

## 7-17 SANITARY SEWERS

### 7-17.1 Description

This Work consists of constructing sanitary sewer lines in accordance with the Plans, these Specifications, and the Standard Plans, as staked.

### 7-17.2 Materials

Pipe used for sanitary sewers may be:

<b>Rigid</b>	<b>Thermoplastic</b>
Concrete	ABS Composite
Vitrified Clay	PVC (Polyvinyl Chloride)
Ductile Iron	

All sanitary sewer pipe shall have flexible gasketed joints unless otherwise specified.

It is not intended that materials listed are to be considered equal or generally interchangeable for all applications. The Engineer shall determine from the materials listed those suitable for the project, and shall so specify in the Specifications or the Plans.

Materials shall meet the requirements of the following sections.

Plain Concrete Storm Sewer Pipe	9-05.7(1)
Reinforced Concrete Storm Sewer Pipe	9-05.7(2)
Vitrified Clay Sewer Pipe	9-05.8
Solid Wall PVC Sanitary Sewer Pipe	9-05.12(1)
Profile Wall PVC Sanitary Sewer Pipe	9-05.12(2)
Ductile Iron Sewer Pipe	9-05.13
ABS Composite Sewer Pipe	9-05.14

All pipe shall be clearly marked with type, class, and thickness. Lettering shall be legible and permanent under normal conditions of handling and storage.

### 7-17.3 Construction Requirements

Sanitary sewers shall be constructed in accordance with Section 7-08.3.

#### 7-17.3(1) Protection of Existing Sewerage Facilities

All existing live sewers including septic tanks and drain fields shall be kept in service at all times. Provision shall be made for disposal of sewage flow if any existing sewers are damaged. Damage to existing sewers shall be repaired by the Contractor, at no expense to the Contracting Agency, to a condition equal to or better than their condition prior to the damage.

Water accumulating during construction shall be removed from the new sewers but shall not be permitted to enter the existing system. The Contractor shall be responsible for flushing out and cleaning any existing sewers into which gravel, rocks, or other debris has entered as a result of their operations, and shall repair lift stations or other facilities damaged by the Contractor's operations.

The physical connection to an existing manhole or sewer shall not be made until authorized by the Engineer. Such authorization will not be given until all upstream lines have been completely cleaned, all debris removed, and where applicable, a pipe temporarily placed in the existing channel and sealed.

**7-17.3(2) Cleaning and Testing****7-17.3(2)A General**

Sewers and appurtenances, where required in the Plans, shall be cleaned and tested after backfilling by either the exfiltration or low pressure air method at the option of the Contractor, except where the ground water table is such that the Engineer may require the infiltration test.

All Work involved in cleaning and testing sewer lines between manholes or rodding inlets as required shall be completed within 15-working days after backfilling of sewer lines and Structures. Any further delay will require the written consent of the Engineer. The Contractor shall furnish all labor, materials, tools, and equipment necessary to make the test, clean the lines, and perform all incidental Work. The Contractor shall perform the tests under the direction and in the presence of the Engineer. Precautions shall be taken to prevent joints from drawing during tests, and any damage resulting from these tests shall be repaired by the Contractor at no expense to the Contracting Agency. The manner and time of testing shall be subject to approval by the Engineer.

All wyes, tees, and stubs shall be plugged with flexible jointed caps, or acceptable alternate, securely fastened to withstand the internal test pressure. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

Testing side sanitary sewers shall be for their entire length from the public sewer in the street to the connection with the building's plumbing. Their testing shall be as required by the local sanitary agency but in no case shall it be less thorough than that of filling the pipe with water before backfilling and visually inspecting the exterior for leakage. The decision of the Engineer as to acceptance of the side sanitary sewer shall be final.

If any sewer installation fails to meet the requirements of the test method used, the Contractor shall determine, at no expense to the Contracting Agency, the source or sources of leakage and shall repair or replace all defective materials or workmanship at no expense to the Contracting Agency. The complete pipe installation shall meet the requirements of the test method used before being considered acceptable.

**7-17.3(2)B Exfiltration Test**

Prior to making exfiltration leakage tests, the Contractor may fill the pipe with clear water to permit normal absorption into the pipe walls provided, however, that after so filling the pipe, the Contractor shall complete the leakage test within 24-hours after filling. When under test, the allowable leakage shall be limited according to the provisions that follow. Specified allowances assume pre-wetted pipe.

Leakage shall be no more than 0.28-gph per inch diameter per 100-feet of sewer, with a hydrostatic head of 6-feet above the crown at the upper end of the test section, or above the natural ground water table at the time of test, whichever is higher. The length of pipe tested shall be limited so that the pressure at the lower end of the Section tested does not exceed 16-feet of head above the invert, and in no case shall be greater than 700-feet or the distance between manholes when greater than 700-feet.

Where the test head is other than 6-feet, the maximum leakage shall not exceed the amount determined from the following equation:

Maximum leakage (in gallons per hour) =  $0.28 \times (\sqrt{H}/\sqrt{6}) \times D \times (L/100)$

where: D = diameter (in.)  
L = length of pipe (ft.)  
H = test head (ft.)

When the test is to be made 1 joint at a time, the leakage per joint shall not exceed the computed allowable leakage per length of pipe.

#### 7-17.3(2)C Infiltration Test

Where the natural ground water head over the pipe is 2-feet or less above the crown of pipe at the upper end of the test section, the infiltration test leakage shall not exceed 0.16-gallons per hour per inch of diameter per 100-feet of pipe length. The length of pipe tested shall not exceed 700-feet or the distance between manholes when greater than 700-feet.

Where the natural ground water head is greater than 2-feet, the maximum leakage shall not exceed the amount determined from the following equation:

Maximum leakage (in gallons per hour) =  $0.16 \times (\sqrt{H}/\sqrt{2}) \times D \times (L/100)$

where: D = diameter (in.)  
L = length of pipe (ft.)  
H = natural ground water head (ft.)

When a suitable head of ground water exists above the crown of the pipe and when the pipe is large enough to work inside, acceptance may be based on the repair of visible leakage by means satisfactory to the Engineer.

#### 7-17.3(2)D Other Test Allowances

For either the infiltration or exfiltration test, all lateral or side sewer branches included in the test section shall be taken into account in computing allowable leakage. An allowance of 0.2-gallons per hour per foot of head above invert shall be made for each manhole included in a test section.

Upon final acceptance of the Work all sewers, side sewers and fittings shall be open, clean, and free draining.

#### 7-17.3(2)E Low Pressure Air Test for Sanitary Sewers Constructed of Air Permeable Materials

Air permeable materials include concrete and vitrified clay. Low pressure air testing may be used for air permeable pipes 30-inches in diameter and smaller.

The test equipment to be used shall be furnished by the Contractor and shall be inspected and approved by the Engineer prior to use. The Engineer may at any time require a calibration test of gauges or other instrumentation that is incorporated into the test equipment. Calibration tests shall be certified by an independent testing Laboratory.

Plugs used to close the pipe for the air test must be securely braced to prevent the unintentional release of a plug, which can become a high velocity projectile. Gauges, air piping manifold, and valves shall be located at the top of the ground. No one shall be permitted to enter a manhole or catch basin where a plugged pipe is under pressure. Air testing apparatus shall be equipped with a pressure release device, such as a rupture disk or a pressure relief valve, designed to activate when the pressure in the pipe exceeds 2-psig above the required test pressure.

If the pipe to be tested is submerged by groundwater, the backpressure on the pipe created by the groundwater submergence must be determined. All gauge pressures described in the test shall be increased by that amount.

The first section of pipe installed by each crew shall be tested in order to qualify the crew and material. A successful test for the section shall be a prerequisite to further installation by that crew. Following the initial test, pipes shall be tested from manhole to manhole, catch basin to catch basin, or such shorter lengths as determined by the Contractor.

Air shall be slowly supplied to the plugged pipe section until the internal air pressure reaches 4-psig. Wait at least 2-minutes to allow for pressure and temperature stabilization to occur within the pipe.

When the pressure decreases to 3.5-psig, the air pressure test shall begin. The test shall consist of measuring the time in seconds for the pressure in the pipe to drop from 3.5-psig to 2.5-psig. The pipe shall be considered acceptable if the time in seconds for the pressure drop is equal to or greater than the required time as calculated below:

$$K = 0.0111d^2L$$

$$C = 0.0003918dL$$

$$\text{If } C_T \leq 1, \quad \text{then time} = K_T$$

$$\text{If } 1 < C_T < 1.75, \quad \text{then time} = K_T / C_T$$

$$\text{If } C_T \geq 1.75, \quad \text{then time} = K_T / 1.75$$

where:  $d$  = Pipe diameter (inches)

$L$  = Pipe length (feet)

$K$  = value for each length of pipe of a specific diameter

$C$  = value for each length of pipe of a specific diameter

$K_T$  = sum of all  $K$  values

$C_T$  = sum of all  $C$  values

This method was developed based on an allowable air loss rate of 0.003-cubic feet per minute (cfm) per square foot of internal pipe surface, with the total air loss rate not less than 2-cfm nor greater than 3.5-cfm. At the Contractor's option, the pipe may be tested without pre-wetting; however, the allowable air loss rate assumes pre-wetted pipe.

Pipe over 30-inches in diameter shall be tested 1 joint at a time in accordance with ASTM C1103.

### **7-17.3(2)F Low Pressure Air Test for Sanitary Sewers Constructed of Non Air Permeable Materials**

Non air permeable materials include ductile iron, ABS composite, polyvinyl chloride (PVC), and polyethylene (PE). When non air permeable pipe is subjected to a low-pressure air test, all of the provisions of Section 7-17.3(2)E shall apply, except that the time in seconds for the pressure drop shall be equal to or greater than 4 times the required time calculated in Section 7-17.3(2)E.

Pipe over 30-inches in diameter shall be tested 1 joint at a time in accordance with ASTM C 1103.

Reaches of thermoplastic pipe containing no joints shall be exempt from testing requirements.

**7-17.3(2)G Deflection Test for Thermoplastic Pipe**

Sanitary sewers constructed of thermoplastic pipe shall be tested for deflection not less than 30-days after the trench backfill and compaction has been completed. The test shall be conducted by pulling a properly sized “go-nogo” mandrel through the completed pipeline. Testing shall be conducted on a manhole-to-manhole basis and shall be done after the line has been completely flushed out with water.

The mandrel shall be a rigid, nonadjustable mandrel having an effective length of not less than its normal diameter and an odd-number of legs (9-legs minimum). Minimum diameter at any point along the full length of the mandrel shall be 95-percent of the base inside diameter of the pipe being tested.

Base inside diameter is derived by subtracting a statistical tolerance package from the average inside diameter. The tolerance package is defined as the square root of the sum of squared manufacturing tolerances. The tolerance package for controlled outside diameter pipe consists of (1) outside diameter tolerance specified in applicable ASTM Standard, (2) 12-percent of 1 wall thickness specified in applicable ASTM Standard, and (3) out of roundness tolerance listed in appendix of applicable ASTM Standard. The items in the tolerance package for controlled inside diameter pipe consists of (1) inside diameter tolerance listed in appendix of applicable ASTM Standard and (2) out of roundness tolerance listed in appendix of applicable ASTM Standard. When out of roundness tolerance is not listed, use 3-percent of average inside diameter.

The average inside diameter for pipe with controlled outside diameter shall be equal to the average outside diameter as specified in applicable ASTM Standard minus 2 minimum wall thicknesses as specified in applicable ASTM Standard and minus 2 times excess wall tolerance of 6-percent. The average inside diameter for pipes with controlled inside diameter shall be the average inside diameter as specified in applicable ASTM Standard.

The Contractor shall be required, at no expense to the Contracting Agency, to locate and uncover any sections failing to pass the test and, if not damaged, reinstall the pipe. The use of a vibratory re-rounding device or any process other than removal or reinstallation shall not be acceptable. The Contractor shall retest the section after replacement of the pipe.

Pipe large enough to work inside of may be accepted on the basis of direct measurement.

**7-17.3(2)H Television Inspection**

The Engineer may require any or all sanitary sewer lines be inspected by the use of a television camera before final acceptance. The costs incurred in making the initial inspection shall be borne by the owner of the sanitary sewer.

The Contractor shall bear all costs incurred in correcting any deficiencies found during television inspection including the cost of any additional television inspection that may be required by the Engineer to verify the correction of said deficiency.

The Contractor shall be responsible for all costs incurred in any television inspection performed solely for the benefit of the Contractor.

**7-17.4 Measurement**

The length of sewer pipe will be the number of linear feet of completed installation measured along the invert and will include the length through elbows, tees and fittings. The number of linear feet will be measured from the center of manhole to center of manhole or to the inside face of catch basins and similar type Structures.

The length of testing sewer pipe in conformance with Section 7-17.3(2) will be the number of linear feet of completed installation actually tested.

**7-17.5 Payment**

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“Plain Conc. or V.C. Sewer Pipe \_\_\_\_ In. Diam.”, per linear foot.

“Cl. \_\_\_\_ Reinf. Conc. Sewer Pipe \_\_\_\_ In. Diam.”, per linear foot.

“PVC Sanitary Sewer Pipe \_\_\_\_ In. Diam.”, per linear foot.

“Ductile Iron Sewer Pipe \_\_\_\_ In. Diam.”, per linear foot.

“ABS Composite Sewer Pipe \_\_\_\_ In. Diam.”, per linear foot.

The unit Contract price per linear foot for sewer pipe of the kind and size specified shall be full pay for furnishing, hauling, and assembling in place the completed installation including all wyes, tees, special fittings, joint materials, bedding and backfill material, and adjustment of inverts to manholes for the completion of the installation to the required lines and grades.

“Testing Sewer Pipe”, per linear foot.

The unit Contract price per linear foot for “Testing Sewer Pipe” shall be full pay for all labor, material and equipment required to conduct the leakage tests required in Section 7-17.3(2).

“Removal and Replacement of Unsuitable Material”, per cubic yard.

The unit Contract price per cubic yard for “Removal and Replacement of Unsuitable Material” shall be full pay for all Work to remove unsuitable material and replace and compact suitable material as specified in Section 7-08.3(1)A.