

1.0 GENERAL

1.1 Scope

1.1.1 The work shall consist of testing wastewater and/or storm mains to ensure construction conforms to the proper line, grade, cross section and performance.

1.2 Related Sections

1.2.1 Section 01300 – Sewer Mains

1.2.2 Section 01330 - Manhole and Catchbasin Construction

1.2.3 Section 02997 – Sewer Cleaning and CCTV Inspections

2.0 PRODUCTS

2.1 The Contractor shall be responsible to provide all labour and equipment as required to complete the tests.

3.0 EXECUTION

3.1 General

3.1.1 The following tests shall be carried out after completion of backfilling. All tests shall be carried out under direct supervision of the Engineer. The Contractor shall assist the Engineer in preparing a log documenting all tests completed. The log shall be property of the City and kept for record purposes. One copy shall be turned over to the Contractor for his records. All repairs and replacements necessary within the maintenance period shall be responsibility of the Contractor.

3.2 Obstruction

3.2.1 Sewer mains shall be tested for obstructions using a ball test. The sewer main shall be deemed unobstructed if a wood or metal ball having a diameter of 50 mm less than the inside diameter of the pipe can be readily pulled through the sewer main.

3.3 Deflection Testing – Flexible Pipe

3.3.1 Deflection testing shall be completed on at least 20% of all sewer mains installed, at locations as directed by the Engineer, as well as any sewer mains where CCTV inspections indicate excessive deflections may be present, using the go-/no-go mandrel method, or another method as approved by the Engineer.

3.3.2 Deflection testing shall not be completed any sooner than 30 days following the installation of flexible pipe.

3.3.3 All deflection testing shall be in accordance with ASTM D3034 latest edition. To ensure accurate testing, the lines must be clean. A mandrel, cylindrical in shape, with a minimum of nine (9) evenly spaced arms shall be used. The

minimum diameter of the circle scribed around the outside of the mandrel arms shall be equal to the allowable deflected pipe diameter +/- 1 mm. The contact length of the mandrel shall be measured between the points of contact on the mandrel arm or between sets of prongs. This length shall not be less than that shown in the following table.

Nominal Pipe Size	Mandrel Contact Length	Nominal Pipe Size	Mandrel Contact Length
mm	mm	mm	mm
150	100	500	400
200	150	525	450
250	200	600	500
300	250	675	575
350	300	750	675
375	300	900	750
400	300	1050	900
450	350	1200	1050

- 3.3.4 The maximum allowable deflection is 7.0% of the pipes inside diameter for pipe sizes less than 750mm. For pipes 750 mm diameter and larger, the allowable deflection is 5.0% of the pipes inside diameter.
- 3.3.5 All locations with pipe exceeding the maximum allowable deflection will require removal, replacement and retesting. All sections of pipe that fail the deflection test shall be repaired and retested. Re-rounding is not accepted. Retesting shall be carried out no sooner than 30 days after backfill has been placed.
- 3.3.6 For pipes up to 750 mm diameter, when deflection is greater than 5.0% 30 days after installation but less than the maximum allowable deflection will require a remedy action plan to be submitted by the Contract for approval of the Engineer.

3.4 Pipe Exfiltration Testing

- 3.4.1 At least 10% of all domestic sewer lines shall be designated by the Engineer and tested for exfiltration. The exfiltration test and records shall be conducted in accordance with the procedure for Leakage Testing of Gravity Domestic Sewers prepared by Municipal Engineering Department (December 18, 1996) and/or ASTM C969. Copies of the Procedure are available from Public Works Division Water, Wastewater and Wastewater Management.
- 3.4.2 The maximum allowable exfiltration for 200 mm to 600 mm diameter pipe is 4.6 litres/day/mm/km. For larger than 600 mm pipe, the maximum allowable exfiltration rate is 55 litres/day/mm/km per CSA B182.11. A tested section of domestic gravity sewer exceeding this limit shall not be accepted. Sections on either side of the failed section shall be immediately tested. The test failed section of the sewer line shall be rectified and retested.

3.5 Manhole Exfiltration Testing

3.5.1 At least 10% of all domestic sewer manholes shall be designated by the Engineer and tested for exfiltration potential in terms of their integrity of installed materials and construction procedures. The test procedure shall be as per ASTM C1244M or the Hydrostatic Water Leakage Test procedure included in this specification.

3.5.2 If the manhole leakage rate is excessive, the manhole leaks shall be located, repaired or reconstructed. Retesting shall be completed until a satisfactory test is obtained.

3.5.3 The Engineer may require additional manholes to be tested for leakage if testing of more than one manhole fails.

3.6 Sewer Cleaning and CCTV Inspection

3.6.1 Sewer Cleaning and CCTV inspection shall be performed as described in Section 02997 – Sewer Cleaning and CCTV inspection

PROCEDURE FOR LEAKAGE TESTING OF GRAVITY DOMESTIC SEWERS

TEST PROCEDURE

1. Sewers are to be tested for leakage upon completion of backfilling. Pipe test section to be selected by the Engineer.
2. Plug the downstream end of the sewer line and plug the upstream end with a "flow through type plug" at the upstream manhole. Ensure all connections in the test section have been capped and inspected by the Engineer. (See Standard Drawing No. S-10).
3. Fill the test section with water by adding it through the test vessel and the flow through type plug. Allow air to escape from the sewer line.
4. Fill the test vessel with water to a point of one metre above the top of the pipe. If the pipe is concrete, allow a minimum of 12 hours pre-test absorption stabilization period before starting the test. If the pipe is PVC or other non concrete material, allow a minimum of 3 hours pre-test absorption period.
5. After absorption into the pipe has stabilized, the water in the upstream manhole is to be brought to the test level of 1000mm above top (upstream end) of pipe.
6. Start the test and observe the water level in the test vessel. If the level drops to 600mm above the top of the pipe, add water. Maintain head between 1000 and 600mm, continue the test for a total duration of 120 minutes and record the water volume lost over that time. Water volume lost includes all water added to maintain the head and water required at the end of the test to re-establish the 1000mm head.
7. Compute the maximum allowable volume loss for the main and for the service connections. Add the two values to find the total allowable loss.
8. Compare the actual volume of water lost to the total allowable volume loss to determine if the line segment passes or fails.
9. Remove the downstream plug, exercising care with respect to the rapid flow of water.
10. Submit the signed and witnessed test record form (Section 1320, Page 4 of 6) to the City of Regina, Development Services.
11. This test is to be applied to at least 10% of all new gravity domestic sewer lines installed.

Domestic Gravity Sewer Exfiltration Test

Location: _____	Key No.: _____
From: _____	To: _____
MH(STA): _____	MH (STA): _____
Length of Domestic Main (A): _____ km	Type of pipe: _____
Diameter of pipe (B): _____ mm	
Length of Service Connections (C): _____ km (below the 1000mm head)	Diameter of Service Connections (D): _____ mm
Pre Test Fill Time and Date: _____	_____
Date of Test: _____	
Time Test Started: _____	Time Test Completed: _____
Duration of Test (E): _____ hrs	
Volume of Water Lost (F): _____ litres	
Connections in place: No <input type="checkbox"/> Yes <input type="checkbox"/>	Number: _____ Plugs Inspected: No <input type="checkbox"/> Yes <input type="checkbox"/>

CALCULATIONS:

1. Calculate L₁, the maximum allowable volume loss for Domestic Main

$$L_1 = 4.6 \text{ litres/day/mm/km} \times 1 \text{ day/24hr} \times (E) \times (A) \times (B)$$

NOTE: If pipe size is larger than 600mm, substitute 55 for 4.6 litres/day/mm/km in this calculation.

$$L_1 = 4.6 \times 1/24 \times \text{_____} \times \text{_____} \times \text{_____}$$

$$L_1 = \text{_____} \text{ litres}$$

2. Calculate L₂, the maximum allowable volume loss for Service Connections

$$L_2 = 4.6 \text{ litres/day/mm/km} \times 1 \text{ day/24hr} \times (E) \times (C) \times (D)$$

$$L_2 = 4.6 \times 1/24 \times \text{_____} \times \text{_____} \times \text{_____}$$

$$L_2 = \text{_____} \text{ litres}$$

3. Calculate L₃, the total allowable loss

$$L_3 = L_1 + L_2$$

$$L_3 = \text{_____} + \text{_____}$$

$$L_3 = \text{_____} \text{ litres}$$

4. Compare the volume of water lost (F) to the total allowable loss (L₃)

If F > L₃, the test section **FAILS**

If F ≤ L₃, the test section **PASSES**

CHECK ONE

- Section Fails
 Section Passes

Witnessed by: _____	Contractor/Consultant: _____	Date _____
_____	Inspection (City of Regina): _____	Date _____

**PROCEDURE FOR HYDROSTATIC WATER LEAKAGE TESTING OF DOMESTIC
MANHOLES**

(as required by Section 1320-3.4.3 of Standard Construction Specifications)

TEST PROCEDURE

1. Manholes are to be tested for leakage after backfilling is completed. Manholes to be tested shall be selected by the Engineer.
2. All lift holes (if any) shall have been previously plugged with an approved nonshrink grout.
3. Install watertight plugs or seals on inlets and outlets of the test manhole and fill with water to the top of the cone. Allow a minimum of 12 hours for pre-test absorption stabilization period before starting the test.
4. To start the test, top up the manhole with water. Then add measured volumes of water to maintain the level in the manhole for one hour.
5. Calculate the volume of the manhole and express the leakage loss as a percentage of the volume of the manhole.
6. Submit the signed and witnessed test form (Section 1320, Page 6 of 6) to the City of Regina, , Development Services.
7. Manholes where excessive leakage is detected shall be repaired or reconstructed.

Hydrostatic Leakage Test Domestic Manholes

Location: _____ Key No.: _____
From: _____ To: _____
MH (STA): _____
Depth of Manhole: _____m
Conical top section? ____ YES ____ NO
Pre Test Fill Time and Date: _____
Date of Test: _____
Time Test Started: _____ Time Test Completed: _____
Duration of Test (T): _____ hrs
Volume of Water Lost (L): _____ litres

CALCULATIONS:

1. Calculate V, the volume of the manhole in litres. ($1\text{m}^3 = 1000$ litres)

Volume of conical manhole section $V = 1/3\pi h \{ (R_1)^2 + (R_2)^2 + R_1R_2 \}$ where "R₁" and "R₂" are the radii at the top and bottom of the cone and "h" is the height of the conical section.

Volume of cylindrical manhole section $V = \pi R^2 h$ where "R" is the radius of the cylindrical section and "h" is the height.

2. Calculate P, the leakage loss as a percentage of the volume of the manhole per hour.

$$P = \{ (L \div V) \div T \} \times 100$$

$$P = \{ (\text{_____} \div \text{_____}) \div \text{_____} \} \times 100$$

$$P = \text{_____} \% \text{ per hour}$$

3. Calculate P₁, the ratio of actual percentage of volume lost per hour (P) over the maximum acceptable leakage rate which is 0.3% per hour (P_{ma}).

$$P_1 = P \div P_{ma}$$

CHECK ONE

$$P_1 = \text{_____} \div 0.3$$

Meets

$$P_1 = \text{_____}$$

Does not meet

If $P_1 > 1.0$, the manhole does not meet the standard

If $P_1 \leq 1.0$, the manhole meets the standard

Witnessed by: _____ Contractor _____ Date

_____ Engineer/Consultant _____ Date

_____ City of Regina _____ Date