SECTION 803

SANITARY FORCE MAIN SYSTEMS

I. GENERAL

1.1. DESCRIPTION OF WORK

The Contractor shall furnish all labor, supervision, material (except as herein provided), tools, equipment, supplies, and services; and, shall perform all Work necessary and incidental for the construction of sanitary sewer force main systems less than or equal to 36-inch in diameter. All pipe larger than 16-inch diameter shall be ductile iron, unless modified by Special Provision. The sanitary sewer force main systems shall be constructed in accordance with the Contract Documents and the applicable laws, rules, ordinances, standards, and specifications of regulatory agencies.

1.2. SUBMITTALS

Submittals shall be made by the Contractor in accordance with the procedures set forth in Section 105 and as described below:

A. Submit each manufacturer's, and/or supplier's certification attesting that the pipe, gaskets, castings, and appurtenances meet or exceed the specified requirement. The following information is to be shown on each certificate:

1. Name and location of the work
2. Name and address of Contractor
3. Quantity and date or dates of shipment and/or delivery to which the certificate applies.
4. Name of the manufacturing or fabricating company.

B. Certification shall be in the form of a letter or company-standard form containing all required data and signed by an officer of the manufacturing, fabricating, or supplying company.

If requested by the Owner, all laboratory test reports shall be provided at no additional cost and shall show the following information:

1. Date or dates of testing. Test data should be the most current available and be within 5 years of the Bid opening.
2. The specified requirements for which testing was performed.
3. Results of the test or tests.

C. Manufacturer's catalog cuts, technical data, operation and maintenance data, and/or shop drawings are required for the following sanitary sewer force main system components (shop drawings shall be drawn to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the work):

1. Air Vent Assemblies
2. Air Vent Assembly Vaults and Boxes
3. Fittings, Sleeves, and Couplings
4. Gauges
5. Pipe
6. Coatings and linings

7. Pipe Restraints
8. Tapping Sleeves
9. Tracer Wire and Marking Tape
10. Valves
11. Valve Boxes

D. Ductile Iron Pipelines greater than 16-inch diameter

In addition to the above submittal requirements, pipe diameters greater than 16-inches shall provide the following information:

1. Laying schedule

   a. Submit a tabulated laying schedule for approval which references stations and invert elevations as shown in the Contract Documents as well as all fittings, valves, bends, outlets, restrained joints, tees, special deflection bells, adapters, solid sleeves and specials, along with the manufacturer's drawings and specifications providing complete details of all items.

   b. Show pipe class, class coding, station limits and transition stations for various pipe classes.

   c. The location of all pipes shall conform to the locations indicated in the Contract Documents.

   d. Each pipe supplied shall be identified with sequential numbering consistent with the laying schedule and marking drawings and each marked pipe will appear on the marking drawings in the identified location for installation.

   e. Special fittings, bends, and appurtenances requiring specific orientation will be supplied appropriately marked with the words "TOP" in the correct position and in a consistent location.

2. Submit shop drawings for approval before manufacture and shipment including, but not be limited to:

   a. The grade of material, size, wall thickness of the pipe and fittings and appurtenances;

   b. The type of fittings and valves;

   c. The type and limits of the lining, lining reinforcing and coating systems of the pipe and fittings.

   d. Joint details, methods and locations of supports, and complete information concerning type, size and location of all welds. Shop welds (no field welding will be allowed) will be clearly differentiated and welds will be clearly detailed with preparation procedures for all pipe and parent material comprising each weld. Critical welding procedures will be identified along with methods for controlling welding stresses and distortions. Locations and proposed joint details will also be clearly identified; and,

e. All other pertinent information for all items to be furnished; product data to show compliance of all couplings, supports, fittings, coatings and related items.

3. Submit anticipated production and delivery schedule.

4. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.

5. Prior to shipment of pipe, submit:

a. Certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, including hydrostatic tests.

b. A certified affidavit of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.

E. Work Plan for Tie-ins to Existing Systems

At a minimum the Contractor's Work Plan shall include the following:

1. Schedule:

a. Starting date.

b. Sequential listing of specific tasks required to complete the tie-in.

c. Anticipated duration for each task of the tie-in operation.

2. Testing procedures.

3. Identification of businesses and residences that may be impacted and will require notification.

4. Method of dewatering the existing force main including where the sewage is to be disposed, and provide quantity of wastewater anticipated in dewatering.

5. Method of handling constant flow if valves or line stops do not close completely. The Owner cannot guarantee that full stoppage of flow will be achieved.

6. List of pump stations that must be maintained.

7. Number of pumper trucks, to include total capacity, to be supplied to handle flow at the existing stations and the pipe dewatering operations.

8. Contingency plan for handling flow at the existing pump station if the shutdown hours exceed the anticipated time frame.

9. Contingency plan for meeting a deadline for full traffic to be restored if a roadway is taken out of service or the capacity reduced during the tie-in and the completion schedule cannot be met.

10. Mobile phone contacts for Contractor and Owner personnel, and HRSD, and other identified key stakeholders' personnel, as appropriate.

11. List of equipment and number of crews to verify adequacy of Contractor's ability to work both ends of the tie-in simultaneously and continuously until connections are complete.

12. Stone and other backfill materials to be on-site if rain is forecast and used if a heavy rain event occurs during the tie-in backfill and compaction stage.

13. Confirmation of availability and scheduling of asphalt placement and proper cure time for tie-ins under existing pavement to restore traffic movement.

II. EXECUTION

2.1. GENERAL

A. The Contractor shall furnish and install a complete piping system as shown in the Contract Documents.

B. The Owner reserves the right to reject defective material shipped to and/or stored on site, and to examine the same to determine if damage has occurred prior to installation.

C. The Contractor shall unload, handle, and store pipe and appurtenances in accordance with Section 200 and ANSI/AWWA C600 and AWWA C605.

D. Proper implements, tools and facilities satisfactory to the Owner and as recommended by the material manufacturer shall be provided and used by the Contractor for the safe and convenient execution of the Work. All pipe, valves, fittings, and accessories shall be carefully lowered into the trench in such a manner as to prevent damage to the force main materials and any protective coatings and linings.

2.2. PIPE INSTALLATION

A. Cleaning: All lumps, blisters and excess coatings shall be removed from the bell and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be cleaned and dry, and be free from dirt, grease, oil, sand, grit, or any foreign materials before the pipe is installed.

B. Trenching, bedding, backfilling and compaction shall be in accordance with Section 303 and the Special Provisions.

C. Pipe Laying:

1. Pipe shall be laid to a true, uniform line and grade. High points, other than those indicated in the Contract Documents where an air vent assembly is to be placed, shall be avoided.

2. Pipe laying shall be in accordance with the manufacturer's recommendations. Pipe

laying shall proceed upgrade, bells ahead. Each section of pipe shall be laid to form a close concentric joint with the adjoining section and to prevent sudden offsets in the flow line. Each section of pipe, as it is laid, shall be backfilled as specified in the Contract Documents, at least up to the centerline, before the next joint is made.

3. As the work progresses, the interior of the pipe shall be cleared of dirt and superfluous material.

4. Trenches and other excavations shall be kept free of water until backfilled. Concrete or masonry work shall not be constructed in water, nor shall water be allowed to rise over the work until concrete or mortar has had ample time to set.

5. When work is not in progress, open ends of pipe and fittings shall be closed, so that trench water, earth, and other substances will not enter the pipe or fittings.

6. Whenever a pipe requires cutting for the insertion of valves, fittings, closure pieces, or to bring it to the required location, the work shall be performed in a satisfactory manner so as to leave a beveled end in accordance with the manufacturer's instructions or recommendations. Cuts shall be made at 90° with the centerline of the pipe so that a framing square placed against the side of the pipe will reveal not more than 1/4-inch variation across the diameter of the pipe in any direction. The pipe shall be cut with an abrasive wheel, rotary wheel cutter, guillotine pipe saw, milling wheel saw or other equipment specifically designed for that purpose. The Contractor shall grind smooth cut ends and rough edges and for push-on connections; the cut ends should be beveled slightly. Pipe damaged by the Contractor in cutting shall be replaced at the Contractor’s expense.

7. Laying of the pipe shall commence immediately after the excavation is started, and every means must be used to keep pipe laying closely behind the trenching. No more than 100 feet of trench may be open ahead of the pipe laying operation, unless otherwise specified in the Special Provisions for each locality. Holes shall be scooped out where the bells occur leaving the entire barrel of the pipe bearing on the pipe bed.

8. Pipe joint assembly practices and joint assembly materials such as lubricants, primers and adhesives shall be in accordance with the manufacturer’s recommendations and specifications, and in accordance with ANSI/AWWA C111.

D. Alignment and Grade:

1. The Contractor shall not deviate from the line and grade indicated in the Contract Documents, except with approval of the Owner.

2. Where it is necessary to deflect pipelines to avoid obstructions, the amount of deflection shall not exceed ½ of that recommended by the manufacturer of the pipe. Where necessary to maintain the required line, short sections of pipe and fittings shall be provided.

3. The Contractor shall investigate the proposed location of the main far enough in advance of the work to determine where conflicts will occur and to determine joint deflections necessary to clear any obstructions.

E. Polyethylene Encasement:

1. Pipe shall be encased with polyethylene where specified in the Contract Documents.

2. In the event that corrosive soils (as defined by Appendix "A" of ANSI/AWWA C105/A21.5) are encountered during excavation (and have not been identified as such in the Contract Documents), the Owner may direct that all, or a portion, of the pipeline be encased.

3. Materials and methods of installation shall be in accordance with AWWA C105; Method A, B, or C may be used unless otherwise specified in the Contract Documents. Polyethylene shall be at least 4 mils thick, cross laminated, and shall conform to the requirements of ANSI/AWWA C105/A21.5.

4. A fabric type or padded sling shall be used when handling polyethylene encased pipe to prevent damage to the polyethylene encasement.

5. All seams in the polyethylene encasement shall be sealed completely with approved 2-inch wide plastic adhesive tape.

6. Pull loose tube along pipe barrel up snugly around the pipe and fasten in-place with adhesive tape at 3 foot intervals.

7. Completely cover fittings and connections with film held snugly in place with point tape or strapping.

8. Extreme care shall be taken when backfilling to avoid damaging the polyethylene encasement.

F. Tracer Wire:

All underground non-metallic pipe pressure systems shall be installed with a continuous tracer wire conforming to Section 200, attached every 10 feet to the piping system with plastic strapping. The wire shall terminate above ground at every valve box, tracer wire box, and air release valve. The wire shall be of sufficient length to allow the wire to be uncoiled and extended one (1) foot above the finished grade. The tracer wire installation will be considered complete and acceptable for service when the Owner can trace the wire using the locating equipment. Any breaks shall be repaired by the Contractor prior to project acceptance.

G. Subsurface Utility Tape:

All force mains shall be identified by a subsurface utility warning tape, conforming to Section 200, placed at an elevation not less than 6-inches, nor more than 12-inches below the proposed finished grade, or directly under the roadway base material if the base material is greater than 12-inches.

2.3. VALVE INSTALLATION

A. Prior to installation, the Owner shall inspect valves for direction of openings, interior and exterior coating systems, freedom of operation, tightness of pressure containing bolting, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Valves determined to be defective by the Owner shall be replaced by and at the sole expense of the Contractor. The Contractor shall operate all valves greater than 3-inches once prior to

installation to determine the number of rotations of the operating nut; this number of rotations shall be recorded on the record drawings.

B. The Contractor shall set and join valves to pipe in accordance with the manufacturer's requirements for the type and class of valve and pipe.

C. The valve box shall be centered and set plumb with the top of the box neatly to grade of the surface of the existing ground, unless otherwise directed by the Owner. Shock and stress shall not be transferred from the box to the valve.

D. The top of the operating nut shall be less than 36-inches below the rim of the valve box (as measured from final grade). When the distance from the operating nut to the top of the valve box is greater than 36-inches, the Contractor shall install an approved valve stem extension device to result in a distance of 12- to 24-inches from the top of the operating nut to the rim of the valve box.

E. Valves shall be set vertical and bedded in accordance with the Standard Details.

2.4. APPURTENANT INSTALLATION

All appurtenances (fittings, air vent assemblies) shall be installed in accordance with the manufacturer's recommendations and as indicated in the Contract Documents and Standard Details.

2.5. RESTRAINT

A. Fittings, valves, and pipe joints shall be restrained as indicated in the Contract Documents and in accordance with Section 200. Alternate methods of thrust restraint other than specified herein may be used only with the written approval of the Owner.

B. Concrete and reinforcing shall be in accordance with Section 200. Blocking shall be placed between undisturbed earth and the fitting to be restrained. The blocking shall be in accordance with the Special Provisions and Standard Details, oriented to contain the resultant thrust force and to leave the fitting joints accessible.

C. All exposed piping, flanges, couplings, nuts and bolts shall receive a minimum of two coats of an approved protective coating.

2.6. CONNECTIONS TO EXISTING MAINS

A. For pipe diameters larger than 16-inches, connections shall be made in accordance with the Special Provisions.

B. The Owner and Contractor shall have a coordination meeting with the Owner's personnel at least 10 days prior to the planned force main shutdown and provide a written Work Plan. The Owner shall review the Work Plan and either approve it or meet with the Contractor within 3 business days after receipt of the schedule to satisfactorily modify it.

C. The Contractor shall notify the Owner at least 5 business days in advance of performing the offset/shutdown. Work can be delayed a maximum of 48 hours from the anticipated shutdown if due to inclement weather, and is approved or directed by the Owner.

D. The Contractor is required to schedule a meeting on site on the morning of a planned nighttime

tie-in and shall notify the Owner, and HRSD, affected jurisdictions and private utility owners, as appropriate. At the time of the meeting, the Contractor shall have all materials and equipment necessary for the tie-in on site and assembled for inspection by the Owner.

The following items will be reviewed and discussed at this meeting:

1. Site conditions
2. Weather forecasts / weather impacts
3. Work and contingency plans
4. Contact information
5. Emergency equipment

E. The Owner reserves the right to postpone the scheduled tie-in if:

1. The site or Contractor is not prepared as required in the Work Plan and as agreed upon at the pre-tie-in meeting.
2. The Owner or HRSD/impacted jurisdiction (as appropriate) has an emergency in another part of their system.
3. A rain event has occurred in the three (3) days before the scheduled tie-in date or is forecasted in the 24 to 48 hours after the scheduled tie-in date in a portion of the sewer system with historical problems with inflow and/or infiltration.

F. Shutdowns shall not begin until all required materials are on-hand and ready for installation and a written Work Plan has been submitted and approved by the Owner.

G. The Owner reserves the right to cancel scheduled shutdowns if conditions warrant.

H. A decision point will be established by the Owner for the Contractor to cut the active force main. This decision during the tie-in will be based upon the Contractor's progress leading up to the cutting into the active force main. Inadequate progress by the Contractor leading up to this critical decision point may lead to a postponement of the tie-in completion, backfilling the excavation, placing temporary pavement, and rescheduling the remainder of the tie-in work**.**

I. The Contractor shall provide a crew with equipment for each connection point so that multiple connections can be completed simultaneously.

J. The Contractor is responsible for conveying sewage from all affected pump stations to prevent overflow throughout the entire duration of each shutdown. The fact that a facility served by one of these stations is closed at night is not a guarantee of zero sewage flow.

K. At a time approved by the Owner, the shutdown period will commence and the Contractor shall proceed with the Work continuously, start to finish, unless otherwise noted, until the Work is completed and the system is tested and ready for operation. If the Contractor completes all required Work before the specified shutdown period has ended, the Owner may immediately place the existing system back in service. If problems occur, the Contractor along with appropriate staff and equipment to remain on site to be an extension of the Owner's operational response until all operational issues have been resolved to the satisfaction of Owner.

L. All existing system valves shall be operated by the Owner's personnel unless otherwise indicated. The Owner shall make every effort to have a complete shutdown. Failure by the Owner to achieve a complete shutdown shall not entitle the Contractor to any additional

compensation.

M. The operation of all existing privately-owned mainline valves, air vents, and pump stations will be performed only by forces of the private utility.

N. The Contractor is responsible for providing adequate support and restraint, against system pressure of the exposed piping prior to and during startup and final backfill.

O. The Contractor shall follow the procedures herein for any joints of the new force main and fittings that have not been previously hydrostatically pressure tested:

1. The Owner reestablishes services in the line.
2. One half hour will elapse, after air venting is complete by the Owner.
3. Joints will be visually inspected for signs of leakage by Owner or Owner's Representative.
4. Any leakage noted shall be corrected to the satisfaction of the Owner.
5. After satisfactory visual testing of exposed joints by the Owner and any corrective action, the Contractor shall wrap the pipe and/or fitting as required and immediately proceed to backfill the pipe and restore to grade conditions or for reestablishment of traffic if in a roadway. Soil backfill compaction tests may be specified by the Owner for work within roadway travel lanes.
6. If specified, utility warning tape shall be installed above the connection in accordance with the Contract Documents.
7. Any joints not inspected by the Owner will not be approved and shall be excavated for inspection.

P. The Contractor shall assist the Owner during the reestablishment of flows as follows:

1. Provide riser pipe, fittings, and sewage containment drums for each control air vent location, and temporary valve at the air release point to vent air.
2. Provide means of electronic communication to coordinate this operation.

Q. Connection shall be made to the existing main through the installation of a tee in the existing main or by tapping sleeve and valve, as indicated in the Contract Documents. Taps shall be sized based on manufacturer's recommendations, but in no case shall the taps be of equal or larger size than the main.

R. Careful attention shall be given to the depth of new pipelines at points where tie-ins to existing mains are to be made. The existing main shall be uncovered in the presence of the Owner and the new pipeline set to proper elevation to provide for a perpendicular and level tie-in.

S. The allowable duration of any service interruption shall be approved by the Owner prior to the execution of the Work. Restoration of service due to the Contractor taking too much time to complete the connection or the Contractor's lack of proper equipment, personnel, or materials, shall not entitle the Contractor to any claim for additional time or compensation.

T. The Contractor shall be responsible for ascertaining the exact location, depth, and joint pattern of existing mains prior to making connections. Prior to cutting into any force mains the Contractor shall have on site all required fittings, pipe, tools, personnel and equipment, and shall satisfy the Owner through field measurements, that his fittings will properly join the existing line.

1. All materials shall be installed in accordance with the manufacturer's recommendations including, but not limited to alignment, torque requirements, and tolerances.

2. Connections shall only be made in the presence of the Owner.

U. Tapping Existing Mains Under Pressure:

1. Tapping sleeves and valves shall be utilized for connecting to existing mains where indicated in the Contract Documents.

2. It shall be the Contractor's responsibility to verify the actual outside diameter of the existing main at the location of the proposed tap in order that the tapping sleeve or couplings to be provided can be properly installed.

3. The centerline of the tapping sleeve and valve assembly shall be located the following minimum distances from existing pipe joints:

Size of Tapping Sleeve	Minimum Recommended Separation from Existing Joint
4-, 6- & 8-inch dia.	3-1/2 feet
10-, 12- & 16-inch dia.	5-1/2 feet
Greater than 16-inch dia.	See Special Provisions

4. In cases where the horizontal alignment as indicated in the Contract Documents would result in a "sleeve to joint" distance less that the minimum stated above, the Owner may direct the Contractor to substitute a MJ x MJ x Flange tee connection using acceptable sleeves and pipe sections.

5. In addition to pressure testing of newly installed pipelines in accordance with Paragraph 2.7 of this Section, the Contractor shall test each tapping sleeve and valve assembly prior to making the tap. Water shall be injected into the body of the sleeve, to a pressure of 150 psig, through the test plugs. If test plugs are not provided in the sleeve, a tapped mechanical joint plug shall be assembled to the valve for testing purposes. Pressure shall be maintained for a one (1) hour period without evidence of leakage. Upon obtaining a satisfactory test (which shall be witnessed by the Owner), the tapping operation may commence.

6. All installed tapping sleeves shall be restrained in accordance with the Standard Details.

7. Only taps of size equal to the diameter of the branch are acceptable. Upon completion of the tap the Contractor shall save the pipe coupon to show the Owner.

V. Sleeve-In of Straight Pipe:

Sleeve-in connections shall be as indicated in the Contract Documents.

W. Connections to Manholes:

1. The force main shall enter the receiving manhole with its centerline horizontal and

with an invert elevation that will ensure a smooth flow transition to the gravity flow section.

2. In no case shall flow from the force main enter the manhole at a point more than one foot above the flow line.

3. Force main to manhole connections shall be in accordance with the Standard Details.

X. Offsets to Existing Force Main

1. The Contractor shall comply with the above procedures for connections to existing mains.

2. Prior to performing an offset or cut-in, a trial shutdown will be performed to determine the working conditions to be encountered when the Work is performed.

3. All bends, valves, sleeves, pipe, and fittings shall be fully restrained with retainer glands.

4. The Contractor shall perform cut-in or offset work at night, unless otherwise indicated. Under most circumstances the hours of operation will be from 12:00 midnight to 6:00 A.M. The excavation for the Work shall be completed no later than 3:30 P.M. on the day the offset or cut-in is to begin to allow for inspection by the Owner.

5. The materials to be installed and the tools to be used shall be assembled and ready for inspection no later than 3:30 P.M. on the day installation of the Work is to commence. The inside of all pipe and fittings to be installed shall be cleaned and ends of lines capped until the time of installation. All visible dirt and foreign materials shall be removed from the interior of the pipe and fittings. The Contractor shall review in detail his plan of operation with the Owner at the time the excavation and pipe work are inspected for readiness.

6. Excavation around the existing pipe shall be sufficient to allow the Work to be performed without requiring additional excavation during installation of the offset or cut-in. Excavation shall be of sufficient depth to accommodate a minimum of 8-inches uniform depth of VDOT #57 stone, which shall be placed by the Contractor over the entire bottom of the excavation. In addition there shall be a minimum of 12-inches clearance between the bottom of the pipe and the top of the VDOT #57 stone.

7. The Contractor shall clean and mark the locations on the existing pipe where the pipe cuts are to be made by 3:30 P.M. on the day the offset or cut-in is to be installed. The Contractor shall measure the outside diameter of the pipe to be cut-in to be sure the proposed pipe and fittings are compatible with the existing pipe to be cut. All measurements shall be double checked in the presence of the Owner just prior to cutting of the existing pipe.

8. All spoil material not used as backfill shall be removed the same day as excavated and approved select or suitable material to be used as backfill shall be stockpiled in the vicinity of the excavation.

9. The Contractor shall have sufficient crews and equipment on hand to perform the Work for each offset. All equipment to be used during the Work, including pump,

backup pump, backhoe, at least two pipe saws, fuel, tools, generators, light towers, sewage tanker truck(s) and similar equipment shall be test run and determined to be in proper running order prior to cutting of the existing pipe. If the Contractor fails to provide adequate equipment in proper running order, the Owner will cancel the Work and the Contractor shall request rescheduling when the deficiencies have been corrected.

10. The Contractor shall have on hand at the site of the cut-in or offset two full circle stainless steel repair clamps and two DIMJ plugs or caps as necessary for each size of pipe to be cut. If plugs or caps are used, appropriate thrust restraint shall be provided by the Contractor.

11. After a cut-in or an offset has begun, the Contractor shall make continuous progress toward restoring the force main to full service. The Contractor shall maintain sufficient crews, equipment, and supplies and shall not leave the work site until the force main work has been completed and restored to complete operation. The Contractor shall direct his pump discharge in such a manner as to insure drainage away from the excavation so it will not flood streets or adjacent private property, and in accordance with all environmental regulations required by the locality.

12. When weather forecasts call for freezing temperatures the night of the cut-in or offset, the Contractor shall have on site sufficient coarse granular sand to spread over all paved areas, sidewalks, and bike paths wetted by the discharge of his pumps. During freezing weather, the Contractor shall minimize wetting of paved areas, sidewalks, and bike paths.

13. When bends are used in offsetting around obstructions, a 1-inch corporation stop shall be installed on each side of the offset to provide air release.

2.7. TESTING AND INSPECTION

A. General:

1. All flushing and pressure testing shall conform to this Section and the applicable sections of the Virginia *Sewerage Regulations*.

2. The Contractor shall provide the Owner at least 48 hours' notice to schedule testing and inspection.

3. Only properly functioning, calibrated, clean, and approved equipment shall be used for flushing and pressure testing force mains. Pressure gauges shall display readings to 1.0 psi.

4. All valves in the existing sewer system shall be operated only by or in the presence of the Owner or HRSD or private utility, as applicable.

5. See the Special Provisions for potential testing modifications, if any, for the specific locality.

B. Pressure Test:

1. New force mains shall be pressure tested in accordance with ANSI/AWWA C600-

Section 5.2, except as herein provided. Force mains shall be filled with water and subjected to a pressure of 1.5 times the expected working pressure or 150 psig, whichever is greater, measured at the highest point along the test section. The pressure test shall be of at least a two hour duration and any damaged or defective pipe, fittings, or valves that are discovered following the pressure test shall be replaced by the Contractor. The Contractor shall furnish all necessary equipment, materials and labor for making the tests as specified. Before applying the specified test pressure, air shall be slowly expelled completely from the pipe and valves. The pressure test shall not be performed against an active valve.

2. The Contractor shall test the line prior to contacting the Owner for the formal pressure test.

3. Testing shall be performed on each section of pipe between main line valves.

4. Water for the pressure test shall be obtained through a fully valved manifold, with an approved backflow preventer, as indicated in the Standard Details, or other source and procedure approved by the Owner.

5. The Contractor shall furnish all pumps, fittings, and gauges as necessary to fill the line with water, expel air from the system, and pressurize the pipeline for the tests.

6. The Owner reserves the right to test gauges to determine their accuracy.

7. The Contractor shall coordinate arrangements for water to be used for the pressure testing with the Owner.

8. The test pressure shall not vary by more than +/- 5 psi for the duration of the test.

9. Testing allowance shall be defined as the quantity of makeup water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Testing allowance shall not be measured by a drop in pressure. No pipe installation will be accepted if the amount of makeup water is greater than that determined by the allowable leakage formula, in Section 2.7.C, or as specified in the Special Provisions. There shall be no leakage in heat-fusion joined HDPE pipe.

10. The Contractor shall provide all necessary temporary restraint and support during testing at no additional cost to the Owner.

11. The Contractor will be responsible for providing proper safety measures during pressure testing operations.

12. In addition, heat-fusion joined HDPE pipe pressure testing shall be in accordance with ASTM F2164 and shall also comply with the following:

    a. Before testing, heat fusion joints are to be completely cooled.

    b. All parts of the test section shall be restrained against movement. Temporarily remove, restrain, or isolate expansion joints and expansion compensators before starting.

c. Observe all safety precautions identified in ASTM F2164.

d. To compensate for expansion, add make-up water during the initial expansion phase. The quantity of water needed to fill the pipe test section and accommodate expansion (and possible leakage at non-fusion joints and seals) is estimated using:

$V_{gal} = 1.015 \times 0.04 \times (ID_{in})^2 \times L_{ft}$

where:

V_{gal} = pipe section volume, gallons
ID_{in} = pipe inside diameter, inches
L_{ft} = test section, feet

e. Allow the test section and the test liquid to equalize to a common temperature.

f. Initial Expansion Phase:

(1) When the test section is completely filled and purged of air, gradually increase the pressure to the required test pressure identified in paragraph 2.7.B.1 above.

(2) Add make up water as necessary to maintain the maximum test pressure for 4 hours.

g. Test Phase:

(1) Reduce the test pressure by 10 psi and monitor pressure for 1 hour. Do not increase the pressure or add make up water.

(2) No visible leakage shall be observed and the pressure shall remain steady (within 5% of the test phase pressure) for the 1 hour test phase period for a passing test.

h. Retesting - If retesting is necessary, depressurize the test section per ASTM F2164 and correct any faults/leaks. Allow the test section to "relax" for at least 8 hours before repressurizing and repeat the Initial expansion and test phases as indicated above.

C. Leakage Test:

1. Leakage shall be in accordance with VDH requirements, unless stricter provisions are required in the Special Provisions. No leakage shall be allowed for heat-fusion joined HDPE pipe or fPVC pipe.

2. The leakage test shall be conducted concurrently with the pressure test.

3. No pipe installations will be accepted if the leakage is greater than the values determined as follows:

The allowable leakage value shall be determined using the equation below, or Table 803-

1:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

Where:
L = Allowable leakage, in gallons/hr.
S = Length of pipe tested, in feet
D = Nominal diameter of the pipe, in inches
(P) ½ = Square Root of average test pressure during leakage test, in psig

4. The Contractor shall, at its expense, locate and repair any defective material until the leakage is eliminated.

5. If a force main or section fails to meet the specified test requirements or has to be repaired, it shall be retested.

6. All joints, not subjected to pressure testing, shall be visually inspected under pressure for not less than 30 minutes for leakage.

TABLE 803-1
Leakage Testing Allowance per 1,000 feet of Pipeline (Gallons per Hour)
Pipe diameters 16-inches and less
(Based on AWWA C600, Table 5A)

Avg. Test Pressure psi	Nominal Pipe Diameter, inches							
	3	4	6	8	10	12	14	16
250	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71
225	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62
200	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32

III. MEASUREMENT FOR PAYMENT

A. Ductile Iron, HDPE, fPVC or PVC Force Main, installed complete in place.

1. Measurement of ductile iron, HDPE, or PVC force main will be made along the centerline of the pipeline and based upon the linear footage of each size pipe installed and satisfactorily tested. No depth measurement will be made for trench excavation and native material backfill. Pipe will be measured through fittings or valves. The unit price bid will not include the cost of valves.

2. Payment will include the cost of the following:

   a. Backfilling, compacting, and compaction testing
   b. Bedding material, as detailed in the Contract Documents
   c. Exterior Coatings,
   d. Dewatering,
   e. Disposal of surplus material,

f. Excavation,
g. Flushing,
h. Force main, including fittings and appurtenances,
i. Heat fusion equipment and any specialized technical operational support required
j. Restoration in right-of-way and easements (not including curb and gutter restoration or pavement restoration, unless otherwise noted),
k. Shoulder restoration,
l. Temporary seeding and stabilization,
m. Temporary sheeting and bracing,
n. Testing,
o. Thrust restraint,
p. Top soiling,
q. Tracer wire and subsurface marking tape, and
r. Water for testing

B. Air Vent Assembly, installed complete in place.

Payment will be made at the unit price bid for each manual air release valve installed and satisfactorily tested and will include the cost of furnishing and installing the air vent assembly and all required appurtenances in accordance with the Standard Details, including tap to proposed force main to provide satisfactory operation in accordance with the Contract Documents.

C. Valves, installed complete in place.

Payment will be made at the unit price bid for each size and type of valve installed, in place, and satisfactorily tested, and will include the cost of the following:

1. Bedding material
2. Coatings and linings
3. Stem extensions
4. Valve, valve box, with frame and cover for each size in accordance with the Contract Documents

5. Valve wrench, if specified

D. Tapping Sleeve and Valve (TS&V), installed complete in place.

Payment will be made at the unit price bid for each size TS&V installed, in place, and satisfactorily tested, and will include the cost of the following:

1. Bedding material
2. Coatings and linings
3. Stem extensions
4. Valve, valve box, with frame and cover for each size in accordance with the Contract Documents
5. Valve wrench, if specified
6. Tapping sleeve assembly and appurtenance
7. Pressure testing
8. Thrust Restraint

E. Connections to existing force mains or manholes.

1. Force main connections will be measured based upon each complete in place and satisfactorily tested.

2. Connections to existing force mains or manholes will be paid for each assembly installed and will include:

a. Backfilling,
b. Compaction and compaction testing,
c. Dewatering,
d. Disposal of surplus material,
e. Excavation,
f. Materials,
g. Restoration of shoulders and right of way (not including pavement restoration or curb and gutter, unless otherwise noted),
h. Site restoration and cleanup as shown in the Contract Documents,
i. Temporary piping, valves, and control air vents,
j. Temporary seeding,
k. Temporary sheeting and bracing,
l. Testing,
m. Top soiling,
n. Thrust restraint,
o. Work Plan and all notifications to include re-notifications as necessary, and
p. All other Work incidental to the connection to the existing main or manhole.

F. Interior Pipeline Corrosion Resistant Lining

1. The application of interior coatings for ductile iron pipe as indicated in the Contract Documents and described in Section 200, shall be measured on a linear foot basis for the complete, in-place application and successfully tested.

2. Payment will be made on a unit price basis per linear foot of a specified pipe diameter.

G. Polyethylene Encasement installed complete in place.

Payment will be made at the unit price bid per linear foot for polyethylene pipe encasement satisfactorily installed.

H. Offset of Existing Force Main

Offsets of existing force main shall be paid for at the contract unit price per foot. The unit price shall include the cost of:

1. Backfilling,
2. Bedding,
3. Compacting and compaction testing,
4. Coordinating line shutdown,
5. Cutting of existing line,
6. Dewatering,
7. Disposal of surplus materials,
8. Excavating,

9. Furnishing and installing the pipe and fittings,
10. Restoration of shoulders and right of way (not including pavement restoration and curb and gutter unless otherwise noted),
11. Testing,
12. Temporary piping, valves, and control air vents,
13. Temporary seeding,
14. Temporary sheeting and bracing,
15. Thrust protection,
16. Top soiling,
17. Seeding,
18. Site restoration and cleanup as shown in the Contract Documents,
19. Work Plan and all notifications, including re-notifications, as necessary, and
20. All other Work incidental to the offset.

I. Cutting in of Tees, Crosses, and Valves into Existing Mains (larger than 2-inches)

Cutting in of Tees, Crosses, and Valves into Existing Mains (larger than 2-inches) shall be paid based upon the number of each tee, cross, or valve cut in. The unit price bid shall not include pipe or valves and valve boxes, which shall be paid for under their respective unit price. The unit price bid shall include the cost of:

1. Backfilling with suitable material,
2. Coarse aggregate fill,
3. Compacting,
4. Cutting in of any valves at or near the tee or cross
5. Dewatering,
6. Disposing of surplus material
7. Excavating,
8. Furnishing and installing all fittings such as tees, bends, reducers, sleeves, plugs, as well as other appurtenances,
9. Other site restoration and cleanup,
10. Pavement replacement
11. Seeding,
12. Temporary sheeting and bracing,
13. Testing,
14. Thrust protection, and
15. Top soiling.

J. Tracer Wire Box

Payment will be made at the unit price bid for each tracer wire box installed and will include the cost of furnishing and installing the box, lid, riser pipe, aggregate base material, backfilling, compaction, topsoil (if required), and all required appurtenances, in accordance with the Standard Detail.

End of Section