CLEANING, INSPECTION, AND TESTING OF SEWERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cleaning, Inspecting, and Testing Sanitary Sewers

B. Cleaning, Inspecting, and Testing Storm Sewers

C. Cleaning and Inspecting Pipe Culverts

D. Cleaning and Inspecting Rehabilitated Pipes

1.02 DESCRIPTION OF WORK

A. Clean, inspect, and test sanitary sewer gravity mains, sanitary sewer force mains, and sanitary sewer service stubs.

B. Clean, inspect, and test storm sewers.

C. Clean and inspect pipe culverts.

D. Clean, inspect, and test rehabilitated pipe.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Notify Engineer at least 24 hours prior to performing testing.

B. The Engineer must be present to review testing procedures and to record results.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

Cleaning, inspecting, and testing sanitary sewers, storm sewers, pipe culverts, and rehabilitated pipes (including video inspection) are incidental to other project costs and will not be paid for separately.

PART 2 - PRODUCTS

2.01 TESTING EQUIPMENT

A. General: Comply with applicable sections of ASTM and other applicable industry standards and codes.

B. Video Inspection:

1. Camera:
   a. High-resolution color with adjustable iris focus.
   b. Pan and tilt capabilities.
   c. Integral lighting suitable to provide proper illumination and a clear video image of the entire periphery of the pipe.
   d. Capable of operating in 100% humidity conditions.
   e. Produce a high quality video image.

2. Provide closed-circuit video inspection equipment capable of displaying on-screen footage of distance measured to within 1% of actual distance.

3. Record the inspection in color in the recording media specified by the Engineer. Forward the recording to the Engineer.

PART 3 - EXECUTION

3.01 CLEANING

A. Clean all sanitary sewers, storm sewers, and pipe culverts prior to testing by flushing with high pressure water and removing debris by vacuum extraction, and by removing sheeting, bracing, shoring, forms, soil sediment, concrete, or other debris.

B. Do not discharge soil sediment or debris to drainage channels, existing storm sewers, or existing sanitary sewers.

3.02 VIDEO INSPECTION

A. General:

1. Unless otherwise specified in the contract documents, conduct video inspection of all new and rehabilitated sanitary and storm sewers after all backfill and compaction operations are completed, but prior to paving.

2. Notify the Engineer the day prior to inspection so the Engineer may be present during the inspection.

3. Complete inspections under the supervision of a competent employee who has completed NASSCO's Pipeline Assessment Certification Program (PACP).

4. Notify the Engineer of the extent of noncompliance with the low spot depth tolerances in Section 4010 for sanitary sewers and Section 4020 for storm sewers.

5. Re-inspect sewers after any corrective action has been completed.

B. Inspection Procedure:

1. Prior to video inspection, run sufficient water through the pipe to saturate potential low spots so they may be detected during inspection.

2. Inspect each pipe segment between manholes or access points in a single, continuous run. Progress through the entire project in a uniform direction.

3. Inspect all lateral connections and other observations at right angles utilizing the pan and tilt capabilities of the camera.

4. Center the video camera in the pipe during the inspection.

5. Do not exceed 30 feet of inspection per minute.

C. Inspection Reporting:

1. Provide a copy of the video inspection including on-screen continuous footage, pipe diameter, direction of viewing, and manhole and street location references in the recording. Affix labels to the recording media to include the name of the project, the date, and the location of the inspection.

2. Provide a written report of the inspection. In the report, include true-to-scale drawings of all sewer defects and observation locations. Reference the time stamp on each line item entry on the written report.

D. Inspection Acceptance: The Engineer may reject low quality videos or videos failing to meet specifications.

3.03 SANITARY SEWER LEAKAGE TESTING

Perform one or more of the following tests on new sanitary sewer gravity mains and sanitary sewer service stubs. Conduct tests only if service lines to any private properties are plugged and not active. Test sanitary sewer manholes separately as specified in Section 6030.

A. Sanitary Sewer Infiltration Testing:

1. Use only where ground water is more than 2 feet above top of pipe at highest point in section being tested.

2. Provide documented verification of ground water elevations for no less than 24 hours before measurement of infiltration.

3. Measure infiltration in sanitary sewer with a V-notch weir in a downstream manhole.

4. The maximum allowable infiltration for new sanitary sewers, including manholes, is 200 gallons per inch of diameter per mile of pipe per day.

B. Sanitary Sewer Exfiltration Testing:

1. General: Use an exfiltration test when ground water level is less than 2 feet above top of pipe at highest point in section being tested. Sectionalize the test section so the internal pressure in the pipe does not exceed 5 feet of water.

2. Test Procedures:

a. Install a watertight plug in the inlet of the upstream and downstream manhole of sewer section being tested.
b. Fill the sewer and upstream manhole with potable water until the water elevation in the upstream manhole is 2 feet higher than outside top of pipe in section being tested or 2 feet above existing ground water level, whichever is highest elevation.
c. Allow the water level to stabilize for 30 minutes, then refill the upstream manhole with water to the original level and begin the test.
d. Measure the amount of water lost in the upstream manhole in 1 hour. Use that amount to determine exfiltration in a 24 hour period.

3. Exfiltration Rate: The following table may be used to determine exfiltration in gallons per 24 hours by measuring the loss that occurs in 1 hour. The table is applicable only for 48 inch diameter manholes.

The maximum allowable exfiltration for new sanitary sewer, including manholes, is 200 gallons per inch of diameter per mile of pipe per day.

Table 4060.01: Loss in Gallons per 24 Hours for Drop in Water Level per Hour in 48 Inch Diameter Manhole (table may be interpolated to the nearest 1/4" drop)

Drop	0"	1"	2"	3"	4"	5"	6"	7"	8"	9"
	0	188	376	564	752	940	1128	1316	1504	1692

For manholes larger than 48 inch diameter use the following formula:

$$G = 0.0816(H)(D^2)$$

Where:
G = loss in gallons.
D = diameter of manhole in inches.
H = water level drop in manhole in inches.

3.03 SANITARY SEWER LEAKAGE TESTING (Continued)

C. Sanitary Sewer Low Pressure Air Testing:

1. General:

a. A low pressure air test may be used in lieu of an exfiltration test except as noted.
b. Air test is not recommended when ground water elevation is 2 feet or greater above the top of the pipe, and cannot be used when ground water is greater than 6 feet above the top of the pipe.
c. Use extreme care and follow safety precautions during testing operations. No one is allowed in manholes during testing.

2. Test Procedures:

a. Clean entire line of all debris. Flush or wet line to produce consistent results.
b. Plug all inlets and outlets to resist the test pressure. Special attention must be given to stoppers and laterals.
c. Determine the test duration for the section being tested from the following table. This table ignores pipe length and uses the factor 0.472 x d, with "d" being in inches. Pressure holding time is based on average holding pressure of 3.0 psi or drop from 3.5 psi to 2.5 psi.

Table 4060.02: Test Duration

Size Pipe (inches)	Test Period Duration (minutes)
8	4.0
10	5.0
12	6.0
15	7.0
18	8.5
21	10.0
24	11.5
27	13.0
30	14.0
36	17.0
42	20.0
48	23.0
54	25.5
60	28.5

d. Add air to the line segment being tested until the internal air pressure of the sewer line is raised to approximately 4.0 psi greater than the average back pressure of any ground water that may be over the top of the pipe. Pressure in the sewer should not exceed 5.0 psi. Allow at least 2 minutes for air pressure to stabilize.
e. When pressure has stabilized and is at or above the starting test pressure of 3.5 psi, commence the test. Record the drop in pressure for the test period. The test may be discontinued when the prescribed test time has been completed, even though 1.0 psi drop has not occurred.
f. If the ground water level at the time of testing is above the pipe invert, add 0.43 psi of air per foot of water above the invert to the test air pressure range of 2.5 psi to 3.5 psi stated above.
g. If the pressure drop exceeds 1.0 psi during the test period, the test will be considered to have failed. Repair and retest the line.

3.03 SANITARY SEWER LEAKAGE TESTING (Continued)

D. Sanitary Sewer Vacuum Testing: Comply with ASTM C 1244.

1. General:

a. Vacuum testing may be used in lieu of other specified test methods.
b. Use extreme care and follow safety precautions during testing operations. Keep personnel out of and away from manholes during testing.
c. Where practical, clean the pipe prior to testing and wet the pipe surface. Isolate the test segment as necessary, including closing service connections.

2. Test Procedures:

a. Determine the test time for the size of pipe being tested using the following table.

Table 4060.03: Minimum Test Time

Nominal Pipe Size (inches)	Time (Minutes/100 feet of pipe)
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

b. Test time is the time required for vacuum to drop from 3.5 to 2.5 psi.
c. Use a vacuum pump with the capacity to evacuate the sewer test section in time equal or less than that shown in Table 4060.03 for the size of pipe being tested.
d. Evacuate air until the internal air pressure of the sewer line is lowered by approximately 4.0 psi. Allow the air pressure to stabilize.
e. When the air pressure is stabilized near the starting test vacuum of 3.5 psi, commence the test by allowing gage pressure to drop to 3.5 psi, then commence time recording. Record the drop in vacuum for the test period.
f. If the drop in vacuum is 1.0 psi or less during the test period, the test will be considered successfully passed.
g. If the drop in vacuum is greater than 1.0 psi during the test period, inspect, evaluate, repair, and retest.

3.04 DEFLECTION TESTING

A. Perform deflection tests on all flexible sanitary sewer mains, excluding ductile iron pipe. Also perform deflection tests on all flexible storm sewer or culvert pipe 12 inches in diameter or greater.

B. Perform deflection tests after backfill has been in place at least 30 calendar days and before paving activity takes place, or as per appropriate sections of these specifications.

C. Pull 9 arm deflection mandrel, complying with applicable ASTM Standards, through sewer by hand.

D. Ensure pipe deflection does not exceed 5% of average inside diameter as established by ASTM Standards.

3.04 DEFLECTION TESTING (Continued)

E. Remove and replace pipe exceeding deflection limits.

F. Handle and divert existing flows during deflection testing.

3.05 FORCE MAIN TESTING

A. Provide test pumps, test plugs, pipe, and gages. Make necessary piping connections.

B. Fill the force main with potable water and flush before testing to remove entrapped air. Other water sources may be used if approved by the Engineer.

C. Insert taps as required to remove air. Plug taps after the completion of tests.

D. Use a test pressure of 1.5 times the working pressure at the lowest point along the test section, but not less than 50 psi.

E. Pressurize the test section and allow it to stabilize prior to beginning the leakage test.

F. Maintain pressure to within 5 psi of the test pressure by pumping in potable water as required.

G. Leakage is the quantity of water that must be supplied into the test section to maintain pressure within 5 psi of the specified test pressure during a 2 hour test period.

H. The maximum allowable leakage is determined by the following formula:

$$L = \frac{(S)(D)(P)^{0.5}}{148{,}000}$$

Where:
L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal pipe diameter, in inches
P = average test pressure, in pounds per square inch

The following table assumes an average test pressure (P) of 50 psi and length of pipe (S) of 1,000 feet.

Table 4060.04: Maximum Allowable Leakage Rate

Pipe Diameter (inches)	Allowable Leakage Rate (gallons/hour/1,000 feet of pipe)
4	0.19
6	0.29
8	0.38
10	0.48
12	0.57
14	0.67
16	0.76

I. Examine exposed pipe and fittings during testing. Repair all visible leaks.

J. If the test indicates leakage greater than allowed, locate, repair, or replace damaged or defective pipe, and repeat tests until the requirements are met.

END OF SECTION