

TABLE OF CONTENTS

APPENDIX I.H – WATER MAIN TESTING AND PROCEDURES AND FORM 2

I.H.1 GENERAL 2

I.H.2 FLUSHING..... 2

I.H.3 PRESSURE AND LEAKAGE TESTING 3

 I.H.3.1 PRESSURE AND LEAKAGE TESTING - GENERAL3

 I.H.3.2 PROCEDURES – PRESSURE AND LEAKAGE TEST – D.I. AND PVC PIPE3

I.H.4 VALVE TEST 4

I.H.5 – EXPANSION ALLOWANCE (POLYETHYLENE AND HDPE)..... 4

I.H.6 DISINFECTION 5

 I.H.6.1 DISINFECTION - GENERAL.....5

 I.H.6.2 GENERAL PROCEDURES FOR CHLORINATION OF WATER MAINS6

I.H.7 SAMPLING 6

 I.H.7.1 SAMPLING - GENERAL6

 I.H.7.2 GENERAL PROCEDURES FOR WATER SAMPLING6

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL
PART I - PROCEDURES
APPENDIX I.H - WATER MAIN TESTING PROCEDURES AND FORM**

APPENDIX I.H – WATER MAIN TESTING AND PROCEDURES AND FORM

I.H.1 GENERAL

All Water main installations connected to the City of Whitehorse water distribution system must be installed, disinfected and commissioned according to general accepted practices and the current version of standards referenced in this Section.

The Consultant’s Engineer and the Contractor installing the pipe are responsible for ensuring pressure testing and disinfecting is performed for all new Water mains tying into the City of Whitehorse water distribution system. The Water main Testing Form and Disinfection and Sampling Form must be stamped by a professional engineer.

Any pipe 75mm or larger will require disinfection and pressure testing.

Bacteriological sampling is to be carried out following pressure testing by the Consultant’s Engineer or the City Representative who will submit the samples to Yukon Environmental Health for analysis.

A Water main testing plan is to be submitted to the City of Whitehorse Engineering Department for approval a minimum of 5 days before testing is scheduled to begin. The testing plan must include, the Water main plan and profile (design or as- built), locations for flushing, test ports (if required), proposed pressure test sections, the chlorination injection point, de-chlorination procedures, disposal methods for super chlorinated water and sampling points.

I.H.2 FLUSHING

All water main flushing is to be carried out in accordance with AWWA C651 before the disinfecting of the mains begins.

Water mains shall be flushed with a minimum flow velocity of 0.8 metres per second to ensure that all foreign materials and contaminants are removed from the main. Flushing must be witnessed and signed off by the Consultant’s Engineer or the designated City Representative.

**TABLE 1.H.2
FLOW CONDITIONS TO ACHIEVE 0.8 m/s FLOW RATE**

PIPE DIAMETER (mm)	REQUIRED FLOW FOR 0.8 M/S VELOCITY (L/S)	SIZE OF TAP (MM)			NUMBER OF 2.5” HYDRANT NOZZLES*
		25	40	50	
100	6.5	1	-	-	1
150	13.0	-	1	-	1
200	26.0	-	2	1	1
250	38.0	-	3	2	1
300	57.0	-	-	2	2

CITY OF WHITEHORSE SERVICING STANDARDS MANUAL
PART I - PROCEDURES
APPENDIX I.H - WATER MAIN TESTING PROCEDURES AND FORM

450	100.0	-	-	4	2
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I.H.3 PRESSURE AND LEAKAGE TESTING

I.H.3.1 PRESSURE AND LEAKAGE TESTING - GENERAL

All pressure and leakage testing is to be carried out in accordance with AWWA C600.

The purpose of the pressure and leakage test is to determine if the installation is capable of withstanding ordinary operating pressures without failure or excessive leakage at the joints and service connections.

This is to be done after all service connections are complete and curb cocks (CC's) are installed.

Contractors may perform an unofficial pressure test after the installation of the mains and before service connections are done to determine if there are any leaks in the main before continuing with service connections.

The pressure pump must be capable of meeting required test pressure and include 2 accurate pressure gauges, backflow preventer and a pressure relief valve with an upper limit of 1400 KPa.

The pump is to be dedicated to Water main pressure testing and will not be used for other construction activities.

Water storage tanks are to be of a non-corrosive material and be dedicated to Water main testing. The volume of the tank shall not be more than 10 times the allowable leakage for the duration of the test.

I.H.3.2 PROCEDURES – PRESSURE AND LEAKAGE TEST – D.I. AND PVC PIPE

- 1) Install all water services, air relief valves and blow offs.
- 2) If boundary valves are required to be opened contact PW's. Under no circumstances is a Contractor or Consultant to operate a boundary valve.
- 3) Partially or completely backfill excavation before testing.
- 4) Wait a minimum 3 days for concrete thrust blocks to cure.
- 5) Ensure that main stops are open and curb stops are closed.
- 6) Inform City of Whitehorse and Consultant 48 hours prior to pressure test.
- 7) Open all mains valves in the test section.
- 8) Slowly fill mains with water ensuring that all air is expelled at high points.
- 9) Maximum length of test section shall be no longer than 450 meters unless approved by the City.
- 10) Raise the Water main pressure to 1050 KPa.
- 11) No pressure drop allowance will be made for services.
- 12) Test duration to be 2 hours.
- 13) When test duration is done slowly re-pressure the Water main to 1050 KPa and record amount of make-up water required.
- 14) Consultant or City to witness and record pressure and leakage test results on City provided form.
- 15) Pressure testing must precede Chlorination and Bac-T testing.

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL
PART I - PROCEDURES
APPENDIX I.H - WATER MAIN TESTING PROCEDURES AND FORM**

I.H.4 VALVE TEST

Each section between valves shall be brought to test pressure. Test pressure shall be held without loss for 2 minutes before opening the valve and releasing the pressure into the next section.

**TABLE I.H.4
VALVE TEST - ALLOWABLE LEAKAGE**

Ductile Iron & Polyvinyl Chloride Pipe Leakage Allowance Allowable Leakage (litres per 300 m per hour)										
Pressure (KPa)	Pipe Diameter (mm)									
	100	150	200	250	300	350	400	450	500	600
3100	2.42	3.60	4.81	6.02	7.23	8.44	9.65	10.82	12.04	14.46
2760	2.27	3.41	4.54	5.68	6.81	7.95	9.08	10.22	11.36	13.63
2410	2.12	3.18	4.24	5.30	6.40	7.46	8.52	9.58	10.64	12.76
2070	1.97	2.95	3.94	4.92	5.90	6.89	7.91	8.68	9.84	11.81
1900	1.89	2.84	3.79	4.69	5.64	6.59	7.53	8.48	9.42	11.32
1720	1.78	2.69	3.60	4.50	5.37	6.28	7.19	8.10	8.97	10.79
1550	1.70	2.57	3.41	4.28	5.11	5.98	6.81	7.68	8.52	10.22
1380	1.63	2.42	3.22	4.01	4.84	5.60	6.43	7.23	8.02	9.65
1210	1.51	2.23	3.03	3.75	4.50	5.26	6.02	6.78	7.49	9.01
1030	1.40	2.08	2.80	3.48	4.16	4.88	5.56	6.28	6.96	8.36
860	1.29	1.89	2.54	3.18	3.82	4.47	5.07	5.72	6.36	7.61
690	1.14	1.70	2.27	2.84	3.41	3.97	4.54	5.11	5.68	6.81

I.H.5 – EXPANSION ALLOWANCE (POLYETHYLENE AND HDPE)

This pressure test involves pressurizing the pipe and adding makeup water until the pipe has reached its initial deformation. This level of deformation is usually attained after 3 to 4 hours depending on the size of the pipe. It is characterized by a noticeable reduction in the amount of makeup water required to return the piping system to the test pressure.

After initial deformation has been attained the actual pressure test period begins. Its duration shall be 2 hours. At the end of the test period, a measured amount of makeup water is to be added to return the pipe to the test pressure.

CITY OF WHITEHORSE SERVICING STANDARDS MANUAL
PART I - PROCEDURES
APPENDIX I.H - WATER MAIN TESTING PROCEDURES AND FORM

TABLE I.H.5
ALLOWABLE AMOUNT OF MAKEUP WATER

Allowance for Expansion Under Test Pressure [Litres per 30m of pipe] at 23°C			
Nominal Pipe Size (mm)	1 hour Test	2 hour Test	3 hour Test
75	0.38	0.57	0.95
100	0.49	0.95	1.52
150	1.14	2.28	3.41
200	2.65	4.93	7.96
275	3.79	7.58	11.75
300	4.17	8.72	12.89
350	5.30	10.23	15.92
400	8.33	12.51	18.93
450	8.33	16.29	24.63
500	10.23	20.84	30.31
550	13.26	26.52	39.78
600	17.05	33.72	50.39
700	20.84	42.06	63.27
800	26.52	54.18	85.24
900	34.10	68.19	102.29
1000	41.67	83.35	125.02

The amount of expansion taking place during the pressure testing of polyethylene pipe is dependent on the temperature of the pipe during testing. The temperature of the pipe can be taken as an average of the temperature of the water pumped into the pipe and the temperature of the empty pipe immediately before testing (ambient air temperature).

When testing the pipe at temperatures below 23 degrees Celsius, the amount of makeup water should be multiplied by the manufacturer's appropriate correction factor.

I.H.6 DISINFECTION

I.H.6.1 DISINFECTION - GENERAL

All Water main disinfection is to be carried out in accordance with AWWA C651.

The purpose of disinfection is to destroy pathogens (harmful microorganisms) which may be present in the Water mains after construction is complete.

CITY OF WHITEHORSE SERVICING STANDARDS MANUAL
PART I - PROCEDURES
APPENDIX I.H - WATER MAIN TESTING PROCEDURES AND FORM

Chlorine can be introduced into the mains from either a hydrant, service connection or a test port. Ensure that feed point is no more than 3 metres from the beginning of the new Water main.

I.H.6.2 GENERAL PROCEDURES FOR CHLORINATION OF WATER MAINS

- 1) Inform City of Whitehorse and Consultant 48 hours prior to test.
- 2) Ensure that all boundary valves are closed.
- 3) Open hydrant, service or test port to discharge water as chlorinated water is being fed through main.
- 4) Feed chlorinated water at a concentration of 50ppm to 100ppm into the Water main. Do not introduce a solution of more than 100ppm into the Water main.
- 5) Check that chlorinated water has reached all sections of the main to be disinfected by flushing and testing chlorine residual at each hydrant using an approved field kit.
- 6) Operate all valves in test section to thoroughly disinfect all appurtenances.
- 7) Once Water main has been thoroughly chlorinated as approved by the Consultant or the City, wait a minimum of 12 hours for residual test.
- 8) Residual chlorine tests are to be taken at a minimum of 2 locations along the main, at every hydrant and must be at least 20ppm after 12 hours. If any residual test is below 20ppm then each section on either side of the failed test and the failed section will require re-chlorination.
- 9) De-chlorination must be done no longer than 24 hours after chlorination.
- 10) The Contractor must determine how chlorinated water is to be neutralized or disposed and ensure this procedure is acceptable to the City. Under no circumstances will chlorinated water be allowed to be discharged into a sewer system or near a water course.
- 11) Once de-chlorination is done, low concentration test strips are to be used to confirm that chlorinated water has been flushed out of the mains.
- 12) Consultant or City to witness and record test results on City provided form.
- 13) Pressure testing should be completed before Bac-T testing sampling.

I.H.7 SAMPLING

I.H.2.I SAMPLING - GENERAL

The purpose of the sampling is to ensure that water inside the mains is of a suitable quality for human consumption as determined by Yukon Government, Environmental Health Services. The assumption is that the samples are representative of the water in the Water main.

I.H.7.2 GENERAL PROCEDURES FOR WATER SAMPLING

- 1) Notify City and Consultant when water samples are scheduled to be taken.
- 2) A minimum of 16 hours after de-chlorination, the first water sample may be taken.
- 3) Samples are to be taken by the Consultant or the City with assistance from the Contractor.
- 4) Every sample shall be collected, stored and delivered to Yukon Government, Environmental Health Services (as per their instructions) at #2 Hospital Road.
- 5) Sampling locations should be done at a service or test port. Hydrants can be used but are not ideal.

CITY OF WHITEHORSE SERVICING STANDARDS MANUAL
PART I - PROCEDURES
APPENDIX I.H - WATER MAIN TESTING PROCEDURES AND FORM

- 6) Samples are required for every 350 meters of Water main and one from each end of the main.
- 7) A minimum of 24 hours after the first samples are taken a second set of samples can be done.
- 8) If any of the samples produces an unsatisfactory result the main will be flushed and samples re-taken a minimum 24 hours later.
- 9) If additional test come back unsatisfactory then mains will require re-chlorination.
- 10) Two complete sets of satisfactory sample results are required before the Water main will be activated by the City.

Once all Water main testing has been satisfactorily completed and test results signed by the Consultant's Engineer or City Engineering Department, Water mains can be activated for public use.

The City reserves the right in the interest of public safety to deny activation of Water mains if proper testing procedures have not been followed regardless of sample results

CITY OF WHITEHORSE SERVICING STANDARDS MANUAL
PART I - PROCEDURES
APPENDIX I.H - WATER MAIN TESTING PROCEDURES AND FORM



CITY OF WHITEHORSE
Water main Testing

Water main Testing Must Be Witnessed By the Engineering Consultant or City Representative

Development/ Project Name _____

Contractor _____

Flushing

Date _____

Test Section From _____ To _____

Testing Witnessed By: _____
Print Name Signature

Pressure and Leakage Test

Date _____

Test Section From _____ To _____

Length of Test Section _____ Diameter of Pipe _____

Test Start Time _____ Test End Time Test _____

Start Pressure _____ Test End Pressure _____

Allowable Loss _____ Actual Loss _____

Testing Witnessed By: _____
Print Name Signature

Sketch Area of Water main Being Tested or Attach Drawing

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL
PART I - PROCEDURES
APPENDIX I.H - WATER MAIN TESTING PROCEDURES AND FORM**



Disinfection and Sampling

Development/Project Name _____

Contractor _____

Date of Chlorination _____ Time _____ ppm _____

Date of Residual Test _____ Time _____ ppm _____

Date of De-chlorination _____ Time _____

Date of 1st Water Sample _____ Time _____

Date of 2nd Water Sample _____ Time _____

Testing Witnessed By: _____

Name

Signature



Consulting Engineer's Seal

Sketch Area of Water main Being Tested:



All test results must be submitted to the City of Whitehorse before Water Main is activated

Engineering Office: (867) 668-8305

Office Location: 187 Range Road

engineering@whitehorse.ca

This section is to be completed by City of Whitehorse Engineering Department only:

Received By: _____
Date

Print Name

Signature