

WATER MAIN
TESTING PROCEDURES AND PRACTICES

6.0 WATER MAIN TESTING PROCEDURES AND PRACTICES

6.1 Standards

- a. All water mains and their accessories shall be installed and pressure and leak tested in accordance with the applicable provisions of AWWA Standard C600 "Installation of Ductile Iron Water Drains and their Appurtenances," C602 "Cement -Mortar Lining of Water Pipelines in Place - 4-inch and Larger," C603 "Installation of Asbestos Cement Pressure Pipe," C605 "Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water" or C606 "Grooved and Shouldered Joints."
- b. All water mains and their accessories shall be disinfected and tested in accordance with the applicable provisions of AWWA Standard C651, AWWA Manual M12, and the *Standard Methods for the Examination of Water and Wastewater*.
- c. The persons working with the distribution system are required to be familiar with the standard construction and testing requirements. The identified standards are available at the office of the water utility for review.
- d. Unless otherwise specified, all procedures apply to new mains, cleaned mains, cleaned and relined mains, repaired mains, and mains that have been out of service.

6.2 Procedures

Water main construction shall be immediately followed by pressure and leakage testing followed by disinfection and bacteria sampling.

6.3 Procedure Records

During the testing and disinfection procedure of a facility to be connected to the existing water system, the Contractor (i.e. person controlling the construction activity) shall maintain a record of activity. The record of activity shall include:

- a. Flushing of the main- how long the line is flushed (start and end time), the rate of flow from the flowing hydrant or blowoff connection including flushing-flow velocity (2.5-4.0 fps), and calculated volume of water wasted.
- b. Pressure & Leakage Test- record diameter of the main, length of the main, starting pressure (150 psi) and time, ending pressure and time, volume of recovery water required.
- c. For testing of private systems connected to the Town's system that have operating pressures above 100 psi, test pressures shall be double the operating pressure. Such tests and systems shall be completely buffered from the Town's system by adequate backflow and pressure reducing devices. Required test data shall be the same as above.
- d. Disinfection- including volume of the treated line in gallons, type and amount of chlorine reagent used, concentration of available chlorine applied, residual chlorine value in the new main, date and time of the 24-hr retention period, date and time of the second flushing of line, and the date and time when line is finally refilled with system water.
- e. Bacterial Analyses- including date and time of samples, receipt of instructions of laboratory or supervisor to release line or repeat disinfection, and time the line is opened for use in system.
- f. Forms are available for procedure documentation.
- g. The person in responsible charge shall obtain a signature of approval from the Water Superintendent prior to the Town's acceptance of the water mains permanent connection to the existing water system.

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6.4 Water Utility Supervision

No water valve shall be operated for filling, flushing or testing of a main without the direct supervision of a town employee familiar with the operations requiring the valve's operation. The Town will provide the necessary personnel upon request.

6.5 Pressure and Leakage Test

- a. Under the direction of the town, the new water mains shall be slowly filled to ensure that all air has been expelled from the main, hydrants, air valves and service leads. Once all air is expelled, the new main shall be flushed at a minimum velocity of 2.5 feet per second for a minimum of 1 hour. The required "scour" flow rate shall be calculated as shown in Table 6-A, and shall be verified in the field using a pitot gage, flow meter or trajectory measurement. The Contractor shall be responsible for all dechlorination and disposal of all flushing water and providing any necessary hoses or equipment for flushing and prevent unnecessary erosion.

Flow Rate for 2.5 ft/s Line Velocity

Main Size(in.)	Gallons per Minute
6	200
8	400
12	900
16	1600

- b. The tap for the pressure and leak testing and chlorination shall be installed within ten feet of the source if practical. Otherwise, the tap shall be installed immediately outside of existing pavement. The Contractor is responsible for all work associated with the excavation, including proper trench protection, barricades, traffic control and proper backfilling and compaction upon successful completion of the test.
- c. The Contractor shall conduct the pressure and leak test and provide the required testing equipment after the new main has been properly filled and flushed. The pressure and leak test shall be conducted as follows:
- 1) Purge all air from the line.
 - 2) Decrease pressure in the main to be tested to approximately 20 psi. Observe test gauge to ensure the pressure doesn't rise due an existing valve or tapping valve leaking by. This is done to ensure that water that is not disinfected does not enter the existing main from installed main while performing the actual test.
 - 3) A pressure test pump, sanitized for connection to a municipal water main, will be connected to the main at the testing point. The pressure will be slowly increased to 150 psi and allowed to stabilize (+/- 2.5 psi) for a minimum of 15 minutes.
 - 4) A reservoir of potable water, capable of being calibrated to fractions of a gallon, shall be connected to the test pump and the initial level of water recorded.
 - 5) The pump pressure shall be maintained at 150 psi for two hours with all makeup water withdrawn from the reservoir.
 - 6) After two hours, the water level in the reservoir will be measured and the volume of water drawn from the reservoir calculated and compared with the following allowable leakage:

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$$\text{Allowable leakage} = \frac{\text{Pipe length (ft)} \times \text{Nominal diameter (in)}}{10,875}$$

(Based upon an allowable leakage of 11.65 gpd/mi/in. and a 150 psi test pressure)

Allowable leakage per 1,000 feet of DIP at 150 psi Test Pressure

Test pressure	Nominal Pipe Diameter, inches										
	4	6	8	10	12	14	16	18	20	24	30
	Allowable Leakage, gallons										
150	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76

- 7) If any test discloses leakage greater than that specified above, the Contractor shall, at his own expense, locate and make repairs as necessary until the leakage is within the specified allowance. No repair clamps of any kind will be allowed. Repair shall consist of removing leaking section and replacing with couplings and pipe.

6.6 Pre-Flushing

The Town shall flush the source water, as near the shutoff as possible prior to tying-in to ensure that contaminants or debris are not introduced into the new pipe.

6.7 Flushing

The main shall be flushed through a hydrant at the end of the main at a velocity not less than 2.5 ft./sec. If no hydrant is installed at the end of the main, the Contractor shall provide a tap large enough to develop a velocity in the main of at least 2.5 ft./sec, unless the water utility determines that conditions do not permit the required flow to be discharged to waste. The gallons per minute to achieve 2.5 ft./sec velocities for different diameter pipes are provided in Table 6.B.

NOTE - Flushing is no substitute for preventive measures during construction.

- a. The Town shall supply water for use in disinfecting and flushing mains. However, all such supply is at the Contractor's expense. Discharge to Town sewers of flushing volumes is prohibited unless approved by the Town. If approved, expenses for such discharge will be the Contractor's obligation.
- b. The person in responsible charge shall furnish all necessary pipe and hose connections. The person in responsible charge shall exercise care in the use of the water to prevent contamination of the existing water supply.
- c. Measures shall be taken prior to flushing to provide adequate drainage during flushing.
- d. Drainage shall be directed away from the main, and flooding of the trench shall be prevented.
- e. Coordinate activities with the Town 72 hours in advance to allow for meter placement and authorization.

6.8 Methods of Disinfection

Disinfection of water main shall be in accordance with AWWA C651 "Disinfecting Water Mains."

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All portions of the water main that was worked on as well as any portion(s) of the network that was taken out-of-service to allow completion of the contract shall be chlorinated. The chlorine solution to be used may be made from Calcium or Sodium Hypochlorite.

The use of Calcium Hypochlorite granules left in the main to be dissolved on filling of the main is not an approved method.

a. Continuous Feed Method

- 1) The continuous feed method consists of completely filling the main to remove all air pockets, flushing the completed main to remove particulates, and filling the main with chlorinated potable water so that after a 24±4-hour holding period in the main there will be a free chlorine residual of not less than 10 mg/L at all locations of the main.
- 2) At a point not more than 10 ft. downstream from the beginning of a new main, water entering the new main shall receive a dose of chlorine pumped at a constant rate such that the water at any location will have not less than 25 mg/L of chlorine. To assure that this concentration is provided, a water department representative shall measure the chlorine concentration at regular intervals at available blow-offs or hydrants in accordance with procedures described in the current editions of "Standard Methods for the Examination of Water and Wastewater" or using an appropriate chlorine test kit.
- 3) The table below gives the amount of chlorine required for each 100 ft. of pipe of various diameters. Solutions of 1% chlorine may be prepared with Sodium Hypochlorite or Calcium Hypochlorite. During the application of chlorine, valves shall be closed so that the strong chlorine solution in the main being treated will not flow into water mains in active service. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall be retained in the main for at least 24±4 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24±4-hour period, the treated water in all the portions of the main shall have a residual of not less than 10 mg/L of free chlorine.

Chlorine Required to Produce 25 mg/L Concentration in 100 feet of Pipe by diameter

Pipe size (in.)	Volume (gals in 100 feet of Pipe)	15% Chlorine solution gals per 100 feet of Pipe	1% Chlorine solution gals per 100 feet of Pipe
4	65	2 oz.	0.2 (1 1/2 pts)
6	150	3 oz.	0.4(1 1/2 qts)
8	260	5 oz.	0.6 (2 1/2 qts)
10	410	1 cup	1.0 Gal
12	590	1 Pint	1.4
16	920	1Quart	2.3
24	2350	1 1/2 Quarts	5.8
30	3680	2 1/2 Quarts	9.1
36	5290	0.9	13.0
42	7200	1.2	18.0
48	9400	1.5	23.0
54	11900	2.0	30.0
60	14690	2.5	36.0

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NOTE: To make 1% chlorine solution using HTH granular Calcium Hypochlorite add 1 pound of Calcium Hypochlorite to 8 gallons of water. Using Sodium Hypochlorite, dilute the hypochlorite according to the percent available chlorine on the container. For example, if you have 5% household bleach, place 1 gallon in 4 gallons of water. You then have 5 gallons of 1% solution.

b. Slug Method (Emergency Use Only)

- 1) At a point not more than 10 ft. downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 100 mg/L of free chlorine. To assure that this concentration is provided, a water department representative shall measure the chlorine concentration at regular intervals along the main where taps and/or hydrants have been provided. The chlorine shall be applied continuously and for sufficient period to develop a solid column or 'slug' of chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration of approximately 100 mg/L for at least 3 hours.
- 2) The free chlorine residual shall be measured in the slug as it moves through the main. If at any time it drops below 50 mg/L, the Contractor shall stop the flow, chlorination equipment shall be relocated at the head of the slug, and as flow is resumed, chlorine shall be applied to restore the free chlorine in the slug to not less than 100 mg/L.
- 3) As the chlorinated water flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.

6.9 Flushing after Disinfection

After the applicable retention period, the heavily chlorinated water shall be flushed from the main into the sewer until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system. Where domestic sewers are not available, the heavily chlorinate shall be dechlorinated. The replacement water shall be allowed to remain in the pipeline for 24 hrs.(+/- 4 hrs.) prior to sampling for physical, bacteriological, and chemical testing.

6.10 Analytical Tests

After the appropriate retention time (24±4 hours or 3 hours for the slug method), after flushing and before the water main is placed into service, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected for sanitary analysis. Suitable sample piping shall be furnished by the Contractor to allow sample collection. The sampling point or points shall provide samples, which are representative of the water in all sections of the main for which sanitary approval is requested. All samples shall be collected in a manner as to avoid contamination from the environment surrounding the main. Rubber or synthetic hose shall not be connected to the main to collect a representative sample. The area around the sampling point of the main shall not be filled with water. At least one sample shall be taken from each main, and in the case where a main is greater than 1000 feet, one sample from each 500 feet of line. The samples shall be submitted to a certified laboratory for bacteriological, chemical, and physical analysis. The following analyses shall be completed and reported on the appropriate form. Total chlorine residual, Total Coliform (Membrane Filtration method), pH, and turbidity.

6.11 Final Flushing

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Disinfected water mains shall be flushed within 4 hours of being placed into service. Flushing shall be designed to restore water quality to that of the source water, immediately prior to being placed into service. The length of time of flushing shall depend on the size and length of the water main, however at least three volumes of water should flow through the entire length of the main.

6.12 Redisinfection

If the initial disinfection and flushing fail to produce satisfactory analytical results, the main may be reflushed and shall be resampled. If check samples show the presence of coliform organisms, then the main shall be rechlorinated by the Contractor, using the continuous feed method of chlorination, until satisfactory results are obtained.

6.13 Final Connection

Water mains and appurtenances must be completely installed, flushed, tested for leakage, disinfected, and satisfactory bacteriological sample results received prior to permanent connections being made to the active distribution system where the new main was isolated from the existing system. Sanitary construction practices must be followed during installation of the final connection to insure that there is no contamination of the new or existing water main with foreign material or groundwater. The new pipe, fittings, and valve(s) required for the connection will be spray-disinfected or swabbed with a minimum 1 - 5% solution of chlorine just prior to being installed.

6.14 Dechlorination

Contact the wastewater superintendent before discharging the highly chlorinated water to the sewer. The discharge of water to the environment with chlorine concentrations greater than the ambient distribution system chlorine residual is prohibited. The highly chlorinated water must be dechlorinated before being discharged to the environment. The method of dechlorination is at the discretion of the contractor as long as the procedure does not cause harm to the environment.