

SECTION 02215 DUCTILE IRON PIPE (DIP) AND FITTINGS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Ductile Iron Pipe (DIP) and fittings for water lines, wastewater force mains, gravity sanitary sewers and storm sewers.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

- 1. No separate payment will be made for Ductile Iron Pipe (DIP) 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 02400 – Water Lines.
 - b. Section 02500 – Gravity Sanitary Sewers.
 - c. Section 02510 – Sanitary Sewer Force Mains.
 - d. Section 02600 – Storm Sewers.
- 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.

- B. Extra Ductile Iron Pipe (DIP) 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 the Project Manager. This bid item includes additional fittings as may be necessary to complete job in conformance with intent of the Drawings.

C. Stipulated Price (Lump Sum):

- 1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES

- A. AASHTO – American Association of State Highway and Transportation Officials.
- B. AREMA – American Railway Engineering and Maintenance-of-Way Association.
 - 1. Manual for Railway Engineering.
- C. ANSI – American National Standards Institute.
 - 1. ANSI A21.4 (AWWA C104) – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings, for Water.
 - 2. ANSI A21.10 (AWWA C110) – Standard for Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in.
 - 3. ANSI A21.11 (AWWA C111) – Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. ANSI A21.15 (AWWA C115) – Standard for Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.
 5. ANSI A21.16 (AWWA C116) – Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey iron Fittings for Water Supply Service.
 6. ANSI A21.50 (AWWA C150) – Standard for Thickness Design of Ductile-Iron Pipe.
 7. ANSI A21.51 (AWWA C151) – Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids.
 8. ANSI A21.53 (AWWA C153) – Standard for Ductile Iron Compact Fittings, 3 inches through 24 inches and 54 inches through 64 inches for Water Service.
- D. ASME – American Society of Mechanical Engineers.
1. ASME B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
- E. ASTM – American Society for Testing and Materials.
1. ASTM D1248 – Standard Specification Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable.
 2. ASTM F477 – Elastomeric Seals (gaskets) for Joining Plastic Pipe.
 3. ASTM G62 – Standard Test Methods for Holiday Detection in Pipeline Coatings.
- F. AWWA – American Water Works Association.
1. AWWA C102 – American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 2. AWWA C300 – Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and other Liquids.
 3. AWWA C600 – Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.
- G. CFTS – City of Friendswood Technical Specifications.
- H. SSPC – Steel Structures Painting Council.
1. SSPC-SP 6 – Steel Structures Painting Council, Commercial Blast Cleaning.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. For pipes sixteen inches (16 In) and greater submit shop drawings signed and sealed by a Professional Engineer registered in the State of Texas showing the following:
 1. Manufacturer's pipe design calculations
 2. Lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fitting, 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 the Drawings. Do not start production of pipe and fittings prior to review and approval by the Project Manager.

- Provide final approved lay schedule on CD-ROM in Adobe portable document format (*.PDF).
3. Calculations and limits of thrust restraint
 4. Class and length of joint
- C. Submit manufacturer's certifications that Ductile Iron Pipe (DIP) and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A21.51.
 - D. Submit certifications that pipe joints have been tested and meet requirements of ANSI A21.11.
 - E. Submit affidavit of compliance in accordance with ANSI A21.16 for fittings with fusion bonded epoxy coatings or linings.

1.5 QUALITY ASSURANCE

- A. Provide manufacturer's affidavits that pipe was manufactured in compliance with standards referenced in this Section.

PART II: PRODUCTS

2.1 DUCTILE IRON PIPE (DIP)

- A. Ductile Iron Pipe (DIP) Barrels: ANSI A21.15, ANSI A21.50 or ANSI A21.51; bear mark of Underwriters' Laboratories approval; minimum thickness Class 51 for water lines and thickness Class 52 for sanitary sewers or as shown on the Drawings. Provide minimum thickness Class 53 for flanged pipe.
- B. Provide pipe sections in standard lengths, not less than eighteen feet (18 Ft) long, except for special fittings and closure sections as indicated on shop drawings.
- C. Modify pipe for cathodic protection in accordance with Section 02285 – Cathodic Protection. In lieu of furnishing Ductile Iron Pipe (DIP) with cathodic protection system, furnish Ductile Iron Pipe (DIP) with polyethylene encasement, provided the following criteria is met:
 1. Provide minimum thickness class
 2. Provide polyethylene encasement material and installation in accordance with AWWA C105 and backfill as specified. Minimum of two (2) complete wraps of eight (8) mil thick polyethylene.
 3. Use polyethylene encasement for open cut installations only. For augered sections or sections installed inside a casing, provide coating in accordance with paragraph 2.5.D.1.
 4. Adhere to other requirements specified herein (e.g., insulation kits, etc.).
- D. 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 the Drawings.

Design pipes with Marston's earth loads for a transition width trench for zero feet (0 Ft) to sixteen feet (16 Ft) of cover. Use Marston's earth loads for a trench width of O.D. (of pipe) plus four feet (+4 Ft) for pipe greater than sixteen feet (16 Ft) 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:

1. Working pressure = One hundred pounds per square inch (100 psi).
 2. Hydrostatic field test pressure = One hundred fifty pounds per square inch (150 psi).
 3. Maximum pressure due to surge = One hundred fifty pounds per square inch (150 psi).
 4. Minimum Pressure due to surge = Minus five pounds per square inch (-5 psi).
 5. Design tensile stress due to surge or hydrostatic test pressure: No greater than fifty percent (50%) minimum yield.
 6. Design bending stress due to combined earth loads and surge or hydrostatic test pressure: No greater than forty-eight thousand pounds per square inch (48,000 psi).
 7. Unit weight of fill \geq One hundred twenty pounds per cubic foot (120 pcf).
 8. Deflection lag factor (D_f) = One and two tenths (1.2).
 9. Bedding constant (K) = One tenth (0.1).
 10. Moment coefficient = Sixteen hundredths (0.16).
 11. Fully saturated soil conditions $hw=h$ =depth of cover above top of pipe.
- E. Hydrostatic Test of Pipe: AWWA C151, Section 5.2.1, at point of manufacture. Hold test for a minimum two minutes (2 Min) for thorough inspection of pipe. Repair or reject pipe revealing leaks or cracks.
- F. Pipe Manufacturer for large diameter water lines: Minimum of five years (5 Yrs) of successful pipe installations in continuous service. Manufacturer must maintain on site or in plant enough fittings to satisfy the requirements as specified in TABLE 4.1 – REQUIRED BENDS in this Section.
Manufacturer or supplier must be capable of delivering bends to job site within twelve hours (12 Hrs) of notification. Use fittings at direction of the 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.
- G. Provide flange adapter with insulating kit as required when connecting new piping to existing piping and piping of different materials, unless otherwise approved by the Project Manager.
- H. Clearly mark pipe section to show location and thickness/pressure class color coded.

2.2 JOINTS

- A. 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 Drawings or required by these specifications. For bolted joints, conform to requirements of AWWA C111; provide minimum 304 stainless steel for restraint joints.
- B. Where required by the Drawings, provide approved restrained joints for buried service.
- C. Threaded or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.
- D. Provide for restrained joints designed to meet test pressures required under Section 02450 – Hydrostatic Testing of Waterlines or Section 02510 – Sanitary Sewer Force Mains, 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.
- E. Bond rubber gasketed joints to provide electrical continuity along entire pipeline, except where insulating flanges are required by the Drawings.
- F. 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 the Project Manager. When other methods are deemed satisfactory, install at no additional cost to the City.

2.3 GASKETS

- A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F477 (One Bolt only); for flanged joints one-eighth inch (1/8 In) thick gasket in accordance with ANSI A21.15.

2.4 FITTINGS

- A. 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.
- B. Push-on Fittings: ANSI A21.10; Ductile Iron Pipe (DIP) ANSI A21.11 joints, gaskets and lubricants; pressure rated at two hundred pounds per square inch (250 psi).
- C. Flanged Fittings: ANSI A21.10; Ductile Iron Pipe (DIP) ANSI A21.11 joints, gaskets and lubricants; pressure rated at two hundred fifty pounds per square inch (250 psi).
- D. Mechanical Joint Fittings: ANSI A21.11; pressure rated at two hundred fifty pounds per square inch (250 psi).
- E. Ductile Iron Pipe (DIP) Compact Fittings for Water lines: ANSI A21.53; four inch (4 In) through twelve inch (12 In) diameter fusion bonded epoxy-lined or cement mortar lining.

2.5 COATINGS AND LININGS

- A. Water line Interiors: ANSI A21.4, cement lined with seal coat; ANSI A21.16 fusion bonded epoxy coating for interior; comply with NSF 61.
- B. Sanitary Sewer and Force Main Interiors:
 - 1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.
 - 2. Liner thickness: Nominal forty (40) mils, for pipe barrel interior; minimum six (6) mils to ten (10) mils at gasket groove and outside spigot end to six inches (6 In) back from end.
 - 3. Testing: ASTM G62, Method B for voids and holidays; provide written certification.
 - 4. Acceptable Lining Materials:
 - a. Provide approved virgin polyethylene conforming to ASTM D1248, with inert fillers and carbon black to resist ultraviolet degradation during storage; heat bonded to interior surface of pipe and fittings.
 - b. Ceramic Epoxy – Protecto 401
- C. Sanitary Sewer Point Repair Pipe: For pipes which will be 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 2.5.B.4, Sanitary Sewer and Force Main Interiors.
- D. Exterior:
 - 1. Water Lines:
 - a. Auger Holes: Conform to requirements of Section 02265 – Polyurethane Coatings on Steel or Ductile Iron Pipe.
 - b. Above Ground (or Exposed): Conform to requirements of Section 02250 – Steel Pipe and Fittings, Paragraph 2.3.
 - c. Tunnel, Casing or Direct Bury: Conform to requirements of Paragraph 2.5.E.
 - 2. Sanitary Sewers: 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.
- E. Polyethylene Wrap: For buried pipes not cathodically protected, provide polyethylene wrap unless otherwise specified or shown. Conform to requirements of Section 02260 – Polyethylene Wrap.
- F. For flanged joints in buried service, provide petrolatum wrapping system, Denso or equal, for the complete joint and alloy steel fasteners. Alternatively, provide bolts made of Type 304 stainless steel.
- G. 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.
- H. For water lines cathodically protected, supply Ductile Iron Pipe (DIP) with

either tape coatings or some other bonded dielectric coating as specified in Section 02255 – Steel Pipe and Fittings for Large Diameter Water Lines.

PART III: EXECUTION

3.1 INSTALLATION

- A. Conform to installation requirements of Sections 02400 – Water Lines, 02500 – Gravity Sanitary Sewers, 02510 – Sanitary Sewer Force Mains 02600 – Storm Sewers, 02540 – Sanitary Sewer Point Repairs and 02560 – Sanitary Sewer Obstruction Removal, except as modified in this Section.
- B. Install in accordance with AWWA C600 and manufacturer's recommendations.
- C. Install all Ductile Iron Pipe (DIP) in double polyethylene wrap, unless cathodic protection is provided. Do not use polyethylene wrap with a cathodic protection system.
- D. Holiday Testing:
 - 1. Polyurethane: Conform to requirements of Section 02265 – Polyurethane Coatings for Steel or Ductile Iron Pipe.
 - 2. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

3.2 FIELD REPAIR OF COATINGS

- A. Polyurethane: Conform to requirements of Section 02265 – Polyurethane Coatings for Steel or Ductile Iron Pipe.
- B. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

PART IV: TABLES

4.1 – REQUIRED BENDS

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

*Based on total length of contract [minimum of four (4)]. Any combination of bends may be substituted at manufacturer's option [i.e. two (2) – twenty-two and one half degree (22.5°) bends are equivalent to one (1) – forty-five degree (45°) bend] and shall be counted as one (1) fitting.

END OF SECTION