

SECTION 02618 – DUCTILE IRON PIPE FOR WATER MAINS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section covers materials and installation of pipe, fittings and relevant appurtenances associated with the installation of ductile iron pipe water mains. This section applies to all water mains 54 inches in diameter and smaller. This section also applies when diameters larger than 54 inches is specified for the project.
- B. This section also includes Shop Coatings, Linings, Bolts, Nuts, Polyethylene Encasement and other Protective Coatings.

1.02 SPECIFICATION MODIFICATIONS

- A. It is understood that throughout this section these Specifications may be modified by appropriate items in Section 01015 – Specific Project Requirements or as otherwise indicated on the Contract Drawings.

1.03 RELATED SECTIONS

- A. Section 01000 – General Project Requirements.
- B. Section 01015 – Specific Project Requirements.
- C. Section 01300 – Submittals.
- D. Section 02200 – Earthwork.
- E. Section 02250 – Trenching, Pipe Embedment and Backfill.
- F. Section 02669 – Thrust Restraints.

1.04 CODES AND STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - ASTM A276 Standard Specification for Stainless Steel Bars and Shapes
 - ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
 - ASTM D4976 Standard Specification for Polyethylene Tubing.
- C. American National Standards Institute (ANSI):
 - ANSI/NSF61 Drinking Water Treatment Chemicals
 - ANSI B18.2.2 Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
- D. American Water Works Associations (AWWA):
 - AWWA C104/ANSI A21.4 Cement-Mortar Lining for Cast-Iron Pipe and Fittings
 - AWWA C105/ANSI A21.5 Polyethylene Encasement for Ductile Iron Piping
 - AWWA C110/ANSI A21.10 Gray-Iron and Ductile Iron Fittings
 - AWWA C111/ANSI A21.11 Rubber-Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings
 - AWWA C115/ANSI A21.15 Flanged Ductile-Iron Pipe with Ductile Iron or Gray Iron Thread
 - AWWA C150/ANSI A21.50 Standard for the Thickness Design of Ductile Iron Pipe
 - AWWA C151/ANSI A21.51 Ductile Iron Pipe Centrifugally Cast for Water
 - AWWA C153/ANSI A21.53 Ductile-Iron Compact Fittings, 3 in. through 24 in.

- | | |
|--|---|
| <p>AWWA C203 AWWA C550</p> <p>AWWA C600</p> | <p>Standards for Steel Pipe Protective Epoxy Interior Coatings for Valves and Hydrants</p> <p>Installation of Ductile Iron Water Mains and their Appurtenances.</p> |
| <p>E. International Organization for Standardization (ISO): ISO 8179-1</p> | <p>Ductile Iron Pipes, Fitting, Accessories and their Joints – Zinc-Bases Coating – Part 1: Metallic Zinc with Finishing Layer.</p> |

1.05 INFORMATION PROVIDED BY THE CITY

- A. As provided in the Contract Documents.

1.06 SUBMITTALS

- A. Submit as specified in Section 01300 – Submittals.
- B. Shop Drawings:
1. Submit shop drawings and project data (laying schedule) for piping work showing pipe and fitting sizes, valve locations, joint details; and hydrant locations.
- C. Product Data:
1. Pipe Data. In accordance with paragraph QUALITY ASSURANCE.
 2. Test Data. In accordance with paragraph QUALITY ASSURANCE.
 3. Polyethylene Encasement.
 4. Push On Joints.
 5. Mechanical Joints.
 6. Flanged Joints.
 7. Appurtenances:
 - (a) Tie rods.
 - (b) Couplings.
 8. Interior Coatings.
 9. Exterior Coatings.
 10. Bolts and Nuts.
 11. Polyethylene Encasement.
- D. Other Submittals:
1. Manufacturer’s Experience. In accordance with paragraph QUALITY ASSURANCE.

1.07 QUALITY ASSURANCE

- A. Follow provisions of AWWA C600.
- B. Manufacturer’s Experience. The manufacturer shall be a company specializing in manufacturing the Products specified in this section with minimum three years documented experience. Submit manufacturer’s experience in accordance with paragraph SUBMITTALS.
- C. Mark rejected or defective materials and remove them from the work site.
- D. The Contractor shall submit to the City written evidence of the following:
1. Pipe Product Data. That the pipe furnished under this specification is in conformance with the material and mechanical requirements specified herein.
 2. Test Data. Certified copies of independent laboratory test results or mill test results from the pipe supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM or AWWA testing standards by experienced, competent personnel. Pipe manufacturer’s test results shall be stamped by a licensed Professional Engineer (PE) employed by the pipe manufacturer. In case of doubt

as to the accuracy or adequacy of mill tests, the City may require that the Contractor furnish test reports from an independent testing laboratory on samples of pipe materials.

- E. The City will inspect all pipe, fittings, and accessories delivered to the site for damage, cleanliness, and conformance to the specifications. No damaged, broken, cracked, deformed, mishandled, imperfectly coated, defective pipe or fittings shall be used. At the sole discretion of the City and at no additional cost to the City, items that are not acceptable shall either be repaired or completely removed from the site.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Follow the provisions for the delivery, storage, protection and handling products to and at site provided in Section 01000 – General Project Requirements, paragraph PRODUCT DELIVERY, STORAGE AND HANDLING.
- B. Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in a sound, undamaged condition. Equipment, tools, and methods used in unloading, reloading, hauling, and laying pipe and fittings shall be such that the pipe, pipe coating, and fittings are not damaged. Hooks shall not be used.
- C. Under no circumstances shall pipe or accessories be dropped or dumped.
- D. Pipe and fittings shall not be moved by inserting anything into pipe ends.
- E. Pipe and fittings on which the cement lining has been broken or loosened shall be replaced at no additional cost to the City.
- F. Where the damaged areas are small and readily accessible, the lining may be permitted to be repaired in accordance with AWWA C104 at no additional cost to the City.

1.09 ADDITIONAL COMPLIANCE SUBMITTALS

- A. Additional requirements for compliance submittals will be found in Section 01015 – Specific Project Requirements.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be designed and manufactured in accordance with AWWA C151/A21.51.
- B. All pipe shall be manufactured from at least 90% recycled ferrous scrap material.
- C. Pipe Thickness:
 - 1. Pipe thickness shall be in accordance with AWWA C150/ANSI A21.50. The following minimum thickness shall apply:
 - (a) Pipe 4 inches through 12 inches in diameter: Class 52.
 - (b) Pipe 16 inches through 54 inches diameter: Class 54.
 - 2. Pipe thickness classifications shall be as noted on the Drawings.
- D. Exterior Coating:
 - 1. The exterior of ductile iron pipe (not including fittings) shall be coated with a layer of arc-sprayed zinc conforming to ISO 8179-1.
 - 2. The mass of the zinc applied shall be 200 g/m² of pipe surface area.
 - 3. A finishing layer topcoat shall be applied to the zinc.
 - 4. The mean dry film thickness of the finishing layer shall not be less than 3 mils with a local minimum not less than 2 mils.
 - 5. The manufacturer shall clearly mark the outside of each pipe indicating the pipe has been coated in accordance with these specifications.

- E. Interior Coating/Lining:
 - 1. All pipe shall be cement mortar lined in accordance with AWWA C104/ANSI A21.4.
 - 2. Pipe cement-mortar lining shall be without an asphaltic interior seal coating.

2.02 PUSH ON JOINTS

- A. Pipe joints shall be of the push-on type unless otherwise specified or as shown on the Drawings.
- B. Joints shall conform to ANSI/AWWA C111/A21.11.
- C. Gaskets shall be neoprene or synthetic rubber. Gaskets shall be certified as suitable for chlorinated potable water in accordance with ANSI/NSF61. Natural rubber will not be acceptable.
- D. Restrained Joints. See Section 02669 – Thrust Restraints.

2.03 TESTING

- A. All pipe shall be tested and documented per AWWA C151 and paragraph 1.07 D.2 defined herein.
- B. All pipe 30” and larger shall also be hydrostatically tested to 75% of the yield strength of the metal based on the nominal thickness of the pipe.

2.04 FITTINGS

- A. All fittings shall be made of Ductile Iron and manufactured according to AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53.
- B. Fitting joints shall be Mechanical Joint (MJ), Flange Joint (FLG), or Push-On Joint, per AWWA C111/ANSI A21.11. All MJ glands shall be ductile iron. Fittings shall have distinctly cast upon them, the pressure rating and the letters “DI” or “Ductile”. FLG Fittings shall be used only for aboveground installations.
- C. Welded-on outlets may not be used in lieu of tees.
- D. Flanged Joints: Shall be provided with full-face gaskets and shall meet the requirements of AWWA C115/ANSI A21.15.
- E. The exterior of fittings shall be coated with a layer of arc-sprayed zinc conforming to ISO 8179-1 or a zinc-rich primer conforming to ISO 8179-2. A finishing layer topcoat shall be applied to the zinc.
- F. Interior coating/lining shall be cement in accordance with ANSI/AWWA C104/A21.4, with double cement lining.
- G. As an alternative for interior/exterior coatings on fittings, the manufacturer may use a fusion bonded epoxy that is NSF 61 approved for potable water use and compiles with AWWA C550.

2.05 GLANDS AND OTHER APPURTENANCES

- A. All glands shall have a polyester triglycidyl isocyanurate (TGIC) powder coating or an approved equal applied for corrosion protection. See also Section 02669 – Thrust Restraints.
- B. Tie Rods shall be ASTM A276, Type 304 or Type 316 Stainless Steel.
- C. Couplings (when approved for use by the Water Services Department) shall be:
 - 1. Dresser “Style 38”.
 - 2. Smith-Blair “441 or 411 Flexible Coupling”; without pipe stop.
 - 3. Bolted compression type couplings shall be manufactured of epoxy coated steel or ductile iron specifically for use with ductile iron pipe.

2.06 TEE-BOLTS AND NUTS

- A. Tee-Bolts shall be manufactured with high-strength, low-alloy steel in accordance with AWWA C111 and ASTM A307, with chamfered or rounded ends projecting 1/4 to 1/2 inch from surface.
- B. Nuts shall be hexagonal manufactured in accordance with ASTM A307 and ANSI B18.2.2.
- C. Provide ceramic-filled, baked-on, fluorocarbon resin coating for tee-bolts and nuts.
- D. Include factory-applied lubricant that produces a low coefficient of friction for the ease of installation.

2.07 MARKINGS

- A. Markings shall be legibly cast in the pipe or painted thereon with waterproof paint.

2.08 POLYETHYLENE ENCASEMENT

- A. Polyethylene encasement materials shall be in accordance with ASTM D4976 and AWWA C105/ANSI A21.5.
- B. The Contractor may use either Linear Low Density (LLD), High Density Cross Laminated (HDCL) or V-Bio[®] Enhanced Polyethylene film with the minimum properties indicated in Table 1 below:

| Table 1. Minimum Requirements for Polyethylene Encasement | | | |
|--|------------|-------------|--------------------------|
| Item | LLD | HDCL | V-Bio[®] |
| Thickness, mil | 12 | 4 | 8 |
| Tensile Strength, psi | 4,400 | 6,300 | 3,600 |
| Elongation, percent | 1,000 | 100 | 700 |
| Dielectric Strength, v/mil | 1,900 | 800 | 800 |
| Tear Resistance, gf | 4,400 | 250 | 2,550 |
| Impact Resistance, g | 1,100 | 800 | 600 |

- C. Polyethylene encasement shall be provided in tubes. Sheeting is not allowed. The minimum tube size for each pipe diameter shall be in accordance with Table 2.

Table 2. Polyethylene Flat Tube Width (inches)

| Nominal Pipe Diameter (inches) | Push-on Bell & Spigot Joints | Mechanical Joints |
|---------------------------------------|---|--------------------------|
| 4 | 14 | 16 |
| 6 | 17 | 20 |
| 8 | 21 | 24 |
| 10 | 25 | 27 |
| 12 | 29 | 30 |
| 14 | 33 | 34 |

Table 2. Polyethylene Flat Tube Width (inches)

| Nominal Pipe Diameter (inches) | Push-on Bell & Spigot Joints | Mechanical Joints |
|-----------------------------------|---------------------------------|-------------------|
| 16 | 37 | 37 |
| 18 | 41 | 41 |
| 20 | 45 | 45 |
| 24 | 53 | 53 |
| 30 | 67 | 67 |
| 36 | 81 | 81 |
| 42 | 81 | 81 |
| 48 | 95 | 95 |
| 54 | 108 | 108 |

- D. Color: The color of polyethylene encasement shall be blue.
- E. Adhesive Tape: Adhesive tape shall be a general purpose adhesive tape 1-inch wide and approximately 8 mils thick, such as Scotch Tape No. 50, Polyken No. 900, Tape coat CT or approved equal (duct tape is not allowed).
- F. Sheeting is permitted for use on point repairs under 12 foot in length. All point repairs 12 foot and longer shall use tubing.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation.
- B. Spigot ends shall be examined with particular care since they are vulnerable to damage from handling.
- C. All defective, damaged, or unsound pipe or fittings shall be rejected and marked as such and removed from the Site.

3.02 PREPARATION

- A. Cutting Pipe:
 1. Cutting shall be done in a neat manner without damage to the pipe or the cement lining. Cuts shall be smooth, straight, and at right angles to the pipe axis.
 2. After cutting, the end of the pipe shall be dressed with a file to remove all roughness and sharp corners.
 3. Cutting of pipe with a torch will not be permitted.
- B. Cleaning:
 1. The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been accepted.
 2. Surfaces shall be wire brushed, if necessary, wiped clean, and kept clean until jointing is completed.

3.03 LAYING PIPE

- A. Runs intended to be straight shall be laid straight.

- B. Deflections from a straight line or grade shall not exceed the maximum joint deflections for full length pipe as stipulated in AWWA C600. Shorter pipe sections or special bends shall be installed where the alignment or grade requires them.
- C. Pipe shall be protected from lateral displacement by pipe embedment material installed as specified in Section 02250 – Trenching, Pipe Embedment and Backfill.
- D. Under no circumstances shall the pipe be laid in water; and no pipe shall be laid in unsuitable trench conditions.
- E. Pipe shall be laid with the bell ends facing the direction of laying except when reverse laying is specifically authorized by the City.
- F. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug that will prevent water and other debris from entering the pipe.
- G. No pipe length less than 18 inches in length shall be used.

3.04 MECHANICAL JOINTS

- A. After proper joint cleaning, the gasket and gland shall be in position on the spigot before shoving the pipe to its final position. Center the entering spigot so that the gland or follower ring is parallel to the face of the connecting bell.
- B. Joint shall be shoved "home" and the gland properly positioned with respect to the connecting bell with the connecting pipes in as nearly perfect alignment as practicable.
- C. The bolts shall be slightly and uniformly tightened.
- D. Deflection may be made after the bolts are tightened.
- E. Coat the gasket with a lubricant (suitable for potable water) supplied by the pipe manufacturer and all surfaces of the bell, spigot, and gland that will come in contact with the gasket at any time during assembly.
- F. Gasket shall be carefully pushed into position and evenly seated in the bell. The gland shall be shoved into place against the gasket, the bolts inserted, and the nuts tightened with the fingers until snug. Final tightening of the bolts shall be done with a ratchet torque wrench.
- G. Partially tighten the bottom bolt, then the top bolts, alternately either side, and finally the remaining bolts, alternately tightening bolts 180 degrees apart. This cycle is then to be repeated until all bolts are tightened to the torque specified by the manufacturer:

5/8" bolts --- 40 to 60-foot pounds

3/4" bolts --- 60 to 90-foot pounds

- H. If sealing is not maintained at the torque specified, the joint shall be disassembled, thoroughly cleaned, and reassembled. Overstressing of bolts to compensate for poor installation practice will not be permitted.

3.05 PUSH-ON JOINTS

- A. Wipe the gasket seat clean with a cloth and position in place. Coat the gasket with a lubricant supplied by the pipe manufacturer. Apply to all of the inner surface of the gasket that will come into contact with the entering pipe.
- B. Clean the plain end of the pipe and apply a thin film of lubricant (suitable for potable water) to the outside of the plain end of the pipe and its beveled edge. Align the plain end of the pipe with the bell of the pipe to which it is to be joined. The joint deflection angle should not exceed the recommended maximum of the manufacturer.
- C. Bring the plain end of the pipe in contact with the gasket and exert sufficient force on the entering pipe so that its plain end compresses the gasket and makes contact with the base of the socket of the bell. This force can be applied by means of a jack type tool, backhoe, or other methods approved by KC Water.

3.06 FLANGED JOINTS

- A. When bolting, care shall be taken to provide uniform gasket compression and prevent unnecessary stress on the flanges. Flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually and at a uniform rate to provide uniform gasket compression.
- B. Use full-face gaskets only.

3.07 RESTRAINED JOINTS

- A. Restrained joints shall be installed in accordance with the pipe manufacturer's recommendations.
- B. All joints within utility casings shall be restrained joints.

3.08 POLYETHYLENE ENCASEMENT

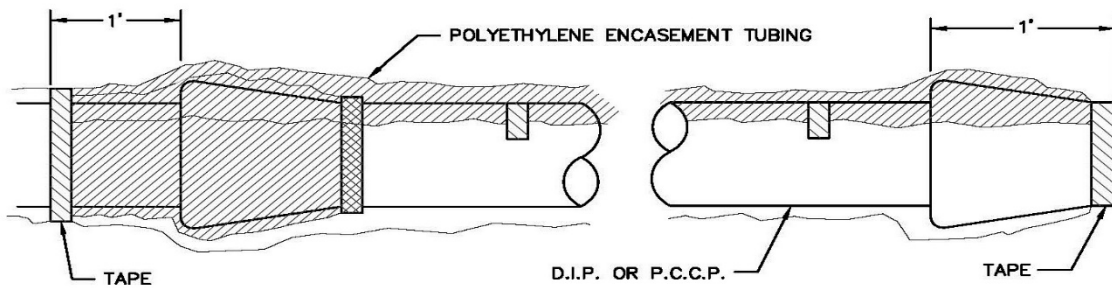
- A. Polyethylene encasement shall be installed on all ductile iron pipe, fittings and appurtenances. The polyethylene shall be installed in a manner to prevent contact between the pipe, fittings, and the surrounding embedment.
- B. The polyethylene encasement shall be installed as shown on the Construction Detail No. 02618-1 and as follows:
 - 1. Polyethylene encasement tubing shall be approximately two (2) feet longer than the length of the pipe section to provide a one (1) foot of overlap on each adjacent pipe section.
 - 2. Repair rips, punctures, or other damages to the polyethylene encasement with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe, and secured with adhesive tape as directed by the City.
- C. Bolted Connections: All bolted connection shall be protected by 2 layers of polyethylene encasement. A minimum of 6 inches of overlap is required on each side of the connection.
- D. Pipe-Shaped Appurtenances: Bends, reducers, offsets, and other pipe-shaped appurtenances shall be covered with polyethylene in the same manner as the pipe.
- E. Odd-Shaped Appurtenances:
 - 1. Valves, tees, crosses, and other odd-shaped pieces that cannot practically be wrapped in a tube shall be wrapped with a flat sheet or split length of polyethylene encasement tube.
 - 2. The sheet shall be passed under the appurtenance and brought up around the body.
 - 3. Seams shall be made by bringing the edges together, folding over twice, and taping down.
 - 4. Tape polyethylene encasement securely in place at overlaps, valve tops and all other penetrations.
- F. Lifting devices shall not be placed over polyethylene.
- G. Polyethylene shall be protected from exposure to weather or damage at all times.
- H. Openings in Encasement:
 - 1. Openings for branches, blow-offs, air valves, and similar appurtenances shall be made by making an x-shaped cut in the polyethylene and temporarily folding the film back.
 - 2. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut as well as any other damaged areas in the polyethylene with tape.
 - 3. The new appurtenance shall be wrapped.
- I. Junctions between Wrapped and Unwrapped Pipe:
 - 1. Where polyethylene wrapped pipe joins an existing pipe which is not wrapped, extend the polyethylene tube to cover the unwrapped pipe a distance of at least three feet.
 - 2. Secure the end with three circumferential turns of tape.

J. Service Taps:

1. Wrap 3 layers of adhesive tape over the polyethylene encasement, covering the area where the tapping machine will be mounted.
2. Mount the machine over the tape.
3. Make the tap and install the corporation stop through the tape and polyethylene encasement.
4. After making the service connection, inspect the polyethylene and repair damaged areas with tape.

DETAIL 02618-1 ON NEXT PAGE

DETAIL 02618-1



NOTES:

1. TAPE IN ACCORDANCE WITH AWWA C105

**POLYETHYLENE ENCASEMENT
FOR BURIED PIPE**

WATER SERVICES
CITY OF KANSAS CITY, MISSOURI
DRAWING NO.

02618-1

DEVELOPED BY: _____
TECHNICAL ADVISORY COMMITTEE

APPROVED BY: _____

DATE: 12/02/2020

1 OF 1

END OF SECTION