**SECTION 02651**

**SEWER SYSTEM TESTING**

PART 1. GENERAL

1.01 SECTION INCLUDES

A. The Work of this Section includes, but is not limited to:

1. Testing Gravity Sewer Pipelines:

a. Low-Pressure air test
b. Infiltration test

2. Testing Pressure Pipelines:

a. Hydrostatic leakage test

3. Deflection Testing of Plastic Pipe

4. Testing Manholes

a. Vacuum test

1.02 RELATED SECTIONS

A. Utility Piping: Section 02600 - Utility Piping

B. Manholes: Section 02605 - Manholes

1.03 QUALITY ASSURANCE

A. Test Acceptance:

1. No test will be accepted until the results are below the specified maximum limits.

2. The Contractor shall, at his own expense, determine and correct the causes of test failure and retest until successful test results are achieved.

1.04 SUBMITTALS

A. Testing procedures

B. List of test equipment

C. Testing sequence schedule

D. Provisions of disposal of flushing and test water

E. Certificate of test gauge calibration

F. Deflection mandrel drawings and calculations

1.05 JOB CONDITIONS

A. Do not allow personnel in manholes during pressure or vacuum testing.

B. Provide relief valves set at 10 psig to avoid accidentally over-pressurizing gravity sewer line during low pressure air testing.

PART 2. PRODUCTS

2.01 AIR TEST EQUIPMENT

A. Air compressor

B. Air supply line

C. Shut-off valve

D. Pressure regulator

E. Pressure relief valve

F. Stop watch

G. Plugs

H. Pressure gauge, calibrated to 0.1 lb./sq. in.

2.02 INFILTRATION TEST EQUIPMENT

A. Weirs

2.03 HYDROSTATIC TEST EQUIPMENT

A. Hydro pump

B. Pressure hose

C. Water meter

D. Test connections

E. Pressure gauge, calibrated to 0.1 lb./sq. in.

F. Pressure relief valve

2.04 DEFLECTION TEST EQUIPMENT

A. Go, No-Go mandrels

B. Pull/Retrieval ropes

2.05 VACUUM TEST EQUIPMENT

A. Vacuum pump

B. Vacuum line

C. Vacuum testing base with compression seal and outlet port

D. Shut-off valve

E. Stop watch

F. Plugs

G. Vacuum gauge, calibrated to 0.1 inches Hg

PART 3. EXECUTION

3.01 PIPE TESTING PREPARATION

A. Backfill trenches in accordance with detail on Drawings.

B. Provide pressure pipeline with concrete reaction support blocking.

C. Flush pipeline to remove debris. Collect and dispose of flushing water and debris.

D. Clean pipelines by propelling a snug fitting rubber ball through the pipeline with water from the upstream manhole to the downstream manhole. Investigate and correct any stoppage of the cleaning ball. Collect and dispose of cleaning water and debris.

E. Lamping:

1. After flushing and cleaning, lamp gravity pipeline in the presence of the Engineer.

2. Assist the Engineer in the lamping operation by shining a light at one end of each pipeline section between manholes. The Engineer will observe the light at the other end. Pipeline that has not been installed with uniform line and grade will be rejected. Remove and re-lay rejected pipeline section. Reclean and lamp until pipeline section achieves a uniform line and grade to the satisfaction of the Engineer.

F. Plug outlets, wye-branches and laterals. Brace plugs to offset thrust.

F. All testing for pipes and manholes shall be conducted with an Owner representative on site.

3.02 TESTING GRAVITY SEWER PIPELINES

A. Low Pressure Air Test:

1. Test each newly installed section of gravity sewer line between manholes.

2. Slowly introduce air pressure to approximately 5.0 psig.

3. Allow pressure to stabilize for at least five (5) minutes. Adjust pressure to 5.0 psig or the increased test pressure as determined below if groundwater is present. Start the test.

4. Test:

a. Determine the test duration for a sewer section with a single pipe size from the table below:

Low Pressure Air Test - Test Times

| Nominal Pipe Size (inches) | T (Time) Min/100 Ft. (inches) | Nominal Pipe Size | T (Time) Min/100 Ft. |
|---|---|---|---|
| 4 | .3 | 21 | 3.0 |
| 6 | .7 | 24 | 3.6 |
| 8 | 1.2 | 27 | 4.2 |
| 10 | 1.5 | 30 | 4.8 |
| 12 | 1.8 | 33 | 5.4 |
| 15 | 2.1 | 36 | 6.0 |
| 18 | 2.4 | | |

b. Record the drop in pressure during the test period. If the air pressure has dropped more than 1.0 psig during the test period, the line is presumed to have failed. If the 1.0 psig air pressure drop has not occurred during the test period, the test shall be discontinued and the line will be accepted.

c. If the line fails, determine the source of the air leakage, make corrections and retest. The Contractor has the option to test the section in incremental stages until the leaks are isolated. After the leaks are repaired, retest the entire section between manholes.

B. Infiltration Test:

1. Use only when gravity pipeline is submerged in groundwater. Obtain prior approval of the Engineer.

2. Maximum Allowable Infiltration: 200 gallons per inch of pipe diameter per mile per day for any one section under test, including the allowances for leakage from manholes.

3.03 TESTING PRESSURE SEWER PIPELINES

A. Hydrostatic Leakage Test:

1. Test each newly laid pressure pipeline, including any valved section thereof, hydrostatically at 1.5 times the working pressure of the pipelines based on the elevation of the lowest point in the pipeline corrected to the elevation of the test gauge. Obtain test pressure from the Engineer.

2. Slowly fill the section to be tested under water, expelling air from the pipeline at the high points. Install corporation stops at high points if necessary. After all air is expelled, close air vents and corporation stops and raise the pressure to the specified test pressure.

3. Observe joints, fittings and valves under test. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage. Retest.

4. After visible deficiencies are corrected, continue testing at the same test pressure for an additional two (2) hours to determine the leakage rate. Maintain pressure within plus or minus 5.0 psig of test pressure. Leakage is defined as the quantity of water supplied to the pipeline necessary to maintain test pressure during the period of the test.

5. Compute the maximum allowable leakage by the following formula:

$$L = \frac{N D P^{0.5}}{7{,}400}$$

Where: L is the allowable leakage in gallons/hour
N is the number of joints in the section tested
D is the nominal diameter of the pipe in inches
P is the average test pressure in psig

If the line under test contains sections of various diameters, the allowable leakage shall be the sum of the computed leakage for each size.

6. If the test of the pipe indicates leakage greater than that allowed, locate the source of the leakage, make corrections and retest until leakage is within allowable limits. Correct visible leaks regardless of the amount of leakage.

3.04 DEFLECTION TESTING OF PLASTIC SEWER PIPE

A. Perform vertical ring deflection testing on all portions of PVC sewer piping in the presence of the Engineer, after backfilling has been in place for at least thirty (30) days but not longer than twelve (12) months.

B. The maximum allowable deflection for installed plastic sewer pipe shall be limited to 5% of the original vertical internal diameter.

C. Perform deflection testing with a deflectometer, calibrated television, or a properly sized "Go, No-Go" mandrel. The mandrel(s) shall be constructed at the Contractor's expense and subject to the approval of the Engineer.

D. Pipe exceeding the allowable deflection shall be located, excavated, replaced, and retested at the sole expense of the Contractor.

3.05 TESTING MANHOLES

A. General:

1. Conduct tests in presence of and to complete satisfaction of the Engineer.

2. Should a manhole not satisfactorily pass testing, discontinue manhole construction in the Project until such manhole does test satisfactorily.

3. Provide tools, materials (including water), equipment and instruments necessary to conduct manhole testing specified herein.

a. Vacuum Testing Equipment:

1) Use vacuum apparatus equipped with necessary piping, control valves and gauges to control air removal rate from manhole and to monitor vacuum.

2) Provide an extra vacuum gauge of known accuracy to frequently check test equipment and apparatus.

3) Vacuum testing equipment and associated testing apparatus subject to Engineer's approval.

4) Provide seal plate with vacuum piping connections.

4. Prior to testing, clean manholes thoroughly and seal openings both to the complete satisfaction of the Engineer. Seal openings using properly sized plugs.

5. Perform testing with frames installed. Include the joint between the manhole and manhole frame in the test.

6. The Contractor may elect to make a test for his own purposes prior to backfilling. However, conduct tests of the manholes for acceptance only after the backfilling has been completed.

B. Vacuum Test Procedure:

1. Perform vacuum testing in accordance with the testing equipment manufacturer's written instructions.

2. Draw a vacuum of ten (10) inches of mercury and close the valves.

3. Consider manhole acceptable when vacuum does not drop below nine (9) inches of mercury for the following manhole sizes and times:

a. Four (4) foot diameter - 60 seconds
b. Five (5) foot diameter - 75 seconds
c. Six (6) foot diameter - 90 seconds

C. Exfiltration Test Procedure:

1. Completely fill manhole to top of frame with water.

2. Allow water-filled manhole to stand four (4) hours prior to testing to allow absorbing in materials.

3. At commencement of test, fill manhole to top lip of manhole frame.

4. During a consecutive four-hour period, keep an accurate record of the amount of water to be added because of exfiltration.

5. Consider manhole acceptable when exfiltration rate does not exceed a rate of 0.038 gallons a day per inch of manhole diameter per vertical foot of manhole.

D. Repair and Retest: Determine source or sources of leaks in manholes failing acceptable limits.

1. Repair or replace defective materials and workmanship, as is the case, before conducting such additional Manhole Acceptance Tests and such subsequent repairs and retesting as required until manholes meet test requirements.
2. Materials and methods used to make manhole repairs must meet with Engineer's approval prior to use.
3. Make repairs, replacements and retests at no additional expense to Owner.