

# 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

#### 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 02605 - Manholes
- H. Section 03300 - Cast-in-Place Concrete
- I. Section 11360 - Pump Stations
- J. 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-12 - Practice for Installing Vitrified Clay Pipe Lines
  - 3. ANSI/ASTM C-14 - Concrete Sewer, Storm Drain, and Culvert Pipe
  - 4. ANSI/ASTM C-76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

5. ANSI/ASTM C-425 - Compression Joints for Vitrified Clay Pipe and Fittings
6. ANSI/ASTM C-443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
7. ANSI/ASTM C-700 - Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated
8. ANSI/ASTM C-923 - Resilient Connectors between reinforced concrete manhole structures and pipes
9. ANSI/ASTM D-2321 - Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
10. ANSI/ASTM D-2729 - Polyvinyl chloride (PVC) Sewer Pipe and Fittings
11. ANSI/ASTM D-2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
12. ANSI/ASTM D-2774 - Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
13. ANSI/ASTM D-3033 - Type PSP Polyvinyl chloride (PVC) Sewer Pipe and Fittings
14. ANSI/ASTM D-3034 - Type PSM Polyvinyl chloride (PVC) Sewer Pipe and Fittings
15. ANSI A21.11 - Rubber Gasket Joints for Cast Iron and Ductile-Iron Pressure Pipe and Fittings
16. Pennsylvania Department of Transportation Specifications, Publication 408/Latest Edition.
17. ANSI/ASTM D-2665 Schedule 40 polyvinyl chloride (PVC) sewer lateral pipe and fittings for gravity applications.
18. ANSI/ASTM D-1785 or ASTM F-480 Schedule 40 PVC sewer lateral pipe and fittings for pressure applications.

#### 1.04 **SUBMITTALS**

- A. Submit Shop Drawings/Product Data from manufacturer's descriptive literature and specifications for all materials used in this Section. Submit in accordance with Section 01300

#### 1.05 **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. Sheeting 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 five (5) 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.

**1.06 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 1/2 the roadway width shall be open for use at all times, with traffic control.

**1.07 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), Cast Iron Pipe (CIP), Ductile Iron Pipe (DIP), Acrylonitrile-Butadiene-Styrene (ABS), truss pipe, Reinforced Cement Concrete Pipe (RCCP), Vitrified Clay (VC), or Asbestos Cement (AC), as shown on the Plans and 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. Acceptable bell lengths for PVC SDR-35 pipe are as follows:

<u>Pipe size</u>	<u>Socket size</u>
6 inch	3.5 inch
8 inch	4.1 inch
10 inch	4.7 inch
12 inch	5.15 inch
15 inch	5.95 inch
18 inch	5.90 inch
21 inch	6.40 inch
24 inch	11.25 inch
30 inch	12.34 inch

- b. Force mains of PVC pipe shall conform to ASTM D-2241, be SDR21 (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. Schedule 40 PVC pipe may also be used if stamped ASTM D-1785 or ASTM F-480
- 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.
- d. Lateral pipes (4 or 6 inch) that extend from the property line to the building, in a gravity application, must be constructed with Schedule 40 PVC pipe bearing the ASTM D-2665 stamp.
- e. Approved Manufacturers:
 

<u>PVC SDR 35 pipe</u>	<u>PVC Schedule 40 pipe</u>
Johns-Manville	Crestline
Certainteed	National
Equal with approved submittals	Equal with approved submittals

2. Cast Iron Pipe (CIP)

- a. CIP shall be used only for a repair to an existing system or if particularly specified. Pipe shall conform to ASTM A-74. Pipe ends are usually bell and spigot conforming to ANSI A21.11, but may be plain end for mechanical clamp and gasket joints.

3. 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 'USIFLEX' 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. Approved Manufacturers:
  - i. U.S. Pipe and Foundry Company
  - ii. American Cast Iron Pipe Company
  - iii. Equal with approved submittals

4. Acrylonitrile-Butadiene-Styrene Pipe (ABS)

- a. ABS truss pipe shall conform to the requirements of ASTM D-2680. ASTM D-2321 outlines installation specifications.
- b. ABS truss pipe will not be permitted at any depth greater than 18 feet.

- c. ABS truss pipefittings shall conform to ASTM D-2680 and joints shall be solvent welded.
  - d. Approved Manufacturers:
    - i. ARMCO
    - ii. Equal with approved submittals
- 5. Reinforced Cement Concrete Pipe (RCCP)
  - a. RCCP shall conform to ASTM C-76, Class IV
  - b. Joints shall conform to ASTM C-443.
  - c. Interior surfaces shall be covered with two coats of an approved bituminous coating. Coating shall be applied by the manufacturer at the plant.
  - d. Approved Manufacturers:
    - i. New Enterprise Stone and Lime Company
    - ii. Schuylkill Products, Inc.
    - iii. Equal with approved submittals
- 6. Vitrified Clay Pipe (VC) - Extra Strength
  - a. VC pipe shall conform to ASTM C-700. The pipe shall meet the minimum crushing strength as determined by the three edge bearing test for extra strength vitrified clay pipe.
  - b. Pipe shall be furnished in 4 to 5 feet lengths.
  - c. Joints shall be a factory made compression type, conforming to ASTM C-425. Pipes warped at either end shall be rejected.
  - d. Approved Manufacturers:
    - i. Logan Clay Products
    - ii. Equal with approved submittals
- 7. Asbestos Cement Pipe (AC)
  - a. AC pipe shall only be specified to repair existing lines where another type cannot be incorporated.
  - b. AC pipe shall conform to ASTM C-428, C-644, C-500 and D-1869.
  - c. Joints shall be made with ring-tite couplings of the same strength and material as the pipe. If necessary, rubber-sealing rings shall be used to provide a watertight joint.
  - d. Approved Manufacturers:
    - i. Certainteed
    - ii. Equal with approved submittals

## **2.02 CEMENT CONCRETE**

- A. Concrete for cradling and encasement shall meet the requirements of Section 03300 - Cast-In-Place Concrete for Class B (2500 psi).
- B. Concrete for flow lines shall meet the requirements of Section 03300 – Class A (3300 psi)

## **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 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 four (4) feet of cover is required over all pipes. All pipe 8" diameter or greater shall be terminated with a manhole.
- 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.
- 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 bulk-headed 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. 5B for spacing and construction details.
- H. Where pipe enters a manhole with precast seal, and is bedded on undisturbed (not over-excavated) earth, the cradle is not necessary. The connection shall be sealed on the manhole exterior with a non-shrinking grout material and painted with a bituminous sealant.
- I. After piping has been flushed, the Authority will televise the construction to inspect for defects in material and/or workmanship.

### **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 cap properly braced to preclude testing failure.

### **3.05 DEEP CUT LATERALS**

- A. Where elevations of main sewers and service connections are such that requires lateral trenching of over seven (7) feet, a riser connection off the main shall be made.
- 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 6 inches.
- E. Mark ends of all laterals with a 4" x 4" post of 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 Nos. 5 and 5A.

### **3.06 CLEANOUTS**

- A. Cleanouts consist of a Wye, 45° 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 for four (4) inch diameter 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 B concrete encasement, twelve (12) inches thick, reinforced with 6x6x10 gauge (W1.4) wire fabric.

- F. Where the cleanout is to be used for observation, a tee shall be used in lieu of a Wye and elbow.
- G. Refer to Standard Detail Drawing Nos. 10 and 11.
- H. Cleanout riser pipe is to be the same size of pipe and the same pipe material as the lateral.

### **3.07 BUILDING/HOUSE CONNECTION**

- A. This work consists of constructing the house sewer from lateral at property line to the building/house.
- B. Any separate connection of a detached structure to the primary use on the lot shall be considered a "Private to Private" connection and shall follow the same requirements as the primary building connection however it shall require a separate permit as described in the Rate Resolution.
- C. This work shall be performed under all specifications heretofore described or referenced in regard to material, trenching, backfill and compaction.
- D. The house sewer shall be installed in a trench separate from the water line with a minimal horizontal separation of five (5) feet.
- E. 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. 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 in lateral at location just outside building.
- F. Refer to Standard Detail Drawing No. 11.

### **3.08 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.
- 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 pressure treated lumber, 4 equally spaced on each pipe, of a thickness when strapped to the pipe shall protect the pipe bells from damage when sliding the pipe through the casing.
- D. Lubricant used on the skids shall not be injurious to the pipe joint gaskets.
- E. Fill casing pipe with sand or flowable fly ash before sealing ends.
- F. Enclose ends of casing with sewer brick or concrete masonry units laid up with waterproof mortar with a 1 inch weep hole placed in the low end.
- G. Refer to Project Drawings and/or Highway Occupancy Permit for special conditions relative to each location.
- H. Refer to Standard Detail Drawing Nos. 11A and 11B for schematic elevation views of casing.

### **3.09 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 to all requirements of the Railroad for work on their right-of-way.
- E. The Contractor shall take these costs into consideration when bidding.

### **3.10 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. 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:
  - i. From control panel to pneumatic plugs for inflation.
  - ii. From control panel to sealed line for introducing the low pressure air.
  - iii. 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 backpressure 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 constructed, 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 3.5 to 2.5 psig

<u>Pipe Size (Inches)</u>	<u>Time</u>	<u>Pipe Size (Inches)</u>	<u>Time</u>
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

**3.11 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.

**3.12 RETESTING**

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

**END OF SECTION**