Section 16061

JOINT BONDING AND ELECTRICAL ISOLATION

PART 1 GENERAL

1.01 SUMMARY

This Section includes:

A. Joint bonding requirements for electrical continuity along steel, ductile iron and concrete cylinder pipe on water pipeline projects.

B. Electrical isolation devices for installation at connections to existing piping, at selected below grade to above ground piping transitions, at cased crossings and at tunnels.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

No separate payment will be made for Work performed under this Section. Include cost of such Work in contract unit price for Section 16640 – "Cathodic Protection for Pipelines".

1.03 REFERENCES

A. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

B. ASTM D1248 - Polyethylene Plastics Molding and Extrusion Material.

C. AWWA C207 - Steel Pipe Flange for Waterworks Service.

D. AWWA M9 Manual - Concrete Pressure Pipe.

E. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

F. ANSI B16.5 - Pipe Flange and Flanged Fittings.

1.04 SUBMITTALS

A. Submit in accordance with the requirements of Section 01330 – "Submittal Procedures".

B. All required computations and drawings shall be prepared by or under the direct supervision of a Professional Engineer, registered in the State of Texas with a minimum of ten years of corrosion control experience.

C. Submit manufacturer's catalog cuts for each item. Include the manufacturer's name in the catalog cuts and provide sufficient information to show that the materials meet the requirements of the Plans and specifications. Where more than one item or catalog number appears on a catalog cut, clearly identify the item proposed.

D. Submit electrical continuity and flange isolation test results to the Project Manager or designated representative.

1.05 RELATED REQUIREMENTS

A. Section 01330 – "Submittal Procedures".

B. Section 02502 – "Steel Pipe and Fittings".

C. Section 02507 – "Prestressed Concrete Cylinder Pipe".

D. Section 02511 – "Water Lines".

E. Section 02518 – "Steel Pipe and Fittings for Large Diameter Water Lines".

F. Section 02613 – "Bar Wrapped Steel Cylinder Pipe".

G. Section 16062 – "Corrosion Control Test Stations".

H. Section 16640 – "Cathodic Protection for Pipelines".

I. Section 16645 – "AC Interference Mitigation Systems for Pipelines Gradient Control Systems".

1.06 QUALITY ASSURANCE

A. Provide manufacturer's certification that all electrical continuity bonding meets the requirements of the Plans and specifications. Reference certification to applicable section of specifications and applicable standard detail.

B. Provide manufacturer's certification that all isolation devices meet the published material specifications.

C. All materials, fabrication, and installations are subject to inspection and testing by the Owner.

1.07 – 1.13 NOT USED

PART 2 PRODUCTS

2.01 MANUFACTURER(S) (NOT USED)

2.02 MATERIALS AND/OR EQUIPMENT

A. Description of Materials

1. Joint bonding and electrical isolation materials to be incorporated into the project include, but are not limited to, the following:

a. Electrical continuity bonds.

b. Flange isolation assemblies.

c. Casing spacers.

d. End seals.

2.03 ELECTRICAL CONTINUITY BONDS

A. Applications: Applications for electrical continuity bonding include the following:

1. Bonding across bolted joint assemblies.

2. Bonding across gasketed joint assemblies.

B. Preparation of Prestressed Concrete Pipe for Bonding:

1. General:

a. Fabrication: Use prestressed concrete pipe for this project that has been fabricated in such a manner as to establish electrical continuity between metallic components of pipe and joints.

b. Acceptable Methods: Establish electrical continuity as indicated in Plans and specifications.

2. Criteria for Electric Continuity:

a. Tensile Wire: Pipe manufacturer to obtain a resistance no greater than 0.03 ohms between any wire and steel joint ring at end of pipe farthest from that wire. Manufacturer to report values obtained and method of measurement.

b. Internal Pipe Joint Components: Pipe manufacturer to obtain resistance of less than 0.03 ohms between any component and steel pipe cylinder.

3. Tensile Wire Continuity:

a. Establish continuity between tensile wire coils and steel cylinder on embedded cylinder type prestressed pipe by tightly wrapping tensile wire over longitudinal mild steel straps during pipe manufacture.

1) Use and install two continuous straps 180 degrees apart longitudinally along the pipe. These straps must maintain electrical continuity between metallic components.

2) Use steel straps made of mild steel and free of grease, mill scale, or other high resistance deposits.

3) Make longitudinal straps electrically continuous with pipe cylinder by steel fasteners of suitable dimensions placed between steel cylinder and longitudinal straps. Connect fasteners so as to remain intact during pipe fabrication process.

4. Steel Cylinder Continuity:

a. Establish continuity of all joint components and steel cylinder. These components include the following:

1) Anchor socket brackets.

2) Anchor socket.

3) Spigot ring.

4) Bell ring.

b. If mechanical contact does not provide a resistance of less than 0.03 ohms between components, tack weld component to provide electrical continuity.

C. Preparation of Steel Pipe for Bonding: Bonding wires are not required for welded steel pipe.

D. Preparation of Ductile Iron Pipe for Bonding: Install insulated bond wires as shown on Plans.

E. Electrical Bond Wires: Electrical bond wires are to be a minimum No. 2 AWG, seven strand, copper cable with THHN insulation. Remove one inch of THHN insulation from each end of the bond wire. Provide the minimum number of bond wires as shown on Plans for steel or ductile iron pipe.

F. Electrical Bond Clip: Weld three (3) ASTM A1008/A1008M steel bonding clips, each approximately 0.13 inches thick, 2.5 inches long, and 1.25 inches wide, with 1/8-inch fillet welds to the bell and spigot of adjacent prestressed concrete cylinder pipe or steel pipe with rubber gasketed joints. Manufacture clips to maintain continuity regardless of small deflections of finished joints.

2.04 FLANGE ISOLATION

A. Applications: Required applications of dielectric flange isolation assemblies include but are not limited to the following:

1. At selected locations where new piping is mechanically connected to existing piping.

2. At selected below-grade to aboveground piping transitions.

3. At locations shown on the Plans.

B. For concrete cylinder pipe, provide electrical isolation through the installation of the following materials:

1. Flange connection to Lock Joint bell adapter.

2. Flange connection to Lock Joint spigot adapter

3. Insulating Gasket:

a. For piping 30 inches diameter and greater, provide Pyrox G-10 with nitrile seal, Type "E" LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

b. For piping between 12 inches and 24 inches diameter, provide Phenolic PSI with nitrile seal, Type "E" LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

c. Alternately, provide plain-faced phenolic gasket, as manufactured by Pipeline Seal and Insulator, Inc., or approved equal. Place phenolic gasket between two full-faced gaskets. Provide cloth-inserted rubber gasket material, 1/8 inch thick in accordance with AWWA C207. Use factory cut gaskets of proper dimensions.

4. Sleeves and Washers:

a. For piping 30 inches diameter and greater, provide full length mylar sleeves with Pyrox G-10 washers, double washer sets as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

b. For piping between 12 inches and 24 inches diameter, provide full length mylar sleeves with Phenolic washers, double washer sets as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

C. For steel pipe, provide electrical isolation through installation of the following materials:

1. Insulating Gasket:

a. For piping 30 inches diameter and greater, provide Pyrox G-10 with nitrile seal, Type "E" LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

b. For piping between 12 inches and 24 inches diameter, provide Phenolic PSI with nitrile seal, Type "E" LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

c. Alternately, provide a plain-faced phenolic gasket, as manufactured by Pipeline Seal and Insulator, Inc., or approved equal. Place phenolic gasket between two full-faced gaskets. Provide cloth-inserted rubber gasket material, 1/8 inch thick in accordance with AWWA C207. Use factory cut gaskets of proper dimensions.

2. Sleeves and Washers:

a. For piping 30 inches diameter and greater, provide full length mylar sleeves with Pyrox G-10 washers, double washer sets as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

b. For piping between 12 inches and 24 inches diameter, provide full length mylar sleeves with Phenolic washers, double washer sets as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

D. For ductile iron pipe, provide electrical isolation through installation of the following materials:

1. Insulating Gasket:

a. For piping 30 inches diameter and greater, provide Pyrox G-10 with nitrile seal, Type "E" LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

b. For piping between 12 inches and 24 inches diameter, provide Phenolic PSI with nitrile seal, Type "E" LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

c. Alternately, provide a plain-faced phenolic gasket, as manufactured by Pipeline Seal and Insulator, Inc., or approved equal. Place phenolic gasket between two full-faced gaskets. Provide cloth-inserted rubber gasket material, 1/8 inch thick in accordance with AWWA C207. Use factory cut gaskets of proper dimensions.

2. Sleeves and Washers:

a. For piping 30 inches diameter and greater, provide full length mylar sleeves with Pyrox G-1 washers, double washer sets as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

b. For piping between 12 inches and 24 inches diameter, provide full length mylar sleeves with Phenolic washers, double washer sets as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

E. Coatings for buried isolation flanges shall be Densyl Tape system manufactured by Carboline, consisting of Densyl Mastic, Densyl Paste, and Densyl Tape, or approved equal.

2.05 CASING SPACERS

A. For water or wastewater piping installed in tunnels or cased crossings, install casing spacers between the piping and the casing or tunnel liner to provide electrical isolation.

B. Inside diameter of casing or tunnel liner must be 4 inches greater in diameter than the outside diameter of the piping. In the case of mechanically coupled piping, the casing must be a minimum of 4 inches greater in diameter than the outside diameter of the coupling at its largest point.

C. For welded steel pipe 12 inch diameter and smaller, use injection molded polyethylene insulators, Model PE as manufactured by Pipeline Seal and Insulator, Inc. or approved equal.

D. For all other pipe materials 12 inch diameter and smaller, use 8 inch wide steel insulators with 2 inch wide glass reinforced runners, Model C8G-2 as manufactured by Pipeline Seal and Insulator, Inc. or approved equal.

E. For all piping greater than 12 inch diameter, use 12 inch wide steel insulators with 2 inch wide glass reinforced runners, Model C12G-2 as manufactured by Pipeline Seal and Insulator, Inc. or approved equal.

2.06 CASING END SEALS

A. For all piping less than 24 inch diameter, use hard rubber seals, Model PL Link Seal as manufactured by the Thunderline Corporation or approved equal.

B. For all piping 24 inch diameter and greater, use pull-on, 1/8 inch thick, synthetic rubber end seals, Model C, as manufactured by Pipeline Seal and Insulator, Inc. or approved equal.

2.03 – 2.04 NOT USED

PART 3 EXECUTION

3.01 – 3.02 NOT USED

3.03 ERECTION/INSTALLATION APPLICATION AND/OR CONSTRUCTION

A. Installation of Electrical Continuity Bond Wires

1. Inspection: Use continuous bond wires with no cuts or tears in the insulation covering the conductor.

2. General: Attach bond wires at required locations by exothermic welding.

a. Charges and Molds: Select weld charges and mold size for the specific surface configuration in accordance with manufacturer recommendations. Use Erico Cadweld, or Continental Industries Thermoweld weld charges and molds.

b. Repair coating in accordance with pipe manufacturer's recommendation. Specific coating system used shall be completely compatible with pipe and factory-applied pipe coating materials.

c. Remove all coating, mill scale, oxide, grease, and dirt from an area approximately 3 inches square to effect a bright metal surface.

d. Remove approximately 1 inch of insulation from each end of the wires to be exothermically welded to the pipe, exposing clean, oxide-free copper for welding.

e. Using the proper size exothermic weld mold and charge as recommended by the manufacturer, place the wire between the graphite mold and the prepared metal surface.

f. Place the metal disk in the bottom of the mold. Pour the exothermic weld charge into the mold. Squeeze the bottom of the cartridge to spread ignition powder over the charge, in case that it is consistent with the manufacturer specification.

g. Close the mold cover and ignite the starting powder with a flint gun.

h. After the exothermic reaction, remove the thermite weld mold and gently strike the weld with a hammer to remove the weld slag. Pull on the wire to assure a secure connection. If the weld is not secure or the wire breaks, repeat the procedure.

i. If the weld is secure, coat all bare metal and weld metal with 2-part epoxy.

3. Post-Installation Inspection: Make post-installation inspection of all electrical continuity bonds through a visual examination of each exothermic weld

connection for strength and suitable coating prior to backfilling. In addition, perform one or more of the following tests:

a. Circulate current through pipe using DC power supply. Calculate resistance through known length of pipe. Resistance must not exceed 150% of theoretical resistance for pipe and bonds.

b. Measure resistance through select bonded joints with a digital low resistance ohmmeter (DLRO). Resistance of 0.001 ohms or less is acceptable.

c. Position a Copper Sulfate Electrode (CSE) at a stationary location adjacent to bonded pipeline. Impress a temporary current on pipe. Record static, current-applied, and instant "off" pipe-to-soil potential readings along the pipe relative to the stationary CSE.

1) Static potential measurements referenced to stationary CSE must be nearly identical along the pipe to indicate electrical continuity.

2) Instant "off" potentials referenced to stationary CSE must be nearly identical along pipe to indicate electrical continuity.

3) The difference between the instant "off" and the static potential referenced to stationary CSE must be equal at each point of contact to pipe to indicate electrical continuity.

d. If any of the above procedures indicates a poor quality bond connection, rebond the joint.

e. Record results and submit to Project Manager or designated representative for approval prior to backfilling. Any discontinuous joints are to be repaired by the contractor at no charge to the Owner.

4. Backfilling of Bonded Joints:

a. Backfill bonded piping in manner that prevents damage to the bond wires and all connections to the metallic structures.

b. If construction activity damages a bonded connection, contractor shall install new bond wire at no charge to the Owner.

D. Installation of Flange Isolation Devices

1. Placement: Install above-grade dielectric insulators at a minimum 12 inches and maximum of 48 inches above final grade.

2. Assembly: Place gasket, sleeves, and washers as shown on the Plans. Follow manufacturer's recommendations for even tightening to proper torque.

3. Testing: Immediately after an insulating fitting has been installed and prior to backfill, test electrical isolation with a Gas Electronics model, 601 meter. Fully document test results. Test shall be submitted to Project Manager for review prior to backfill of pipe.

4. Painting: Do not use metal base paints on insulating fittings.

5. Encapsulation: Encapsulate below-grade insulating flanges with the Carboline Densyl tape system, or approved equal, after the insulating flange has been tested for effectiveness.

E. Installation of Casing Spacers

1. Assemble and securely fasten casing spacers to the pipeline to be installed in casings or tunnels.

2. Avoid inadvertent metallic contact between casing and carrier pipe. Place spacers close enough to ensure that the pipe is adequately supported throughout its length, particularly at the ends, to offset settling and possible electrical shorting. The end spacer must be within 6 inches of the end of the casing pipe, regardless of size of casing and pipe or type of spacer used.

3. Grade the bottom of the trench adjacent to each end of the casing to provide a firm, uniform and continuous support for the pipe. If the trench requires some backfill to establish the final trench bottom grade, place the backfill material in 6-inch lifts and compact each layer.

4. After the casing or tunnel liner has been placed, pump dry and maintain dry until the casing spacers and end seals are installed.

5. Install casing spacers in accordance with the manufacturer's instructions. Correctly assemble, evenly tighten, and prevent damage during tightening of the insulators and pipe insertion.

6. Insulator Spacing:

   a. Maximum distance between spacers to be 10 feet for pipe sizes 4 to 12 inches, and 8 feet for pipe sizes 16 inches and greater.

   b. For ductile-iron pipe, flanged pipe, or bell and spigot pipe, install spacers within one foot on each side of the bell or flange, and one in the center of the joint where 18 foot or 20 foot long joints are used.

   c. If the casing or pipe is angled or bent, reduce the spacing.

F. Installation of End Seals

1. Assemble hard rubber Link-Seals around the pipe and slide into the annular space between the pipe and casing. Evenly tighten the bolts to provide a positive seal.

2. Place pull-on synthetic rubber end seals on the pipe and pull over the end of the casing. Securely fasten stainless steel bands.

3.04 – 3.07 NOT USED

3.08 DEMONSTRATION / TESTING AND INSPECTION

A. Electrical Continuity Tests

1. Immediately after the pipe has been installed in the casing, but prior to connecting the pipe outside the casing, perform an electrical continuity test to determine whether the casing is in fact isolated from the pipe. Have the continuity check fully documented and reviewed by the Project Manager prior to backfilling.

2. If the electrical isolation between pipe and casing is not effective, immediately investigate the cause and remedy the situation. Do not backfill a shorted casing.

3. If the electrical isolation between pipe and connecting metallic structure is not effective, immediately investigate the cause and remedy the situation. Do not backfill a shorted casing.

3.09 – 3.10 NOT USED

END OF SECTION