



MUNICIPAL DEVELOPMENT STANDARDS

SECTION 9 – TESTING PROCEDURES

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Planning & Engineering

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9 TESTING PROCEDURES

9.1 General

It is the responsibility of the Consulting Engineer to ensure that the Contractor properly tests all aspects of each project.

The Developer must submit all test data performed by the accredited testing company to the City on an ongoing basis and prior to issuing the Construction Completion Certificate and Final Acceptance Certificate.

Failure to receive the test results as required will be considered sufficient cause for not accepting such work.

9.2 Materials Testing - Roadways

Subgrades, construction materials and construction standards must be verified with a representative number of standard tests.

The Developer must forward copies of such test results to the City and prior to issuing the Construction Completion Certificate and the Final Acceptance Certificate.

The Developer must engage an accredited materials testing consultant to take representative samples of all materials to be incorporated in the pavement and concrete structures, prepare mix designs for approval by the City and to carry out quality control testing during construction.

9.3 Materials Testing - Trench Backfill

9.3.1 Trench More than 15 m in Length

A minimum of two (2) density tests must be performed per 600 mm of trench depth per 100 m of length. The tests must be representative of the entire length, width and depth of trench backfill, including around catch basins, manholes, valves and service connections.

9.3.2 Trench 15 m in Length or Less

A minimum of three (3) density tests must be performed evenly spaced through the depth of the trench. For service connection trenches, at least one (1) additional (fourth, or more) density test must be taken between the back of curb and separate walk, or between the back of monolithic walk and property line, over each service connection line within the uppermost 0.5 m as measured from final finished grade.

9.4 Roll Testing/Proof Rolling

A roll test must be performed on all roadways after the desired compaction has been achieved, for both the clay subgrade and the granular base. All roll tests must be witnessed by representatives of the City and the Consulting Engineer. Roll tests must utilize a single axle dual wheeled truck with a load of 9100 kg on the rear axle, with tires inflated to a minimum of 275 kPa (40psi); any other equipment used must be approved in advance by the City. The vehicle will be driven slowly along the road surface, with those monitoring the test watching for any deflection in the road surface, for sufficient passes to cover the entire surface. Deflections are only permitted on the clay subgrade at the discretion of the City representative; no deflections are permitted on the granular base. Any areas with unacceptable deflection will be removed and re-compacted and another roll test will be conducted. This process will be repeated until such time as the surface shows no deflections beyond allowable.

The clay subgrade must be approved before the granular base can be installed and the base must be approved before asphalt pavement can be installed. If there is significant rainfall between when the base is approved and the installation of asphalt, the base may need to be tested again before the installation of asphalt, at the discretion of the City.

9.5 Testing – Gravity Sewers

After all sewer mains, manholes and related structures have been installed and cleaned, the system must be tested to ensure that the sewer is free of defects. The testing requirements must follow the relevant ASTM standards and are

generally described in each subsection of this section. The cost of all testing and repair of deficiencies found during the testing will be borne by the Developer. All results of tests must be supplied to the City, including the results of re-testing following initial failures. All tests and inspections must be conducted in the presence of a representative of the City.

9.5.1 Visual Inspection

A visual inspection of surface features and manholes, including, but not limited to:

- Checking between manholes to ensure proper alignment and grade of pipe;
- Checking for joint leaks where access is possible;
- Checking for pipe cracks where access is possible; and
- Checking for signs of infiltration.

9.5.2 Video Inspection

For sewers up to and including 900 mm in diameter, televised inspection of the sewer system must be carried out by the Developer at the end of construction as a requirement of the Construction Completion Certificate. Flushing carried out for this inspection must not result in materials entering any existing manhole. Any deficiencies found during this test must be promptly remedied by the Developer at their own expense. DVDs must be in colour format only and of acceptable clarity, quality and colour. The DVDs must be provided, along with inspection reports and summaries of the televised inspection, to the City prior to issuing the Construction Completion Certificate.

The report must also include the location of all service connections together with a statement of opinion as to whether or not the service connections are leaking.

9.5.2.1 Pipe Walk-Through

For pipes larger than 900 mm, the pipe must be visually inspected by a certified independent operator (at a minimum carrying valid H2S Alive and Confined Space certificates), and have observations (photos, and the distance down the pipe) recorded during a walk-through. CCTV inspections of these larger pipes may be authorized by the City, provided it can be demonstrated acceptable data quality will be obtained.

9.5.3 Exfiltration Test

An exfiltration test will be required to be performed on at least ten (10) percent of the main length on all newly constructed sanitary sewer mains, and at least ten (10) percent of the main length on newly constructed storm sewer mains in areas where a high water table has been identified in the geotechnical report, or when environmental issues are a concern to the City. A high water table is such that the elevation of the current ground water is higher than the invert elevation of the sewage main being installed. An exfiltration test will also be required when the CCTV or visual inspection of any sewage main shows visible evidence of water entering the pipe. When an exfiltration test is required, the City will select the sewer sections to be tested. The exfiltration test must be completed in conformance with the latest City procedure, which is available upon request. All leakage tests will be conducted after the service connections to the main have been installed. Testing must be carried out from manhole to manhole, and all service laterals, stubs, and fittings must be plugged or capped prior to testing. Sanitary sewers which exceed the allowable amount of exfiltration must be repaired and re-tested, until the test results are within the limits specified. Visible infiltration either within the manhole or identified during the visual inspections outlined in Section 9.5.2 must be repaired regardless of the test results.

9.5.4 Deviation from Line

The maximum acceptable displacement from the centre line of designated alignment for pipes 900 mm and smaller will be 150 mm, and the maximum acceptable displacement for pipes 900 mm and larger will be 50

mm per 300 mm of diameter. This must be determined as based on the as-built survey data provided as part of the requirements of the Construction Completion Certificate.

9.5.5 Deflection Test

A deflection test may be required where CCTV or visual walk-through inspections of flexible pipe show evidence of excessive or non-symmetrical deflection (e.g. a non-elliptical deformation pattern). Pipe up to 900 mm in diameter must be inspected with a “go/no-go” mandrel device. Pipe larger than 900 mm in diameter must be inspected with a suitable proving device. A maximum deflection of 5.0% is allowable in the short term (not sooner than 30 days after backfilling, up to one year), and 7.5% is allowable in the long term (after one year of backfilling). The Engineer will select the sewer sections to be tested. Copies of the procedure and specifications of the mandrel device are available from the City upon request. Segments of pipe found to exhibit excessive deflection must be removed and replaced, and the deflection test repeated to verify the repair.

9.6 Testing of Forcemains

Forcemains will be tested as described for watermains.

9.7 Testing of Watermains

9.7.1 Pressure and Leakage Test

The watermain pressure test application form and procedure can be found on the City’s website (www.lloyDMINSTER.ca). In brief, watermain pressure tests are conducted in accordance with the following:

- Test completed mains after services are installed and backfill is complete, after allowing sufficient time for adequate curing of concrete thrust blocks and in accordance with AWWA Standards.
- Test in sections containing no more than 450 m.
- Fill the system with water and expel air at services and hydrants. Install temporary taps wherever necessary to expel air and plug after completion.
- Apply test pressure by means of a test pump with a measurable volume container.
- A City representative must witness all pressure tests.

9.7.1.1 Pressure Testing PVC Pipe

Pressure testing of PVC pipe will adhere to the following procedure:

- Maintain test pressure for a period of two (2) hours. Test pressure must be the greater of 1035 kPa (150 psi) or 1.5 times the normal operating pressure.
- For testing PVC sanitary forcemains, the pressure must be the greater of 690 kPa (100 psi) or 2.0 times the normal operating pressure.
- Table 9.1 outlines a leakage allowance chart. This chart forms the basis for testing all watermains.

Table 9.1 – Leakage Allowance in Litres per 100 Joints per Hour

Pipe Size (mm)	Test Pressure (kPa)	
	690	1035
150	3.10	3.76
200	4.09	5.02
250	5.14	6.27
300	6.14	7.52
350	7.20	8.78
400	8.18	10.00
450	9.24	11.28
500	10.22	12.56

The leakage allowances in Table 9.1 have been calculated from the following formula from AWWA Manual No. M23 (PVC Pipe – Design and Installation):

$$L = \frac{ND\sqrt{P}}{128,300}$$

Where: L = allowable leakage in L/hr
 N = total number of joints
 D = pipe diameter in mm
 P = test pressure in kPa.

Leakage allowance for new construction of materials other than PVC must be in accordance with the applicable AWWA standard.

9.7.1.2 Pressure Testing HDPE Pipe

The test procedure consists of two steps: the initial expansion phase and the test period. In order to accommodate the initial expansion of the main under test, the following steps must be followed:

- Fill the line with water and pressurize to 1.5 times the Standard Pressure Rating of the main. Test pressure must be 1035 kPa (150 psi) for DR11 HDPE pipe. All air must be expelled from the line during filling of the test section;
- Add sufficient make-up water to the main at hourly intervals to return the main to the test pressure. The initial expansion must be done for a three (3) hour period so the main must be re-pressurized three (3) times during this phase;
- After the third repressurization, the test period will begin. Make-up water must not be added to the main until the end of the test period which must be three (3) hours long. At the end of the three (3) hours, a measured quantity of make-up water will be added to the main to re-pressurize it to the test pressure. The amount of make-up water must not exceed the volume allowance for expansion given below; and
- Allowance for expansion (in mm) under test pressure in litres for each 100 m of pipe at 23°C are detailed in Table 9.2 below:

Table 9.2 – Allowance for HDPE Expansion

Nominal Pipe Diameter (mm)	1 Hour Test	2 hour Test	3 Hour Test
75	1.2	1.9	3.1
100	1.6	3.1	5.0
150	3.7	7.5	11.2
200	6.2	12.5	18.7
250	8.7	16.2	26.2
300	13.7	28.7	42.4
350	17.4	33.7	52.4
400	21.2	41.1	62.3
450	27.4	53.6	81.0
500	33.7	68.6	99.7
550	43.6	87.3	130.9
600	56.1	111.0	165.8

- The amount of make-up water shown in Table 9.2 above should be multiplied by the appropriate correction factor taken from below for the water temperature at the time of testing:

Table 9.3 – Water Temperature Correction Factors

Temperature (°C)	Correction Factor
0	0.22
2	0.24
4	0.28
6	0.32
8	0.36
10	0.42
12	0.47
14	0.53
16	0.59
18	0.66
20	0.74
22	0.87
23	1.00
24	1.20

- Under no circumstances should the total time under test exceed eight (8) hours at 1.5 times the pressure rating. If the test is not completed due to leakage, equipment failure or any other reason with this time period, the test section must be permitted to “relax” for an additional eight (8) hour period prior to starting the next testing sequence; and
- Locate and repair defects if leakage is greater than amount specified. Repeat test until leakage is within specified allowance for the test section.

9.7.2 Flushing and Disinfection

The Developer will perform all flushing and disinfection of water mains once a pressure test has been accepted as per Section 6.13, and written test results will be submitted to the City and Water Services. Flushing velocities must conform to the requirements of the latest version of AWWA C651. All flushing and disinfection will be coordinated with Water Services. All associated costs will be the responsibility of the Developer.

9.8 Verification of Gutter Flow

During the Final Acceptance inspection for surface works, the gutters must be tested to verify their function. The Developer will machine-clean the roads, and where necessary manually clean the gutters prior to inspection so that they are free of debris or any material that may impede flow. Utilizing a water truck, water is directed onto the gutter ahead of the inspectors. Any areas of ponding may indicate an issue with gutter grade. The Developer must arrange for any such areas to be checked for proper grade, and replace deficient segments as necessary.