

Section 02501

DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SUMMARY

This Section includes ductile iron pipe and fittings for water lines, wastewater force mains, gravity sanitary sewers, and storm sewers.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for ductile iron pipe and fittings under this Section, with the exception of extra fittings in place. Include cost in unit prices for Work as specified in the following Sections, as applicable:
 - a. Section 02511 – “Water Lines”
 - b. Section 02531 – “Gravity Sanitary Sewers”
2. Refer to Section 01270 – “Measurement and Payment” for unit price procedures.

B. Extra ductile iron compact fittings in place shall be for additional fittings required to complete job. This is not to exclude extension of pipe across driveway or intersection for purpose of terminating line in more advantageous position. This determination shall be at discretion of Project Manager. This bid item includes additional fittings as may be necessary to complete job in conformance with intent of Plans. Payment for Extra Ductile Iron Compact Fittings in Place will be on a per ton basis.

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total stipulated price.

1.03 REFERENCES

- A. ANSI/AWS D11.2 – Guide for Welding Iron Castings
- B. ANSI A21.4 (AWWA C 104) – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
- C. ANSI A21.10 (AWWA C 110) – Standard for Ductile-Iron and Gray-Iron Fittings.
- D. ANSI A21.11 (AWWA C 111) – Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

- E. ANSI A21.15 (AWWA C 115) – Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - F. ANSI A21.16 (AWWA C 116) – Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.
 - G. ANSI A21.50 (AWWA C 150) – Standard for Thickness Design of Ductile-Iron Pipe.
 - H. ANSI A21.51 (AWWA C 151) – Standard for Ductile-Iron Pipe, Centrifugally Cast.
 - I. ANSI A21.53 (AWWA C 153) – Standard for Ductile-Iron Compact Fittings.
 - J. ASME B 16.1 – Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, and 250.
 - K. ASTM D 1248 – Standard Specification Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - L. ASTM F 477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - M. ASTM G 62 – Standard Test Methods for Holiday Detection in Pipeline Coatings.
 - N. AWWA C 105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - O. AWWA C 300 – Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
 - P. AWWA C 600 – Standard for Installation of Ductile-Iron Mains and Their Appurtenances.
 - Q. SSPC-SP 6 – Steel Structures Painting Council, Commercial Blast Cleaning.
 - R. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
 - S. American Association of State Highway Transportation Officials (AASHTO).
- 1.04 SUBMITTALS
- A. Conform to requirements of Section 01330 – “Submittal Procedures”.
 - B. For pipes 30 inches and greater submit shop drawings signed and sealed by Professional Engineer registered in State of Texas showing the following:
 - 1. Manufacturer’s pipe design calculations.
 - 2. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fittings, flange, and special details, with plan view of each pipe

segment sketched, detailing pipe invert elevations, horizontal bends, restrained joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Plans. Do not start production of pipe and fittings prior to review and approval by Project Manager. Provide final approved lay schedule on CD-ROM in Adobe portable document format (*.PDF). Provide As-Built lay schedule if any changes are made during construction.

3. Calculations and limits of thrust restraint.
4. Class and length of joint.
- C. Submit critical locate report meeting the requirements of Section 02317- "Excavation and Backfill for Utilities".
- D. Submit manufacturer's certifications that ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A21.51.
- E. Submit certifications that pipe joints have been tested and meet requirements of ANSI A21.11.
- F. Submit affidavit of compliance in accordance with ANSI A21.16 for fittings with fusion bonded epoxy coatings or linings.
- G. Submit pipe coatings and lining material certifications.
- H. Submit polyethylene encasement material in accordance with Section 02528 – "Polyethylene Wrap".

1.05 RELATED REQUIREMENTS

- A. Section 01270 – "Measurement and Payment"
- B. Section 01330 – "Submittal Procedures"
- C. Section 01782 – "Operations and Maintenance Data"
- D. Section 02317 – "Excavation and Backfill for Utilities"
- E. Section 02511 – "Water Lines"
- F. Section 02515 – "Hydrostatic Testing of Pipelines"
- G. Section 02528 – "Polyethylene Wrap"
- H. Section 02531 – "Gravity Sanitary Sewers"
- I. Section 09901 – "Painting and Protective Coating"

J. Section 15155 – “Couplings and Coupling Adapters”

K. Section 16640 – “Cathodic Protection for Pipelines”

1.06 – 1.13 NOT USED

PART 2 PRODUCTS

2.01 MANUFACTURER(S) (NOT USED)

2.02 MATERIALS AND/OR EQUIPMENT

A. Ductile Iron Pipe

1. Ductile Iron Pipe Barrels: Shall conform to AWWA C115, C150, and C151 and bear mark of Underwriters’ Laboratories approval. Unless otherwise shown on Plans, provide a class of pipe that shall exceed the designed thickness calculations using the conditions listed in Paragraph 2.01.E and meet the following minimum classifications:
 - a. Pressure Class 250 for water lines in open cut.
 - b. Pressure Class 300 for water lines in casing or augered hole.
 - c. Pressure Class 300 for sanitary sewers.
 - d. Pressure Class 350 for flanged pipe.
2. Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings.
3. Provide Cathodic Protection System for pipelines larger than 24 inches in accordance with Section 16640 – “Cathodic Protection for Pipelines” and as shown on Plans. For pipelines 24 inches and smaller, furnish ductile iron pipe meeting the following criteria:
 - a. Provide minimum Pressure Class 300.
 - b. For augered sections or sections installed inside a casing, provide coating and encasement requirements per paragraph 2.05.
 - c. Adhere to other requirements specified herein (e.g., insulation kits, etc.).
4. For all ductile iron pipelines whether or not cathodically protected, provide polyethylene encasement material and installation in accordance with AWWA C105, and backfill as specified. Minimum of two complete wraps of 8-mil-thick polyethylene.

5. For use of pressure class pipe for water lines, design pipe and fittings to withstand most critical simultaneous application of external loads and internal pressures. Base design on minimum of AASHTO HS-20 loading, AREMA E-80 loads and depths of bury as indicated on Plans. Design pipes with Marston's earth loads for a transition width trench for zero to 16 feet of cover. Use Marston's earth loads for a trench width of O.D. (of pipe) + 4 feet for pipe greater than 16 feet of cover. Use Marston's equations for a trench condition in both open-cut and tunnel applications. Design for most critical groundwater level condition. Pipe design conditions:
 - a. Working pressure = 100 psi.
 - b. Hydrostatic field test pressure = 150 psi.
 - c. Maximum pressure due to surge = 150 psi.
 - d. Minimum Pressure due to surge = -10 psi.
 - e. Design tensile stress due to surge or hydrostatic test pressure: No greater than 50% minimum yield.
 - f. Design bending stress due to combined earth loads and surge or hydrostatic test pressure: No greater than 48,000 psi.
 - g. Unit weight of fill \exists 120 pcf.
 - h. Deflection lag factor (D_1) = 1.2.
 - i. Bedding constant (K) = 0.1.
 - j. Moment coefficient = 0.16.
 - k. Fully saturated soil conditions $hw=h$ =depth of cover above top of pipe.
6. Hydrostatic Test of Pipe: AWWA C 151, Section 5.2.1, at point of manufacture. Hold test for a Minimum 2 minutes for thorough inspection of pipe. Repair or reject pipe revealing leaks or cracks.
7. Pipe Manufacturer for large diameter water lines: Minimum of 5 years of successful pipe installations in continuous service. Manufacturer must maintain on site or in plant enough fittings to satisfy the following requirements:

Line Diameter	Required Bends*
20 and 24 inches	Four 45E bends per 5,000 LF of water line
> 24 inches	Four 22.5E bends per 10,000 LF of water line

*Based on total length of contract (minimum of four). Any combination of bends may be substituted at manufacturer’s option (i.e. two 22.5° bends are equivalent to one 45° bend) and shall be counted as one fitting.

Manufacturer or supplier must be capable of delivering bends to job site within 12 hours of notification. Use fittings at direction of Project Manager where unforeseen obstacles are encountered during construction. These fittings are in addition to any fittings called out in construction documents and must be available at all times.

8. Provide flange adapter with insulating kit as required when connecting new piping to existing piping and piping of different materials, unless otherwise approved by Project Manager.
9. Clearly mark pipe section to show location and pressure class color coded.
10. No welding will be permitted on Ductile Iron Pipe except at restrained joint spigots. No field welding is allowed.

B. Joints

1. Joint Types: ANSI A21.11 push-on; ANSI A21.11 mechanical joint; or ANSI A21.16 flanged end. Provide push-on joints unless otherwise indicated on the Plans or required by these specifications. For bolted joints, conform to requirements of AWWA C111.
2. Where required by Plans, provide approved restrained joints for buried service.
3. Threaded or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.
4. Provide for restrained joints designed to meet test pressures required under Section 02515 – “Hydrostatic Testing of Water Lines” as applicable. Provide restrained joints for test pressure or maximum surge pressure as specified, whichever is greater for water lines. Do not use passive resistance of soil in determining minimum restraint lengths.
5. Electrical Bond Wires: Use stranded, copper cable furnished with high molecular weight polyethylene insulation (HMWPE). Use wire gauge (AWG) as shown on Plans.
6. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer for pipe joints or restraint

joints. Submit details of other methods of providing curves and bends for consideration by Project Manager. When other methods are deemed satisfactory, install at no additional cost.

C. Gaskets

1. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F 477 (One Bolt only); for flanged joints $\frac{1}{8}$ -inch-thick gasket in accordance with ANSI A21.15.

D. Fittings

1. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they connect to.
2. Push-on Fittings: ANSI A21.10; ductile iron ANSI A21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.
3. Flanged Fittings: ANSI 21.10; ductile iron ANSI A21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.
4. Mechanical Joint Fittings: ANSI A21.11; pressure rated at 250 psi.
5. Ductile Iron Compact Fittings: Shall conform to AWWA C153 and shall be:
 - a. Fusion bonded epoxy lined or
 - b. Cement mortar lined.
6. For tangential flanged outlets shown on Plans, substitute with a tee with an equivalent sized outlet unless otherwise approved by Project Manager.

E. Coatings and Linings

1. Water line Interiors: ANSI A21.4, cement lined with seal coat; ANSI A21.16 fusion bonded epoxy coating for interior; comply with NSF 61.
2. Sanitary Sewer and Force Main Interiors:
 - a. Preparation: Commercial blast cleaning conforming to SSPC-SP6.
 - b. Liner thickness: Nominal 40 mils, minimum 35 mils, for pipe barrel interior; minimum 6 to 10 mils at gasket groove and outside spigot end to 6 inches back from end.

- c. Testing: ASTM G 62, Method B for voids and holidays; provide written certification.
- d. Acceptable Lining Materials:
 - 1) Provide approved virgin polyethylene conforming to ASTM D 1248, with inert fillers and carbon black to resist ultraviolet degradation during storage; heat bonded to interior surface of pipe and fittings.
 - 2) Ceramic Epoxy - Protecto 401 or approved equal
- 3. Sanitary Sewer Point Repair Pipe: For pipes lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with seal coat in accordance with ANSI A21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.02E, Sanitary Sewer and Force Main Interiors.
- 4. Exterior encasement and coating requirements for buried waterlines:
 - a. Open cut construction method:
 - 1) Provide double wrap polyethylene encasement in accordance with AWWA C105 and the requirements of Section 02528 – “Polyethylene Wrap” for buried waterlines both with and without cathodic protection, and
 - 2) Provide prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings.
 - b. Auger, casing, or liner construction method:
 - 1) Provide prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings, and.
 - 2) Provide double wrap with polyethylene encasement. Place circumferential wraps of tape of plastic tie strap at two-foot intervals along the barrel of the pipe, and thoroughly seal each end of the polyethylene tube.
- 5. Exterior waterline coating requirements for above ground, atmospheric conditions: Refer to Section 09901 – “Protective Coatings”.
- 6. Exterior Coating for Sanitary Sewer: Prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings in open cut excavation and in casings.

7. For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and alloy steel fasteners.
8. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer for maximum resistance to the contaminants identified in the Phase II Environmental Site Assessment Report.

2.03 – 2.04 NOT USED

PART 3 EXECUTION

3.01 – 3.02 NOT USED

3.03 ERECTION/INSTALLATION APPLICATION AND/OR CONSTRUCTION

- A. Conform to installation requirements of Sections 02511 – “Water Lines” and 02531 – “Gravity Sanitary Sewers”, except as modified in this Section.
- B. Install in accordance with AWWA C 600 and manufacturer’s recommendations.
- C. Install double wrap Polyethylene encasement in conformance with requirements of AWWA C105 and Section 02528 – “Polyethylene Wrap”.
- D. Provide electrical continuity bonding across buried mechanical and push-on joint assemblies, except where insulating flanges are required by Plans.
 1. Provide minimum number of bond wires shown on Plans. Remove one inch of HMWPE insulation from each end of bond wire prior to attaching.
 2. Secure wire onto pipe using approved Thermite Welding procedures.
 3. Coat bare metal and weld metal after weld is secure. Use coal-tar compound or other compatible coating. For polyurethane coated pipe, use compatible polyurethane coating.
 4. Visually inspect Thermite Weld connections for electrical continuity, strength and suitable coating prior to backfilling or placing pipe in augered hole or casing.

3.04 REPAIR/RESTORATION

Field Repair of Coatings:

Repair damages to asphalt coating with bitumastic asphalt per manufacturer’s recommendations.

3.05 – 3.10 NOT USED

END OF SECTION