

SECTION 02600
UTILITY PIPING

PART 1. GENERAL

1.01 SECTION INCLUDES

- A. Furnish all labor, material and equipment to install piping for sanitary sewer systems in accordance with the Drawings and as specified herein. Work in this section shall include, but not be limited to:
 - 1. Sewer Mains (Gravity and Force)
 - 2. Sewer Laterals
 - 3. Cleanouts
 - 4. Building/House Connections
 - 5. Private Collection Systems
 - 6. Bore Crossings
 - 7. Railroad Crossings
 - 8. Testing
 - 9. Stream Crossings

1.02 RELATED SECTIONS

- A. Section 01010 - Summary of Work
- B. Section 01300 - Submittals
- C. Section 01400 - Quality Control
- D. Section 01500 - Construction Facilities and Temporary Controls
- E. Section 01570 - Traffic Regulation
- F. Section 02225 - Excavating, Backfilling and Compacting for Utilities
- G. Section 02315 - Tunneling, Jacking, and Boring
- H. Section 02605 - Manholes
- I. Section 03300 - Cast-in-Place Concrete
- J. Section 11306 - Pump Stations
- K. Appendix A - Standard and Special Construction Detailed Drawings

1.03 REFERENCES

- A. American National Standards Institute/American Society for Testing and Materials, Latest Editions.
 - 1. ANSI/ASTM A-74 - Cast Iron Soil Pipe and Fittings
 - 2. ANSI/ASTM C-14 - Concrete Sewer, Storm Drain, and Culvert Pipe
 - 3. ANSI/ASTM C-76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

4. ANSI/ASTM C-443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
5. ANSI/ASTM C-923 - Resilient Connectors between reinforced concrete manhole structures and pipes.
6. ANSI/ASTM D-2321 - Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
7. ANSI/ASTM D-2729 - Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
8. ANSI/ASTM D-2774 - Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
9. ANSI/ASTM D-3033 - Type PSP Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
10. ANSI/ASTM D-3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
11. ANSI A21.11 - Rubber Gasket Joints for Cast Iron and Ductile-Iron Pressure Pipe and Fittings
12. ASTM F2262-09 - HDPE – SDR-9
13. Pennsylvania Department of Transportation Specifications, Publication 408, Latest Edition

1.04 SUBMITTALS

- A. Submit each manufacturer's certification attesting that the pipe, pipe fittings, joints, joint gaskets and lubricants meet or exceed specification requirements.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling: Do not place materials on private property without written permission of the property owner. During loading, transporting and unloading, exercise care to prevent damage to materials. Do not drop pipe or fittings. Avoid shock or damage at all times. Take measures to prevent damage to the exterior surface or internal lining of the pipe.
- B. Storage: Do not stack pipe higher than recommended by the pipe manufacturer. Store gaskets for mechanical and push-on joints in a cool, dry location out of direct sunlight and not in contact with petroleum products.

1.06 JOB CONDITIONS

- A. Safety: The Contractor shall be responsible, at all times, for carrying out all pipe laying operations in a safe and prudent manner to protect all workmen and the public from unreasonable hazard. The necessary sheeting and bracing should be determined in accordance with the field conditions encountered. All applicable OSHA requirements must be strictly adhered to.
 1. Shheeting and bracing shall be used as required for the safety of employees exposed to the hazard of falling or sliding material from any trench or applicable excavation more than five (5) feet above employees' footing. A box shall be used at depths of eight (8) feet or greater and any other time at the discretion of the Inspector.
- B. Protection: Use all means necessary to protect all materials of this section before, during, and after installation and to protect all objects designated to remain.

In the event of damage, immediately make all repairs and replacements necessary to the approval of the Authority and at no additional cost to the Authority.

- C. Qualifications of Workmen: Provide at least one person who shall be thoroughly trained and experienced in the skills required, who shall be completely familiar with the design and application of work described for this Section, and who shall be present at all times during progress of the work of this Section and shall direct all work performed under this Section.
- D. Access and Inspection: All work in this section is subject to Inspection by the Authority or his representative and they shall have full access to the project for same.

1.07 TRAFFIC MAINTENANCE

- A. The Contractor shall furnish the necessary guards, watchmen, warning lights and similar items necessary to maintain state highway and other road/street traffic in accordance with PennDOT requirements. In general, the Contractor will not be permitted to interrupt traffic without specific arrangements for detouring traffic in accordance with PennDOT requirements. When traffic cannot be detoured, a minimum of ½ the roadway width shall be open for use at all times with traffic control.

1.08 WORK DURING INCLEMENT WEATHER

- A. The Authority reserves the right to order cessation of work during inclement weather if, in the opinion of the Authority, the safety of the workmen is endangered or if the work itself is endangered.

PART 2. PRODUCTS

2.01 PIPE

- A. Sewer pipe shall be Polyvinyl chloride (PVC), or, Ductile Iron Pipe (DIP). as shown on the Plans and as specified. Trench depth, loading, type of terrain, etc. shall be taken into consideration when making pipe selection.

1. Polyvinyl Chloride Pipe (PVC)

- a. PVC sewer mains and lateral piping shall conform to ASTM D-3034, Type PSM, SDR-35 for sizes six (6) inches through fifteen (15) inches. Sizes eighteen (18) inches through twenty-four (24) inches, SDR-35 shall conform to ASTM F-679, Type 1. Joints shall be bell and spigot with gaskets, and conform to ASTM D-3212 and ASTM F-477.
- b. Force mains of PVC pipe shall conform to ASTM D-2241, be SDR-21 (200 psi); extruded from clean, virgin approved class 12454-A-PVC resin compound conforming to ASTM D-1784. Rubber gaskets shall meet the requirements of ASTM F-477 with the joint coupling to ASTM D-3139 or a continuous length of HDPE DR-11 (200 psi) conforming to ASTM F – 2262-09
- c. Fittings for PVC pipe shall be compatible to pipe used i.e., material and ASTM specifications. Ductile iron fittings meeting Sub-Section 2.01 A.3(C) shall be used with PVC pressure pipe at thrust locations.

2. Ductile Iron Pipe (DIP)

- a. DIP used in sewer mains, force mains, interconnecting of pump stations and valve pits shall conform to ASTM A-377 and ASTM A-716. Wall thickness shall be minimum Class 52, and may be specified heavier. Joint shall be bell and spigot with gasket conforming to ANSI A21.11 except a restrained joint such as U.S. Pipe's 'Field Lok350' or equal shall be specified for areas which may be susceptible to movement or settlement as may be caused by sinkholes or other ground conditions.
- b. Pipe and fittings shall be coated on the outside with a bituminous coating. The insides shall be cement lined with a minimum thickness of 1/8 inch or as otherwise specified.
- c. Fittings shall be either mechanical joints or flanged, as required. Push-on joints for fittings will not be allowed. Fittings shall have a minimum pressure rating of 250 psi and conform to AWWA C-110 or C-153.
- d. DIP must be used in all boring installations
- e. Approved Manufacturers:
 - (1) U.S. Pipe and Foundry Company
 - (2) American Pipe Company
 - (3) Griffin

2.02 CEMENT CONCRETE

- A. Concrete for cradling and encasement shall meet the requirements of Section 03300 - Cast-In-Place Concrete for Class B.

2.03 OTHER MATERIALS

- A. All other materials not specifically described but required for a complete and proper installation of the work of this Section, shall be new, first quality of their respective kinds, and as selected by the Contractor, subject to the approval of the Authority.

PART 3. EXECUTION

3.01 GENERAL

- A. All types of pipe shall generally employ the same methods for installation. Follow manufacturers' recommendations for respective type.

3.02 TRENCHING

- A. Trenching for sewer mains, laterals, and other appurtenances shall be as heretofore specified in Section 02225.

3.03 PIPE LAYING

- A. All pipe shall be laid true to line and grade on a six (6) inch depth of Type I or Type II bedding, as shown on the Plans, by use of a laser. Place lateral "WYES" at proper locations. The Authority, upon proper notification to the Contractor, may cause the Contractor to require concrete cradle or tamped Type I backfill in any location where the trench has been over excavated.

As specified in Section 02225, Sub-Section 3.04, all pipe shall be stone encased. A minimum of three and one-half (3 1/2) feet of cover is required over all pipes.

- B. Where the sewer line crosses over or under another pipe, and a vertical clearance of eighteen (18) inches for waterlines and twelve (12) inches for others, cannot be maintained between them, the lower pipe shall be encased for its entire periphery with Class B concrete for a distance of ten (10) feet on each side of the higher pipe. In all cases sewer must pass below water lines.
- C. All pipe and appurtenances shall be carefully inspected before being placed such that no cracked, broken, or defective pipe or appurtenances shall be used in the work. All pipes shall be laid with bells upstream and joints shall be made in such a manner that a smooth invert is provided.
- D. The interior of the sewer shall be kept clean as the work progresses, and the open end shall be bulkheaded when pipe laying is in progress and during shutdown.
- E. After the pipe has been laid true to line and grade and the joints made properly, the Contractor shall furnish and install backfill material as specified in Section 02225, Sub-Sections 2.01, 3.04, 3.05 and 3.06.
- F. Where a pipe enters a manhole, the pipe shall be cradled with Class B concrete half the diameter of the pipe to a joint in the pipe, distance of 5 feet outside of the manhole. Place non-shrink grout in the remaining space between the concrete cradle and the manhole wall, filling the void between the pipe, seal gasket and manhole wall. Refer to Section 02605, Sub-section 3.06 B. for treatment when using cast-in-place bases or making connections to existing manholes.
- G. When placing sewers on a steep slope of 20% or greater, they shall be anchored securely with concrete anchor blocks.
 - 1. Refer to Standard Detail Drawing No. 18 for spacing and construction details.

3.04 LATERALS

- A. Laterals shall be constructed using the same materials and installation procedures specified for the mains.
- B. An elbow shall be placed in the main "WYE" directed to meet the line and grade of the lateral.
- C. Laterals, minimum size six (6) inch diameter, shall extend two (2) feet inside the property and end with a bell. Pipe shall be stoppered with a male plug properly braced to preclude testing failure.
- D. The lateral shall have a minimum of one (1) foot horizontal free space at the end of the two (2) foot extension inside the property.
- E. Refer to Standard Detail Drawing No. 9.

3.05 DEEP CUT LATERALS

- A. Where elevations of main sewers and service connections are such that requires lateral trenching of over ten (10) feet, a riser connection off the main shall be made to an elevation approved by the Authority.
- B. Riser assemblies consist of a "WYE" inserted in the main sewer with an elbow for plumb. Place a six (6) inch diameter riser pipe of a length terminating at a height allowing the shallow lateral trenching. Place an elbow on the riser pipe and extend lateral to two (2) feet inside the property line and cap off.

- C. Where appropriate, place a Wye on top of riser pipe and extend to surface, properly capped for a clean-out.
- D. Encase sewer main and riser pipe to height of elbow or Wye with Class B concrete, minimum thickness of six (6) inches.
- E. Mark ends of all laterals with a 4" x 4" post of hardwood or pressure treated lumber. Posts shall be of sufficient length to extend from lateral end to three (3) feet above the ground. Paint exposed end of post with green paint for a minimum length of one (1) foot.
- F. Refer to Standard Detail Drawing No. 11.

3.06 CLEANOUTS

- A. Cleanouts consist of a Wye, 45 degree elbow, and riser pipe placed along a sewer lateral or at the end of a main for maintenance entry.
- B. Cleanouts placed in sewer laterals shall be at minimum intervals of fifty (50) feet, including riser length, for four (4) inch pipe and one hundred (100) feet for six (6) inch diameter pipe.
- C. Riser pipes shall extend to meet finished grade, capped with an adaptor for a threaded flush plug.
- D. Cleanouts terminating in commercial paved areas, where damage may occur, shall be protected by an eighteen (18) inch square of Class A concrete encasement, twelve (12) inches thick, reinforced with 6x6x10 gauge (W1.4) wire fabric. Or the cleanout must be protected with a cast iron cover.
- E. Where the cleanout is to be used for observation, a tee shall be used in lieu of a Wye and elbow.
- F. Refer to Standard Detail Drawing Nos. 13 and 14.
- G. Metal threaded flush plugs installed in all paved areas.

3.07 BUILDING/HOUSE CONNECTION

- A. This work consists of constructing the house sewer from lateral at property line to the building/house.
- B. This work shall be performed under all specifications heretofore described or referenced in regard to material, trenching, backfill and compaction.
- A. The house sewer shall be installed in a trench separate from the water line where possible. If a water line is to be installed in the same trench with house sewer, DEP requirement will govern and may require concrete encasement.
- A. The wall sleeve through which the house sewer passes as it exits the building either through the wall, the footer, or under the footer shall be steel pipe, one pipe diameter bigger than the outside diameter of the house sewer. In an application where the house sewer passes through multiple foundation walls, such as through a porch foundation, a continuous sleeve must be used. A link-seal of the type manufactured by Thunderline Corporation or approved equal shall be used to seal the house sewer where it passes through the sleeve. A trap and vent shall be installed within ten (10) feet in the lateral at location just outside building.
- B. Refer to Standard Detail Drawing No. 10.

3.08 PRIVATE COLLECTION SYSTEM

- A. A private collection system which is constructed to serve a multi-family structure such as an apartment building or a group of single family structures such as townhouses shall be constructed in accordance with the latest edition of the code in force at the time of construction.
- B. All work shall be in accordance with these specifications and to the Plans approved by the Authority.
- C. House sewers shall be provided to each individually owned unit unless approved by the Authority
- D. The Authority, in its discretion, may order the construction of a manhole at the end of the lateral coming off the main line sewer which serves the property for which the private collection system is being built.

3.09 CLAY DIKES

- A. Compacted clay dikes shall extend vertically from undisturbed ground at bottom of trench to within two (2) feet of final grade and from undisturbed ground on trench sides for full width of trench.
- B. Each clay dike shall consist of clay containing no more than 15% (by volume) stone not larger than two (2) inches in diameter. Clay shall be placed in six (6) inch lifts and compacted by mechanical tamper to not less than 95% of maximum density at optimum moisture content.
- C. Refer to Standard Detail Drawing No. 19.

3.10 BORE CROSSINGS

- A. This work consists of placing casing pipe as a conduit for sewer mains and laterals using the horizontal boring method. This installation is used to avoid obstructions or other interference with the work, normally at road crossings. Ductile Iron Pipe must be used in all bore crossings.
- B. Casing pipe shall be welded steel pipe meeting ASTM A-139, Grade B, ASTM A-252 or approved equal. Pipe shall have a wall thickness of 3/8 inch and a diameter to allow passage of pipe on skids.
- C. Skids shall be plastic spacers designed specifically for pipe size/material may be approved.
- D. Lubricant used on the skids shall not be injurious to the pipe joint gaskets.
- E. Enclose ends of casing with fitting designed for this purpose. Typically a rubber fitting with stainless steel bands to seal against carrier and casing pipe.
- F. Refer to Project Drawings and/or Highway Occupancy Permit for special conditions relative to each location.
- G. Refer to Standard Detail Drawing No. 16 for schematic elevation views of casing.

3.11 RAILROAD CROSSINGS

- A. This work consists of placing sewer lines across railroads and within the Railroad Right-of-Way.
- B. For all work within the indicated limits of this special construction, those specifications of the Railroad regarding both workmanship and materials for such work which are in conflict with these

Specifications shall supersede these Specifications if so ordered by the Railroad and approved by the Authority.

- C. The Contractor shall furnish all bonds, insurance and similar items which the Railroad shall require for work on their right-of-way. The Contractor shall direct all his operations toward the protection or railroad track, work and structures. The Contractor shall save harmless the Authority from any action arising out of the Contractor's operations on the Railroad right-of-way.
- D. The Contractor shall compensate the Railroad for all expenses that the Railroad shall claim for inspection and safety personnel required of them by this work, and shall conform with all requirements of the Railroad for work on their right-of-way.
- E. The Contractor shall take these costs into consideration when bidding.

3.12 TESTING (GRAVITY LINES)

A. General

- 1. After the gravity sewers have been laid and backfill has been placed to 2 feet above the pipe, a light will be flashed between manholes, or if the manhole has not yet been constructed, between the location of manholes, by means of a flashlight or mirrored light, to determine whether the alignment of the main is true and whether any pipe has been displaced subsequent to laying. If alignment is correct and no other defects are disclosed, backfilling may be continued. If the test shows poor alignment of the main, misplaced pipe or other defects, such defects shall be remedied by the Contractor, as required by the Authority, before the work of backfilling proceeds.
- 2. After backfilling has been done, the Contractor shall make tests to ascertain if joints are right. Leaky or poor joints shall be repaired, or removed at once by the Contractor to the satisfaction of the Authority.
- 3. No section of gravity sewer lines shall be tested for leakage before backfilling in that section has been completed. If this condition has been fulfilled, the sewer lines shall be tested for leakage between manholes as the work progresses.
- 4. The Contractor shall perform the tests and he shall furnish all apparatus and materials including water required for the tests.
- 5. The tests will be witnessed by an Authority Representative.
- 6. The following tests shall be made:
 - a. All sewers shall be tested by making exfiltration or infiltration tests if requested by the Authority.
 - b. After making the exfiltration or infiltration test, the Contractor shall perform air tests on the lines between manholes.
 - c. Smoke test shall be required in lieu of exfiltration or infiltration tests, or air tests, only where conditions are not appropriate for these tests. Smoke testing shall be done prior to the placement of any paving material.

B. Infiltration, Exfiltration Test

- 1. Infiltration Test
 - a. Plug the upstream manhole and make measurement of the flow at the downstream

manhole. Amount of leakage from any section of the sewer shall not exceed 50 gallons per 1 inch diameter of pipe per mile in 24 hours. This allowance shall include leakage in manholes along the length of the line.

2. Exfiltration Test

- a. When using the exfiltration test method, the average internal pressure in the system under test shall not be greater than 5 pounds per square inch (11.6 ft. hd.), and the maximum internal pressure in any part of the system under test shall not be greater than 10.8 pounds per square inch (25 ft. hd.).

The joints shall pass the minimum joint tightness requirements as specified in ASTM D-3034. The maximum allowable exfiltration shall not be greater than 50 gallons per 1 inch diameter of pipe per mile in 24 hours. When 10 feet or more difference in grade occurs between manholes, use the Air Testing method since an Exfiltration Test will not be feasible under such conditions. This allowance, for exfiltration, shall include leakage from manholes along the length of the line.

C. Air Test

1. General

- a. The sewer mains and/or laterals shall be tested for leakage by the use of low pressure air as specified hereinafter and as approved by the Authority. Each manhole run will be tested separately as the construction progresses, before trench surface restoration, and preferably with not more than 4 manhole runs constructed ahead of testing.

2. Equipment

Equipment shall be manufactured by Cherne Industrial, Inc. of Edina, Minnesota, N.B. Products, New Britain, PA or equal. Equipment used shall meet the following minimum requirements:

- a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
- b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
- (1) All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs must hold against this pressure without having to be braced.
- c. All air used shall pass through a single control panel.
- d. Three individual hoses shall be used for the following connections:
- (1) From control panel to pneumatic plugs for inflation.
- (2) From control panel to sealed line for introducing the low pressure air.

- (3) From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

3. Procedures

- a. After a manhole to manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any ground water than may be over the pipe. At least 2 minutes shall be allowed for the air pressure to stabilize.
- b. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "Acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameters in Table A.
- c. In areas where ground water is known to exist, the Contractor shall install a 1/2 inch diameter capped pipe nipple, approximately 10 inches long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Test, the ground water shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The plastic tube shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11-1/2 feet, then the added pressure will be 5 psig to 7.5 psig, the allowable drop of one pound and the timing remain the same.)

4. Safety

- a. The air test may be dangerous if, because of unfamiliarity or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. Inasmuch as a force of 250 lbs. is exerted on an 8 inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.
- b. As a safety precaution, pressurizing equipment shall include a regulator set at 10 psi to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

D. Deflection Test

1. General

- a. Deflection testing shall be performed on all portions of the sewer system. This test shall be performed in sections between manholes after thirty (30) days but not more than twelve (12) months after final grading has been completed in the area.
- b. Deflection testing shall be performed in accordance with the procedure outlined

below and any section of the sewer system not meeting the minimum requirements for deflection shall be excavated and repaired to the Authority's satisfaction.

2. Maximum Deflection

- a. The maximum allowable deflection for all installed sewer pipe, meeting the minimum wall thickness requirements, shall not exceed 5% of the pipe's original internal diameter.

3. Testing Apparatus

- a. Deflection testing shall be performed with a "go, no-go" mandrel which is sized to such dimensions that it will not "go" when encountering deflection greater than permissible. The test mandrel shall be conducted, at the Contractor's expense, according to the dimensional tolerances as shown in Figure 1.

4. Deflection Testing Procedure

- a. Completely flush the line, making sure the pipe is clean of any mud or debris that would hinder the passage of the mandrel.
- b. During the final flushing of the line, attach a floating block or ball to the end of the mandrel pull rope and float the rope through the line. (A nylon ski rope is recommended).
- c. After the rope is threaded through the line, connect the pull rope to the mandrel and place the mandrel in the entrance of the pipe.
- d. Connect a retrieval rope to the back of the mandrel to pull it back if necessary.
- e. Remove all the slack in the pull rope and place a tape marker on the rope at the ends of the pipe.
- f. Draw mandrel through the sewer line. If any irregularities or obstructions are encountered in the line, corrective action shall be taken as required.
- g. If a section with excessive deflection is found, it shall be located and excavated. The pipe shall be inspected for damage; if any damaged pipe is found, it shall be replaced at the Contractor's expense. If pipe is not damaged, replace and thoroughly tamp the haunching and initial backfill; replace remainder of backfill.
- h. Re-test this section for deflection.

Table A
Air Test Tables

Minimum Holding Time in Minutes Required for
Pressure to Drop from 5 to 4 psig

Pipe Size (Inches)	Time	Pipe Size (Inches)	Time
4	2 minutes	18	9 minutes
6	4 minutes	21	10 minutes
8	5 minutes	24	11 minutes
10	6 minutes	27	13 minutes
12	7 minutes	30	14 minutes
15	8 minutes	36	17 minutes

3.13 TESTING (FORCE MAIN)

- A. After the pipe has been laid and the trench backfilled, the pipe shall be subjected to a hydrostatic pressure 150 percent of normal operating pressure.
- B. Tests shall be made only after completion of partial or complete backfill as specified and not until at least 36 hours after the last joint to be tested has been made and if applicable, at least 36 hours after the last concrete thrust or reaction blocking has been cast.
- C. Each section of pipeline shall be slowly filled with water and the specified test pressure measured at the point of lowest elevation shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer.

The pump, pipe connection, gauges, water, water meter and all necessary apparatus shall be furnished by the Contractor. The Contractor shall also provide all necessary assistance for conducting the test. The duration of the test shall be 30 minutes.
- D. After the pressure test, the pipe shall be tested for leakage. The leakage shall not exceed 10 gallons per inch diameter, per mile of pipe per twenty-four (24) hours tested at 1 1/2 times the working pressure or the pipes rated pressure whichever is greater. The test shall be conducted in the same manner as the pressure test except that the Contractor shall provide suitable equipment for measuring the amount of leakage.
- E. No pipe installation will be accepted until or unless the leakage for the section of line tested is less than the rate of leakage allowance under paragraph D.
 - 1. Should any test of a section of pipeline disclose leakage greater than that permitted, the Contractor shall at his own expense locate and repair the defective joints and/or pipe until the leakage is within the permitted allowance.

3.14 RETESTING

- A. All inspection costs incurred by the Authority for retesting due to failure of product or workmanship shall be paid by the Contractor.