SECTION 02660

PIPELINE TESTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing requirements for potable and non-potable water piping systems and sanitary sewers.

1.02 DEFINITIONS

A. Leakage: The quantity of water required to maintain the specified hydrostatic test pressure after the pipeline has been filled with water and the air expelled.

B. Non-rigid Pipe: Any pipe which requires bedding and backfill material for structural support.

1.03 SUBMITTALS

A. Pipeline Test Report: Include the following items:

1. Type of test.

2. Identification of pipe system.

3. Size, type, location and length of pipe in test section.

4. Test pressure and time.

5. Amount of leakage versus allowable.

6. Date of test approval.

7. Signature of test supervisor.

8. Signature of the City Engineer, Inspector, or City Water Superintendent witnessing and approving the test.

9. One copy of video tape.

1.04 PROJECT CONDITIONS

A. After construction of sanitary or storm sewer lines, they shall be thoroughly cleaned, tested for leakage and alignment, and closed circuit television inspected in the presence of the City Engineer or the City Inspector before acceptance by the City. If directional drilling or underground boring takes place after sewer and/or storm drain lines have been installed, inspected, and tested, the sewer and/or storm drain lines near the drilling/boring shall be inspected a second time with a closed circuit television inspection per Section 2660 - 3.09.

B. Repair pipeline system at no additional cost to City until it passes subsequent retesting.

C. Recording Equipment:

1. Supply all necessary equipment to perform pressure testing.

2. Secure City's approval of pressure gages.

3. Locate all gages and recording equipment away from affects of sunshine or other weather conditions.

4. Place, vents, pressure taps and drains for the test. Repair pipeline at the completion of the test at no cost to City.

PART 2 PRODUCTS

2.01 TESTING MATERIALS

A. Medium: Water or air, as required by test.

B. Equipment: Temporary motors, pumps, pumping apparatus, pressure gages, connections, power, etc. for making the tests.

PART 3 EXECUTION

3.01 PREPARATION

A. Notify City Engineer or City Water Superintendent 48 hours in advance of test.

B. Carry out tests as pipeline construction progresses to ensure construction methods are producing satisfactory results.

C. Disinfect potable water pipelines per Section 2675 prior to pressure testing if connected to an existing system.

3.02 PRESSURE TESTING FOR PRESSURIZED WATER PIPELINES

A. Test shall be performed only after the pipeline has been properly filled, flushed, and purged of air. Provide air release taps at points of highest elevations as needed before testing. Insert permanent plugs after test has been completed. The test pressure shall be applied by means of an approved and disinfectedpumping assembly connected to the pipe in a manner satisfactory to the City.

B. The test pressure shall not exceed the thrust restraint design pressure or 50 psi in excess of the pressure class of the pipe, fittings, or valves, whichever is less (as specified by the manufacturer). During the tests, the system and any exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage.

C. Test pressure and duration: The duration of the hydrostatic test shall be 2 hr. The hydrostatic test pressure shall be set to 50 psi in excess of the lowest class rating of any pipe, saddle, fitting, or valve within the section being tested at the highest pressure along the test section. The test pressure shall not vary by more than 5 psi (plus or minus) for the duration of the test. If necessary, the test pressure shall be maintained by additional pumping during the 2 hr test duration. The pressure reading shall be noted every 10 minutes during the test.

D. The testing allowance: The testing allowance shall be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure. The quantity of water shall be accurately measured in gallons by suitable methods. No installation will be accepted if the quantity of makeup water is greater than that determined by the formula:

$$Q = \frac{LD\sqrt{P}}{148{,}000}$$

Where:
Q = quantity of makeup water in gallons per hour
L = length of pipe section being tested, in feet
D = nominal diameter of pipe, in inches
P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

E. Provide suitable means for determining water lost by leakage under the test pressure.

F. Locate and repair the defective elements and retest until the leakage is within the specified allowance.

G. Repair any noticeable leakage even if total leakage is less than allowable.

H. Service Lines:

1. Potable water service lines shall be connected to a potable water line before disinfection and bacteriological testing of the line is completed in accordance with Section 2675 Part 3.06, unless the service line needs to remain active during a replacement project, or as otherwise approved by the City Engineer. Service lines must be flushed in accordance with Section 2675 Part 3.06.

2. All service lines shall be pressure tested up to the curb stop in accordance with this section.

3. The connection between the water meter box and curb stop shall be either pressure tested in accordance with the guidelines in this section or visually inspected for leaks once the working water pressure is turned into the service line.

3.03 ALIGNMENT AND GRADE TEST

A. No variance will be allowed from line and grade in excess of 1/32" per inch of pipe diameter or ½" maximum provided that such variation shall not result in a level or reverse sloping invert.

B. Variations in invert elevations between adjoining ends of pipe due to eccentricity of joining surface and pipe interior surface shall not exceed 1/64" per inch of pipe diameter, or ½" maximum.

3.04 OBSTRUCTION TEST

A. Visually examine pipe internally for obstructions by use high power light or mirror.

B. When required by the City Engineer, a round incompressible mandrel 1" less in diameter than the internal pipeline diameter and 2 times the diameter in length will be passed through the pipeline.

3.05 NON-RIGID PIPE DEFLECTION TEST

A. When required by the City Engineer, test installed sections of non-rigid pipeline to ensure that circumferential deflection does not exceed 5 percent of the average inside diameter using a rigid mandrel with a circular cross section pulled through the pipe by hand.

3.06 INFILTRATION TEST

A. No pipe section will be accepted if the infiltration rate exceeds 100 gallons per inch diameter per mile per 24 hours.

3.07 FLUSHING OF SANITARY SEWERS

A. All sanitary sewer lines shall be flushed and cleared prior to acceptance by the City.

B. Flushing:

1. Laterals and trunk lines shall be flushed by water with a high pressure sewer jet to remove all foreign material. Flushing shall be completed prior to television inspection.

2. All debris located at the bottom of each manhole shall be removed. Dirt grease, sand, and gravel shall be removed so that the walls of the sewer pipe can be inspected.

3. Wastewater and debris shall not be permitted to enter sewer lines in service, but shall be removed at the lowest manhole of the extension.

4. Other methods of cleaning may be used upon approval of the City Engineer.

5. After the lines have been thoroughly cleaned, they shall be tested between all manholes for displacement.

3.08 LEAKAGE TESTS FOR SANITARY SEWERS

A. General Requirements:

1. The contractor shall test all sanitary sewers by means of an exfiltration test.

2. Length of line tested at one time shall be limited to the length between adjacent manholes.

B. Testing with Water:

1. Each section of the sewer shall be tested between successive manholes by closing the lower end of the sewer to be tested and the inlet of the upper manhole with stoppers.

2. The pipe and manhole shall be filled with water to a point approximately 4-feet above the invert of the sewer at the center of the upper manhole.

3. The allowable leakage will be computed by the formula:

$$E = 0.25\ D\ H$$

Where: E = Allowable leakage in gallons per minute per 1000 feet of sewer tested.
D = Internal diameter of the pipe in inches.
H = Difference in elevation in the water surface in the upper manhole and the invert of the pipe at the lower manhole (feet).

4. Leakage from the sewer, as shown by the test, which exceeds that allowed by the formula will be corrected by the Contractor to reduce the exfiltration to within permissible limits.

5. Where the difference in elevation between inverts of adjacent manholes exceeds 10-feet, the exfiltration leakage test will be modified as directed by the City Engineer.

6. House surface laterals shall be considered part of the main sewer to which they are connected and shall be tested with the main line sewer.

C. Testing with air:

1. Air pressure may be used in lieu of the water exfiltration test subject to the approval of the City Engineer.

2. The low pressure air test shall be conducted by the following method under the direction of the City Engineer or City Inspector with equipment equal to Cherne Industrial, Inc.

3. All wyes, tees, or ends of lateral stubs shall be suitably capped and braced to withstand the internal test pressures. Caps shall be easily removable for future lateral extensions.

4. After a manhole to manhole section of line has been backfilled and cleaned, it shall be plugged at each manhole with pneumatic plugs. One of the plugs shall have three hose connections. Air for inflation of the triple connection pneumatic plug shall be supplied through a factory-equipped control panel. There shall be three hose connections from the control panel to the pneumatic plug. One hose shall be used for inflation of the plug. The second hose shall be used for continuously reading the air pressure in the sealed line. The third hose shall be used for introducing low pressure air into the sealed line.

5. There shall be a 3-1/2" or larger diameter, 0.30 psig gauge mounted on the control panel for reading of the internal pressure in the line being tested. Calibrations from the 0-10 psig range shall be in tenths of pounds and the 0-10 psig portion shall cover 90% of the complete dial range.

6. Low pressure air shall be introduced into the sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any ground water that may be over the pipe.

7. At least two (2) minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the third hose shall be disconnected from the control panel.

8. The pipe and joints shall also be considered acceptable when the time required in minutes for pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameters in the following tables:

PIPE DIAMETER (Inches)	MINUTES
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5

9. If the installation fails to meet this requirement, the Contractor shall determine at his own expense the source of leakage.

10. The Contractor shall repair or replace all defective materials and/or workmanship.

11. Pressure test concrete sewer manholes by the negative air pressure (vacuum) test as per ASTM C1244.

3.09 CLOSED CIRCUIT TELEVISION INSPECTION

A. Contractor shall inspect the sewer and storm drain lines with a color television camera. The camera test shall be supervised and witnessed by the City Engineer or the City Inspector and shall be done as follows:

1. The lines and lateral connections will be televised at the cost of the Developer until the lines are accepted by the City.

2. The camera shall have "PAN and TILT" capability for detailed wall, joint, and service inspection. The camera shall be pulled through the sewer line or propelled with a tractor.

3. The light intensity and camera focus shall be adjusted to obtain a good clear picture at all times.

4. The operator shall control the travel speed of the camera so that the walls of the pipe can be clearly viewed. The speed shall not be greater than 20 feet per minute. The operator shall stop and inspect each service, obstruction, or pipe deformation. Locations of each shall be noted and included in the final Inspection Report.

5. Defects such as high and low spots, joint separations, offset joints, chipped ends, cracked or damaged pipe, infiltration points and debris in lines shall be corrected . The maximum acceptable limits for 8 to 10 inch pipes are: 0.25 inches for joint separations, 0.5 inches for low spots, and 0.25 inches for chipped ends.

6. A flat or reverse grade will not be acceptable.

7. If the pipeline is found unacceptable, the problem shall be corrected by the contractor and re-televised.

8. The television inspection process shall be done immediately after running water in the pipe and no visible discharge occurs at the downstream manhole.

9. Television inspection must be scheduled with the City at least one (1) week in advance of inspection.

10. A typed log of the closed circuit television inspection with a digital CD/DVD video shall be turned over and become the property of the City. The Inspection Report shall contain the following:

    a. Location of sewer line and direction of flows
    b. Connecting manhole numbers with starting and ending manhole
    c. Manhole condition, flowline condition, and cover conditions
    d. Pipeline size, material, and condition, with defect locations noted from center of manhole
    e. Location of services located as to distance from center of manhole
    f. Date of inspection, name of contractor, and signature of operator/logger

11. After cleaning and inspection have been completed and any defects are corrected and accepted, the lines shall be tested for leakage by methods discussed in Section 3.08.

3.10 PIPE TESTING SCHEDULE

A. Irrigation:

1. Alignment and grade test.

2. Pressure test.

3. Operational Testing:
   a. Perform operational testing after hydrostatic test is complete, backfill is in place and sprinkler heads adjusted to final position.
   b. Demonstrate system meets coverage requirements and automatic controls function properly.
   c. Coverage requirements are based on operation of 1 circuit at a time.

B. Sanitary Sewers:

1. Displacement test.

2. Pressure test for gravity pipeline systems.

3. Pressure test for pressure pipeline systems.

4. Video test for sanitary sewers.

5. Pressure test manholes.

C. Subdrains:

1. Alignment and grade test.

2. Obstruction test.

3. Non-rigid pipe deflection test (if applicable)

D. Storm Drains:

1. Alignment and grade test.

2. Obstruction test.

3. Non-rigid pipe deflection test (if applicable).

4. Pressure test for pressure pipeline systems.

5. Video test for storm drain per 1.04 Project Conditions paragraph A.

E. Potable Water System:

1. Obstruction test.

2. Bacteria test.

3. Pressure test.

4. If pressure test fails and line is repaired, the bacteria test shall be repeated.

END OF SECTION