of 839.0 or less, shall be equipped with a cast iron backwater valve with brass flapper and seat, and bolted cover, Wade no. W-4204 or approved equal.
 - c. The floor drain shall be located in the center of the manhole floor.
 - d. Slope the floor to drain.

2.2 ELECTRICAL AND COMMUNICATION DUCT BANK

A. Duct Banks

1. All underground duct banks, including conduit, couplings, bends, and bells, and any special fillings shall be plastic duct. Plastic duct shall be as manufactured by Prime Conduit Inc. or CANTEX Inc.
2. Plastic duct and fittings shall be corrosion-resistant and not adversely affected by acids, alkalis, salts or organic matter. Fittings shall be of a type especially made for use with

plastic duct for electrical service. All plastic conduit and fittings shall be joined by a solvent welding cement. Conduits shall be five inch UL or ETL labeled, Type EB-20.

3. Duct end bells shall have a minimum opening diameter of 6".
4. All joints in the ducts will be made water tight.
5. Factory bends and sharp sweeps in new duct banks shall not be allowed; unless specifically noted otherwise. If factory bends are installed, the minimum bend radius shall be 60".
6. Tracer Wire: Tracer wire shall be installed to enable the detection of plastic pipes, fiber optics, and non-conducting utilities. Tracer wire shall be 12 AWG (min.), THWN or RHW conductor embedded in the concrete envelope.

B. Building Walls – Waterproofing

1. Where exterior building walls are cored for conduit penetrations, follow the waterproofing guidelines described in this specification for manholes.
2. Mechanical pipe seals shall be installed around each conduit entering the building. Seals shall be of the modular link type, Seals shall consist of a series of interlocking, molded synthetic rubber links, with heavy-duty plastic pressure plates, and corrosion resistant nuts and bolts. Seals shall be designed to provide a hydrostatic seal between the pipe and wall penetration. Seals shall be sized and selected in accordance with Manufacturer's recommendations. Provide stainless steel hardware as required. Mechanical pipe seals shall be model "Metraseal" as manufactured by The Metraflex Company®, Chicago.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall locate existing utilities and confirm elevations prior to construction, as determined necessary by the Engineer to insure the continued service of these utilities. When locating such utilities the Contractor shall proceed with caution, using hand instead of machine excavation.
- B. Where exterior building walls are cored for conduit penetrations, follow the waterproofing guidelines described in this specification for manholes. Mechanical seals shall be installed as to allow future tightening or replacement of devices. Seals shall be sized, selected, and installed in accordance with Manufacturer's recommendations.

3.2 ELECTRICAL AND COMMUNICATION MANHOLES

- A. General

1. Whenever a contractor has work to perform in an existing manhole and it is partially or entirely filled with water, it shall be the Contractor's responsibility to pump it out at his expense.
2. The Contractor shall be responsible for the removal and proper disposal of any and all asbestos fire proofing tape on any cables in existing electrical manholes involved in this project. The asbestos removal shall take place prior to performing any work in the manholes.
3. Manholes shall be set to grade established by the Engineers.

B. Waterproofing

1. Precast manhole waterproofing membrane will cover the top, bottom, and all sides. Membrane will be flashed tight to conduits and reinforcing dowels at duct bank entrance.
2. Cast-in-place manhole waterproofing membrane will cover the cove, top, and all sides down to 8 inches below the joint between the wall and floor. Membrane will be flashed tight to conduits and reinforcing dowels at duct bank entrance.
3. Membrane waterproofing shall be installed in the following manner:
 - a. All surfaces shall be primed with a manufacturers approved primer. Roll on membrane overlapped 2-1/2" min. at seams with primer. Apply elastomeric mastic to all seams and edges.
 - b. At all corners, cracks, and construction joints, two layers of membrane shall be applied.
4. All construction joints will have cast-in waterstops.

3.3 ELECTRICAL AND COMMUNICATION DUCT BANK

A. General

1. Primary distribution will be run in fiber or plastic duct with reinforced concrete encasement. Size, location, and elevation will be shown on drawings. The duct bank will be pitched to drain any seepage to a manhole. Duct banks entering buildings will pitch away from the building. Slope will not be less than 4 in./100 ft. of duct. Grade shots will be taken at least every 25 ft. to assure uniform pitch.
2. Duct banks shall have no pull boxes or short radius bends. Long radius sweeps are allowed as shown on the drawings. Any change in direction should take place at a manhole, one for electric and one for communications.
3. Duct banks shall be marked with a marker tape buried in the trench above the duct.

B. Duct Bank Encasement

1. Lay concrete blocks at 4 ft. on center to establish grade and tie ducts to blocks to make secure. Plastic separators shall be used to maintain space between ducts, 1-1/2 inches between electric ducts, 1-1/2 inches between communication duct, and 3 inches between electric and communication ducts.
2. In lieu of the blocks a 3 inch concrete pad may be poured and leveled to the grade established, with the wires inserted every four feet to secure ducts.
3. Reinforce the duct bank as follows.
 - a. Duct bank installed under non-hard surface areas shall be reinforced with two 5/8 inch steel reinforcing bars laid parallel to the ducts in the bottom of the duct bank in the outside corners.
 - b. Duct bank installed under hard surfaces such as roads, sidewalks, and parking lots, shall be reinforced with four 5/8 inch steel reinforcing bars laid parallel to the ducts, two on top and two on the bottom in the outside corners.
 - c. Where the duct bank enters manholes or buildings, the reinforcing bar shall penetrate the manhole or building wall as follows.
 - 1) Three inch penetration in walls that are six inches thick.
 - 2) Four inch penetration in walls that are over six inches and up to eight inches thick.
 - 3) Six inch penetration in walls that are over eight inches thick.
4. A concrete envelope of 3000 PSI test, using 6-AA limestone, shall be poured around ducts with low enough slump to be worked into all openings. When concrete is poured, some method of deflecting the concrete shall be employed to minimize force on the ducts.
5. The concrete shall cover the plastic duct a minimum of 3 inches on both sides, top, and bottom; encasing the reinforcing bars with a minimum thickness of two inches of concrete; and modified as follows:
 - a. Under hard surfaces such as roadways, sidewalks, and parking lots, the concrete shall cover the ducts a minimum of 6 inches on top.
 - b. Where duct enters manholes or buildings, or where duct is to cross new utilities installed, or indicated as proposed, or where duct is to be installed in fresh fill, the duct shall have minimum of 4 inches of concrete on both sides, top, and bottom. Where a duct bank crosses a steam line, there shall be a minimum of 6 inches of sand fill between the outside of the concrete envelope and the insulation around the steam line.

6. There shall be a minimum separation of 12 inches between the concrete envelope of the duct bank and any existing or new gas main or line, water line, sewer line, or steam line or tunnel.
7. Install twelve inches of high density extruded polystyrene insulation between the duct bank and any steam line or tunnel where the duct bank either crosses or is parallel to the steam line or tunnel.
8. The minimum distance between the top of the concrete envelope of the duct bank and final grade shall be 30 inches, unless otherwise specified or special permission is obtained from the Owner.
9. Excessive amounts of concrete shall not be poured around duct. Concrete covering the top and sides of the duct shall not exceed 6", unless special permission is obtained from the Owner. Forms shall be used where necessary to comply.
10. Pour the concrete in several lifts and vibrate the concrete between lifts to remove air pockets.
11. All new duct bank conduits shall be tested by pulling a nominal 4" mandrel through each 4" duct and a nominal 5" mandrel through each 5" duct.

C. Pull String

1. Install a heavy duty nylon pull string in each conduit in the duct bank that is not receiving new cable on this project.

D. Utility Marker Tape

1. Underground duct banks shall be marked with a plastic identifying tape buried in the trench directly above the duct bank at 8 to 12 inches below finished grade. The tape will be vivid opaque red in color with Caution Electric Line Buried Below continuously printed in black letters over the entire length of the tape. The tape will also be magnetic. Tape will be as manufactured by Allen Systems, Inc. or Terra Tape.
2. If the duct bank is 18 inches or less in width the tape shall be 3 inches wide. If the duct bank is over 18 inches in width the tape shall be 6 inches wide.

E. Tracer Wire

1. All new duct banks shall be installed with tracer wire. The tracer wire shall be installed continuously along the new duct banks with access points at each manhole. The tracer wire shall be accessible at the ground surface without entering the manhole. Splices in the tracer wire shall be connected by means of a split bolt or compression type connector to ensure continuity. Wire nuts shall not be used. A waterproof or corrosion-proof connector for direct bury applications shall be used. After installation, the tracer wire shall be tested to verify continuity of the tracer wire system and a report indicating continuity shall be submitted to the Owner as part of the construction record documents.

F. Grounding Cable

1. The Contractor shall furnish and install a new 4/0 THW, stranded copper cable in the entire concrete envelope of all new electric and communication duct banks. All joints in the grounding cable shall be brazed or cadwelded.
2. In manholes, neatly clamp cable to the walls and ground rod.
3. In buildings, neatly clamp cable to the electrical grounding electrode system.

END OF SECTION 337119