

SECTION 33 14 22

TESTING OF SANITARY SEWER MAINS AND MANHOLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes testing and inspection of gravity sewer main, manholes, and service laterals in accordance with NCDEQ and CFPUA requirements. Location or project specific testing requirements and procedures shall be set forth by CFPUA and Engineer in approval conditions. CCTV shall be required as a minimum. Additional Testing may be requested.
- B. Sewer mains, service laterals, and manholes shall be inspected and tested in accordance with the reference standards and following table with notes.

	CCTV Inspection	Low Pressure Air Test	Exfiltration Test	Deflection Test	Infiltration/Ex-filtration Limit	Vacuum Test
Sewer Mains	Yes	Yes (Note 1)	Yes (Note 2)	Yes (Note 3)	100 gpdim (Note 4)	
Sewer Laterals	Yes	Yes (Note 1)			100 gpdim (Note 4)	
Manholes	Yes					Yes (Note 5)

Notes:

1. When sewer main diameters are 24-inches and smaller; unless water table is 2-feet or more above the top of pipe at upstream end of main or the calculated air test pressure is greater than 9 psi.
2. When sewer main diameters are greater than 24-inches.
3. Mandrel pull test after backfill is placed and stable at grade for 30-days. As an alternative to waiting 30-days to permit stabilization of the soil-pipe system, certified test results from an independent testing firm verifying that the backfill of the trench has been compacted to a least 95% maximum density may be accepted by CFPUA.
4. 100-gallons per nominal diameter-inch-mile for section tested and under 2-feet positive head.
5. Not applicable to existing manholes modified or rehabilitated.
6. Vertical compaction testing shall be performed at two (2) feet above the pipe and be completed in 2 ft lifts.
7. Horizontal compaction testing shall be performed at the tie-in point and every 100 ft thereafter.
8. Manhole compaction testing is to be performed in 2 ft lifts.

C. Related Requirements:

1. Section 33 05 13 – Precast Concrete Manholes and Utility Structures.
2. Section 33 31 11 – Sanitary Sewer Gravity Mains.

1.2 REFERENCES

- A. NC-DEQ Minimum Design Criteria for the Permitting of Gravity Sewers.

- B. American Water Works Association:
 - 1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - 2. AWWA M23 – PVC Pipe – Design and Installation.
- C. ASTM International:
 - 1. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
 - 2. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
 - 3. ASTM F1416 – Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air
- D. Uni-Bell PVC Pipe Association:
 - 1. UNI-B-6-98 – Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Acceptance of any deviation from these testing requirements is at the sole discretion of the CFPUA.
- B. All defects in the pipelines, manholes and appurtenances shall be remedied by the Contractor at no additional expense to CFPUA and will be re-inspected as outlined in this Section.

1.4 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Submit following items 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. Test gage calibration.
 - 6. Deflection mandrel drawings and calculations.
- C. Test Results: Certified copies of test results shall be furnished to the Owner and CFPUA within 1 week.
- D. CCTV Inspection: Submit two copies of the CCTV inspection to CFPUA on hard drives. The digital media recordings, television inspection logs, and digital photographs shall be named and labeled to indicate the specific sewer segment, location, and contents.

PART 2 PRODUCTS

2.1 CCTV INSPECTION EQUIPMENT

- A. The equipment used for the CCTV inspection shall be specifically designed and constructed for sanitary or pressure sewer inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera shall be a color, pan-and-tilt model. The camera shall be capable of being moved through the line in either direction at a uniform rate. A push camera system is acceptable for sewer laterals.
- B. The camera, television monitor, and other components of the video system shall be capable of producing picture quality and resolution to the satisfaction of the Engineer.
- C. Inspections shall be submitted to the Engineer or Owner in electronic (digital) NASSCO format that can be imported and exported with other NASSCO PACP certified software including POSM.

2.2 DEFLECTION TESTING OF PLASTIC SEWER PIPING

- 1. "Go/ No Go" mandrel.
- 2. Pull/retrieval ropes.

2.3 EXFILTRATION TESTING

- A. Equipment:
 - 1. Plugs.
 - 2. Pump.
 - 3. Measuring Device.

2.4 INFILTRATION TESTING

- A. Equipment:
 - 1. V-notch weirs.

2.5 LOW-PRESSURE AIR TESTING

- A. Equipment:
 - 1. Air compressor.
 - 2. Air supply line.
 - 3. Shutoff valves.
 - 4. Pressure regulator.
 - 5. Pressure relief valve.
 - 6. Stopwatch.
 - 7. Plugs.
 - 8. Pressure Gage: Calibrate to 0.1 psi.
 - 9. Clear tubing for water table measurement.

2.6 VACUUM TESTING

- A. Equipment:
 - 1. Vacuum pump.
 - 2. Vacuum line.
 - 3. Vacuum Tester Base:
 - a. Compression band seal.

- b. Outlet port.
- 4. Shutoff Valve.
- 5. Stopwatch.
- 6. Plugs.
- 7. Vacuum Gage: Calibrated to 0.1 in. Hg.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Verify the following:
 - 1. Piping and manholes installation methods are compatible with testing requirements.
 - 2. Testing equipment is calibrated and functioning.
 - 3. Test procedures and recording methods have been submitted and approved.

3.2 PREPARATION

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Plugs:
 - 1. Plug outlets, wye branches, and laterals.
 - 2. Brace plugs to resist test pressures.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements
- B. Section 01 70 00 – Execution and Closeout Requirements.
- C. CCTV Procedures:
 - 1. After the sewers are completely cleaned and water is introduced, the sewers shall be inspected by means of closed-circuit television to verify that the sewers have been thoroughly cleaned, to locate active sewer services and other connections, to document the condition, and to locate sewer defects.
 - 2. Existing flow in the sewer being inspected shall be temporarily bypassed in accordance with the Bypass Pumping Plan if satisfactory images cannot be obtained with flow on the sewer. CFPUA will determine if the images are satisfactory.
 - 3. Provide ventilation and air movement to prevent the presence of vapor or mist in the sewer.
 - 4. CCTV inspections shall be performed in accordance with PACP® standards including the specific date and time of inspection.
 - 5. The camera shall be moved through the sewer by devices that do not obstruct the camera view, or interfere with proper documentation of the sewer conditions, such as manual or power winches, TV cable, and powered rewinds.

6. When manually operated winches are used to pull the television camera through the line, two-way radios, telephones, or other suitable means of communication shall be established between the two manholes or access points to ensure adequate communications between members of the crew.
7. The camera shall be moved through the line in either direction at a moderate rate, stopping to permit proper documentation of the condition. In no case shall the television camera be pulled at a speed greater than 30-feet per minute. The camera shall be stopped at joints, defects, points of significance, tributary connections, service laterals, and other connections and shall be panned, tilted, and rotated to fully view the defects and connections. Inspections shall be documented.
8. Perform dye testing during the CCTV inspections to locate and confirm active service laterals when directed to by Engineer or CFPUA.
9. Inspections shall be performed from manhole centerline to manhole centerline or access point to access point.
10. Record accurate measurements of distances. Accuracy of the distance meter shall be checked above grade by a suitable device. The accuracy shall be within 1 percent.

D. Deflection Testing of Plastic Sewer Piping:

1. Perform vertical ring deflection testing on PVC sewer piping after backfilling has been in place for at least 30 days.
2. Allowable maximum deflection for installed plastic sewer pipe is no greater than five percent of original vertical internal diameter.
3. Perform deflection testing using "go, no go" mandrel.
4. Mandrel Diameter:
 - a. Not less than 95 percent of base or average ID of pipe.
 - b. Pipe Diameter: Comply with ASTM D2122.
5. Perform testing without mechanical pulling devices.
6. Locate, excavate, replace, and retest piping that exceeds allowable deflection.

E. Exfiltration Testing of Pipes Larger Than 24 Inches in Diameter:

1. Perform exfiltration testing not exceeding 100 gal. for each inch of pipe diameter for each mile per day for each reach of piping undergoing testing.
2. Perform testing with minimum positive head of 2 feet.

F. Infiltration Testing:

1. Maximum Allowable Infiltration: 100 gallons per nominal inch diameter of pipe for each mile per day for the reach of piping undergoing testing.
2. Include allowances for leakage from manholes.

G. Low-Pressure Air Testing:

1. Testing shall be accomplished by plugging the line at each end with pneumatic plugs.
2. Test each reach of gravity sewer piping between manholes.
3. Low-pressure air test all connected service laterals.
4. Introduce air pressure slowly to approximately 4 psig.
5. Determine ground water elevation above spring line of piping.
6. For every foot of ground water above spring line of piping, increase starting air test pressure by 0.43 psi.
7. Do not increase pressure above 9 psig.

8. Allow pressure to stabilize for at least five minutes.
9. Adjust pressure to 3.5 psig or to increased test pressure as determined above when ground water is present.
10. Do not make allowance for laterals unless a test section having more than 625 square feet of lateral surface area fails to pass the air test. Adjust the time required according to UNI-B-6-98.
11. Minimum Testing Duration in Minutes:
 - a. Shall be calculated by multiplying the nominal pipe size (inches) by 0.625.
12. Record drop in pressure during testing period.
13. If air pressure drops more than 1.0 psi during testing period, piping has failed.
14. If 1.0 psi air pressure drop has not occurred during testing period, piping is acceptable; discontinue testing.
15. If piping fails, test reach of piping in incremental stages until leaks are isolated, repair leaks, and retest entire reach between manholes.
16. If unsatisfactory testing results are achieved, make necessary repairs and retest until result meets criteria.
17. Repair visible leaks regardless of quantity of leakage.
18. UNI-B-6-98 TABLE I – MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015

Min. Pipe Dia. (in.)	Time (min: sec)	Length For Min. Time (ft)	Time For Longer Length (sec)	Time (min:sec) for Length (L) Shown					
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46

H. Vacuum Testing:

1. Repair both outside and inside of joint to ensure permanent seal.
2. Test manholes prior to backfill.
3. Test manholes with manhole frame set in place.
4. Vacuum Testing:
 - a. Comply with ASTM C1244.
 - b. Plug pipe openings; securely brace plugs and pipe.
 - c. Plug lift holes with non-shrink grout.
 - d. Inflate compression band to create seal between vacuum base and structure.
 - e. Connect vacuum pump to outlet port with valve open, then draw vacuum to 10 in. Hg (5 psig).
 - f. Close valve.
 - g. Manhole Test Duration in Seconds:
 - 1) Manhole Diameter of 4 Feet: 60.
 - 2) Manhole Diameter of 5 Feet: 75.

- 3) Manhole Diameter of 6 Feet: 90.
- h. Record vacuum drop during test period.
- i. If vacuum drop is greater than 1 in. Hg during testing period, repair and retest manhole.
- j. If vacuum drop of 1.0 in. Hg does not occur during test period, manhole is acceptable; discontinue testing.
- k. If vacuum test fails to meet 1.0-in. Hg drop in specified time after repair, repair and retest manhole.
- 5. If unsatisfactory testing results are achieved, repair manhole and retest until result meets criteria.
- 6. Repair visible leaks regardless of quantity of leakage.

END OF SECTION