

SECTION 026602
WASTEWATER FORCE MAIN

1. DESCRIPTION

This specification shall govern all work required for the installation of all wastewater force mains required to complete the project.

2. GENERAL REQUIREMENTS

1. All work shall be done in a workmanlike manner, in accordance with the drawings and specifications.
2. Prior to construction, the Contractor shall submit, for approval, certificates of inspection in duplicate to the Engineer from the pipe and fittings manufacturer(s) that said materials supplied have been inspected at the plant and meet the requirements of this specification.
3. It shall be the responsibility of the Contractor to keep on hand extra fittings and pipe, as he may deem necessary to make adjustments due to unknown obstructions, or to replace defective materials without delay to the project. When defective materials are discovered, they shall be immediately marked and removed from job site.
4. All pipe and fittings shall be clearly marked with trademark of manufacturer, batch number, location of plant, ASTM/ANSI/AWWA designation, size, pressure rating, class/SDR, and pressure rating.
5. Wastewater marking tape shall be continuously applied along the top of the force main, except at joints. The tape shall be green and 2 inches wide and state "Sewer".

3. MATERIALS

- A. **Ductile Iron Pipe Fittings:** See City Standard Specification Section 026206.
- B. **PVC Pipe (AWWA C900 or C905):** See City Standard Specification Section 026210.
- C. **Concrete:** Concrete shall have a minimum compressive strength of 3000 PSI at 28 days.

- D. **Bedding Sand for Encasement:** Sand shall be as indicated on the drawings.
- E. **Non-Standard Fittings:** Fittings having non-standard dimensions or fabricated especially for this project shall have a minimum pressure rating of 250 psi and durability comparable to that of the system. Drawings and specifications for non-standard fittings shall be submitted for approval of the Engineer prior to construction. Couplings and adapters for DIP and PVC connections shall be considered non-standard fittings.
- F. **Ceramic Epoxy Lining for Ductile Iron Pipe Fittings:** When indicated in the drawings or Special Provisions, the interior of DI pipe and fittings shall be furnished with a factory applied ceramic epoxy lining. Lining material shall be Protecto 401 Ceramic Epoxy Lining, of 40 mils nominal dry thickness. The epoxy shall be fused to the interior of the pipe by heat, forming a securely bonded lining.
1. **Operating Limits:** The lining shall have the capability of withstanding operating temperatures from 0° F to 170° F and withstanding sewage with a minimum pH of 4.0.
 2. **Application:** The interior surface of each pipe shall be blast-cleaned to remove high temperature oxide film and to form an anchor pattern over the entire surface prior to heating and lining. Epoxy lining is to cover the inner surface of the pipe, extending from the plain or beveled end to the rear of the gasket socket.
 3. **Adhesion:** Pipe shall be checked at the point of manufacture to assure bond of the lining to the pipe. Any indication of separation of lining from pipe is cause for rejection. .
 4. **Entrapped Material:** Any sizeable protrusion in the lining, obviously caused by lining over foreign materials, shall be cause for rejection.
 5. **Separations:** Linings which have separations caused during the lining operation shall be rejected.
 6. **Damages to Lining:** Injurious mechanical damage, such as chuck marks and gouges, extending to bare metal are not acceptable. The pipe having such a defect shall be rejected.
 7. **Lining Thickness:** Linings of nominal 40 mil thickness shall generally equal or exceed 40 mil throughout the pipe. At pipe ends, lining thickness may taper for a distance of 4 inches from the ends, to a minimum of 20 mil thickness. However, the lining shall not deviate by more than 5 mil from the 40 mil nominal thickness as required through the pipe. The lining thickness of each pipe and fitting shall be taken at the point of manufacture using a general electric magnetic dry film thickness device, digital coating thickness gauge, Positector 2000, or approved

equal. Pipe and/or fittings with a lining thickness less than the minimum specified shall be rejected.

8. **Bell and Plain End Overcoat:** The bell socket and the last 2 inches of the plain end of each pipe shall be coated on the inside and outside with a factory applied mastic or epoxy coating. This coating shall be a minimum of 10 mil thickness and shall be Koppers 300M, Industrial Ruff Stuff, Roskote Mastic A-938, or equal.
9. **Pinholes and/or Holidays:** The inside surface of each pipe or fitting shall be free of pinholes, holiday discontinuities and any blister type surface imperfections. The manufacturer shall check each pipe and fitting for holidays at the point of manufacture with a high voltage holiday detection device. Tinker & Rasor Model AP-W, or approved equal. Testing shall be conducted at the voltage as calculated in Section 3: Testing and Voltages of the "Recommended Practice for High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation" as published by the National Association of Corrosion Engineers (NACE) Technical Practices Committee. All actual holiday testing procedures shall conform to NACE standard RP-02-74 and American Society for Testing Materials (ASTM) Designation: G62-(latest) "Standard Test Methods for Holiday Detection in Pipeline Coatings." No holidays, misses or skips larger than a pinhole will be accepted for repair. A maximum of 6 holidays, as defined in ASTM Standard G62 and as determined by the detection test described above, on any one standard pipe length, fitting or special may be repaired with epoxy.
10. **Independent Testing Laboratory Representation:** All testing as specified herein including the lining thickness test and the holiday test shall be witnessed by a representative from an approved independent testing laboratory. The independent laboratory shall be a member of the American Council of Independent Laboratories. Manufacturer must submit for approval by the City the name of the testing laboratory and actual qualifications of actual representative that will witness the testing. The manufacturer shall furnish three (3) copies of report by independent testing laboratory depicting results of all testing witnessed by the independent laboratory.
11. **Field Testing:** Each pipe and fitting is subject to inspection in the field by the City for conformance to these specifications prior to installation. Any defects as specified herein with any pipe or fittings shall be grounds for rejection.
12. **Sealing Cut Ends and Repairing Field Damaged Areas:** Remove burrs from field cut ends and smooth out edge of epoxy lining. Remove all traces of oil or lubricant used during field cutting operation. All areas of loose lining associated with the cutting operation shall be removed and the exposed metal cleaned by sanding or scraping. For larger areas, roughen the bare pipe surface with a small chisel to provide an anchor pattern for the epoxy. The epoxy lining shall be "stripped" back by chiseling, cutting or scraping about 1" to 2" into well adhered

lined area before patching. After removal of loose lining and dirt, the area to be patched shall be "scratched" or "gouged" to offer an anchor pattern for the epoxy. Include an overlap of 1" to 2" of roughened epoxy lining in the area to be epoxy coated. The roughening shall be done with a rough grade emery paper (40 grit), rasp, or small chisel. Avoid honing, buffing, or wire brushing since these tend to make surface to be repaired too smooth. With the area to be sealed or repaired absolutely clean and suitably "roughened," apply a thick coat of two-part coal tar epoxy. The detailed mixing and application procedure for the epoxy shall follow the epoxy manufacturer's instructions. This heavy coat of epoxy shall be "worked" into the scratched surface by brushing. The Contractor shall maintain a supply of epoxy on the job site as required to seal cut ends and repair damaged pipe when encountered. Epoxy shall be of the type recommended or supplied by the pipe manufacturer.

13. **Warranty:** A five year warranty shall be furnished by the manufacturer on the serviceability of the lining. This warranty shall include, but not be limited to the statement, at any time up to the end of the fifth year from the date of pipe shipment:
- a. The lining shall not have disbound.
 - b. The lining shall not have suffered any appreciable underfilm migration.
 - c. The interior pipe metal, at points of pinholes or holidays, shall not have suffered detrimental deterioration.
 - d. The lining shall have maintained its smooth surface characteristics.

Contractor and/or manufacturer shall not make any exemption or exception to the above stated conditions or warranty within the limits as stated in this specification section.

14. **Certification:** The manufacturer shall furnish notarized certificates of compliance stating that the lining conforms to all requirements of these specifications.

4. CONSTRUCTION METHODS

4.1 HANDLING AND STORAGE OF MATERIALS

- A. **General:** The Contractor shall be responsible for the safe storage of all materials furnished to or by him and accepted by him until the materials have been incorporated in the completed project.

All material found during the progress of the work to have cracks, flaws or other defects will be rejected, and the Contractor shall remove such defective material from the site of the work.

- B. **Unloading and Distribution of Materials at Work Site:** Pipe and other materials shall be unloaded at point of delivery, hauled to, and distributed at the job site by the Contractor. Materials shall at all times be handled with care and in accordance with manufacturer's recommendations. Care shall be taken not to scratch PVC pipe. Excessive scratching shall be considered cause for rejection of PVC pipe. Materials may be unloaded opposite or near the place where it is to be installed provided that it is to be incorporated into the work within ten days. The Contractor shall not distribute material in such a manner as to cause undue inconvenience to the public.
- C. **Storing Materials:** Materials that are not to be incorporated into the work within 10 days shall be stored on platforms. The interior of pipes and accessories shall be kept free from dirt and foreign matter.

4.2 INSTALLATION

- A. **Alignment and Grade:** All pipes shall be laid and maintained to the required line and grade.

Temporary support and adequate protection of all underground and surface utility structures encountered in the progress of the work shall be furnished by the Contractor.

Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, connections to sewers or drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the Contractor at the Contractor's expense, in cooperation with the owners of such utility structures.

Force Mains shall be laid with no less than 36 inches of cover, unless indicated otherwise in the drawings. Greater depths will be permitted when required to avoid conflicts with existing structures.

Lines shall be laid to grade which permit entrapped air to flow to a high point for release through an air release valve as shown on the drawings. The Contractor shall investigate well in advance of pipe laying for conflicts which may necessitate the readjustment of planned line and grade.

- B. **Trench Excavation and Backfill:** See City Standard Specification Section 022020 "Excavation and Backfill for Utilities and Sewers", and drawings.
- C. **Force Main Connection to Existing Manhole:** Where new force main is connected to existing manhole, the manhole shall be prepared to receive the proposed force main and restored after connection. Manhole inverts shall be repaved as necessary to provide a smooth flowing system.
- D. **Polyethylene Encasement:** All metallic pipe, valves and fittings, except those

which occur in encasement pipe or in concrete valve boxes, shall be wrapped in polyethylene. The polyethylene material shall have a thickness of 8 mils and may be either clear or black. The wrapping shall be lapped in such a manner that all surfaces of pipe valves and fittings, including joints, shall have a double thickness of polyethylene. If a single longitudinal lap is made using a double thickness of polyethylene, it shall be lapped a minimum of 18 inches and the lap shall be placed in the lower quadrant of the pipe and in such a manner that backfill material cannot fall into the lap. The polyethylene shall be secured in place with binder twine at not more than 6-foot intervals. If wrapping is applied before the pipe is placed in the trench, then special care shall be taken in handling the pipe so that the wrapping will not be damaged. Care shall also be exercised in backfilling around the pipe and fittings and in blocking fittings so as not to damage the wrapping. Any wrapping that may be damaged shall be repaired in a manner satisfactory to the Engineer and so as to form the best protection to the pipes.

- E. **Sand Encasement:** Sand shall be granular soil of low plasticity such that 30% minimum passes a #4 sieve and no more than 20 % passes a #200 sieve, and the plasticity index (PI) shall not exceed 10. Soils with a Unified Classification of SW and SP, or AASHTO Classification of A3 and some A2 soil shall be required.
- F. **Pre-Placement Inspection:** Prior to lowering into trench, all pipe and accessories shall be inspected for defects. All foreign matter or dirt shall be removed from the interior of the pipe prior to lowering into trench. Pipe shall be kept clean at all times during the laying.
- G. **Jointing Pipe and Fittings:** All pipes and fittings shall be made up in accordance with manufacturer's recommendation. Pipe deflection shall not exceed 75% of the maximum amount recommended by the manufacturer.
- H. **Concrete Thrust Blocks:**

Temporary thrust blocks or other means of carrying thrust loads generated by hydrostatic testing shall be provided at all ends of lines to be tested. Details of the end connections and method of temporary blocking shall be submitted to the Engineer for approval. After satisfactory completion of the hydrostatic test, this temporary blocking shall be removed so that connections may be made with existing lines. This work is subsidiary and no separate payment will be made for it.
- I. **Restrained Joints and Fittings:** Metal harness, tie rods and clamps or restrained fittings shall be used to prevent movement when soil conditions will not withstand thrust blocking. Steel rods and clamps shall be galvanized or otherwise rust-proofed or coated with hot coal tar enamel then wrapped with two layers of polyethylene wrapping.

4.3 HYDROSTATIC TESTING WASTEWATER FORCE MAIN

See City Standard Specification Section 026202, Hydrostatic Testing of Pressure Systems.

5. MEASUREMENT AND PAYMENT

Unless otherwise specified in the Bid Form, wastewater force mains will be measured by the linear foot along the centerline of pipe. Payment shall include, but not be limited to, trenching, dewatering, pipe, bedding, thrust blocks, fittings, restraints and backfill, and shall be full compensation for all labor, materials, equipment, tools and incidentals required to complete the work at the unit price bid.