

## **SECTION 17 INSPECTION & TESTING OF INSTALLED FACILITY**

### **17.1 Inspection of Sewerage and/or Water Distribution System During Course of Construction**

All construction of sewerage or water distribution systems shall be under the jurisdiction of the Engineer for the Authority, either directly or through inspectors under his supervision.

- (a) The Authority Engineer shall enforce compliance with the approved plans and specifications.
- (b) The Authority Engineer shall have the authority to have the work discontinued in the event of noncompliance.
- (c) The applicant shall also furnish the name of the occupant, the street address, and lot and block number two (2) weeks prior to request for certificate of occupancy from the Building Inspector in order that the wiring, meter installations and lateral inspections can be accomplished.
- (d) No sewer or water connections shall be made to the appropriate street main whether tested or not, unless under the supervision and inspection of the Engineer for the Authority.

A temporary, leak proof bulkhead type plug shall be installed in the upstream (inlet) side of the manhole furthest downstream in any sewer main or branch under construction and shall remain intact and unloosened until written permission is received from the Authority Engineer to remove same. Water mains shall be capped, plugged or valves closed and shall remain intact and unloosened until written permission is received from the Authority Engineer to remove same.

This permission will not be granted until each section of the sewer has been cleaned and flushed in a manner acceptable to the Authority's Engineer or water mains have been flushed and sterilized in a manner acceptable to the Authority Engineer.

### **17.2 Testing of Completed System**

All sewers and water mains shall be subjected to one or more of the following types of tests (infiltration, exfiltration or pressure test). Exfiltration tests shall be conducted in lieu of infiltration tests when the pipe has been laid above the groundwater level. The tests shall be performed between two manholes or as otherwise directed by the Engineer for the Authority and shall include all related sewerage including house connections.

The Contractor shall furnish all labor, materials and equipment necessary for the testing.

Exfiltration tests shall be under at least a four (4) foot head or a pressure corresponding to the head equal to the depth of the lower manhole of the section under the test.

An infiltration test should be performed in the late winter or early spring following construction. Allowable infiltration or exfiltration shall not exceed a rate of 100 gallons per mile, per inch of diameter of sewer per 24 hours.

In order to ensure that there shall be no gushing or spurting streams entering the sewer, the Contractor shall be held responsible for water tightness of the line, shall satisfactorily repair all joints and other parts not sufficiently watertight and then shall make additional tests of the infiltration or exfiltration until the test results conform to the requirements given herein.

When individual or house connections are connected to sewer mains already tested, the individual or house connections shall be pressure tested prior to connection to the sewer main. Individual or house connections shall be pressure tested under a ten (10) foot head of water and shall be made tight from the point of connection at the main to the lowest cleanout in the building.

Water pressure tests should be made with pressure in excess of the normal anticipated water pressure.

## **17.3 Infiltration**

### **17.3.1 Objective**

This procedure establishes the method(s) to be used for the testing of sanitary sewer system.

### **17.3.2 Purpose**

The purpose of this procedure is to establish a uniform method and practice in testing sanitary sewers for infiltration, exfiltration and alignment.

### **17.3.3 Infiltration Test**

The test shall be performed in the presence of the Mantua Township MUA's Engineer

Examine the sanitary sewer system for infiltration at the downstream end of the system after construction has been completed and prior to any sanitary building connections.

In the event that there is infiltration and water is flowing at the downstream end of the system, then the source and volume of flow must be determined.

To isolate the source, it is necessary to go upstream one manhole at a time, to find where the flow is originating. This is done by plugging the first upstream manhole and observing to see if the flow stops. This procedure is repeated one manhole at a time until the infiltration has been isolated.

When the infiltration has been isolated to a section or area, the volume of flow shall be determined as follows: (Installation and use of V-Notch weirs)

- (a) Insert a 60 degree V-Notch weir into the downstream end of pipe and ensure there is no leakage between weir seal and pipe wall.
- (b) Allow water to build up and flow over weir until a maximum crest is established.
- (c) To read, observe the water level against the back side, or upstream side, of the transparent dial at the side away from the "V" opening. The figures at this point will give you the rate of flow in gallons per day.
- (d) The permissible infiltration is based on the allowable rate of 100 gallons/inch diameter of pipe per mile/24 hours.

- (e) The installation of the eight (8”), ten (10”), twelve (12”) inch or larger weir is very simple. Place weir in the pipe and adjust to proper position as indicated by level bubble. However, on the larger size pipes, select the adapter numbered for size or pipe to be tested. Place in the pipe, the upper crescent of this adapter has a fifteen (15”) inch diameter. Set the fifteen (15”) inch weir in this crescent, adjust using level bubble and clamp tight.
- (f) If the permissible infiltration number is greater than the actual infiltration number, the infiltration test passes. If the actual infiltration is greater than the permissible infiltration, the infiltration test fails, and further investigation by the Contractor will be required to reduce the infiltration.

## **17.4 Exfiltration Test Procedures**

### **17.4.1 Testing Sanitary Sewer Lines For Exfiltration**

The test shall be performed in the presence of the Mantua Township MUA’s Engineer

When testing sanitary sewer lines for exfiltration, the following method shall be used:

The low pressure air test is the most desirable method of testing and should be used when possible. The low pressure air test is very fast, and isolation of leaks is very precise.

Prior to the start of the exfiltration test, all construction work for the system under test shall be completed. This includes backfilling and completion of all manholes.

- (a) Low Pressure Air Test (4.0 lbs.) to be conducted between two consecutive manholes, as directed by the Engineer.
- (b) The test section of the sewer line is plugged at each end. One of the plugs used at the manhole must be tapped and equipped for the air inlet connection for filling the line from the air compressor.
- (c) All service laterals, stubs and fittings into the sewer test section should be properly capped or plugged, and carefully braced against the internal pressure to prevent air leakage by slippage and blowouts.
- (d) Connect air hose to tapped plug selected for the air inlet. Then connect the other end of the air hose to the portable air control equipment which consists of valves and pressure gauges used to control:
  - (1) The air entry rate to the sewer test section, and
  - (2) To monitor the air pressure in the pipe line.

More specifically, the air control equipment includes a shut- off valve, pressure regulating valve, pressure reduction valve and monitoring pressure gauge having a pressure range from 0 to 5 psi. The gauge should have a minimum division of 0.10 psi and an accuracy of .04+/- psi. See Figure No. 1 for typical control equipment apparatus.

Connect another air hose between the air compressor (or other source of compressed air) and the air control equipment. This completes the test equipment set up. Test operations may commence.

Supply air to the test section slowly, filling the pipe line until a constant pressure of 4.0 psi is maintained. The air pressure must be regulated to prevent the pressure inside the pipe from exceeding 5.0 psi.

When constant pressure of 4.0 psi is reached, throttle the air supply to maintain the internal pressure above 3.5 psi for at least 5 minutes. This time permits the temperature of the entering air to equalize with temperature of the pipe wall. During this stabilization period, it is advisable to check all capped and plugged fittings with a soap solution to detect any leakage at these connections.

If leakage is detected at any cap or plug, release the pressure in the line and tighten all leaky caps and plugs. Then start the test operation again by supplying air. When it is necessary to bleed off the air to tighten or repair a faulty plug, a new five-minute interval must be allowed after the pipe line has been refilled.

After the stabilization period, adjust the air pressure to 4.0 psi and shut off or disconnect the air supply. Observe the gauge until the air pressure reaches 3.5 psi. At 3.5 psi, commence timing with a stop watch which is allowed to run until the line pressure drops to 2.5 psi at which time the stop watch is stopped. The time required, as shown on the stop watch, for a pressure loss of 0.5 psi is used to compute the air loss. Most authorities consider it unnecessary to determine the air temperature inside the pipe line and the barometric pressure at the time of the test.

If the air pressure drops but remains above (Greater than shown in Table #1) 3.5 psig, (3.5 psig being the cut off) and does not exceed the starting pressure of 4.0 psig in the allowable time, in minutes and seconds, shown in Table 1 for the designated pipe size, the section undergoing the test shall have passed and shall be presumed to be free of defects. The test may be discontinued at that time.

If the air pressure drops below (LESS than shown in Table 1) 3.5 psig in the allowable time, in minutes and seconds, shown in Table 1 for the designated pipe size, the section undergoing the test shall not have passed the test; therefore, adequate repairs must be made and the line retested.

**TABLE 1**

<u>TIME REQUIREMENTS FOR AIR TESTING</u>		
<u>PIPE SIZE</u>	<u>TIME</u>	
<u>(In Inches)</u>	<u>Minutes</u>	<u>Seconds</u>
4	2	32
6	4	00
8	5	6
10	6	22
12	7	39
14	8	56
15	9	35
16	10	12
18	11	34
20	12	45
21	13	30

NOTE: Test at 4.0 PSI with .5 PSI Maximum Allowable Loss

- a) Pipe sizes with their respective Recommended Minimum Times, in Minutes and Seconds, for Acceptance by the Air Test Method.
- (b) For eight (8) inch and smaller pipe, only: if, during the five minute saturation period, pressure drops less than 0.5 psi after the initial pressurization and air is NOT added, the pipe section undergoing test shall have passed.
- (c) Multi Pipe Sizes: When the sewer line undergoing test is 8" or larger diameter pipe and includes 4" or 6" laterals, the figures in Table 1 for uniform sewer main sizes WILL NOT give reliable or accurate criteria for the test. Where multi-pipe sizes are to undergo the air test, the engineer can compute the "average" size in inches which is then multiplied by 38.2 seconds. The results will give the minimum time in seconds acceptable for a pressure drop of 0.5 psi for the "averaged" diameter pipe.

An air pressure correction is required when the prevailing ground water is above the sewer line being tested. Under this condition, the air test pressure must be increased .433 psi for each foot the ground water level is above the invert of the pipe.

**17.4.2 Procedures for Making Air Pressure Correction**

Determination of Ground Water Elevation.

Where ground water is known to exist or is anticipated in the area before the air testing would be conducted, the following procedure is suggested at the time the sewer main and manholes are constructed.

Determine air pressure correction, which must be added to the four (4.0) psi normal starting pressure of test, by dividing the vertical height in feet by 2.31. The result gives the air pressure correction in pounds per square inch to be added. Example: If the vertical height of water from the sewer invert to the top of the water column measures 11.55 feet, the additional air pressure required would be:

$$\frac{(11.55)}{2.31} = 5 \text{ psi}$$

Therefore, the starting pressure of the test would be four (4.0) plus five (5.0) or nine (9.0) psi, and the one half pound drop becomes 8.5 psi. There is no change in the allowable drop (0.5 psi) or in the time requirements established for the basic air test.

All force mains and pressure lines shall be tested at 50 psi or 2 times the operating pressure whichever is greater or as required by the specifications.

Each section of pipe shall be slowly filled with water. Before applying the specified test pressure, all air shall be expelled from the pipe through blow-offs or taps that may be required for the release of air at the highest points.

When the test pressure has been reached, the amount of make-up water to maintain the test pressure in two (2) hours shall be measured.

No pipe installed will be accepted until the amount of leakage does not exceed 50 gallons per day per inch diameter per mile of pipe.

Where sections of pipeline fail to meet this requirement, they shall be repaired, again maintained under pressure in two (2) hours and retested as necessary until these requirements are complied with.

Calculations to determine loss per inch of pipe per day per mile shall be done as follows:

- a. Gallons of make-up water x 24 = gallons loss/day.
- b. Gallons x loss/day x 5280 feet/mile = gallons loss/ mile/ day  
Feet or Pipe Being Tested
- c. Gallons loss/mile/day = gallons/inch dia./mile/day  
Pipe Dia. Inches

Allowable exfiltration rate is 50 gallons/inch dia./mile/day

Example:      2 x TDH x (.4333)  
                    TDH = 130  
                    Test Pressure = 90 PSI  
                    TDH = Total Dynamic Head

## **17.5 Alignments**

Alignment (Lamp Test) shall be done on all gravity sanitary sewer lines.

Alignment consists of visually examining inside of pipe between two consecutive manholes with the aid of a light and mirror.

A light is shown from one manhole towards the other manhole. A mirror is held at the invert of pipe and adjusted so the light and barrel of pipe can be seen. The barrel of the pipe shall have no vertical deflection and at least 75% of the barrel shall be visible in the horizontal direction.

In the event that alignment shows the pipe not laid true and to grade it shall be repaired and be aligned as necessary until the alignment complies with these requirements,

The applicant shall perform a T.V. video inspection of the condition of the sanitary sewer system prior to dedication of the main. The Authority Engineer may require a mandrel test to be performed, if not satisfied with other forms of testing and /or construction practices in the field.

## **17.6 Television Inspection**

### **17.6.1 Objective**

This procedure establishes the method(s) to be used for the televising of sanitary sewer systems.

### **17.6.2 Purpose**

The purpose of this procedure is to establish a uniform method and practice in testing sanitary sewers for defects via television inspection.

### **17.6.3 Television Inspections Procedures**

- \* The test shall be performed in the presence of the Authority Engineer.
- a) The televising shall be performed following the approval of the sewer system's air pressure testing.
- b) Television inspection will be employed as the method of final inspection of the completed gravity sewer mains. All sanitary sewer mains shall be cleaned with a combination jet/vacuum vehicle prior to any televising and/or dedication of the mains to the Township. The contractor shall furnish a complete portable closed-circuit television system for visual inspection of the interior of the sewers. The television inspection shall be video recorded to document same and lateral locations. One copy shall be provided to the Authority Engineer.
- c) The system to be furnished by the Contractor shall include all required television equipment, related equipment, electrical power to operate the equipment, trained personnel all floats, cables, reels, footage, counting devices, lights and other materials necessary to perform the inspection.

- d) The equipment used shall produce a clear, sharp image on the monitor screen. Any equipment not producing a satisfactory result on the monitor screen shall be replaced with another unit. The personnel operating the equipment shall be thoroughly familiar with the operation of the equipment and in interpreting the visual results obtained. One (1) copy of the video tape for each televised section shall be provided to the Department's Engineer for review to the Department's files.
- e) Any irregularities in the pipe such as cracks, misalignment (horizontal or vertical) or poor joints, shall be corrected by the Contractor at his expense prior to acceptance of the project or for final payment. If in the opinion of the Engineer the sewer is not acceptable for reasons such as poor alignment, obvious leaks or cracks in pipes or manholes, excessive amount of deposits in pipes or manholes, etc., the Contractor shall repair or replace the defective section or sections of pipe and manholes at his own expense and to the satisfaction of the Engineer. Where excessive amount of deposits are noted, the Contractor will be required to flush such sections of sewers to remove the foreign material from the pipes. The flushing will be done between two manholes at a time, with a plug inserted in any section previously cleaned to prevent foreign material from entering this pipe section. All water used to flush lines shall be pumped from the lines and disposed of by the Contractor.
- f) Television reinspection of the sewer, or any portion thereof, may at the Owner's option, be repeated at any time prior to the release of the maintenance bond. Any deficiencies disclosed in such reinspection shall be immediately repaired or replaced by the Contractor as a condition precedent to the release of said maintenance bond.
- g) The Authority or Authority Engineer has the right to waive the television inspection if all other forms of testing meet the proper specifications.

## **17.7 Testing Procedure for Public Water Supply Systems**

### **17.7.1 Objective**

This procedure establishes the methods which are to be used for the testing of public water supply systems.

### **17.7.2 Purpose**

The purpose of this procedure is to establish a uniform method and practice in testing public water supply systems for exfiltration, chlorine residual, (sterilization), and bacteria.

### **17.7.3 Exfiltration Test Procedures**

The test shall be performed in the presence of the Mantua Township MUA's Engineer. After the pipe has been laid or installed, it shall be subjected to a pressure and leakage test. For pressure piping trench, this shall be conducted prior to the complete backfilling of the trench, unless otherwise permitted by the Mantua Township MUA Engineer, and for pressure piping in structures, this shall be conducted prior to the completion of any construction which would make it impossible or difficult to gain access to the pipe if found defective. The Contractor shall test sections of the pipes between valves, where practicable or where ordered by the Mantua Township MUA Engineer.

The Contractor shall make the necessary arrangements with the Authority for the procurement of water for the pressure and leakage tests, and for subsequent sterilization, and shall furnish the

necessary labor, pumps, valves, pressure gauges, water meters and all other equipment required for this purpose. Each section of pipe shall be subjected to a hydrostatic pressure 150 psi and maintained for a period of two (2) hours. Before applying the specified test pressure, all air shall be expelled from the pipe, through hydrants, blow-offs, or any taps that may be necessary for the release of air from the highest points. Taps required for the release of air and blow-offs required for filling the line shall be furnished and installed by the Contractor. The cost of such taps shall be included in the unit prices bid for the water main.

When the test pressure has been reached, the amount of make-up water to maintain the test pressure shall be measured. No pipe installed will be accepted until the amount of leakage meets the following requirements. Where sections of pipelines fail to meet this requirement, the Contractor shall, at his own expense, locate and make necessary, again maintained under pressure for two (2) hours, and retested as necessary until these requirements are complied with.

Leakage shall be defined as the quantity of water that must be supplied into the newly installed pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure (150 psi) after the pipe have been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

Calculations to determine loss per inch of pipe per day per mile shall be done as follows:

- Gallons of make up water x 24 = gallons loss/day.
- Gallons loss/day x 5280 Ft./Mile = Gallons loss/mile/
- Feet of Pipe being Tested day
- Gallons loss/mile/day = Gallons/inch dia./mile/day
- Pipe Dia. in Inches

**Allowable leakage at various pressures is shown in Table 2.**

<b>PRESSURE TESTING WATER</b>	
<b>PIPE SIZE In Inches</b>	<b>GALLONS LOSS (1,000 Ft.)</b>
3	0.28
4	0.37
6	0.55
8	0.74
10	0.92
12	1.10
14	1.29
16	1.47
18	1.66
20	1.84
24	2.21
30	2.76
42	3.86
48	4.41
54	4.97
<b>BASED ON AWWA STANDARD @ 150 PSI FOR ONE HOUR</b>	
<b>* AWWA standard shall be latest revision.</b>	

NOTE: Due to Table 2 being based on a one (1) hour test, the allowable loss determined must be doubled for the two (2) hour test.

NOTE: The testing methods described in this section are specific for water-pressure testing. These procedures should not be applied for air-pressure testing because of the serious safety hazards involved.

**Sterilization**

Each completed unit of the water main and distribution system shall be thoroughly sterilized with chlorine before it is placed in operation. The amount of chlorine applied shall be such as to provide a dosage of at least fifty (50) ppm. The contact period shall be at least twenty-four (24) hours, at the end of which time the chlorine residual shall be at least ten (10) ppm. The line should then be flushed with clean water until the chlorine residual is not greater than 0.2 ppm.

The chlorine required shall be in the form of high test calcium hypochlorine (HTH) in tablet form. The number of tablets required per length of pipe shall be determined from the following table:

<u>Length of Section</u>	<u>6"</u>	<u>8"</u>	<u>10"</u>	<u>12"</u>
13'	2	3	4	4
18'	3	3	4	4
20'	3	4	5	6

The required number of tablets should be fastened to the top of each length of pipe as it is laid using hot tar or "Permatex No. 2" gasket cement as the adhesive. Care should be taken to see that the adhesive only covers the side of each tablet so that as much surface as possible is exposed to the water when it is introduced into the main. A newly installed main shall be disinfected in accordance with ANSI/AWWA C651. Following chlorination, the main should be flushed as soon as possible, since prolonged exposure to high concentrations of chlorine might damage the asphaltic seal coating.

**NOTE:** *Other methods of sterilization may be used, however, approval by the Mantua Township MUA, in writing, must be obtained prior to the test being performed.*

**Bacteria Test**

- a. After flushing has been completed and the chlorine residual is not greater than 0.2 ppm, a bacteriological sample shall be taken in accordance with the New Jersey Department of Environmental Protection Agency, Potable Water Standards bulletin PW-D 10, December, 1970.
- b. The mouth of the valve, hydrant, blow off etc., shall be sterilized using a propane torch or equivalent and the water then allowed to flow for a period of not less than 5 minutes.
- c. The standard sample taken shall be collected in sterile bottles care being taken not to contaminate the neck of the bottle or stopper during collection.
- d. This sample shall be collected by the certified laboratory designated by the Mantua Township MUA or its Engineer for analysis.
- e. Copies of the analysis shall be sent to the engineer directly from the laboratories.

- f. In the event that the laboratory analysis shows bacteria present the line shall be rechlorinated, flushed, sterilized and a new sample taken until such time as the New Jersey Department of Environmental Protection, Potable Water Standard PW-D 10, December 1970 are met.

TO: Mantua Township M.U.A.  
397 Main Street  
Mantua, N.J. 08051

DATE: \_\_\_\_\_

Attn.: Superintendent

RE: \_\_\_\_\_  
Project  
\_\_\_\_\_  
Section  
\_\_\_\_\_  
As Built - Water

This is to inform you that the water mains referred to above and for which we have requested an inspection for pressure compliance have been disinfected in accordance with the project specifications.

Very truly yours,

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Company

cc: Mantua Township M.U.A.  
Authority Engineer