

SECTION 02515

STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnish and install direct buried steel pipe, fittings, specials, and appurtenances.

B. Related Sections

1. Section 01300 – Submittals
2. Section 02200 – Earthwork
3. Section 02675 – Disinfection of Water Mains
4. Section 02704 – Pipeline Pressure and Leakage Testing

1.02 REFERENCES

A. American National Standards Institute (ANSI):

1. B1.1 Unified Inch Screw Threads.
2. B18.2.1 Square and Hex Bolts and Screws.
3. B18.2.2 Square and Hex Nuts.

B. American Society for Testing and Materials (ASTM):

1. A139 Specification for Electric-Fusion (Arc)-Welded Steel Pipe.
2. C150 Specification for Portland Cement.
3. C881 Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
4. E709 Standard Guide for Magnetic Particle Testing

C. American Water Works Association (AWWA):

1. C200 Steel Water Pipe - 6 In. and Larger.
2. C203 Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied.

3. C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. and Larger - Shop Applied.
 4. C206 Field Welding of Steel Water Pipe.
 5. C207 Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.
 6. C208 Dimensions for Fabricated Steel Water Pipe Fittings.
 7. C209 Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
 8. C210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
 9. C214 Tape Coating Systems for the Exterior of Steel Water Pipelines.
 10. C219 Bolted Sleeve Type Couplings for Plain End Pipe.
 11. C222 Polyurethane Coatings and Linings for Steel Water Pipe and Fittings
 12. C602 Cement-Mortar Lining of Water Pipelines - 4 In. and Larger - in Place.
 13. M11 - Steel Pipe - A Guide for Design and Installation.
- D. American Petroleum Institute (API):
1. API Standard 1104, Welding of Pipelines and Related Facilities.
 2. API Specification 5L, Specification for Line Pipe.
- E. American Welding Society (AWS):
1. Standard for Certification of AWS Welding Inspectors
- F. American Society for Nondestructive Testing:
1. Recommended Practice No. SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
- G. United States of America Federal Government
1. 113th Congress Public Law 76 - "Consolidated Appropriations Act, 2014"
- H. NACE International
1. Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates NACE SP0188 recent revision.

SUBMITTALS

A. Submit the following in accordance with Section 01300:

1. Specifications, test reports, and product data for proposed materials including pipe, fittings and specials, and rust preventive compound.
2. ASTM designation for material from which each grade of pipe is fabricated.
3. An affidavit of compliance from pipe lining company indicating that all instructions and requirements of coating materials manufacturer will be followed and that company is acceptable to coating materials manufacturer.
4. An affidavit of compliance from pipe manufacturer certifying that all materials used and work performed comply with Contract Documents.
5. Pipe manufacturing plant's Steel Pipe Fabricators Association (SPFA) or ISO 9000 certification.
6. Layout drawings and details for pipe installation. Tabulated layout schedule shall include the following:
 - a. Order of installation and closures.
 - b. Pipe invert station and elevation at each change of grade and alignment.
 - c. Elements of curves and bends both in horizontal and vertical alignment, including elements of the resultant true angular deflections in cases of combined curvature.
 - d. Limits of each reach of pipe thickness class.
 - e. Limits of each reach of concrete encasement or encasement in casing.
 - f. Locations of valves and other mechanical equipment.
7. Shop details of fabrication and design calculations for reinforcement of fittings and specials, joint details including lining and coating hold back, and field coating details.
8. Certification from fabricator indicating that pipe joints will withstand test and working pressures. Complete details and specifications for joints shall accompany data.

9. Certification from manufacturer of shop hydrostatic test and non-destructive testing.
10. Welding procedures to be used.
11. Field welder qualifications and certifications.
12. Test reports of all laboratory tests.
13. Copies of all test data and certifications of welder qualifications by independent testing laboratory.

1.04 QUALITY ASSURANCE

- A. Furnish weld test specimens to independent testing laboratory when requested by the inspector.
- B. Welding Procedures, Welder Qualifications and Testing:
 1. Shop inspection and testing shall be as specified herein. Field welding procedures, welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and as defined in Section 4 of ANSI/AWWA C206 or ANSI/AWWA C200, as applicable. All qualifications shall be in accordance with all-position pipe tests as defined in Section 5 of AWS D1.1.
 2. The welder qualification testing for field welding shall be conducted at the project site by an independent testing laboratory. Results of previous qualification tests will not be accepted.
 3. Upon completion of each field-welded joint, the welding operator shall mark his regular identification number and the last two digits of the year the work was completed on the interior of the steel pipe. Steel stamping directly on piping will not be permitted unless "low stress" die stamps, such as interrupted dot or round-nose types, are used.
 4. Field welds shall be inspected and tested, by an independent testing laboratory. Field lap welds shall be inspected by magnetic particle or dye penetration methods. Field butt welds shall be inspected by the radiographic method and in accordance with the acceptance criteria of API 1104. Test results shall be submitted within five days following testing.
 5. Personnel performing visual inspection of welds shall be qualified and currently certified as Certified Welding Inspectors (CWI) in accordance with AWI QC1, Standard for Qualification and Certification of Welding Inspectors. Personnel performing non-destructive tests shall be qualified and certified to the requirements of SNT-TC-1A.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping

1. Ship pipe to site with wood lagging between pipes to prevent contact of pipe surfaces.
2. Pipe shall be supported with crossed wood stulls at both ends of each pipe length to maintain roundness of + 1% during shipping and handling.
3. Pack fittings, jointing materials and piping accessories to prevent damage.
4. Seal ends of pipe and fittings with dust-tight cover before shipment to prevent foreign matter from entering the pipe and fittings.
5. Prevent damage to coated pipe, fittings, specials and appurtenances during shipping in accordance with AWWA C214.

B. Acceptance at Site

1. Reject all pipe, fittings, specials and appurtenances not in compliance with Contract Documents, remove from the site and replace at no additional cost to the Authority.

C. Storage and Protection

1. Unload and store pipe, fittings, and accessories to prevent damage and weathering before installation, and in conformance with AWWA C214.
2. Do not handle pipe and fittings by hooks inserted in ends.
3. Replace pipe and fittings in which lining has been damaged at no additional cost to the Authority.
4. Repair damaged exterior coatings before installation of pipe, fittings, specials or appurtenances at no additional cost to the Authority.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pipe, Fittings, Specials, and Appurtenances:

1. Northwest Pipe Company, Vancouver, WA (800-989-9831);
2. Thompson Pipe Group, Grand Prairie TX (972-262-3600);
3. American Spiral Weld Pipe Company, Birmingham, AL (866-442-2997);

4. Or equal.

2.02 MATERIALS:

A. General:

1. Steel pipe, fittings, specials and appurtenances shall be fabricated in accordance with AWWA C200 to sizes, dimensions, and shapes specified herein.

B. Pipe: AWWA C200.

1. Pipe Wall Thickness:

- a. All pipe shall have a minimum thickness as indicated below:

Pipe Diameter	Minimum Thickness
60-inch	0.500-inch

2. The pipe shall be ASTM A139, Grade C or D.

3. Pipe Pressure rating shall be 250 psi.

C. Fittings, Specials, and Appurtenances: AWWA C200

1. Dimensions: AWWA C208.

2. Reinforcement:

- a. Provide reinforcement or wall thickness such that combined stresses due to internal pressure (circumferential and longitudinal) do not exceed 21,000 psi. Internal pressure shall be the specified field test pressure for piping adjacent to item in question.
 - b. Provide reinforcement or wall thickness to withstand external loads, including backfill, live and impact loads, in accordance with the requirements of AWWA M11.
 - c. Wall thickness of smaller end of reducing sections shall not be less than thickness for larger end.

D. Joints:

1. Welded: Furnish lap-welded slip joints or butt strap joints unless otherwise indicated on the Contract Drawings or specified herein. Joints shall be welded in the field. Butt straps shall not be used in lieu of insulating couplings where insulating couplings are indicated.

2. Couplings

- a. Couplings: AWWA C219 for pipes less than 60-inch in diameter.

E. ***Corrosion Control:***

1. ***General Requirements***

- a. ***Provide exterior protective coatings for all buried steel pipe, fittings, specials, and appurtenances. Coatings shall be shop-applied unless otherwise indicated. Surface preparation shall comply with the coating manufacturer's instructions and applicable AWWA standards.***

2. ***Straight Pipe External Coating***

- a. ***Straight pipe shall receive one of the following exterior protective coatings:***

1) ***Polyurethane Coating***

- a) ***Minimum 25 mils DFT***

- b) ***Conforming to ANSI/AWWA C222***

2) ***Tape Coating System***

- a) ***Conforming to AWWA C209***

- b) ***Four-layer system consisting of primer, one inner wrap, and two contrasting outer wraps***

- c) ***Nominal total applied thickness: 80 mils***

3. ***Fittings, Specials, Connections, and Appurtenances***

- a. ***Fittings and special sections shall receive one of the following exterior coatings:***

1) ***Liquid Epoxy Coating***

- a) ***Minimum 16 mils DFT***

- b) ***Conforming to ANSI/AWWA C210***

2) ***Polyurethane Coating***

- a) ***Minimum 25 mils DFT***

b) Conforming to ANSI/AWWA C222

b. Tape Coating System

1) Conforming to AWWA C209

2) Four-layer system consisting of primer, one inner wrap, and two contrasting outer wraps

3) Nominal total applied thickness: 80 mils

4. Cut-backs:

1) Coupled joints: 4¼-inches at plain end. Shop primer on all bare exterior surfaces.

2) Restrained joints: 4¼-inches at bell end, 4¼-inches at spigot end.

5. Inspection

a. Inspect exterior coatings before installation. Perform electrical holiday testing of coatings in accordance with NACE SP0188.

F. Interior Lining:

1. Straight pipe shall be lined with cement-mortar, applied centrifugally by a machine designed to spin the pipe. Where machine applied mortar is not practical, such as at fittings and special sections, the mortar shall be placed by hand. Cement-mortar lining shall conform to AWWA C205.

2. No seal coating or interior bitumastic shall be applied to the cement mortar lining.

2.03 FABRICATION

A. Ends of Sections:

1. For Field Welding;
 - a. Ends of pipe, fittings, specials and appurtenances for field-welded butt strap joints shall have plain ends.
2. For Fittings with Flanges: Prepare ends to be fitted with slip-on flanges in accordance with manufacturer's recommendations.
3. For Connection to Dissimilar Pipe Materials: Where steel pipe is to be connected to buried or submerged concrete, cast-iron or ductile-iron pipe, make connection by means of an insulating coupling that conforms to AWWA C219.
4. For connection to existing steel pipe, refer to paragraph 3.02.E.

B. Seams:

1. All piping shall be made from steel plates rolled into cylinders or sections thereof with longitudinal seams double butt-welded, or spirally formed and double butt-welded. There shall be not more than two longitudinal seams. Double butt-weld girth seams and space not closer than 10 feet apart except in specials and fittings.

C. Coatings and Linings:

1. All direct buried steel pipe, fittings, specials, wall fittings, and accessories shall be lined, coated, or wrapped as specified herein. All concrete encased steel pipe, fittings and specials shall be internally lined as specified herein and shall be black pipe without an exterior coating.
2. Surface preparation shall be in accordance with coating or lining manufacturer's instructions.
3. Cement Mortar Lining:
 - a. Shop-applied cement mortar linings in accordance with AWWA C205.
 - 1) Fittings and Specials: Use wire fabric reinforcement in lining of fittings and specials in accordance with AWWA C205.
 - 2) Field Repair:
 - a) Perform field repair of inside joint surfaces in accordance with AWWA C205, Appendix A,

Paragraph A2, except that an epoxy bonding agent and latex admixture shall be used in conjunction with sand and cement mortar. Addition of lime or pozzolan will not be permitted.

- b) Clean exposed steel and remove all grease. Apply a coat of epoxy bonding agent over area to be lined in accordance with manufacturer's recommendations. Apply a coat of soupy mixture of cement and water over epoxy after it becomes tacky. Cement mortar to which latex admixture has been added shall then be packed into area to be patched and screeded off level with adjacent cement mortar lining. Give patched area an initial floating with a wood float followed by a steel trowel finish.
- c) Remove, clean surfaces, and repair damaged shop-applied cement mortar linings as specified herein for joint repair.

- 3) Adjacent to Valves: Provide steel pipe installed adjacent to butterfly valves with tapered cement mortar lining so that valve disc does not interfere with lining material during valve operation.

- b. Cement-mortar line the interior surfaces of all pipe, fittings, specials and appurtenances.

4. Shop-Applied Tape Coat:

- a. Except as modified or supplemented herein, shop-applied tape coating shall comply with AWWA C214. Outer layer(s) of tape shall be contrasting in color.

D. Outlets:

- 1. Field welded outlets and tapping saddles are not permitted.

2.04 SOURCE QUALITY CONTROL:

A. Tests:

- 1. Pipe shall be hydrostatically tested by the pipe manufacturer per AWWA C200. Fittings and specials that have welds not subjected to the hydrostatic testing shall be ultrasonically tested in accordance with API 5L requirements or examined by the mag-particle method in accordance with ASTM E709. Acceptance criteria for the mag-particle method shall be in accordance with ASME Code Section VIII, Division 1, Appendix six.

PART 3 EXECUTION

3.01 PREPARATION:

- A. Clean foreign matter from interior of all pipe, fittings and specials before installation.

3.02 INSTALLATION

A. General:

- 1. Install piping complete with all fittings, specials, jointing materials, and appurtenances.

B. Alignment and Grade:

- 1. Lay pipe to lines and grades as indicated on the Drawings.
- 2. Maintain alignment and grade. Take at least one elevation reading on each length of pipe. Make periodic elevation measurements with surveying instruments to verify accuracy of grades if laser beam equipment is used. Prevent further thermal deflections if such measurements indicate thermal deflection of laser beam due to differences between ground temperature and air temperature within pipe.

C. Buried Piping:

- 1. Seal open end of pipe with a watertight plug when pipe laying is stopped.
- 2. Pipe embedment and backfilling shall follow installation and jointing of steel pipe in trench to prevent flotation of pipe and to prevent longitudinal movement.

D. Out-of-Round Pipe:

- 1. Pipe which deviates from a true circle by more than one percent shall be corrected in accordance with AWWA M11 and C200. Perform final inspection, repair, and checking of interior lining after struts or jacks have been removed.
- 2. Pipe, after backfill, that is out of round by more than 5% shall be removed and replaced at no additional cost to the Authority.
- 3. Pipe end roundness shall conform to AWWA C200.

E. Connection to Existing Pipes:

- 1. Potable water pipes:

- a. Prevent contamination in accordance with AWWA C651.

F. Field Repair of Protective Coatings and Linings:

1. Entry into pipe for application of interior linings to unlined ends shall be from open ends or manhole flanges if available.
2. Field Repair of Shop-Applied Coatings and Linings:
 - 1) Field-Welded Joints:
 - a) Cement Mortar: Hold back coating and lining 4-inches from joint. Field repair in accordance with AWWA C205 as modified herein.
 - b) Tape Coating: Hold back at least 4-inches from joint. Field repair in accordance with AWWA C209, except total applied tape thickness shall be not less than 80 mils.
 - 2) Flanged Joints: Extend cement mortar lining to ends of pipe and tape coating to back of flange. Shop prime back of flange with primer conforming to AWWA C209

G. Field Joints:

1. Provide joints for all buried pipe as indicated on the Drawings.

H. Flanged Joints:

1. Bolt flanged joints so that there is no restraint on opposite end of piece. Pipe or fitting must be free to move in any direction while bolting. Gradually tighten bolts in a crisscross pattern, to uniformly compress gasket.
2. Permanently support all connecting piping to match bolt holes and to establish uniform contact over entire surface of flanges before any bolts are installed in flanges.
3. Flange faces shall be normal to pipe axis. Do not exceed allowable angular deflection (layback) of flange faces set forth in Section 4.3 of AWWA C207. Reface all flanges after welding to the pipe to prevent distortion of connecting valve bodies from excessive flange bolt tightening and to prevent leakage at joint.
4. Coordinate pipe lengths and dimensions and drilling of flanges with lengths and flanges for valves or other equipment to be installed in piping. All mating flanges shall have same diameter and drilling and shall be able to withstand testing and working pressures.

5. Install insulating flanged joints where indicated on the Drawings. In addition to one full-faced insulating gasket, flange insulating assembly for each insulated flanged joint shall consist of one full-length sleeve, one insulating washer, and two backing washers for each flange bolt. Insulating gasket ID shall be 1/8-inch less than ID of flange in which it is installed. Install insulating flanged joint accessories in accordance with instructions and recommendations of manufacturer.
6. Install additional gasket at insulating flanged joints for proper seal. Gaskets shall be Ethylene-Propylene (EPDM), NSF 61 listed, compounded to resist water, oil, acids, alkalies, (aliphatic) hydrocarbon fluids and chloramines, except in contaminated areas. Gaskets for use in contaminated areas shall be nitrile gaskets designed to resist degradation from volatile organic compounds.

I. Welded Joints:

1. All welds shall be sound and free from embedded scale or slag, shall have tensile strength across weld not less than that of thinner of connected sections, and shall be watertight.
2. Field welding of joints shall conform to AWWA C206 except as modified herein.
3. Weld butt straps, on both inside and outside of pipe and at each end of pipe and strap.
4. Field welded lap joints shall have fillet welds on either the inside or outside of the pipe; the outside weld may be a seal weld. Use fillet welds for flange attachment in accordance with AWWA C207.
5. A yield point determination of a welded joint shall be made by an independent testing laboratory.

3.03 FIELD QUALITY CONTROL:

A. Welding Inspection and Testing:

1. The Contractor shall engage an independent testing laboratory to perform inspection and testing of field welds. Defective welds shall be repaired and retested at no additional cost to the Authority. Refer to Section 1.04.B.4 for testing methods.
2. The Authority may engage an independent test laboratory to perform non-destructive testing in addition to any testing specified herein.

B. Inspection:

1. Inspect and repair exterior coatings before installation of pipe, fittings, specials and appurtenances.
2. Perform electrical inspection of tape coatings after installation of the pipe, fittings, or special in the trench.

3.04 REMOVAL AND DISPOSAL / ABANDONMENT OF SECTION W10

- A. Remove all cast iron frames and covers from all of the valve and access chambers to be abandoned.
- B. Remove the top section of the brick or concrete chamber, a minimum 4 feet from ground surface.
- C. Backfill the excavation with compacted gravel borrow per Section 02200 – Earthwork .
- D. Pipelines to be abandoned are to be filled with Controlled Density Fill (CDF) as specified in Section 02200 - Earthwork.
- E. CDF shall meet the requirements of the applicable municipal street opening permit included as Appendix J - Belmont Street and Trench Opening Permit Regulations and Appendix K – Waltham Street Opening, Curb Cut & utility Permit Rules and Regulations. The work to be done to abandon the 60-inch Steel Section W10 Pipe consists of furnishing all materials, labor, tools and equipment, and performing all operations necessary to complete the abandonment of the existing Section W10, as indicated on the Drawings.
- F. Work shall be scheduled so as to eliminate the storage of materials and equipment in the way of vehicular and pedestrian traffic required for the abandonment of existing Section W10 water main.
- G. Coordinate and cooperate with all commercial, industrial and residential users or abutters for disconnecting, rerouting, and maintenance of services required.

**** END OF SECTION ****