SECTION 02651 – SEWER AND MANHOLE TESTING

1. GENERAL

1.2 DESCRIPTION

A. Work included but not limited to:

1. Vacuum testing sewer manholes
2. Exfiltration testing sewer manholes
3. Testing gravity sewer pipelines
   a) Low-pressure air test
   b) Infiltration test
4. Hydrostatic testing pressure pipelines
5. Deflection testing plastic pipelines

B. Related Work:

1. Section 02601 – Manholes
2. Section 02610 – Sanitary Sewer Pipe

1.3 QUALITY ASSURANCE

A. Reference Standards:

1. American Society for testing and Materials (ASTM)
   a) C828 Standard test method for low-pressure air test of vitrified clay pipe sewer pipeline.
   b) C924 Testing concrete pipe sewer lines by low-pressure air test method.
   c) C969 Infiltration and exfiltration acceptance testing of installed precast concrete pipe sewer lines.
   d) C1244 Standard test method for concrete sewer manholes by negative air pressure (vacuum) test.

B. Test Acceptance:

1. No test will be accepted until the results are below the specified maximum limits.
2. The Contractor shall determine and correct the causes of test failure and retest until successful test results are achieved.

1.4 SUBMITTALS

A. Submit the following prior to start of testing:

1. Testing procedures
2. List of test equipment
3. Testing sequence schedule
4. Provisions for disposal of flushing and test water
5. Certification of test gauge calibration
6. Deflection mandrel drawings and calculations

1.5 JOB CONDITIONS

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

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

2. PRODUCTS

2.1 VACUUM TESTING EQUIPMENT

A. Vacuum pump

B. Vacuum line

C. Vacuum tester base with compression band seal and outlet port

D. Shut-off valve

E. Stop watch

F. Plugs

G. Vacuum gauge, calibrated to 0.1” Hg

2.2 EXFILTRATION TEST EQUIPMENT

A. Plugs

B. Pump

C. Measuring device

2.3 AIR TEST EQUIPMENT

A. Air compressor

B. Air supply line

C. Shut-off valves

D. Pressure regulator

E. Pressure relief valve

F. Stop watch

G. Plugs

H. Pressure gauge, calibrated to 0.1 psi.

2.4 HYDROSTATIC TEST EQUIPMENT

A. Hydro pump

B. Pressure hose

C. Water meter

D. Test connections

E. Pressure relief valve

F. Pressure gauge, calibrated to 0.1 psi.

2.5 DEFLECTION TEST EQUIPMENT

A. Go, No-Go mandrels

B. Pull/retrieval ropes

3. EXECUTION

3.1 TESTING MANHOLES

A. General: Test shall be done whenever possible prior to backfilling to assist in locating leaks. Joint repairs by parging are to be done on both outside and inside of the joint to ensure a permanent seal.

B. Vacuum Test:

1. Plug all pipe openings; take care to securely brace the plugs and pipe.

2. Inflate the compression band to effect a seal between the vacuum base and the structure; connect the vacuum pump to the outlet port with the valve open; draw a vacuum to 10" of Hg.; close the valve; start the test.

3. Test:

   a) Determine the test duration for the manhole from the following table:

VACUUM TEST TABLE

MANHOLE DIAMETER	TEST PERIOD
48"	60 sec.
60"	75 sec.
72"	90 sec.

   b) Record the vacuum drop during the test period; if the vacuum drop is greater than 1.0" of Hg during the test period, the manhole shall be repaired and retested; if a vacuum drop of 1" of Hg does not occur during the test period, the test shall be terminated and the manhole will be accepted.

   c) If a unit fails to meet a 1" Hg drop in the specified time after repair, the unit shall be subjected to the water exfiltration test and repaired as necessary.

C. Exfiltration Test:

1. Plug all pipes in the manhole; remove any water that has accumulated in the manhole; observe plugs over a period of not less than 1 hours to ensure that there is no leakage into the manhole.

2. Determine ground water level outside the manhole by means of a ground water height indicator.

3. Fill the manhole with water to within 4" of the top of the cover frame. Prior to test allow the manhole to soak from a minimum of 4 hours to a maximum of 72 hours; after the soak period, adjust the water level inside the manhole to within 4" of the top of the cover frame.

4. Measure the water level from the top of the manhole frame; at the end of the 4 hour test period, again measure the water level from the top of the manhole frame; compute the drop in the water level during the test period.

5. The manhole exfiltration test shall be considered satisfactory if the drop in water level is less than the values listed in the table below:

Manhole Depth (Feet)	Allowable Drop in Water Level (Feet) in 24" Diameter Section	
	4' Dia. MH	5' Dia. MH
4	0.11	0.14
6	0.17	0.21
8	0.23	0.28
10	0.28	0.35
12	0.34	0.43
14	0.40	0.50
16	0.45	0.57
18	0.51	0.64
20	0.57	0.71
22	0.62	0.78
24	0.68	0.85
26	0.74	0.92
28	0.79	0.99

30	0.85	1.06

Based on an allowable exfiltration of 4 gallons per day per foot of depth of a 4 foot diameter manhole with a conical top and a 24" diameter opening; for purposes of the tests, the manhole depth shall be the depth from invert to the bottom of the cover frame, or the depth from the ground water surface to the bottom of the cover frame, whichever is less.

6. In case of unsatisfactory test results, the Contractor shall repair the manhole and retest as often as necessary until satisfactory results are achieved; repair visible leaks regardless of the amount of leakage.

3.2 PIPELINE PREPARATION

A. Backfill trenches in accordance with the specifications.

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.

E. Lamping:

1. After flushing and cleaning, lamp gravity pipelines 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 relay rejected pipeline sections; re-clean 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.

3.3 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 4.0 psig.
   a) If ground water is present, determine its elevation above the springline of the pipe by means of a ground water height indicator. For every foot of ground water above the springline of the pipe, increase the starting air test pressure reading by 0.43 psig; do not increase pressure above 10 psig.
3. Allow pressure to stabilize for at least five minutes. Adjust pressure to 3.5 psig or the increased test pressure as determined above if ground water is present. Start the test.
4. Test:
   a) Determine the test duration for a sewer section with a single pipe size from the following table. No allowance will be made for laterals.

AIR TEST TABLE

Minimum Test Time for Various Pipe Sizes

Nominal	T (time),	Nominal	T (time),

Pipe Size, inches	min/100 ft.	Pipe Size, inches	min/100 ft.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1		
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 failed; if the air pressure drop is less than 1.0 psig during the test period, the line will be accepted.

c) If the line fails, determine the source of the 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. Testing Pipe Over 36" Diameter:

1. Pipe larger than 36" diameter shall be subjected to a visual interior inspection.

C. Infiltration Test:

1. Use only when gravity pipeline is submerged in ground water a minimum of 4 feet above the crown of the pipe for the entire length being tested; obtain prior approval of the Engineer.
2. Maximum Allowable Infiltration: 50 gallons per inch of pipe diameter per mile per day for any one section under test, including the allowances for leakage from manholes.

3.4 TESTING PRESSURE SEWER PIPELINE

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 pipeline 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 with water, expelling air from the pipeline at the high points. Install corporation cocks at high points if necessary. After all air is expelled, close air vents and corporation cocks and raise the pressure to the specified test pressure.
3. Observe joints, fittings and valves under test. Repair 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 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:

$$L = \frac{ND(P)^{\frac{1}{2}}}{7400}$$

Where: L – allowable leakage in gallons/hour

N – number of joints in the section tested
D – nominal diameter of the pipe in inches
P – average test pressure in psig

6. If test results indicate 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.

3.5 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 30 days but not longer than 12 months.

B. The maximum allowable deflection for installed plastic sewer pipe shall be limited to 7.5% 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 provided 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.

END OF SECTION 02651