CW 2125 - FLUSHING, HYDROSTATIC LEAKAGE TESTING AND DISINFECTION OF WATERMAINS AND WATER SERVICES

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1. DESCRIPTION

1.1 General

.1 This specification covers flushing, hydrostatic leakage testing, disinfection, bacteriological sampling and reporting of results for watermains and water services.

1.2 Referenced Standard Construction Specifications

.1 CW 2110 - Watermains

1.3 Referenced Industry Standards

.1 AWWA C651 - Disinfecting Watermains

2. MATERIALS

2.1 Corporation Stops

.1 Corporation stops to be in accordance with CW 2110.

3. CONSTRUCTION METHODS

3.1 Filling and Flushing

.1 Fill and flush watermains and water services larger than 50 millimetres with potable water before hydrostatic leakage testing and disinfection. Provide a written plan for filling and flushing to the Contract Administrator for approval before starting.

.2 Expel air from the section being tested by opening available outlets and slowly filling the section from the supply source at a maximum rate of 0.3 metres per second. Locate outlets within 1.0 metre of the end of each section being flushed and tested.

.3 Provide a minimum flushing velocity of 0.76 metres per second once the section has been filled and continue flushing until trapped air and debris is completely removed from the section.

.4 Flush in a uni-directional manner from the supply source to the outlet to prevent contamination of the existing system. One connection to the existing system at a time will be allowed as a supply source for flushing purposes.

.5 Flushing through a new hydrant will be allowed if the hydrant tee is less than 3 metres from the downstream end of the section being flushed.

.6 Flush watermains and water services as indicated in Table CW 2125.1 unless otherwise indicated in the Specifications.

.7 Direct flushing water to nearest combined sewer or wastewater sewer in a manner that will not cause damage or injury.

.8 Provide flow requirements and discharge appurtenances for flushing in accordance with Table CW 2125.1.

TABLE CW 2125.1 - FLUSHING FLOW REQUIREMENTS

Nominal Pipe Size (millimetres)	Minimum Required Flow for Flushing Velocity of 0.76 m/s (Litres per second)	Corporation Stop Requirements (Includes up to 6 metres of Discharge Pipe) *		Hydrant Nozzle Requirements (Using 63 millimetre nozzles) *
150	15	1 - 38 mm	or	1
200	25	1 – 50 mm	or	1
250	38	2 - 50 mm	or	1
300	56	2 - 50 mm	or	1
350	76	2 - 50 mm	or	2
400	100	3 - 50 mm	or	2
450	125	4 – 50 mm	or	2

* Based on 0.25 MPa discharge pressure.

3.2 Hydrostatic Leakage Testing Procedure

.1 Provide at least 24 hours notice to the Contract Administrator in advance of hydrostatic leakage testing. Perform hydrostatic leakage testing in presence of the Contract Administrator.

.2 Perform hydrostatic leakage testing after flushing test section.

.3 Compressed air testing will not be allowed.

.4 Conduct testing once concrete thrust blocks have developed sufficient strength to resist the test pressure unless joint harnesses or other restraining methods approved by Contract Administrator are used.

.5 Test against closed corporation stops where services are reconnected to a new watermain and test against closed curb stops where new services are installed.

.6 Perform hydrostatic leakage testing at a test pressure of 1.0 MPa for a minimum of 1 hour.

.7 Allowable apparent hydrostatic leakage rates to be less than indicated in Table CW 2125.2. Maximum allowable pressure drop during test to be 0.1 MPa.

.8 Limit length of leakage test section to 365 metres in one single operation. Obtain approval from the Contract Administrator to test longer sections. Allowable apparent leakage rate for 365 metres will be used for sections longer than 365 metres.

.9 Corporation stops for water services 50 millimetres and smaller will not be considered a joint.

.10 Isolate the test section and close discharge outlets before hydrostatic leakage testing. Introduce potable water for hydrostatic leakage testing through appurtenance used for flushing purposes. Chlorine solution used for disinfection may be substituted for potable water.

.11 Provide the following equipment on the discharge line of the pressure pump and protect from freezing.

.1 Pressure gauge next to the pump before the pressure recording chart.

.2 Pressure recording chart with pressure gauge.

.3 High pressure water meter.

.12 Before testing provide the Contract Administrator with documentation that the high pressure water meter has been calibrated to the intermediate rate accuracy limits in accordance with AWWA Manual of Water Supply Practices M6 not more than 1 year before the date being used. Have the high pressure water meter re-calibrated whenever adjusted or repaired.

.13 Where test caps or plugs are used, the section left out for closure to be no more than 5.5 metres in length.

.14 Record tests whether acceptable or not, on Leakage Test Form CW 2125.1. Indicate time pump is initially started and each time pump is started and stopped. Sign and submit Leakage Test Form and pressure meter chart to the Contract Administrator.

.15 Locate and repair visible pipe leaks as directed by the Contract Administrator. Repeat leakage test after repairing the leak(s).

TABLE CW 2125.2 – ALLOWABLE APPARENT LEAKAGE RATES FOR PVC WATERMAINS

PIPE DIAMETER (millimetres)	ALLOWABLE APPARENT LEAKAGE LITRES/HOUR (l/h) PER 100 JOINTS TEST PRESSURE 1.0 MPa
150	2.1
200	2.8
250	3.5
300	4.2
350	4.9
400	5.6
450	6.3

3.3 Disinfection

.1 Provide at least 24 hours notice to the Contract Administrator in advance of disinfection. Perform disinfection in presence of the Contract Administrator.

.2 Complete flushing operations before beginning disinfection.

.3 Disinfection may be done with hydrostatic leakage testing.

.4 New valves and hydrants are to be open to ensure they are disinfected.

.5 Disinfect watermains and water services larger than 50 millimetres.

.6 Disinfect using continuous-feed method with liquid chlorine, solution-feed chlorinator and booster pump in accordance with AWWA Standard C651. Introduce chlorine solution for disinfection at appurtenance used for initial flushing of test section.

.7 Disinfection to be performed by person(s) having as a minimum Class II Water Distribution Operator and Class II Water Treatment Operator certification from the Manitoba Water and Waste Association or approved equivalent association.

.8 Chlorine feed and discharge rates to be in accordance with Table CW 2125.3. Discharge rate to be approved by the Contract Administrator. Ensure free chlorine residual of initial chlorine solution is between 25 milligrams per litre and 75 milligrams per litre. Chlorine gas will not be permitted for chlorination.

.9 Open new hydrants and valves on section of watermain being tested. Supply water for chlorinator from hydrant on active system or water tank. Use pump to inject chlorine solution into pipe if using water tank. Connect to hydrant on active system in accordance with SD-019.

.10 Continue feeding chlorinate solution for the length of time indicated in Table CW 2125.3 for pipe size, length and discharge rate.

.11 Isolate the watermain or water service containing chlorine solution and maintain for 24 hours.

.12 Determine the chlorine residual after the 24 hour retention time using the "drop dilution" method or the method indicated in AWWA Standard C651 in the presence of the Contract Administrator. Acceptable minimum free chlorine residual after 24 hours is 10 milligrams per litre.

.13 Ensure chlorine residual in hydrants used for introducing the chlorine solution does not exceed 75 milligrams per litre at the conclusion of chlorination.

.14 Perform final flushing of pipe with potable water using the appurtenance used for initial flushing once actual chlorine residual is acceptable. . Continue flushing until chlorine residual is less than 2 milligrams per litre. Test chlorine residual in presence of the Contract Administrator. Sign and complete Form CW 2125.2 - Disinfection Report provided by the Contract Administrator.

.15 Discharge chlorine solution flushed from pipe to nearest wastewater sewer or combined sewer. Ensure flushing rate of chlorine solution does not exceed the allowable rate approved by the Contract Administrator.

.16 Disinfect watermains less than 5.5 metres long and watermain repairs by swabbing or spraying with a maximum 5% solution of chlorine or a 1% hypochlorite solution either before or after installation.

TABLE CW 2125.3 - DISINFECTION FEED RATE

NOMINAL SIZE OF PIPE (Millimetres)					150	200	250	300	350	400	450
Litres of Water per 100 Metres of Pipe					1827	3248	5075	7308	9948	12993	16444
	10 milligrams per Litre				0.018	0.032	0.051	0.073	0.099	0.130	0.164
	25 milligrams per Litre				0.046	0.081	0.127	0.182	0.249	0.325	0.411
	50 milligrams per Litre				0.091	0.162	0.254	0.365	0.499	0.650	0.822
	75 milligrams per Litre				0.137	0.243	0.381	0.548	0.746	0.974	1.233
DISCHARGE RATE: Litres per Minute:	Milligrams per Litre				Approximate Flow Through Time for 100 Metres of Pipe Hours – Minutes						
	10	25	50	75							
	Feed Rate: Kilograms per Day				150	200	250	300	350	400	450
100	1.4	3.6	7.2	10.8	0-18	0-32	0-51	1-13	1-39	2-09	2-44
150	2.2	5.4	10.8	16.2	0-12	0-21	0-33	0-49	1-06	1-29	1-50
200	2.9	7.2	14.4	21.6	0-09	0-16	0-25	0-37	0-50	1-05	1-22
250	3.6	9.0	18.0	27.0	0-07	0-13	0-20	0-29	0-40	0-52	1-06
300	4.3	10.8	21.6	32.4	0-06	0-11	0-17	0-24	0-35	0-43	0-55
350	5.0	12.6	25.2	37.8	0-05	0-09	0-15	0-21	0-28	0-37	0-47
400	5.8	14.4	28.8	43.2	0-05	0-08	0-13	0-18	0-25	0-32	0-41
450	6.5	16.2	32.4	48.6	0-04	0-07	0-11	0-16	0-22	0-29	0-36

3.4 <u>Bacteriological Samples</u>

.1 The Contract Administrator will take bacteriological samples in accordance with procedures outlined in latest edition of AWWA publication “Standard Methods for the Examination of Water and Wastewater” after final flushing of watermain or water service.

.2 2 sets of 2 samples will be taken at least 24 hours apart from the end of the main section of pipe being tested as well as 1 set of 2 samples from the end of each branch pipe connected to the main section where branches are more than 3.0 metres long. Samples will be taken from the discharge pipe used for leakage test after adequate flushing time to replace water in discharge pipe

.3 The Contract Administrator will submit the samples to an accredited laboratory as soon as possible after obtaining. Samples that cannot be submitted within 1 hour after collection will be stored in an iced cooler at 4 degrees Celsius during transport to the laboratory. Samples will be submitted for processing no more than 30 hours after obtaining.

.4 Disinfection will be acceptable when bacteriological test results from both samples show total Coliform result is < 1 colony forming unit (cfu) per 100 millilitres, Heterotrophic Plate Count (HPC) does not exceed 500 cfu per millilitre and total chlorine residual does not exceed 2 milligrams per litre after flushing.

.5 The Contract Administrator will enter bacteriological test results on Form CW 2125.2 - Disinfection Report once received from the laboratory. Original copies of the laboratory results

will be appended to Disinfection Report. Test results will be recorded on the Disinfection Report whether acceptable or not.

.6 If either sample fails bacteriological testing repeat flushing and the Contract Administrator will take 2 new samples for testing. If either of the second set samples taken fail bacteriological testing repeat disinfection and flushing and the as specified Contract Administrator will take 2 new samples for testing. Repeat this procedure until acceptable results are obtained.

3.5 Placing Watermains and Water Services into Service

.1 Upon receipt of Form CW 2125.1 - Leakage Test, the pressure meter chart, documentation of high pressure meter calibration, Form CW 2125.2 - Disinfection Report and written communication from the Contract Administrator to the Construction Services Coordinator, Design and Construction Branch of the Water and Waste Department the results are acceptable, the Construction Services Coordinator will advise the Water Services Division the installation may be put in service.

4. MEASUREMENT AND PAYMENT

4.1 Flushing, Hydrostatic Leakage Testing and Disinfection

.1 Flushing, hydrostatic leakage testing and disinfection of watermains and large diameter water services will be included with payment for “Watermains” and “Watermain Renewals”

.2 Locating and repairing leaks will be at own expense.

4.2 Bacteriological Testing

.1 Bacteriological testing will be paid for by the City.

FORM CW 2125.1 - LEAKAGE TEST

DEPARTMENT _____ DATE _____

Project or Bid No. _____ Drawing No._____

Location _____From _____ To_____

Size & Type of Pipe _____ Length of Section Under Test _____ Number of Joints _____

Allowable Leakage Per Hour _____ (Litres) at 1.0 MPa

Actual Leakage Per Hour _____ (Litres) at 1.0 MPa

Pump Start Time	Meter Reading	Pump Stop Time	Meter Reading	Total Loss (Litres)

High Pressure Water Meter Used (Brand name, model and serial number)

_____

Date meter tested and calibrated _____

Date Completed_____ Operator's Signature _____

Company _____ Company Address _____

Company Phone No. _____

Contract Administrator's Signature _____

File Number _____

FORM CW 2125.2 - DISINFECTION REPORT

CHLORINATION

Date _____Department: _____

Project or Bid No._____ Drawing Nos._____

Location _____ From _____ To _____

Pipe Size and Type_____ Length in Metres _____

Location of No. 1 Flush and Chlorinating Corp. _____

Location of No. 2 Flush and Chlorinating Corp. _____

Rate of Discharge _____ L/minute Rate of chlorine feed _____ kg/day

Flow through time _____ hours - minutes_____ Residual at finish _____ mg/L

FINAL FLUSHING

Date _____

Time started _____ Chlorine residual _____ mg/L

Time finished _____ Chlorine residual _____ mg/L

SAMPLES FOR RESIDUAL CHLORINE TEST

Sample Number	Sample Location	Discharge Rate L/min	Time Taken	Date Taken	Chlorine Residual
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

_____ _____
Operator's Name Operator's Signature

_____ _____ _____
Company Name Address Phone Number

SAMPLES FOR BACTERIOLOGICAL TESTS

Sample Number	Location Taken	Time Taken	Date Taken	Total Coliforms	HPC
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

_____
Testing Laboratory

_____ _____
Date Testing Submitted Date Testing Completed

_____ _____
Consulting Firm or City Department Contract Administrator's Signature