

SECTION 3810 - GRAVITY SEWER LEAKAGE TESTS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

Provide all labor, materials, equipment and services required for gravity sewer leakage testing specified herein.

PART 2 - EXECUTION

2.1 GRAVITY SEWER TESTING - LEAKAGE:

All completed piping shall be tested as specified herein by low-pressure air test, exfiltration, or infiltration test after backfilling to test for leaks. The maximum leakage allowance for all sanitary sewers shall be 50 gallons per inch diameter per mile of pipe per 24 hours. If the level of the current prevailing groundwater is two feet (2') or more above the top of the sewer pipe, an infiltration test will be required. At the request of the ENGINEER, a low-pressure air test or exfiltration test will be performed instead of or in addition to an infiltration test if the ground water level is uncertain. Labor, equipment and supplies required for all tests shall be furnished by the CONTRACTOR. The CONTRACTOR shall flush and clean the sewer line to the satisfaction of the OWNER prior to testing. The ENGINEER shall witness and approve all leakage tests. In the event that the CONTRACTOR performs any test without witness by the ENGINEER, the CONTRACTOR will be required to test the section again at no cost to the OWNER. The CONTRACTOR and ENGINEER shall sign all test reports. Note that only four sections (approximately 1,200 - 1,600 feet) of sewer will be permitted to remain untested at any time.

A. Low Pressure Air Test:

After backfilling, the air test shall be conducted between two consecutive manholes. Low pressure air tests shall be in accordance with ASTM C 924 for concrete pipe or F 1417 for plastic pipe, except as specified otherwise herein. All pipe outlets must be plugged in the section being tested with suitable test plugs. One of the plugs used at a manhole must be tapped and equipped for an air inlet connection for filling the line from the air compressor.

Air shall be supplied slowly to the test section until the internal pressure reaches approximately 4 pounds per square inch (psi). At least 2 minutes shall be allowed for the air pressure to stabilize. When the pressure has stabilized and is at or above 3.5 psi, the air supply shall be disconnected and timing shall begin. Timing shall continue until the pressure has dropped 1.0 psi. If the time elapsed before the pressure drops 1.0 psi is greater than the specified minimum holding time, the section shall be considered to have passed the test. If the time is less than the specified minimum holding time, the section shall be considered to have failed and must be repaired or replaced.

Minimum Holding Time shall be calculated from the following equation:

$$\text{Holding Time (minutes)} = 0.00037 \times D^2 \times L / Q$$

where D = Pipe Diameter (inches)
L = Length of Pipe Tested (feet)
Q = Allowable Air Loss (ft³/min) from Table B.2.

An air pressure correction is necessary when the current prevailing groundwater is above the invert of the sewer line being tested. Under this condition, the air test pressure shall be increased 0.433 psi for each foot the groundwater level is above the invert of the pipe. All gauge pressures shall be increased by this amount. If the current prevailing groundwater is more than 27 inches above the invert of the pipe, the infiltration or exfiltration test should be used as required above. Thus, internal air pressures should never exceed 5.0 psi.

| Nominal Pipe Size, in. | Time per 100 ft. |
|------------------------|----------------------|
| 6 | 42 seconds |
| 8 | 1 minute-12 seconds |
| 10 | 1 minute-30 seconds |
| 12 | 1 minute-48 seconds |
| 15 | 2 minutes-6 seconds |
| 18 | 2 minutes-24 seconds |
| 21 | 3 minutes |
| 24 | 3 minutes-36 seconds |
| 27 | 4 minutes-12 seconds |
| 30 | 4 minutes-48 seconds |
| 33 | 5 minutes-24 seconds |
| 36 | 6 minutes |

| Nominal Pipe Size, in. | Air Loss (Q), ft ³ /min |
|------------------------|------------------------------------|
| 6 and 8 | 2 |
| 10 | 2.5 |
| 12 | 3 |
| 15 | 4 |
| 18 | 5 |
| 21 | 5.5 |
| 24 | 6 |
| 27 | 6.5 |
| 30 | 7 |
| 33 | 7.5 |
| 36 | 8 |
| 42 | 9 |
| 48 | 10 |
| 54 | 11 |
| 60 | 12 |
| 66 | 13 |
| 72 | 14 |

B. Infiltration Test:

The CONTRACTOR may elect to use an infiltration test when the level of the current prevailing groundwater is two feet (2') or more above the top of the sewer pipe, including all service laterals, at the highest point of the section being tested. The inlet end(s) of the upstream manhole shall be securely sealed. The downstream sewer shall be completed and open to allow the sewer to drain. The ENGINEER shall approve the length of sewer to be tested at one time. The ENGINEER may require that each manhole span be tested separately. The amount of infiltration shall be measured by means of a weir located in the downstream manhole. The test head shall be maintained for a period of at least 24 hours before the weir measurement is made. Infiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours. This infiltration test may not be performed until the sewer line and manholes are completed and all known leaks are repaired. The CONTRACTOR will be required to correct all conditions that permit visible infiltration and may be required to relay sections with such conditions that cannot be corrected, even though infiltration is within allowable limits.

C. Exfiltration Test:

When the exfiltration test is selected, the inlet ends of the upstream and downstream manholes shall be sealed with watertight plugs or bulkheads, and the sewer along with the upstream manhole shall be filled with water until the elevation of the water in the upstream manhole is: 1) two feet (2') higher than the top of the sewer pipe, including all service laterals, at the highest point of the section being tested, or 2) two feet (2') above the level of the current prevailing groundwater, whichever is the higher elevation. The test level shall be clearly marked in the upstream manhole. The entire length of section to be tested shall be filled and maintained full of water for a period of at least 24 hours prior to the start of the test. If the water level in the upper manhole drops during this 24 hour period, the level shall be raised to the test level mark prior to start of the test. Exfiltration will be determined by measuring the amount of water required to maintain the marked water level for a period of 1 hour from the start of the test. The allowable leakage of 50 gallons per inch diameter per mile of pipe per 24

hours is based on a maximum difference in elevation of 8 feet between the water level in the upstream manhole and the invert of the pipe being tested in the lower manhole or the current prevailing groundwater level, whichever is higher. If this difference in elevation exceeds 8 feet, the allowable leakage shall be increased 5 percent for each 1 foot in excess of 8 feet. All observed leaks shall be corrected even if exfiltration is within the allowable limits.

D. Smoke Testing:

Smoke testing may be used only to locate leaks and in no case shall be considered conclusive. In all cases the smoke test shall be accompanied by an air test, exfiltration test or infiltration test. The ENGINEER may order a smoke test if another leakage test fails and the source of the leak cannot be determined by other means. Smoke testing may only be performed where ground water is low and the conduit is properly sealed. Smoke shall be blown into a sealed section of sewer under pressure, and the CONTRACTOR and ENGINEER shall observe for any smoke appearing on top of the ground indicating the presence of leaks. The ENGINEER may require that the CONTRACTOR excavate the sewer to determine the source of any smoke appearing during a smoke test. All leaks or breaks discovered by the smoke tests shall be repaired and/or corrected by the CONTRACTOR at his own expense in a manner acceptable to the ENGINEER. Equipment and supplies required for smoke tests shall be furnished by the CONTRACTOR. Smoke tests may be performed by the CONTRACTOR at any time during construction at his option; however, any such tests shall not supplant the final tests of the completed work.

PART 3 - BASIS OF PAYMENT

Testing of gravity sewers for leakage is not a pay item.

END OF SECTION