

Section 02533**SANITARY SEWAGE FORCE MAINS****1.0 GENERAL****1.01 SECTION INCLUDES**

- A. Sanitary sewage force mains.
- B. References to Technical Specifications:
 - 1. Section 01200 – Measurement and Payment Procedures
 - 2. Section 01350 – Submittals
 - 3. Section 01450 – Testing Laboratory Services
 - 4. Section 02634 – Ductile Iron Pipe and Fittings
 - 5. Section 03300 – Cast-in-Place Concrete
 - 6. Section 02318 – Excavation and Backfill for Utilities
- C. Referenced Standards:
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM F 477, “Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe”
 - b. ASTM D 1248, “Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable”
 - 2. American Concrete Institute (ACI)

1.02 MEASUREMENT AND PAYMENT

- A. Measurement for pipe is on a linear foot basis taken along the center line of the pipe from end to end, measured and complete in place.
- B. Payment for sanitary sewage force mains includes pipe, fittings, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes and pipe, accessories, inspection and testing.
- C. Refer to Section 01200 – Measurement and Payment Procedures.

1.03 SUBMITTALS

- A. Make Submittals required by this Section under the provisions of Section 01350 – Submittals.

- B. Submit proposed methods, equipment, materials, and sequence of operations for force main construction.
- C. Submit Shop Drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.
- D. Submit product quality, material sources, and field quality information in accordance with this Section.

1.04 TESTING

- A. Testing and analysis of product quality, material sources, or field quality shall be performed by an independent testing laboratory provided by the Owner under the provisions of Section 01450 – Testing Laboratory Services and as specified in this Section.

2.0 PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS

- A. Conform to requirements of Section 02634 – Ductile Iron Pipe and Fittings. All pipe used for sanitary sewer force mains shall be painted white.

2.02 PVC PIPE

- A. Provide PVC pressure pipe conforming to the minimum working pressure rating specified in this Section. All pipe used for sanitary sewer force mains shall be white.
- B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting the requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use EBAA Iron Series 2000PV, Uniflange Series 1350 restrainer, or equal joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.
- C. Fittings: Provide ductile iron fittings as per this Section, 2.03 “Thrust Restraint”, except furnish all fittings with one of the following internal linings:
 - 1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to the interior surface of the fitting, as manufactured by American Cast Iron Pipe "Polybond", or U.S. Pipe "Polyline".
 - 2. Nominal 40 mils (35 mils minimum) polyurethane, Corro-pipe II by Madison Chemicals, Inc.
 - 3. Nominal 40 mils (35 mils minimum) ceramic epoxy, Protecto 401 by Enduron Protective Coatings.

- D. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with this Section, 3.04A “Hydrostatic Testing”.
- E. Manufacturers: Approved manufacturers of pressure rated, solid wall PVC pipe for sanitary sewer force mains are:
 - 1. J & M Manufacturing Company, Inc.
 - 2. CertainTeed Corporation
 - 3. Diamond Plastics Corporation
 - 4. Carlon Company
 - 5. North American Pipe Corporation (NAPCO)
- F. Provide lined ductile iron fittings conforming to Section 02634 – Ductile Iron Pipe and Fittings.

2.03 THRUST RESTRAINT

- A. Unless otherwise shown on the Plans, provide concrete thrust blocking for force mains up to 12-inches in diameter, to prevent movement of buried lines under pressure at bends. Blocking shall be Portland cement concrete. Place concrete in accordance with details on the Plans. Place thrust blocks between undisturbed ground and the fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Concrete shall extend from 6 inches below the pipe or fitting to 12 inches above.
- B. For all force mains larger than 12 inches in diameter, and where indicated on the Plans, provide restrained joints conforming to the requirements of the force main pipe material specifications. Restrained joints shall be installed for the length of pipe on both sides of each bend or fitting for the full length shown on the Plans.
- C. Horizontal and vertical bends between zero and 10° deflection angle will not require thrust blocks or harnessed or restrained joints.
- D. Horizontal and vertical bends between 10° and 90° deflection angle shall have thrust restraint as shown on the Plans.
- E. Reinforced concrete encasement of force main pipe and fittings may be used in lieu of manufactured joint restraint systems. Alternate joint restraint systems using reinforced concrete encasement shall conform to the following design requirements.
 - 1. Design calculations shall be performed and sealed by a Professional Engineer licensed in the State of Texas.
 - 2. Design calculations shall be based upon soil parameters quantified in the geotechnical report for the site where the alternative thrust restraint system is to be installed. If data is not available for the site, use parameters recommended by the geotechnical engineer.
 - 3. The design system pressure shall be the specified test pressure.

4. The following safety factors shall be used in sizing the restraint system:
 - a. Apply a factor of safety equal to 1.5 for passive soil resistance.
 - b. Apply a factor of safety equal to 2.0 for soil friction.
5. The encasement shall be contained entirely within the standard trench width and terminate on both ends at a pipe bell or coupling.
6. Concrete encasement reinforcement steel shall be designed for all loads including internal pressure and longitudinal forces. Concrete design shall be in accordance with ACI 318.

3.0 EXECUTION

3.01 PREPARATION

- A. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

3.02 PIPE INSTALLATION BY OPEN-CUT

- A. Perform excavation, bedding, and backfill in accordance with Section 02318 – Excavation and Backfill for Utilities.
- B. Install pipe in accordance with the pipe manufacturer's recommendations and as specified in this Section.
- C. Install pipe only after excavation is completed, the bottom of the trench is fine graded, bedding material is installed, and the trench has been approved by the Engineer.
- D. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench so the interior surfaces of the pipe follow the grades and alignment indicated. Provide bell holes where necessary.
- E. Install pipe with the spigot ends toward the direction of flow. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.
- F. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed. Remove foreign material and debris from the pipe.
- G. Provide lubricant, place and drive home newly-laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Engineer.

- H. Keep excavations free of water during construction and until final inspection.
- I. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.
- J. Where sanitary sewer force main is to be installed under an existing waterline with a separation distance of less than 2 feet, install one full joint length of pipe centered on the waterline and maintain a minimum 6 inch separation distance.

3.03 PIPE INSTALLATION OTHER THAN OPEN-CUT

- A. For installation of pipe by augering or jacking conform to requirements of specification sections for augering or jacking work.

3.04 FIELD QUALITY CONTROL

- A. Hydrostatic Testing
 - 1. After the pipe and appurtenance have been installed, test line and drain. Prevent damage to the Work or adjacent areas. Use clean water to perform tests.
 - 2. The Engineer may direct tests of relatively short sections of completed lines to minimize traffic problems or potential public hazards.
 - 3. Test pipe in the presence of the Engineer.
 - 4. Test pipe at 150 psig or 1.5 times design pressure of the pipe, whichever is greater. Design pressure of the force main shall be the rated total dynamic head of the lift station pump.
 - 5. Test pipe at the required pressure for a minimum of 2 hours according to requirements of UNI-B-3.
 - 6. Maximum allowable leakage shall be as calculated by the following formula:

$$L = (S) (D) (P^{0.5}) / 133,200$$

Where:

L	=	Leakage in gallons per hour
S	=	Length of pipe in feet
D	=	Inside diameter of pipe in inches
P	=	Pressure in pounds per square inch

- 7. Correct defects, cracks, or leakage by replacement of defective items or by repairs as approved by the Engineer.

8. Plug openings in the force main after testing and flushing. Use cast iron plugs or blind flanges to prevent debris from entering the tested pipeline.

B. Pigging Test

1. When requested by the Engineer and after completion of hydrostatic testing and prior to final acceptance, test force mains longer than 200 feet by pigging to ensure piping is free of obstructions.
2. Pigs: Provide proving pigs manufactured of an open-cell polyurethane foam body, without any coating or abrasives which would scratch or otherwise damage interior pipe wall surface or lining. Pigs shall be able to pass through reductions of up to 65 percent of the nominal cross-sectional area of the pipe. Pigs shall be able to pass through standard fittings such as 45° and 90° elbows, crosses, tees, wyes, gate valves, or plug valves, as applicable to the force main being tested.
3. Test Execution: Pigging test shall be conducted in the presence of the Engineer. Provide at least 48 hours notice of scheduled pigging of the force main prior to commencing the test.
4. All pigging tests shall be borne by the Contractor at no cost to the City.

END OF SECTION