

## QUALITY ASSURANCE

- A. Design Requirements
  - 1. Force mains shall be laid with a minimum cover of 36" below the finished grade.
  - 2. PVC force mains six inches (6") and larger in diameter shall be constructed with cast iron fittings.
  - 3. Force mains four inches (4") and smaller in diameter shall be constructed of PVC pipe with PVC fittings.
- B. Pipe Inspection
  - 1. The contractor/owner shall obtain from the pipe manufacturer a certificate of inspection to the effect that the pipe and fitting supplied for a particular contract have been inspected at the Plant and that they meet the requirements of these specifications. All pipe and fittings shall be subjected to visual inspection at the time of delivery, also just before they are lowered into the trench to be laid, and joints or fittings that do not conform to these specifications will be rejected and must be removed from the site immediately by the contractor.

## SUBMITTALS

- A. Shop Drawings
  - 1. In general, three (3) copies of the following shop drawings shall be submitted to the Wastewater Treatment Department for approval prior to construction.
    - a) Mill test certificates or certified test reports on pipe
    - b) Details of restrained and flexible joints
    - c) Valve vaults
    - d) Valve and valve boxes
    - e) Air release valves
    - f) Pipe laying schedule
    - g) Temporary plug and anchorage system for hydrostatic pressure test

## JOB CONDITIONS

- A. Water in Excavation
  - 1. Water shall not be allowed in the trenches while the pipes are being laid and/or tested. The contractor shall not open more trench than the available pumping facilities are able to dewater to the satisfaction of the City. The contractor shall assume responsibility for disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working and in compliance with OSHA Standards. In no case shall the

pipelines being installed be used as drains for such water, and the ends of the pipe shall be kept properly and adequately blocked during construction by the use of approved stoppers and not by improvised equipment. All necessary precautions shall be taken to prevent the entrance of mud, sand or other obstructing matter into the pipelines. If on completion of the work any such material has entered the pipelines, it must be cleaned as directed by the City so that the entire system will be left clean and unobstructed.

## MATERIALS

- A. Ductile Iron Pipe and Fittings
1. Ductile iron pipe shall conform to the requirements of ANSI Standard A21.51, Class 51 for four-inch (4") lines and Class 50 for all other sizes, unless otherwise specified. Joints for ductile iron pipe shall be mechanical or push-on joints, unless otherwise specified. Pipe interior shall be epoxy lined.
  2. The material shall be a two component epoxy with the following minimum requirements:
    - a) A permeability rating of .15 perms when measured by ASTM D-1653-72.
    - b) A direct impact resistance of 100 in lbs. With no cracking when measured by ASTM D-2794.
    - c) The ability to build at least 20 mils, dry in one coat.
  3. Fittings
    - a) All ductile iron fitting shall be mechanical joint or single gasket, push-on type with a minimum pressure rating of 350 psi and shall conform to the requirements for epoxy lined.
    - b) Mechanical joint and/or single gasket, push-on type fittings shall be polyethylene lined, seal coated and outside coated as specified above for ductile iron pipe.
  4. Mechanical joints consisting of bell, socket, gland, gasket, bolts and nuts shall conform to ANSI Standard A21.11. Bolts shall be high strength, annealed, cast iron, or high strength low alloy steel, T-head type having hexagonal nuts. Bolts and nuts shall be machined true and nuts be tapped at right angles to a smooth bearing surface. Single seal gasket push-on type joints shall conform to the requirements of ANSI A21.11 and shall be "Tyton", "Fastite", "Super Bell Tite", or Wastewater Treatment Department approved equal.
  5. Restrained joints that require field welding will not be acceptable, and the thickness of the pipe barrel remaining at grooves cut for restraint shall not be less than that required for the design wall thickness. Joints using set screws will not be acceptable. Restrained joints shall be furnished for 24-inch and larger pipe at changes in direction of the main.

6. Gaskets shall be of neoprene and shall have plain tips unless otherwise specified.
7. Cast iron pipe fittings for PVC pipe shall be mechanical joint or single gasket, push-on type with a minimum pressure rating of 150 psi and shall conform to the requirements of ANSI Standard A21.4. Exterior of fitting shall have a bituminous coating.

B. Polyvinyl Chloride Pipe and Fittings

1. Polyvinyl chloride (PVC) pipe four inches (4") and larger in diameter shall conform to the requirements of AWWA C-900.
2. Fittings:  
PVC fittings four inches (4") and larger shall be furnished by the manufacturer of the pipe with which they are used or approved equal by the City.

PVC fittings smaller than four inches (4") shall be Scheduled 80 PVC.

3. Joints  
PVC pipe four inches (4") and larger shall have provision for expansion and contraction provided in the joints. All joints, except solvent weld and threaded joints, shall be designed for push-on make up connection. A push-on joint may be a coupling manufactured as an integral part of the pipe barrel consisting of a thickened section with an expanded bell with a groove to retain a rubber sealing ring of uniform cross section similar and equal to Johns-Manville Ring\_Tite and Davis Meter Dav-Tite, or may be made with a separate twin gasketed coupling similar and equal to Certainteed Fluid-Tite.

Joints in PVC smaller than four inches (4") shall be solvent welded in accordance with the recommendations of the pipe manufacturer using the solvent welding compound furnished with the pipe, or shall be threaded. Threaded joints shall be used only with Schedule 80 pipe or better.

C. Gate Valves

1. Gate valves three inches (3") in diameter and larger shall be iron body, non-rising stem, bronze mounted gate valves, mechanical joint and/or single gasket push-on type, conforming to requirements of the AWWA Standard C500 and shall be provided with a two-inch (2") square operating nut. Valves shall be of the single-wedge gate and shall turn to the left (counterclockwise) to open. The seat and gate shall have smooth, perfectly machined surfaces and shall be watertight when in contact. All valves shall be provided with o-ring seals. The design and machining of valves shall be such as to permit replacing the o-ring seals while in service without undue leakage.
2. Gate valves 16 inches in diameter and larger, installed horizontally, shall be provided with bevel gearing, a gear case that can be repacked from the

outside, rollers, tracks, and scrapers constructed so that the weight of the gate is carried on the rollers throughout the entire length of travel. The design shall conform to the requirements of AWWA Standard C500.

3. Gate valves for pipe less than three inches (3") in diameter shall conform to the requirements of Federal Specifications WW-V-54 for Class A, Type I, and shall be bronze, single wedge, non-rising stem, screwed bonnet, 125-pound S.P., 300-pound W.O.G., with stuffing box repackable under pressure and all parts renewable. Ends shall be as shown on the Drawings.

Body ends shall be:

1. Flanged with dimensions, facing and drilling in full conformance with ANSI B 16.1, Class 125.
2. Mechanical joint to meet the requirements of AWWA C111/ANSI A21.11.

The valve plug shall be constructed of cast iron ASTM A 126, Class B. The plugs shall have a conical seating surface, which is eccentrically offset from the center of the plug shafts. The plug shafts shall be integral. The entire plug face shall be totally encapsulated with Buna N (Nitrile) rubber in all valve sizes. The rubber compound shall be approximately 65 (Shore A) durometer hardness. The rubber to metal bond must withstand 75 lbs. pull under test procedure ASTM D-429-73 Method B. Plug geometry and valve rotational characteristics must allow drop-tight shutoff in both standard and "reverse-flow" direction with minimal "break-away" torque.

When plug is in full open position, plug geometry and body waterway contours must provide the following:

- a) A "round" passageway that allows flow capacity equal to 100% of the adjacent pipe area.
- b) Allowance of maximum passage of "solids".
- c) No cavities where debris can collect.
- d) Minimal head loss (no turbulence)

Valve seat mating surface shall be constructed of solid, one-piece 304 stainless steel ring or cast iron with welded nickel seating surface. The ring shall be threaded in place in the valve body to allow easy seat adjustment and/or replacement in the field. Seat ring contour must be precision machined to effect drop-tight shutoff in either direction with minimum rubber interference and "break-away" torque. Seat mating surfaces coated with non-metallic materials shall not be acceptable.

Shaft bearings shall be sleeve-type, fitted in both the upper and lower trunnions. Bearings shall be corrosion-resistant, have a low coefficient of friction and possess inert properties so that the possibilities of galvanic corrosion as well as galling between shaft and bearing material is eliminated.

A heavy-duty, two-way thrust collar shall be provided to ensure proper plug centering to accommodate drop-tight shutoff with minimum "break-away" torque at pressures specified. The thrust collar shall be accurately set at the factory and then "locked" in place to prevent tampering in the field.

A mechanical "brake" shall be supplied on 3"-8" valves, ordered without auxiliary actuators. The valve "brake" shall be capable of "locking" the valve in any intermediate position between full-open and full-closed.

Manual gear, electric motor and cylinder valve actuators shall be supplied as specified. Each type shall be designed to open or close their respective valve without the application of excessive force. Manual gear and electric motor actuators shall hold the valve in any intermediate position between full-open and full-closed. Manual gear actuators shall be of the worm gear type and shall be totally enclosed and sealed. Enclosed actuators shall be furnished with hand-wheel or chain-wheel and position indicators.

Plug valves shall have Buna-N or neoprene rubber faced plugs and shall be of eccentric construction. Valves shall be made of cast iron, or semi-steel at least equal to ASTM A126, Class B. Body seats of valves three inches (3") and larger shall have a welded in overlay of not less than 90 percent pure nickel or fusion bonded A1-Clad Nylon II on all surfaces contacting the plug face. Stem bearings shall be of corrosion resistant material. All exposed bolts, nuts, springs, washers, etc., shall be stainless steel. Port areas for valves 24 inches through 60 inches shall be 70 percent of full pipe area. Valves four inches (4") and larger shall have adjustable packing glands or permanent non-adjusting packing and shall be capable of being packed without the bonnet or plug being removed from the valve. Valves shall be designed for not less than 150 psi cold water, oil, or gas working pressure. Valves shall have drip tight shutoff at a bi-directional test pressure of 100 psi with pressure in either direction. Valves shall be permanently lubricated and shall be provided with an angle underground actuator, two inches (2") square operating nut and extended nut for wrench operation. The extended nut shall be within six inches (6") of the top of the valve box, shall have a port position indicator and shall indicate direction to open the valve. Operators shall be sized for a minimum of 50 psi differential pressure. All valves shall be as manufactured by DeZurick, Dresser, Homestead or approved equal.

E. Check Valves

1. Swing check valves four inches (4") and larger shall have a cast iron or cast steel body with a bronze or stainless steel seat ring, a non-corrosive shaft for attachment of weight and lever and a 300 psi hydrostatic test pressure rating. Check valves shall absolutely prevent the return of water back through the valve when the inlet pressure decreases below the delivery pressure. The valve must be full opening, tight seating and its seat ring shall be renewable and must be securely held in place by a threaded joint; the valve disc shall be of cast iron or cast steel and shall be suspended from a non-corrosive shaft which will pass through a stuffing box. A tapped boss with plug shall be provided on the check valve bonnet for future use with a pressure gauge.
2. Check valves smaller than four inches (4") shall be bronze, bronze disc, swing check valves conforming to Federal Specification WW-V-51E, Type 4 Class A-125 pound. Ends shall be as shown or indicated on Drawings.

F. Tapping sleeves and tapping valves used to make "wet" taps into existing mains shall be provided and installed at locations as shown on the Drawings. Tapping sleeves shall be split cast iron units and rated for 150 psi working pressure. Steel units will not be acceptable. The contractor shall determine the diameter of the existing main before ordering the sleeve. Valves shall be of the non-rising stem type with o-ring seals and shall conform to the applicable requirements as specified above for gate valves.

G. Cast iron valve boxes shall be provided for all valves installed underground which do not have extended operators such as is required by the plug valves. The valve boxes shall be adjustable to fit the designated depth of earth cover over the valve and shall be designed so as to prevent the transmission of surface loads directly to the valve or piping. Valve boxes shall be three-piece type and have an interior diameter of not less than five inches (5"). The valve boxes shall be provided with covers marked with the word "Sewer". The covers shall be so constructed as to prevent tipping or rattling. Boxes shall be equal to Clow Corporation No. F-2450 or Mueller Company No. H-10357. Extension sections shall be ductile or cast iron.

H. Air Release Valves and Concrete Vaults

1. Automatic air release valves shall be Empire Duomatic Type II, Fig. #942 or approved equal manufactured for sewage service. The valves shall be so designed that they will not stick shut or leak water under continued long operating conditions and to insure opening under high internal pressure. The design shall incorporate a solids settling chamber or trap and a flushing system by which the trap and the entire valve can be back-flushed and cleaned.
2. All air release valves shall be installed in a pre-cast vault, 3,000 psi, set to grade, with four-inch (4") walls. Vaults shall have a 36" x 36" clear opening with a lockable, aluminum hatch with stainless steel hardware, cast in place. Air release valves shall be offset to the right or left of the force main, so that the vault is situated four to six inches ( 4" – 6") from the force main.

## PREPARATION

- A. Pipe
  1. Gradient: Lines shall be laid straight, and depth of cover shall be maintained uniform with respect to finish grade, whether grading is completed or proposed at time of pipe installation. When a grade or slope is shown on the Drawings, batter boards with string line paralleling design grade, or other previously approved means, shall be used by the contractor to assure conformance to required grade.
  2. Pipe Joint Deflection: Maximum 20%
  3. Rejects: Any pipe found defective shall be immediately removed and replaced with sound pipe at the contractor's expense.
  4. Anchors: Concrete thrust blocks shall be placed at all bends, tees, plugs and other fittings to provide lateral support, except when restrained joints are specified. Thrust blocks shall conform to the details shown on the Drawings and not poured in place. (See Restrained Joints)
  5. PVC: Polyvinyl chloride pipe may be damaged by prolonged exposure to direct sunlight and the contractor shall take necessary precautions during storage and installation to avoid this damage. Pipe shall be stored under cover and sufficient backfill to shield it from the sun shall be placed as the pipe is installed.
- B. Ductile Iron Pipe Joints
  1. Type: The joints of all pipelines shall be made absolutely tight. The particular joint used shall be approved by the Owner prior to installation. Where shown on the Drawings or where, in the opinion of the Owner, settlement or vibration is likely to occur, all pipe joints shall be bolted.
  2. Mechanical Joints: All types of mechanical joint pipes shall be laid and jointed in full conformance with manufacturer's recommendations, which shall be submitted to the Engineer for review and approval before work is begun. Only especially skilled workmen shall be permitted to make up mechanical joints. Torque wrenches set as specified in AWWA Standard C111, shall be used; to spanner type wrenches not longer than specified therein may be used without the permission of the Engineer.

3. Push On Joints: Push on joints shall be made in strict, complete compliance with the manufacturer's recommendations. Lubricant, if required, shall be an insert, nontoxic water soluble compound incapable of harboring, supporting, or culturing bacterial life. Manufacturer's recommendations shall be submitted to the Engineer for review and approval before work is begun.
4. Restrained Joints: Restrained joints shall be provided at changes in direction of all ductile iron pipe sewer mains 24-inches in diameter and larger in lieu of concrete thrust blocks. These distances shall apply to lengths of pipe on each side of the fitting. Tees and dead ends valved or capped shall be considered equivalent to 90° bends. (Lengths are based on cohesive granular, sand and/or silt backfill and 100 (150) psi test pressure.)
- C. Polyvinyl Chloride Pipe Joints: The joints of all piping shall be made absolutely tight, and joints in polyvinyl chloride pipe shall be made in conformity with the requirements of the pipe manufacturer. For threaded joint make-up the male threaded end shall be wrapped with Teflon pipe tape.
- D. Installing Valves and Boxes:
  1. Valves: Valves shall be carefully inspected, opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness. Special care shall be taken to prevent any foreign matter from becoming lodged in the valve seat. Valves, unless shown otherwise, shall be set with stems vertically above the center line of the pipe. Any valve that does not operate correctly shall be removed and replaced.
  2. Valve Boxes: Valve boxes shall be carefully centered over the operating nuts of the valves so as to permit a valve key to be fitted easily to the operating nut. In areas to be paved, valve boxes shall be set to conform to the level of the finished surface and held in position by a ring of concrete placed under the support flange as shown on the Drawings. The valve box shall not transmit surface loads to the pipe or valve. Care shall be taken to prevent earth and other material from entering the valve box. Any valve box which is out of alignment or whose top does not conform to the finished ground surface shall be dug out and reset. Before final acceptance of the work all valve boxes shall be adjusted to finish grade.
- E. Concrete Encasement
  1. Concrete encasement shall be constructed in accordance with details shown on the Drawings and shall be constructed of Class C concrete. Encasement shall be constructed where:
    - ) Indicated on Drawings
    - ) The City shall order the line encased
  2. The points of beginning and ending of pipe encasement shall be not more than 6-inches (6") from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the effects of superimposed live loads.
- F. Identification: In order to preclude possible domestic water tapping, all installed underground sanitary sewage force mains shall be marked with a continuous strip located within the top 90 degrees of the pipe. Said strip shall be a minimum 2-inches (2") in width and shall be "yellow" traffic paint

No. 971-12.3, Code T-2, as specified in the FDOT Standard Specifications or other approved material. Backfill shall not be placed for 30 minutes following paint application. In lieu of the painted stripe on PVC pipe the PVC pipe may be furnished with a brown printed "Force Main" legend as supplied by Davis Industries, Inc. 14 gauge copper wire shall be placed along and attached to the entire length of the force main to serve as locate wire.

- G. Backfilling
  - 1. After pipe has been laid, inspected, and found satisfactory, sufficient backfill shall be placed along the pipe barrel to hold the pipe securely in place during the conduction of the preliminary hydrostatic test. No backfill shall be placed over joints until the preliminary test is satisfactorily completed, leaving them exposed to view for the detection of visible leaks.
  - 2. Upon satisfactory completion of the preliminary hydrostatic test, backfilling of the trench shall be completed.
- H. Concrete Protective Slabs: Where waterways, canals, ditches or other cuts are crossed, protective concrete slabs shall be installed across and to 10 feet each side of the bottom. Approved utility crossing signs shall be placed on the pipe alignment at each side of the canal, waterway, etc.

#### FIELD QUALITY CONTROL

- A. Flushing: All force mains shall be flushed to remove all sand and other foreign matter. The velocity of the flushing water shall be at least 4-feet per second. Flushing shall be terminated at the direction of the Engineer. The contractor shall dispose of the flushing water without causing nuisance or property damage.
- B. Cleaning: Prior to pressure and leakage testing, the interior of each main shall be cleaned of accumulation of sand and other foreign matter by pressure or hand methods. Hand cleaning methods may consist of shoveling the materials and pressure cleaning with a water hose. Care shall be exercised in cleaning to prevent damage to the pipe lining.
- C. Hydrostatic Tests
  - 1. All components of the force main system, including fittings, connections and valves shall remain uncovered until tested and accepted; provided, however, that pipe trenches under traveled streets or roads or in unstable soil conditions may be backfilled with the permission of the City. No testing shall be done until all concrete thrust blocking is in place. In testing, the part of the system under test shall be filled with water and subjected to a sustained pressure of 100 pounds per square inch. The piping shall be tested in sections, thereby testing each valve for secure closure. While the system is being filled, air shall be carefully and completely exhausted. If permanent air vents are not located at all high points, the contractor shall install corporation stops or fittings and valves at such points so the air can be expelled as the pipe system is slowly filled with water.
  - 2. Test pressure shall be maintained by pumping for at least 3 hours and until all sections under test have been checked for evidence of leakage. Rate of loss shall not exceed that specified hereinafter. Visible leaks shall be corrected regardless of total leakage shown by test.



3. The system as a whole, or any part, shall be retested after completion of backfilling. Such retest will be required for final acceptance.
4. All pumps, gauges and measuring devices shall be furnished, installed and operated by the contractor and all such equipment and devices and their installation shall be approved by the City. All pressure and leakage testing shall be done in the presence of a representative of the City Utilities.
5. Water for testing and flushing shall be potable water provided by the Contractor from a source approved by the City.
6. When the section of force main is ready for testing, the line shall be filled with water, pumped to a pressure of 100 psi and maintained at the pressure for a period of three hours. No leakage allowed.