

STANDARD SPECIFICATION
SECTION 15257 STEEL PIPE, FUSION-BONDED EPOXY LINED AND COATED

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, fabrication, installation, and testing of fusion-bonded epoxy lined and coated steel pipe used inside and outside of pressure reducing stations and meter stations. Size range is 4- to 12-inch nominal pipe size.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Standard Drawings.
- B. Record Drawings and Submittals: STD SPEC 01300.
- C. Miscellaneous Metalwork: STD SPEC 05121.
- D. Painting and Coating: STD SPEC 09900.
- E. Polyethylene Sheet or Tube Encasement: STD SPEC 09954.
- F. Corrosion Control for Buried Piping: STD SPEC 13110.
- G. General Piping Requirements: STD SPEC 15050.
- H. Flexible Pipe Couplings: STD SPEC 15122.
- I. Disinfection of Piping: STD SPEC 15141.
- J. Pressure Testing of Piping: STD SPEC 15144.
- K. Installation of Steel Transmission Pipe: STD SPEC 15251.

1.03 SUBMITTALS

- A. Submit submittal packages in accordance with Standard Specification Section 01300.
- B. Submit piping layout drawings showing location and dimensions of all pipe and fittings. Include laying lengths of valves and other equipment determining piping dimensions. Label or number each fitting or piece of pipe and provide the following information for each item:
 - 1. Material of construction, with ASTM or API reference and grade.
 - 2. Wall thickness of steel pipe and fittings.
 - 3. Details of epoxy lining and coating, thickness, materials, and testing.
 - 4. Manufacturer's certificates of compliance with referenced pipe standards, e.g., ASTM A 53, ASTM A 135, API 5L.

- 5. Call out all weld sizes and dimensions of grooved ends, flanges, fittings, and joint harnesses.
- C. Submit coating application test records for measuring coating thickness and holiday detection for each pipe section and fitting. Describe repair procedures used.

1.04 INSPECTION AND FIELD VERIFICATION

- A. The District's Representative or his authorized representative may inspect materials, fabrication, and testing at the manufacturer's plant.
- B. Where new pipelines are to be connected to existing waterlines of the District, the Contractor shall verify in the field the location, elevation, pipe material, pipe outside diameter, and any other characteristics of the existing waterline before proceeding with the pipe fabrication or installation. This field verification shall be performed in the presence of the District's Representative. Adjust and align the new piping as necessary to meet the field conditions and provide all required material, labor, and equipment to make the connection.

PART 2 - MATERIALS

2.01 STEEL PIPE

Pipe shall be black carbon steel conforming to ASTM A 53, Type E or S, Grade B; API 5L, Grade B; or ASTM A 135, Grade B. Pipes shall be standard weight per ASME B36.10.

2.02 STEEL FITTINGS

- A. Steel fittings are defined as a special piece of pipe other than a normal straight section. Elbows, crosses, tees, and reducers are fittings.
- B. Fittings shall be butt-welded conforming to ASME B16.9. Material shall be wrought steel conforming to ASTM A 234, Grade WPB. Wall thickness shall be the same as the pipe.

2.03 SHOP APPLIED EPOXY LINING AND COATING

Lining and coating shall be a 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin. Provide Scotchkote 134 or 206N, Lilly Powder Coatings "Pipeclad 1500 Red", or District approved equal. Epoxy lining and coating shall meet or exceed the following requirements:

Hardness (Minimum)	Barcol 17 (ASTM D 2583) Rockwell 50 ("M" Scale)
Abrasion Resistance (Minimum)	1,000 cycles: 0.05 gram removed 5,000 cycles: 0.115 gram removed ASTM D 1044, Tabor CS 17 wheel, 1,000 gram weight
Adhesion (Minimum)	3,000 psi (Elcometer)
Tensile Strength	7,300 psi (ASTM D 2370)

Penetration	0 mil (ASTM G 17)
Adhesion Overlap Shear, 1/8-inch steel panel, 0.010 glue line	4,300 psi (ASTM D 1002)
Impact (Minimum Value)	100 inch-pounds (Gardner 5/8-inch diameter tup)

2.04 SHOP AND FIELD APPLIED EPOXY COATING FOR PATCHING

Use a two-component, 80% solids, liquid epoxy resin, such as Scotchkote 306 or District approved equal.

2.05 FLANGES

- A. Provide flanges that match the flange of the connecting valve or other equipment.
- B. Provide welding neck flanges for attachment to wrought steel fittings. Provide welding neck or slip on flanges for attachment to pipe. Slip on flanges shall be double welded. Flange material shall conform to ASTM A 105, A 181, or A 182. Flanges shall be flat faced.
- C. Class 150 flanges shall comply with AWWA C207, Class E or ASME B16.5, Class 150.
- D. Class 300 flanges shall comply with AWWA C207, Class F or ASME B16.5, Class 300.

2.06 BOLTS, NUTS AND GASKETS FOR FLANGES

See Standard Specification Section 15050.

2.07 INSULATING FLANGE KITS

See Standard Specification Section 13110.

2.08 OUTLETS

- A. For threaded outlets 3 inches and smaller, use a thredolet type per AWWA Manual M11 (Current Edition), Chapter 13. Outlets shall be 3000 pound WOG forged steel per ASTM A 105 or ASTM A 216, Grade WCB. Threads shall comply with ASME B1.20.1, NPT. Outlets shall be Bonney Forge Co. "Thredolet," Allied Piping Products Co. "Branchlet," or District approved equal. Do not use pipe couplings for outlets.
- B. For flanged outlets 4 inches and larger, use a tee with a welding neck flange.

2.09 MECHANICAL CLAMP-TYPE COUPLINGS

- A. Mechanical clamp-type couplings for grooved end pipe shall be ductile iron, ASTM A 536, Grade 65-45-12. Bolts shall conform to ASTM A 183, 110,000 psi tensile strength. Gaskets shall be EPDM (ethylene propylene diene monomer) conforming to ASTM D 2000. Couplings shall conform to AWWA C606 for flexible, square cut grooved joints in IPS steel pipe. Couplings shall be Victaulic Style 77, or District approved equal.

- B. Line and coat couplings the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

2.10 TYPE OF PIPE JOINTS

- A. Joints in vaults shall be flanged to connect to valves and other equipment.
- B. Joints between pipe, fittings, and welding neck flanges shall be full penetration butt welds. Joints between pipe and slip on flanges shall be fillet welds to the interior and exterior. Do not field weld to join components.
- C. Provide grooved end pipe where mechanical clamp-type couplings are to be used. Grooved end joint shall be flexible, square cut per AWWA C606, Table 2. Apply 10 mils maximum of fusion epoxy coating to the grooved end pipe surface.
- D. Provide plain end pipe where flexible pipe couplings are to be used. Couplings and harnesses shall conform to Standard Specification Section 15122. Line and coat couplings and harnesses the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

2.11 POLYETHYLENE ENCASEMENT

See Standard Specification Section 09954.

PART 3 - EXECUTION

3.01 FABRICATION, ASSEMBLY, AND ERECTION

- A. Beveled ends for butt welding shall conform to ASME B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding. When welding the reverse side, chip out slag before welding.
- B. Fabrication shall comply with ASME B31.3, Chapter V. Welding procedure and performance qualifications shall be in accordance with Section IX, Articles II and III, respectively, of the ASME Boiler and Pressure Vessel Code.
- C. Apply full penetration weld to exterior joint of butt welded pipe, fittings, and welding neck flanges. Apply fillet welds to the interior and exterior circumference of the pipe and slip on flanges. Minimum size of fillet weld shall be equal to the steel cylinder thickness. Complete each pass around the entire circumference of the pipe before commencing the next pass. Use electrodes recommended by the pipe fabricator. Do not deposit more than 1/8-inch of throat thickness per pass. The minimum number of passes or beads in the completed weld shall be as follows:

Steel Cylinder Thickness (inches)	Minimum Number of Passes for Welded Joints
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0.2500 and Less	2
Greater than 0.2500	3

- D. Use the shielded metal arc welding (SMAW) process for welding.
- E. Welding preparation shall comply with ASME B31.3, paragraph 328.4. Limitations on imperfections in welds shall conform to the requirements in ASME B31.3, Table 341.3.2, and paragraph 341.4 for visual examination.
- F. Identify welds in accordance with ASME B31.3, paragraph 328.5.
- G. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush.
- H. Welding electrodes shall comply with AWS A5.1.
- I. After shop fabrication and prior to shop applied epoxy, test each welded joint by the liquid penetrant method. Conform to the requirements specified in ASTM E 165. The materials used shall be either water washable or nonflammable. Products: "Spotcheck" by the Magnaflux Corporation or "Met-L-Check Flaw-Findr" by the Met-L-Check Company. Chip out all defects, reweld, and retest the section affected until it shows no leaks or other defects.

3.02 SHOP APPLICATION OF FUSION-BONDED EPOXY

- A. Apply lining and coating per AWWA C213 except as modified herein.
- B. Grind 0.020-inch (minimum) off the weld caps on the pipe weld seams before beginning the surface preparation and heating of the pipe.
- C. Grind surface irregularities, welds, and weld spatter smooth before applying the epoxy. The allowable grind area shall not exceed 0.25 square foot per location, and the maximum total grind area shall not exceed 1 square foot per pipe section. Do not use any pipe section in which these requirements cannot be met.
- D. Grind outside sharp corners, such as the outside edges of flanges and harness plates, to a minimum radius of 1/4-inch.
- E. Uniformly preheat the pipe prior to blast cleaning to remove moisture from the surface. The preheat shall be sufficient to ensure that the pipe temperature is at least 5°F above the dew point temperature during blast cleaning and inspection.
- F. Sandblast surfaces per SSPC SP-5. Protect beveled pipe ends from the abrasive blast cleaning.
- G. Apply a phosphoric acid wash to the pipe after sandblasting. The average temperature of the pipe, measured in three different locations, shall be 80°F to 130°F during the acid wash procedure. The acid wash shall be a 5% by weight phosphoric acid solution. The duration in which the acid is in contact with the pipe surface shall be determined by using the average pipe temperature as tabulated below:

Pipe Temperature (°F)	Contact Time (seconds)
80	52
85	45
90	36
95	33
100	28
105	24
110	21
130	10

After the acid wash has been completed, remove the acid from the pipe with demineralized water having a maximum conductivity of 5 micromhos/cm at a minimum nozzle pressure of 2,500 psi.

- H. Apply epoxy lining and coating by either the electrostatic spray or fluidized bed process. Minimum thickness of lining and coating shall be 12 mils each, except for grooved end pipe surfaces. Heat and cure per the epoxy manufacturer's recommendations. The heat source shall not leave a residue or contaminant on the metal surface. Do not allow oxidation of surfaces to occur prior to lining and coating. Do not permit surfaces to flash rust before lining and coating.

3.03 QUALITY OF LINING AND COATING APPLICATIONS

The cured lining and coating shall be smooth and glossy, with no graininess or roughness. The lining and coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

3.04 SHOP TESTING OF LINING AND COATING

- A. Test lining and coating with a low-voltage wet sponge holiday detector in accordance with AWWA C213, Section 5.3.3. If the number of holidays or pinholes is fewer than one per 10 square feet of coating surface, repair the holidays and pinholes by applying the coating manufacturer's recommended patching compound to each holiday or pinhole and retest. If the number of holidays or pinholes exceeds one per 10 square feet, remove the entire pipe lining and coating and recoat the entire piping and retest.
- B. Check for coating defects on the weld seam centerlines. There shall be no porous blisters, craters, or pimples lying along the peak of the weld crown.
- C. Measure the lining and coating thickness at three locations on each pipe section using a coating thickness gauge calibrated at least once per eight-hour shift. Record each measured thickness value. Where individual measured thickness values are less than the specified minimum thickness, measure the coating thickness at 6-inch intervals along the pipe length. The average of these measurements shall exceed the specified minimum thickness value, and no individual thickness value shall be more than 2 mils below or 3 mils above the specified minimum value. If a section of pipe does not meet these criteria, remove the entire lining and coating and recoat the entire pipe section or fitting.

- D. The District's Representative will conduct in the field an independent inspection of the lining and coating for compliance with the above criteria. Coated items failing his inspection will be cause for rejection.

3.05 DELIVERY AND TEMPORARY STORAGE OF PIPE

Lift pipe with wide belt slings. Do not use cable slings or chains. Support the pipe on padded wooden blocks. Do not roll or drop the pipe on the ground or allow the pipe to fall from the delivery trucks. Protect the lining and coating of the pipe from damage or scratches. Cover pipe with plastic sheets and secure until ready for installation.

3.06 INSTALLING BURIED PIPE

See Standard Specification Section 15251 for installation requirements of buried steel pipe. Install the pipe with polyethylene encasement and other appurtenant items for the installation. Inspect the lining and coating, and repair damaged areas in the field as described herein.

3.07 INSTALLING PIPE IN VAULTS

- A. Install pipe in vaults without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Provide temporary supports and place the assembled piping at the correct grade and position in the vault.
- B. Provide pipe supports per Standard Specification Section 05121.

3.08 INSTALLING FLANGED JOINTS

See Standard Specification Section 15050 for installation instructions.

3.09 INSTALLING INSULATING FLANGE KITS

Install insulating flange kits with coatings per Standard Specification Section 13110.

3.10 INSTALLING MECHANICAL CLAMP-TYPE COUPLINGS

- A. Install mechanical clamp-type couplings in accordance with the manufacturer's recommendations and the following.
- B. Clean oil, grease, and dirt from the grooved ends of pipe. Repair any damage or holidays in the shop applied coating before installing couplings. Apply the coupling manufacturer's gasket lubricant to the gasket exterior including lips, pipe ends, and housing interiors.
- C. Lubricate threads of bolts and nuts with oil or graphite prior to installation. Uniformly tighten bolts and nuts alternately and evenly until coupling segments are seated. Apply torque to nuts with a calibrated torque wrench as recommended by the coupling manufacturer.

3.11 INSTALLING FLEXIBLE PIPE COUPLINGS

Install flexible pipe couplings and joint harnesses where shown per Standard Specification Section 15122.

3.12 FIELD REPAIRS TO LINING AND COATING

Patch scratches and damaged areas incurred while installing fusion-bonded epoxy pipe with a two-component, 80% solids (minimum), liquid epoxy resin. Wire brush or sandblast the damaged areas per SSPC SP-10. Lightly abrade or sandblast the pipe lining and coating on the sides of the damaged area before applying the liquid epoxy coating. Apply the liquid epoxy coating to damaged linings and coatings to areas smaller than 20 square inches. Patched areas shall overlap the parent or base coating a minimum of 1/2-inch. If a damaged area exceeds 20 square inches, remove the entire pipe lining and coating and recoat the entire piping and retest. Apply the liquid epoxy coating to a minimum dry-film thickness of 12 mils.

3.13 PAINTING AND COATING

Coat exterior surfaces of fusion-bonded epoxy pipe in vaults per Standard Specification Section 09900, System No. 10. Apply finish coat in field. Do not apply prime coat.

Coat exterior surfaces of mechanical clamp-type couplings, flexible pipe couplings, and joint harnesses the same as the adjacent pipes.

3.14 PRESSURE TESTING

See Standard Specification Section 15144 for pressure testing requirements. Test pipe at the same time that the primary pipelines are tested.

3.15 DISINFECTION

See Standard Specification Section 15141 for chlorination requirements.

END OF SECTION