

Water Main Testing and Disinfection Procedures for New Water Main

City of Aurora, IL

Sept 2019

General:

All water distribution system valves shall only be operated by authorized City of Aurora employees and authorized designated representatives of the City of Aurora. Contact the City Water and Sewer Maintenance Division at (630) 256-3710 to schedule operation of water main valves.

Design plans shall be submitted for approval to the Engineering Division of the Department of Public Works with a completed IEPA Application for Construction Permit. Upon approval by the Engineering Division, the plans must be distributed to all contractors and chlorination contractors who will be working on site. Water main work shall not start until an IEPA permit for water main construction has been obtained.

Water main must be disinfected in accordance with AWWA C651-14 Standard, except where these Procedures establish a higher standard. All contamination preventive measures, pressure testing, preliminary flushing, chlorination, and bacteriological sampling of the water main shall be conducted under the supervision of the City of Aurora's Engineering Division or its designated representative. The installation contractor shall notify the City of Aurora's Engineering Division or its designated representative a minimum of 48 hours in advance of each of the following activities: starting construction of a project, pressure testing, preliminary flushing, chlorination, and bacteriological sampling of any water main piping.

Contamination Preventive Measures During Construction:

Soil, organic matter, and other heavy material typically contain bacteria and can prevent even high concentrations of chlorine from contacting and killing the organisms. These bacteria can cause failure of bacteriological sampling. Preventing these types of materials from entering water main pipe either during or before installation is critical. Preventive measures are described in detail in AWWA Standard C651-14 Section 4.8. At a minimum, the following preventive measures shall be followed during water main pipe installation:

1. *Keep pipe clean and dry.* The interiors of pipes, fittings, and valves shall be protected from contamination. All openings in the pipeline shall be closed watertight or with rodent-proof plugs when pipe laying is stopped at the close of the day's activities or for other reasons.
2. *Joints.* Joints of all pipe in the trench shall be completed before work is stopped.
3. *Cleaning and swabbing.* If dirt or other foreign material enters the pipe, it shall be removed and the interior of the pipe surface swabbed with a 1 to 5% sodium hypochlorite (NaOCl) disinfecting solution. If in the opinion of the City of Aurora Engineering Division, or its designated representative, the foreign material in the pipe will not be removed by preliminary flushing activities, the interior of the pipe shall be cleaned using mechanical means at no additional cost to the City of Aurora and then swabbed as described above.

Pressure/Leakage Testing:

All testing activities shall be recorded and witnessed by the City of Aurora's Engineering Division or its designated representative. Any testing not witnessed will not be accepted.

After the water main has been laid and partly backfilled, the water main shall be slowly filled with water to eliminate air pockets prior to testing. The main shall be filled with water at a rate to ensure that the water within the main will flow at a velocity no greater than 1 foot/second. This water shall remain in the pipe for at least 24 hours before testing can begin.

Before applying the test pressure, air shall be completely expelled from the pipe. The test pressure shall be at least 150 psi and the test shall last for a minimum of 2 hours. A loss of more than 5 psi during the test shall result in a test failure and the test must be restarted. Upon completion of the test, the volume of recovery water shall be defined as the amount necessary to restore the pressure within the test section to the value at the commencement of the test. The allowable leakage shall be as determined by AWWA Standard C600-100 Sec. 5.2, based on an allowable leakage of 10.49 gpd/mi/inch. While lengths greater than 1,000 feet may be tested at one time, the permissible leakage will be calculated for the length of water main tested up to a maximum of 1,000 feet regardless if the actual length of main tested is longer.

Preliminary Flushing:

After satisfactory completion of pressure/leakage testing, the water main shall receive a preliminary flush. Flushing of water mains shall be conducted under the supervision of the City of Aurora's Engineering Division, or its designee, in accordance with the approved flushing plan. The flushing shall include 100% of the newly installed water main as well as **every fire hydrant installed**. During the flushing operation the direction of flow through the mains shall be reversed. All main line and hydrant valves shall be opened and closed while flushing in each direction. Flushing shall only take place between 7:30 am and 3:00 pm Monday through Friday, excluding holidays.

The flushing velocity in the main shall be a **minimum of 3.0 feet/second**. See Table A for recommended flows to properly flush piping.

**Table A
Required Flow and Openings to Flush Pipelines***

Pipe Diameter (Inch)	Flow Required to Produce 3.0 ft/s Velocity in Main (gpm)	Size of Tap			Number of 2-1/2 inch Hydrant Outlets
		1-inch	1-1/2 inch	2-inch	
		Number of Taps on Pipe**			
4	120	1	-	-	1
6	260	-	1	-	1
8	470	-	2	-	1
10	730	-	3	2	1
12	1,060	-	-	3	2
16	1,880	-	-	5	2

* Assuming 40 psi residual pressure in existing water main a 2-1/2" hydrant outlet will discharge approximate 1000 gpm and 4-1/2" will discharge 2,500 gpm.

** Number of taps on pipe based on discharge through 5 ft. of galvanized iron (GI) pipe with one 90 degree elbow.

NOTE: *Flushing is no substitute for preventive measures during construction. Certain contaminants, such as caked deposits, resist flushing at any feasible velocity.*

Water Main Disinfection:

Disinfection shall be accomplished by the use of liquid sodium hypochlorite (NaOCl) or chlorine gas only. The City of Aurora's Engineering Division or its designated representative shall witness the chlorination of the water main. Chlorination of the water main shall not be permitted until the main has passed the pressure/leakage test and a preliminary flush has been performed, witnessed, and approved.

Under the supervision of the project field representative, water from the existing distribution system shall be made to flow at a constant rate into the newly laid water main. At a point not more than 10 feet 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 receive not less than 50 mg/L of free chlorine (see Table B or C below).

If chlorine gas is utilized, a minimum of two people employed by the Chlorinator are required when chlorinating a main. One person to monitor the chlorine gas system at the cylinder and one person to monitor the free chlorine levels at the whip/sample locations. The chlorine gas cylinder is not to be left unattended at any time during the disinfection procedure.

All main line and hydrant valves (except for valves at the connection between the new and existing systems) shall be operated after the main has been chlorinated in order to allow the valve disk to make contact with the chlorine solution. As an optional procedure (if specified by the City of Aurora or its designee), water used to disinfect the new main during the application of chlorine will be supplied through a temporary connection. This temporary connection shall be installed with an appropriate cross-connection control device to prevent backflow into the distribution system.

Table B
Chlorine Gas Required to Produce 50 mg/L
Concentration in 100 ft. of Pipe

Pipe Diameter (Inch)	100% Chlorine Gas* (Pounds / 100 LF)
4	.026
6	.060
8	.108
10	.170
12	.240
16	.434

* Approximate dosages required

Table C
1% Sodium Hypochlorite (NaOCl) Solution Required to
Produce 50 mg/L Concentration in 100 ft. of Pipe

Pipe Diameter (Inch)	1% Sodium Hypochlorite Solution* (Gallons / 100 LF)
4	.32
6	.72
8	1.30
10	2.04
12	2.88
16	2.60

* Approximate dosages required

A minimum free chlorine residual of 25 mg/l shall remain in the water main after standing 24 hours in the pipe as tested/confirmed by the City’s Engineering Division or designated representative. A free chlorine concentration less than 25 mg/L indicates an unusually large chlorine demand and can be an indication of significant contamination within the pipe. This condition shall require the contractor to perform a second preliminary flush and also to chlorinate the main a second time prior to collection of any samples.

Final Flushing and Bacteriological Testing:

A minimum of 24 hours after the water main has been properly chlorinated, the contractor shall schedule an appointment for bacteriological testing. The contractor shall contact the City of Aurora’s Microbiology Laboratory at (630) 256-3255 to schedule sample collection. Typically, sample collection will occur on the next business day. Sampling shall only take place between 7:30 am and 3:00 pm Monday through Thursday, excluding holidays. Samples will NOT be collected on Fridays, Saturdays, or Sundays. Sample results shall typically be available within 25 hrs of the sample collection

All of the water main that is covered by one IEPA permit must be tested and sampled as a complete project. Bacteriological sampling will not begin until the entire length of the water main being permitted by the IEPA for that particular project has been installed, pressure tested, and chlorinated. Modifications of this requirement must be discussed with the City’s representative 7 days prior to disinfection procedures.

Just prior to sampling, the main shall be flushed under the supervision of approved City of Aurora personnel or a designated representative to reduce the free chlorine concentration to no more than 3.5 mg/L. City of Aurora Water Production Division personnel shall collect all bacteriological samples. Sample points shall consist of only copper whips attached to the main and shall be located every 1,200 feet, plus one location from the end of the line, and at least one location from each branch greater than one pipe length long (generally 20 feet). Representative samples shall be collected at locations as directed by the City of Aurora’s Water Production Division. **Samples shall not be drawn from hydrants.**

All water mains must be disinfected before being placed into service. Disinfection shall be verified when two (2) consecutive water sample sets collected from the completed water main at least 24 hours apart show the absence of coliform bacteria and the presence of a chlorine residual as required by 35 Ill. Adm. Code 604.725 (≥ 1.0 mg/L combined/total chlorine). All samples shall be analyzed for coliform bacteria at the City of Aurora's Illinois Department of Public Health certified laboratory. Failure to pass the bacteriological test requires that the flushing or disinfection process be repeated.

The City of Aurora will collect a total of three (3) samples from each designated sample location free of charge. If any of the third samples collected from any location indicate bacteriological contamination then the contractor must again perform preliminary flushing and chlorination (as described above) on the water main before additional samples will be collected by the City of Aurora. If the portions of the water main which have not passed the bacteriological sampling can be properly isolated from the portions that have passed, and the City of Aurora Engineering Division or its designated representative approves, then only the unsatisfactory portions of the main will be required to be re-flushed, re-chlorinated, and re-sampled.

Once samples are collected, City of Aurora employees or its designated representative shall stop the flow of water through the copper sample whip and the main. Thus, all valves associated with all hydrants, copper whips, and new main isolation valves shall be closed and may not be left "running" between collections of samples on consecutive days.

After samples are collected, City of Aurora personnel or its designated representative shall close the main isolation valve that provides water from the existing water main into the newly installed water main being tested. This valve shall remain closed until the water main project receives approval to become active or if additional sampling or flushing is required. Approved City of Aurora personnel, or its designated representative, shall be the only individuals allowed to operate this valve.

Any questions concerning installation, testing, or disinfection procedures should be directed to the City's designated representative or the Water Production Division at (630)256-3250.