

SECTION 26 09 13

ELECTRIC, COMMUNICATION CONDUITS, AND GAS SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work Included: Excavation, rock excavation, blasting, rock disposal, dewatering, backfill, bedding, compaction, installation of conduits, vaults, pads and all necessary appurtenances and coordination with the telephone, cable television, electric and gas companies.
- B. Related Work:
 - 1. Site Clearing: Section 02 40 00
 - 2. Topsoil and Revegetation: Section 32 90 00
- C. Definitions:
 - 1. Trench Excavation: Excavation of all material encountered along trench other than rock excavation.
 - 2. Rock Excavation: All solid rock formations which cannot be reasonably broken by a backhoe with 3/4 cubic yard bucket with bucket curling force and stick crowd force 35,000 lbs each, and requiring drilling and blasting.
- D. Utility Company Specifications: All work shall conform to the standard specifications of the telephone company, the cable television company, the electric company and the gas company.

1.02 SUBMITTALS

- A. Submit shop drawings or product data showing specific dimensions and construction materials for pipe, fittings, and vaults; or certifications that products conform with specifications.
- B. Test Reports: Submit laboratory gradation tests for bedding and trench stabilization materials, concrete mix design, and compression test.
- C. Permits: Submit copies of all permits issued for project.

1.03 JOB CONDITIONS

Environmental Requirements: Except by specific written authorization, cease concreting when descending air temperature in shade and away from artificial heat, falls below 35 degrees F, and there is frost in subgrade. When concreting is permitted during cold weather, temperature of mix shall not be less than 60 degrees F at time of placing.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

- A. Polyvinyl Chloride (PVC): 2"-8", Schedule 40 PVC. Electric rated for electric application.
- B. Electric primary conduit supplied by Holy Cross Energy.
- C. Gas pipe to be supplied and placed by gas company.

2.02 VAULTS

All switchgear, transformer, splice vaults, pads, and bases to be supplied by Holy Cross Energy.

2.03 BEDDING

- A. Granular material - 3/4" screened rock.
- B. On-site 1-1/2" minus well graded screened material, free from organic materials, chunks of soil, frozen material, debris, or other suitable materials. Use of on-site bedding material must have prior written approval of the utility company and Engineer.

2.04 CONCRETE MATERIAL

- A. General: All materials furnished from sources agreed to by the Utility Companies.
- B. Cement: ASTM C-150 for Portland Cement, Type II. Cement which has become partially set or contains lumps of caked cement shall be rejected.
- C. Aggregate: ASTM C33.
- D. Water: Water used in mixing or curing concrete shall be clean and free from oil, acids, salt, alkali, or organic materials harmful to concrete.

2.05 CONCRETE MIX

A. Design Mix

- 1. Proportions:
 - Cement 5-1/2 sacks per cubic yard
 - Coarse aggregate - 43%
 - Water - 5.5 gallons per sack
 - Maximum size aggregate - 3/4"
- 2. Slump: 4" maximum
- 3. Strength: Minimum 3,000 psi at 28 days
- 4. Air Content: 5% - 7%

B. Job-Mixed Concrete

Mixed in drum mixer conforming to Concrete Paving Mixer Standards of Mixer Manufacturers Bureau of Associated General Contractors of America. Mixer shall be capable of combining aggregates, cement, and water into thoroughly mixed and uniform mass. Discharge entire contents of drum before recharging. Continue mixing of each batch for not less than ten (10) minutes after all materials are in drum.

C. Ready Mixed Concrete

Proportioned, mixed and transported in accordance with ASTM C94. Any concrete not plastic and workable when it reaches project shall be rejected.

PART 3 EXECUTION

3.01 TRENCHING

A. Trench Excavation: Excavate to depths required. Confine excavation to work limits.

B. Rock Excavation: Prior to removal, notify Engineer of areas requiring rock excavation.

C. Blasting: In general, blasting will be allowed in order to expedite the work if a permit by the local authority having jurisdiction is granted. All explosives and appurtenances shall be transported, handled, stored and used in accordance with the laws of the local, state and federal governments, as applicable.

All blasting shall be controlled so as not to injure any existing structure or facility. The protection of life and property and all liability for blasting shall be placed solely on the person or persons conducting the blasting operation. The hours of blasting shall be in accordance with the permit of the local authority. Prior to blasting, provide minimum 24 hour notification to Owner, Engineer and Fire Department.

D. Trench Support: The trench shall be adequately supported and the safety of workers provided for as required by the most recent standards adopted by the Occupational Safety and Health Administration (OSHA) Standards Board. Sheet piling and shoring shall be utilized where required to prevent any excessive widening or sloughing of the trench, which may be detrimental to human safety, to the pipe and appurtenances being installed, to existing utilities, to existing structures, or to any other existing facility or item.

3.02 UNSTABLE TRENCH BOTTOM AND EXCAVATION IN POOR SOIL

If the bottom of the excavation at subgrade is found to be soft or unstable or to include ashes, cinders, refuse, vegetable or other organic material, or large pieces or fragments of inorganic material that cannot satisfactorily support the pipe or structure, then the Contractor shall further excavate and remove such unsuitable material. Before the pipe or structure is installed, the subgrade shall be accepted by the Engineer.

3.03 BEDDING

Install in conformance with drawings. Place from minimum of 3" below bottom of pipe to centerline for entire width of trench.

3.04 UNDERDRAIN

- A. Water seeping from trench banks, but not flowing in trench bottom: Install gravel underdrain in accordance with drawings.
- B. Water flowing in trench bottom: Install underdrain pipe in addition to gravel where water volume will fill a 4" pipe 1/4 full. Cleanouts at each manhole in conformance with drawings.
- C. Daylight all underdrains as shown on drawings or as directed by Engineer.

3.05 PIPE INSTALLATION

- A. Construct pipe accurately to line and grade shown on drawings. Remove and replace pipe not conforming to line and grade at Contractor's expense.
- B. Install to manufacturer's recommendations, continuously upgrade. Bell ends face upgrade. Prior to making joints, clean and dry all surfaces. Use lubricants in conformance with manufacturer's recommendations for insertion of pipe in joint. Set pipe in position and check line and grade. Keep dirt from entering all exposed pipe ends. Joints watertight.

3.06 PADS AND VAULTS

Install pads and vaults to line and grade shown on drawings.

3.07 PULL STRING

Pull string shall be labeled to identify which utility company or spare conduit the use of the conduit is intended for.

3.08 CONCRETE WORK

- A. Placement: Place to required depth and width conforming to drawings. Place concrete as uniformly as possible in order to minimize amount of additional spreading. Place and consolidate with suitable tools to avoid formations of voids, honeycomb, or pockets. Well vibrated and tamped against forms.
- B. Retempering: Do not retemper concrete or mortar which has partially hardened by remixing with or without additional cement, aggregate, or water. Provide concrete in such quantity as is required for immediate use.
- C. Curing: Protect against loss of moisture, rapid temperature change, rain, and flowing water, for not less than two days from placement of concrete. Immediately after finishing, cover concrete surface with curing medium which is applicable to local conditions as approved by Engineer. Protect exposed edge of concrete slabs exposed by removing forms immediately to provide these surfaces with continuous curing treatment.

3.09 BACKFILL

- A.** One Foot Over Pipe: Use 3/4" screened rock or on-site screened material (if approved by Engineer) for cover material and backfill by approved mechanical methods. Cover material shall be clean soil, free from organic materials, chunks of soil, frozen material, debris, or other unsuitable materials. Place and compact starting at top of pipe bedding extending upwards to above top of pipe for entire trench width. Place in lifts to a density of 90% AASHTO T99.
- B.** Remainder of Trench: Backfill with same materials excavated from work limits unless unsuitable. No rocks over 6" in diameter in top 12" of trench. No backfill material with rocks larger than 12" in diameter. Carefully lower rocks up to 12" in diameter into trench.

3.10 COMPACTION

- A.** Demonstrate method of compaction. Engineer will test compacted demonstration section for uniform density throughout depth of each lift. Alter construction methods until providing one acceptable to Engineer. Continue same procedure until significant change in soils occurs, or compaction is not being achieved, then demonstrate new method.
- B.** Compaction requirements for all trenches:
 - 1.** Predominantly of cohesive soils where AASHTO T99 procedures are applicable: Compacted uniformly throughout each lift to 95% AASHTO T99. Moisture content shall be within 2% of optimum.
 - 2.** Predominately of rock 12" in diameter: Place in loose lifts up to average rock dimension. Placing of occasional boulders of sizes larger than maximum layer thickness may be agreed to by Engineer, provided material is carefully placed and large stones well distributed with voids completely filled with smaller stones, earth, sand, or gravel. Level and smooth each layer to distribute soils and finer fragments of earth. Wet each loose layer as necessary to facilitate compaction prior to placing additional lifts.
 - 3.** Trenches outside road right-of-way: Compact to 95% AASHTO T99. Moisture content shall be within 2% of optimum.

3.11 PAVEMENT REMOVAL AND REPLACEMENT

Score existing surface with cutting wheel to create clean break line. Remove and dispose of existing surface and aggregate base course leave 6" undisturbed subgrade lip on each side of trench. After trench has been backfilled and properly compacted, place aggregate base course in accordance with permit requirements, or minimum thickness in these specifications. Compact aggregate base course to 95% AASHTO T180. Replace pavement in accordance with permit requirements or minimum thickness in these specifications. Compact asphalt to 95% ASTM D1559; consolidate concrete with vibrators.

3.12 FIELD QUALITY CONTROL

- A.** Notify Engineer at least 24 hours in advance of pipe being laid in any trench. Cover no pipes until observed by Engineer. Notify Engineer at least 48 hours before pipe is to be tested.
- B.** Testing

1. General: Conduct testing in accordance with procedures approved by the appropriate utility company or as directed by engineer.

3.13 CLEANUP AND RESTORATION

Restore all pavements, curbs, gutters, utilities, fences, irrigation ditches, yards, lawns, and other structures or surfaces to condition equal to or better than before work began, and to satisfaction of Engineer. Deposit all waste material in designated waste areas. Grade and shape disposal site.

Complete topsoil and reseeding of site, is required. Where disposal sites are not designated, remove and dispose of all waste material off site.

END OF SECTION

**SECTION 26 42 00
SACRIFICIAL ANODE CATHODIC PROTECTION**

PART 1 GENERAL

1.1 WORK INCLUDED

- A. The CONTRACTOR shall furnish all labor, materials, tools, and equipment and perform all work necessary for complete and operational sacrificial anode cathodic protection system(s) for facilities such as ductile iron piping, steel piping, steel tank bottom, and steel pump station as shown on the Drawings and specified herein.

1.2 REFERENCED STANDARDS:

- A. The cathodic protection installation shall comply with applicable requirement codes, laws, and ordinances of Federal, State, and local bodies having jurisdiction.
- B. The cathodic protection systems shall comply with the National Association of Corrosion Engineers (NACE) RP-01-69 latest revision.
- C. Ductile iron pipe polyethylene encasement shall comply with AWWA Standard C105, "Polyethylene Encasement for Gray and Ductile Cast Iron Piping for Water and Other Liquids".

1.3 SUBMITTALS:

- A. The CONTRACTOR shall submit the following items for approval:
 - 1. Category I:
 - a. Sacrificial Anodes
 - b. Test Stations and Shunts
 - c. Exothermic Weld Mastic and Caps
 - d. Conductors, Cables, and Joint Bond Wires
 - e. Wire Splice Connectors and Splice Sealing Kits
 - f. Exothermic Weld Equipment and Materials
 - g. Wire and Cable Marker Tags
 - h. Insulating Flange Kits with One-Piece Sleeve and Washers
 - i. Plastic Warning Marker Tape
 - 2. Category II:
 - a. Record Drawings

PART 2 MATERIALS

2.1 GENERAL

- A. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.

2.2 STANDARD PRODUCTS

- A. Materials and products submitted for approval shall be a product of a manufacturer regularly engaged in the manufacture of the product, shall meet the requirements of the specifications and essentially duplicate materials that have been in satisfactory use for at least two years prior to the bid opening.

2.3 CONDUCTORS

A. Test Station

- 1. Test station wires shall be #12 AWG and #8 AWG single conductor, stranded copper and may have any of the following insulation types: **RHW, RHH or XHHW.**
- 2. Wire color-coding shall be as shown on the Drawings and specified herein.

B. Joint Bond

- 1. Joint bond wires shall be #4 AWG single conductor, stranded copper cathodic protection cable with Type HMWPE insulation.
- 2. The HMWPE insulation shall comply with ASTM D 1248 and shall be high molecular weight polyethylene, Type I, Class C, Grade 5.

2.4 WIRE SPLICE CONNECTIONS

A. Splice Connectors

- 1. All splices of anode wires or of test station wires shall be made using a copper, crimpit type connector.

B. Splice Sealing

- 1. Splices of anode or test station wires (if applicable) shall be sealed using Royston "MINI SPLICE-RITE" cathodic protection splice kits or two half-lapped layers of Scotch 130C followed by two half-lapped layers of Scotch 88 tape

2.5 EXOTHERMIC WELDS

- A. All electrical cable connections to the buried piping shall be made by an exothermic weld.
- B. Exothermic type weld materials including the proper size and type of weld cartridges and welder molds for use on steel or ductile iron pipe shall be by Erico Products Inc. "CADWELD" or Burndy "THERMOWELD" or other approved equal. Weld metal for ductile-iron pipe shall be XF-19 alloy and weld metal for steel pipe shall have a "CA" designation.
- C. Copper sleeves specifically designed for the purpose shall be crimped on all bare wire ends prior to exothermic welding to improve mechanical strength and thermal capacity.

2.6 EXOTHERMIC WELD COATING

- A. Exothermic weld coatings for ductile iron pipe shall be a cold applied compound such as Koppers "Bitumastic 50", Royston Mfg. "Roskote A51", or equal.
- B. All exposed ductile iron pipe and fittings shall also be encased with polyethylene wrap per AWWA C105. The polyethylene film shall be Type I, Class A, Grade E-1 in accordance with ASTM D 1248.
- C. Exothermic weld coatings for steel pipe shall be a cold applied compound such as Koppers "Bitumastic 50", Royston Mfg. "Roskote A51", or equal. In addition, all exothermic welds on steel pipe shall be covered with a weld backfill shield composed of a plastic weld cap specifically made for the purpose and installed in accordance with the manufacturer's directions. The weld caps may be prefilled with mastic by the manufacturer or may be filled in the field with mastic according to the manufacturer's directions. Prefilled weld caps shall be Royston "Handicaps" or equal.

2.7 TEST STATIONS

- A. Type
 - 1. Cathodic protection test stations shall be flush-to-ground type Christy G5 Traffic Valve Box (10 3/8" ID x 12") with a cast-iron lid with "CP TEST" permanently printed on its center.

B. Terminal Board

1. Each test station shall be furnished with a 3/16 inch thick plastic or reinforced laminate terminal block with minimum dimensions measuring three x four inches.
2. The terminal block shall be equipped with five 1/4-inch diameter by 1-inch long brass studs with double brass nuts, flat washers, and lock washers.
3. Test stations shall be equipped with Cott Mfg. 0.01 ohm - 8 ampere shunt (color code -- yellow) as shown on the Drawings. Exception: shunt not required at test stations designated as Insulating Fitting or Pipe Casing type test stations.

2.8 WIRE AND CABLE MARKERS

- A. All test station and wires shall be identified using nonmetallic marker tags.
- B. Marker tags for wire and cables shall be of an opaque nylon material arranged to include a marking area, nonreleasing holding device, and cable fastening tail similar to Panduit Corporation "Part No. PLF1MA".
- C. The marker board shall not be less than 1.0 inches (W) by 0.75 inches (L) and 25 mils thick with one side roughened to hold black nylon marking ink from a fine tip pen similar to Panduit Corporation "Part No. PFX" or 3M Corporation "ScotchCode SMP". Identification shall be permanent and waterproof.
- D. The marker-holding device shall be designed to allow the fastening tail to pass around the cable and through the holding device so that removal of the cable marker can be accomplished only by cutting it loose from the cable.

2.9 INSULATING FITTINGS

- A. Electrical isolation shall be accomplished through the use of insulating pipe fittings as shown on the Drawings.
 1. Type
 - a. Insulating mechanical couplings (IMC) shall be Dresser Style 39-62 or approved equal.
 - b. Insulating flange kits shall consist of full-faced gaskets, nonmetallic one-piece bolt sleeves and washers, and steel backing washers.

2. Insulating flange Kits

- a. Insulating Gaskets shall be Type E (Full Face) Pyrox 1E glass reinforced epoxy or phenolic laminate, 1/8 inch thick, with Buna-N sealing element and shall be rated for the working pressure of the pipe flange.
- b. Insulating bolt sleeves shall be one-piece plastic sleeve and washers made of Minlon or acetyl resin. Two piece insulating sleeves consisting of a separate non-metallic sleeve and washers are not acceptable.
- c. Backing washers shall be cadmium plated steel, 1/8 inch thick, two for each flange bolt.

3. Restrained IMC

- a. In the event an IMC is restrained using tie rods, each tie rod shall be insulated using one-piece rod insulating sleeve and washers and steel backing washers.

2.10 PLASTIC WARNING MARKER TAPE

- A. Warning tape shall be a 6-inch wide, 4-mil thick, yellow plastic tape with the words "CAUTION CATHODIC PROTECTION CABLE BURIED BELOW" permanently printed on the tape.
- B. The tape shall be resistant to alkalis, acids, and other destructive agents commonly found in soils.

2.11 SACRIFICIAL ANODES

- A. Dimensions of the magnesium anodes shall conform to the dimensions for standard sizes of anodes and of the weights specified.
- B. All magnesium anodes shall be cast around a galvanized steel core (flat strap or spring) and be made of high potential magnesium alloy conforming to the following compositions by weight:

Aluminum	0.01% Max.
Manganese	0.50% Min. to 1.30% Max.
Zinc	0.005% Max.
Copper	0.02% Max.
Nickel	0.001% Max.
Iron	0.03% Max.
Other Impurities	0.05% Each Max.
Other Impurities	0.30% Total Max.
Magnesium	Balance

- C. CONTRACTOR shall furnish spectrographic analyses or a letter of compliance on samples from each heat or batch of anodes used on this project.
- D. Sacrificial anodes shall be provided with specific backfill in a permeable cloth sack. Anodes shall be centered in the backfill material. The weight and nominal dimensions of the packaged anode shall be as follows:

32 lb. bare anode (5.0" x 6.0" x 4.4" x 17") = approx. 74 lb. packaged (8" Dia. X 26"L)
- E. The anode package backfill material shall consist of 75 percent gypsum, 20 percent bentonite, and 5 percent sodium sulfate, and shall be of the quick wetting type.
- F. All anodes shall be shipped and stored in waterproof bags or wrapping and shall be AMAX "MaxMag", Dow "Galvomag" or equal.
- G. Sacrificial anode lead wires shall consist of #12 AWG Type **USE-2 OR RHW-2**, black insulated stranded copper wire. Lead wires shall be a minimum of 30 feet in length. The lead wires shall be connected to the galvanized steel core of the anode by silver soldering and this connection shall be sealed with a waterproof epoxy or electrical potting compound.

PART 3 EXECUTION

3.1 GENERAL

- A. The cathodic protection system shall be installed in compliance with the applicable portions of NACE Standard RP-01-69 latest revision.
- B. All materials and equipment shall be in accordance with the directions of the manufacturer to conform to the specification documents.

3.2 SACRIFICIAL ANODE INSTALLATION

- A. CONTRACTOR shall procure, store and install high potential magnesium anodes as indicated herein.
- B. Anodes shall have approved waterproofing protection at all times prior to installation. Damaged anodes or anode wires shall not be used and replacement anodes installed instead. Anode waterproofing protection shall be removed before installing the anode.
- C. The specified high potential magnesium anodes shall be installed at the locations indicated herein. Anode locations or spacing may be adjusted slightly to clear

other buried or topographical obstructions with prior approval of the OWNER's representative.

- D. The specified magnesium anodes shall be installed completely dry and shall be lowered into the excavated (augured or otherwise) holes as shown on the Drawings by rope sling or by grasping the cloth gather. The anode lead wire shall not be used in lowering the anodes. The anode shall be backfilled with fine native excavated soil (imported sand or other select backfill shall not be allowed) in six-inch layers and each layer shall be hand tamped around the anode. Care must be exercised not to strike the anode or lead wire with the tamper. After the anode has been backfilled approximately halfway, a minimum of ten gallons of fresh water shall be added and allowed to soak into and around the anode. After water absorption by the anode and surrounding soil, continue backfilling and tamping with native soil to a point approximately six inches above the anode. Add another ten gallons minimum of fresh water and allow to soak into the soil. After the water has soaked in, backfilling and soil compaction may be completed to the top of the hole. Anodes shall be installed as shown herein.

3.3 TEST STATIONS

- A. The CONTRACTOR shall install cathodic protection test stations as shown on the Drawings and specified herein.
- B. Test stations shall be installed directly over the pipe unless otherwise specified.
- C. Test station wiring shall be arranged and completed as described herein. Wire connections to the test station terminal boards for conductor sizes of #8 AWG and larger shall be made with single hole terminal lugs of corrosion resistant bronze, copper, or nickel plated brass similar to Blackburn Type L (socket), Square D Company Type LU, Burndy SCRULUG Type KPA or other approved equal.
- D. Wire connections to the test station terminal boards for conductor sizes of #14 through #10 AWG shall be terminated with a properly sized uninsulated funnel entry support ring tongue compression connector similar to Panduit PNF or PV Series ring tongue connector, Burndy Type TN or TP Series ring tongue connectors, or other approved equal. Additionally, all wires shall be soldered to the ring tongue connectors.
- E. Test station wires shall be color coded as shown on the Drawings and specified herein and each wire shall be permanently identified using nylon marker tags and plastic cable ties. Marker tag identification shall be completed by using a water-proof ink nylon marker pen designed specifically for this purpose and using block type lettering with the letter size to be a minimum of 1/8" high and shall specify test station number, pipe diameter, pipe material, and pipe service.
- F. Test Station numbering shall be as indicated on the Drawings.

3.4 WIRE CONNECTIONS TO BURIED PIPING

- A. Test station wire and joint bond wire connections to buried piping shall be accomplished by exothermic welding. The surface of the pipe shall be cleaned with a grinder or metal file to a bright, shiny condition. The exothermic weld shall be completed using the appropriate weld charge and welder as per the manufacturer's recommendations. A properly sized copper wire sleeve shall be installed around the bare wire end of all prior to welding to improve weld strength and thermal capacity. Completed welds shall be capable of withstanding moderate hammer blows.
- B. The type of weld metal to be used is different for cast iron pipe and steel pipe. The CONTRACTOR shall ensure that the appropriate weld metal charges are used for each type of pipe material.
- C. For ductile iron pipe, after cooling, the weld and surrounding cleaned metal surface shall be heavily coated with a cold applied mastic compound. The pipe joint with the installed bond wires shall then be encased in polyethylene wrap.
- D. For steel pipe, after cooling, the weld and surrounding cleaned metal surface shall be lightly coated with a cold applied mastic compound or pipeline coating primer and covered with an exothermic weld cap. Pipeline tape wrap shall then be applied as necessary.

3.5 WIRE SPLICE CONNECTIONS

- A. Buried splice connections of anode and/or test station wires shall be completed with a splice connection kit specifically designed for that purpose
- B. Installation of the splice connection kit shall be completed per the manufacturers instructions with the exception that the wires shall also be soldered to the crimpit connector after tightening.

3.6 ELECTRICAL ISOLATION

- A. Electrical isolation of the buried piping shall be accomplished by the use of insulating flange kits or other approved dielectric fittings to be installed at designated locations where as shown on the Drawings.

3.7 JOINT BONDING

- A. All ductile iron pipe joints, except those specified to be insulating joints, shall be bonded to ensure electrical continuity.

- B. All nonwelded steel pipe joints, except those specified to be insulating joints, shall be bonded to ensure electrical continuity.
- C. Two bond wires shall be installed at each joint and shall be stranded copper #4 AWG Type HMWPE as shown on the Drawings.

3.8 TESTS AND MEASUREMENTS

- A. Upon completion of the cathodic protection system installation work, the ENGINEER shall perform testing to ensure proper operation of the system.
 - 1. On water storage reservoir projects, initial testing shall be conducted prior to floor slab / floor plate construction.
- B. Inadequate pipe joint continuity and/or cathodic protection levels due to defective or incorrect installation work shall be corrected by and at the sole expense of the CONTRACTOR.

END OF SECTION

