

SECTION 02615
DUCTILE IRON PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope

1. Furnish and install ductile iron piping complete with all fittings, jointing materials, supports, anchors, blocking, encasement, corrosion control and other necessary appurtenances
2. Service applications
 - a. Raw, partially treated and treated wastewater
 - b. Waste-activated sludge
 - c. Activated sludge
 - d. Unstabilized and stabilized biosolids
 - e. Ambient and high temperature compressed air

B. Additional Requirements Specified Elsewhere

1. Section 01340: Shop Drawings, Product Data, and Samples
2. Section 01400: Quality Control
3. Section 01600: Materials and Equipment

C. Related Requirements Specified Elsewhere

1. Section 02200: Earthwork
2. Section 02622: Plastic Pipe
3. Section 02641: Valves and Accessories
4. Section 02708: Pressure Pipelines and Appurtenances
5. Section 15060: Pipe and Fittings
6. Construction Standards: Thrust Blocks

1.2 QUALITY ASSURANCE

A. Reference Standards: The following referenced standards are for the most current version of each standard.

1. ANSI A21.4/AWWA C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. ANSI A21.5/AWWA C105: Polyethylene Encasement for Ductile-Iron Pipe Systems
3. ANSI A21.10/AWWA C110: Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In., for Water Service
4. ANSI A21.11/AWWA C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

5. ANSI A21.15/AWWA C115: Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
6. ANSI A21.16/AWWA C116: Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
7. ANSI A21.50/AWWA C150: Thickness Design of Ductile-Iron Pipe
8. ANSI A21.51/AWWA C151: Ductile-Iron Pipe, Centrifugally Cast for Water
9. ANSI A21.53/AWWA C153: Ductile-Iron Compact Fittings, 3 In. through 24 In., and 54 In. through 64 In., for Water Service
10. AWWA C600: Installation of Ductile-Iron Water Mains and Their Appurtenances
11. AWWA C651: Disinfecting Water Mains
12. ANSI B16.1: Cast-Iron Pipe Flanges and Flanged Fittings
13. ANSI B16.14: Ferrous Pipe Plugs, Bushings and Locknuts with Pipe Threads
14. ANSI/ASTM A746: Standard Specifications for Ductile-Iron Gravity Sewer Pipe
15. ASTM A536: Ductile-Iron Castings
16. ASTM A307: Carbon Steel Externally Threaded Standard Fasteners

1.3 SUBMITTALS

- A. Shop drawings and product data in accordance with Section 01340
 1. Material specification data
 2. Installation instructions
- B. Test reports: Reports of field tests
- C. Certification of Compliance
 1. Manufacturer's affidavit of compliance certifying
 - a. All tests have been conducted
 - b. All materials comply with applicable standards
 - c. All materials comply with these Specifications
 2. Retain test information and make available to Engineer on request

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. During loading, transporting and unloading, exercise care to prevent damage to material
- B. Do not drop pipe or fittings
- C. Store materials on-site in enclosures or under protective coverings
- D. Assure materials are kept clean and dry
- E. Do not store materials directly on ground
- F. Adequately tag or otherwise mark all piping and fittings as to size and service application

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe

1. Conformance
 - a. ANSI 21.51/AWWA C151; ASTM A536, Grade 60-42-10; Thickness Class 50 or Pressure Class 350, unless otherwise required for internal or external loading
 - 1) Conform to wall thickness requirements associated with equipment or facilities connected to pipe, such as pump suction and discharge flanges, Weld-O-Lets[®], tapping sleeves, or corporation stops
 - b. Fittings shall conform to ANSI 21.10 for flanged, mechanical joints and push-on joints (AWWA C110 or C153)
2. Joints
 - a. Mechanical joint: ANSI A21.11
 - b. Push-on: ANSI A21.11
 - c. Flanged: ANSI B16.1, 125 lb. drilling
 - d. Rubber gaskets: AWWA C111 (ANSI A21.11)
 - 1) Table 8 does not apply for high temperature air service
 - 2) High temperature air service
 - a) Viton A
 - b) Other fluoropolymer elastomeric suitable for pipeline conveying compressed air at a temperature of 300°F
3. Protective coatings and linings
 - a. Underground service
 - 1) Exterior coating: Treatment process pipe and air pipe
 - a) Manufacturer's standard bituminous coating approximately 1 mil thick
 - b) Polyethylene encasement
 - (1) Per AWWA C105
 - (2) Film: Linear, low density polyethylene (LLDPE)
 - (a) Tensile strength: 3600 psi, 28.8 lbs/in
 - (b) Elongation: 800%
 - (c) Minimum thickness: 8 mil
 - 2) Interior lining: Treatment process pipe
 - a) Ceramic epoxy
 - (1) Thickness: 40 mil dry film thickness
 - (2) Design basis
 - (a) PROTECTO 401[®] by Induron Coatings, Inc.
 - (b) Series 431 Perma-Shield[®] PL by Tenemec
 - 3) Interior lining: Air pipe
 - a) None
 - b. Exposed service
 - 1) Exterior coating: Treatment process pipe and air pipe
 - a) Provide manufacturer's standard primer for field applied coating system
 - b) Refer to Section 09900 – Painting

- c) Assure compatibility of shop applied coating with required finish coating
 - 2) Interior lining: Treatment process pipe
 - a) Ceramic epoxy
 - (1) Thickness: 40 mil dry film thickness
 - (2) Design basis
 - (a) Protecto 401[®] by Induron Coatings, Inc.
 - (b) Series 431 Perma-Shield[®] PL by Tnemec
 - 3) Interior lining: Air pipe
 - a) None
- 4. Criteria for acceptance: In addition to any deficiencies covered by the reference specifications above, any of the following visual defects will not be accepted:
 - a. Improperly formed pipe such that pipe intended to be straight has an ordinate, measured from the concave side of the pipe exceeding 1/16 inch per foot of length
 - b. Pipe which is out-of-round to prohibit proper jointing
 - c. Pipe which is fractured, cracked, chipped or damaged in any manner
 - d. Pipe that has been damaged during shipment or handling
 - e. Pipe which has lining which is fractured, cracked, chipped or damaged in any manner and would not provide satisfactory service under the conditions intended

B. Joints

- 1. Push-on joints: ANSI A21.11/AWWA C111
- 2. Mechanical joints: ANSI A21.11/AWWA C111
- 3. Flange joints: AWWA C115, ANSI B16.1, Class 125 drilling
 - a. Where joined with steel pipe, provide compatible flange drilling, thickness and outside diameter
- 4. Gaskets
 - a. Treatment process pipe
 - 1) Gaskets shall be neoprene or other synthetic rubber (SBR); natural rubber will not be acceptable
 - 2) Lubricant: Heavy vegetable soap solution suitable for potable water use
 - b. Air pipe
 - 1) FKM or other fluoropolymer elastomeric suitable for pipeline conveying compressed air at a temperature of 300°F

C. Fittings

- 1. Conform to AWWA C153 unless conditions require C110 fittings for dimensional or connecting conditions
- 2. Mechanical joint restraint
 - a. Ductile iron pipe: Series 1100 MEGALUG[®] by EBBA Iron, Inc.
 - b. PVC pipe: Series 2000 PV by EBBA Iron, inc.

D. Protective Coatings and Linings

- 1. Refer to paragraph 2.1.A.3.

2. Provide coating manufacturer's standard products for field application of coatings on field cut pipe and for repair of damaged coatings and linings

2.2 FABRICATION AND MANUFACTURE

A. Joints

1. As indicated on Drawings
 - a. Underground piping: Push-on joints
 - b. Underground fittings: Mechanical joint
 - c. Exposed service: Flanged joint

B. Shop Coating and Lining

1. Shop apply ceramic epoxy to the interior surfaces of all treatment process pipe and fittings in accordance with the coating manufacturer's specifications and recommendations to a minimum thickness of 40 mil dry film thickness
2. Shop coat the exterior surface of all underground pipe and fittings with a bituminous coating approximately 1 mil thick
3. Shop prime all exterior surfaces of exposed service pipe and fittings in accordance with Section 09900 – Painting

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas for

1. Defects such as weak structural components that adversely affect execution and quality of Work
2. Deviations beyond allowable tolerances for piping clearances
3. Depth of cover and bedding conditions in conformance with Specifications

B. Start installation only when conditions are satisfactory

C. Pipe

1. Carefully examine pipe and fittings for cracks and other defects prior to installation
2. Remove all defective pipe from site and replace
3. Pipe and fittings in which the lining has been damaged shall be replaced
 - a. Small, readily accessible damaged areas may be repaired
4. Repair all damage to pipe coating before installing the pipe

3.2 INSTALLATION

A. Cutting Pipe

1. Cut pipe neatly without damage to pipe or lining
2. Cut smooth, straight and at right angles to pipe axis

3. Dress end of cut pipe to remove roughness and sharp corners
4. Cut ductile iron pipe with saw or abrasive wheel
5. Flame cutting using an oxyacetylene torch is not allowable
6. Coat all cut surfaces with epoxy coatings conforming to the requirements of AWWA C210-03 or manufacturer of lining and coating material
 - a. PROTECTO[®] joint compound
 - b. Tnemec Company Incorporated two-part touchup kit

B. Cleaning

1. Thoroughly clean pipe and fittings of foreign matter before installation
 - a. Assure all unlined pipe has been cleaned to remove all dirt, manufacturing or construction debris, or any substrate or oxidized material on interior of pipe which is not permanently adhered
2. Keep pipe and fittings clean until final acceptance
 - a. Prevent foreign material from entering the pipe
 - b. Debris, tools, clothing or other materials shall not be placed in or allowed to enter the pipe
3. Joint contact surfaces
 - a. Wire brush, if necessary
 - b. Wipe clean
 - c. Keep clean until jointing is complete
4. When pipe laying is stopped, cover open end with a watertight plug

C. Piping Underground

1. Install in accordance with AWWA C600 except as specified herein
2. Protect from lateral displacement by placing embedment material
3. Do not lay pipe
 - a. In water
 - b. Under unsuitable weather conditions
 - c. Under unsuitable trench conditions
4. Lay pipe with the bell ends facing the direction of laying except where Engineer authorizes reverse laying
 - a. Begin pipe laying at lowest point
5. Install polyethylene wrap on all buried pipe and fittings in accordance with AWWA C105
6. Where underground piping transitions to exposed above ground piping, install polyethylene tubing below ground, wrap pipe from 2-feet below ground to 2-feet above ground with cold-applied tape in accordance with AWWA C214. Refer to Section 02617

D. Jointing

1. Follow manufacturer's instructions
 - a. Prepare and coat ends of cut pipe as specified
2. Mechanical joints
 - a. Clean inside of bell and outside of spigot
 - b. Apply thin film of lubricant to inside of bell, outside of spigot, and the gasket
 - c. Tighten all nuts with torque wrench

- 1) Tighten nuts spaced 180 degrees apart alternately to produce equal pressure on all parts of gland
 - 2) Overtightening to compensate for poor installation practice will not be permitted
 - d. If an effective seal is not obtained, disassemble, thoroughly clean joint and reassemble
 - e. Carefully align holes in mechanical joints with tie rods to permit installation of tie rods
 - 1) Tie rod installation in exposed locations shall be parallel with the pipe center line
 - f. Assure proper gasket is used for applicable service
 - 1) High temperature gasket required for air service
3. Push-on joints
- a. Clean inside of bell and outside of spigot
 - b. Bevel spigot ends of field-cut piping
 - c. Apply thin film of lubricant to joint surfaces immediately before completing the joint
 - d. Pipe not furnished with depth mark shall be marked before assembly to assure the spigot end is inserted full depth in the joint
 - e. Assure proper gasket is used for applicable service
 - 1) High temperature gasket required for air service
4. Restrained mechanical joints
- a. Clean inside of bell and outside of spigot
 - b. Insert gasket
 - c. Apply thin film of lubricant to joint surfaces immediately before completing the joint
 - d. Pipe not furnished with depth mark shall be marked before assembly to assure the spigot end is inserted full depth in the joint
 - e. Insert bolts and hand-tighten nuts
 - f. Tighten nuts spaced 180° apart alternately at a uniform rate to the normal range of bolt torque per the manufacturer's specifications
 - g. Tighten the torque limiting twist-off nuts in a 180° alternating manner until all nuts have been twisted off
 - h. Assure proper gasket is used for applicable service
 - 1) High temperature gasket required for air service
5. Flanged joints
- a. Wherever screwed-on flanges are used, pipe shall extend completely through flange
 - b. Flange faces shall be flat and perpendicular to pipe center line
 - c. Pipe end and flange face finished in single operation
 - d. Remove any raised face before connecting to a flange having a plain face
 - e. During bolting operations, insure no restraints are present on the pipe which would prevent uniform gasket compression or cause unnecessary stress on the flanges
 - 1) One end of pipe shall be free to move in any direction while flange bolts are being tightened
 - f. Do not assemble mechanical connections until all flanged joints affected thereby have been tightened
 - g. Tighten nuts spaced 180° apart alternately at a uniform rate to assure uniform gasket compression

- h. Assure proper gasket is used for applicable service
 - 1) High temperature gasket required for air service
- 6. Pipelines or runs intended to be laid straight shall be laid straight
- 7. Joint deflection not to exceed
 - a. Table 4, AWWA C600 for mechanical joint pipe
 - b. Table 3, AWWA C600 for push-on joint pipe

E. Anchorage

- 1. Provide thrust blocks, anchors or harness piping to prevent separation of joints
- 2. In buried piping subject to hydrostatic heads in excess of 13 psi or as otherwise specified, provide reaction blocking, joint harnesses or other acceptable means of preventing pipe movement caused by internal pressure at
 - a. Bends deflecting $11\frac{1}{4}^{\circ}$ or more
 - b. Tees
 - c. Plugs
 - d. Compressed air piping: Mechanical joint restraints required at all fittings
- 3. Other locations: Provide reaction blocking anchorages or other supports for fittings in fills, unstable ground or above grade as required to prevent movement
- 4. Concrete thrust blocks
 - a. Bearing area per Construction Standards
 - b. Extend from fitting to solid undisturbed earth
 - c. Install so joints are accessible for repair
 - d. If adequate support against undisturbed earth cannot be obtained, provide metal harness anchorages across the joint and secure by anchoring to the pipes or fittings or other anchorage facilities as required for adequate support

F. Concrete Encasement

- 1. Provide as indicated on the Drawings
- 2. Suitably support and block pipe and anchor against flotation
- 3. Install polyethylene encasement on all underground pipe

G. Corrosion Control

- 1. Refer to Part 2 – Products for protective coatings and linings
- 2. Metal surfaces
 - a. Coat all steel clamp rods, bolts and other metal accessories used in anchorages or joint harnesses subject to submergence or contact with the earth and not concrete encased
 - b. Apply two coats of epoxy paint to clean, dry, metal surfaces
 - 1) Conform to Section 09900 for surface preparation, application and curing of coatings
 - c. Allow the first coat to dry and harden before applying the second coat
- 3. Repair all damaged shop-coated surfaces with epoxy paint or original coating including satisfactory surface preparation

3.3 FIELD QUALITY CONTROL

A. Leakage

1. All joints shall be watertight and free of leaks
2. Repair each leak discovered by Owner during warranty period

B. Pressure Test

1. Refer to Section 02708 – Pressure Pipelines and Appurtenances for testing required for pipeline

END OF SECTION