

SECTION 33 11 16.03**FACILITY WATER DISTRIBUTION PIPING (Testing and Disinfecting Water Mains)****PART 1 GENERAL****1.1 DESCRIPTION**

- A. The work of this section includes, but is not limited to:
 - 1. Testing Pressure Pipelines:
 - a. Hydrostatic leakage testing
- B. Disinfecting Water Main Pipelines.
- C. Related work specified elsewhere:
 - 1. Facility Water Distribution Piping (Water Mains): Section 33 11 16 00
 - 2. Facility Water Distribution Piping (Valves and Fire Hydrants): Section 33 11 16 02
- D. Definitions: NONE
- E. Applicable Standard Details: NONE

1.2 QUALITY ASSURANCE

- A. Testing Agency:
 - 1. Bacteriological (total Chlorine and/or chlorination) testing shall be performed by a testing laboratory engaged and paid for by the CONTRACTOR and approved by the ENGINEER. CONTRACTOR to provide water samples to testing agency as approved by the ENGINEER.
- B. Reference Standards:
 - 1. American Water Works Association (AWWA):
 - B300 Standard for Hypochlorites
 - B301 Standard for Liquid Chlorine
 - C651 Disinfecting Water Mains
- C. Test Acceptance:
 - 1. No test will be accepted until the results are within the specified limits.
 - 2. The CONTRACTOR shall, at his own expense, determine and correct the sources of leakage and retest until successful test results are achieved.

1.3 SUBMITTALS

- A. Test Procedures:
 - 1. Submit a testing sequence schedule including a list of testing equipment to be used.
- B. Certificates:
 - 1. Submit, prior to starting testing, certification attesting that the pressure gauges to be used have been calibrated and are accurate to the degree specified herein.
 - 2. Submit certification attesting that the chlorine form composition is as specified.
- C. Test Reports:
 - 1. Submit two copies each of test reports of chlorine residual and bacteriological tests.

1.4 JOB CONDITIONS: Section not utilized.**PART 2 PRODUCTS****2.1 HYDROSTATIC TEST EQUIPMENT**

- A. High pressure water pump
- B. Pressure hose
- C. Test connections

- D. Water meter
- E. Pressure gauge, calibrated to 0.1 lbs./sq. in.
- F. Pressure relief valve

2.2 DISINFECTING CHEMICALS

- A. Liquid chlorine, calcium hypochlorite tablets or granules, or sodium hypochlorite (liquid) conforming to AWWA Standards B300 and B301.

2.3 ADHESIVE

- A. Food-grade adhesive such as Permatex Form-A-Gasket No. 2 and Permatex Clear RTV Silicone Adhesive Sealant manufactured by Loctite Corporation, Kansas City, KS, or approved equal.

PART 3 EXECUTION

3.1 PREPARATION

- A. Backfill trenches in accordance with Section 31 20 00.02, Paragraph 3.11.
- B. Provide the water line under test with reaction thrust blocking. Hydrostatic testing shall not begin until the line is entirely restrained. Where concrete has been used to help augment mechanical restraints, allow 3000 psi 28-day strength concrete to cure for a minimum of 7 days prior to testing. If 3000 psi 3-day high early strength concrete is used, hydrostatic testing may not begin until the concrete has cured for a minimum of 2 days.
- C. Provide water, pumps, piping, tanks, connections, plugs, and appurtenances at no additional expense to the OWNER.

3.2 TESTING PRESSURE PIPELINES

- A. Hydrostatic Pressure Test (ASTM C900): 200 psi/30 min
 1. Test each newly laid pressure pipeline, including any valved section thereof, hydrostatically.
 2. Slowly fill the section to be tested with water, expelling air from the pipeline at the high points. Install corporation stops at high points if necessary. After all air is expelled, close air vents and corporation stops and raise the pressure to the specified test pressure.
 3. Observe joints, fittings and valves under test. Remove and replace cracked pipe, joints, fittings, and valves showing visible leakage. Retest.
 4. After visible deficiencies are corrected, continue testing at the same test pressure for an additional two hours to determine the leakage rate. Maintain pressure within plus or minus 5.0 psi of test pressure. Leakage is defined as the quantity of water supplied to the pipeline necessary to maintain test pressure during the period of the test.
 5. Compute the maximum allowable leakage by the following formula:

$$L = \frac{ND(P)^{0.5}}{7,400}$$

Where: L is the allowable leakage in gallons/hour

N is the number of joints in the section tested (does not include services)

D is the nominal diameter of the pipe in inches

P is the average test pressure in psig

Note: Perform calculation based on 2 hour test

- 6. If the line under test contains sections of various diameters, the allowable leakage shall be the sum of the computed leakage for each size.

3.3 DISINFECTION

- A. General:
 - 1. After completion of satisfactory hydrostatic leakage testing, disinfect the water pipelines in accordance with the recommended practice established in AWWA Standard C651. Conduct water line disinfection in the following steps:
 - a. Preliminary flushing
 - b. Chlorine application
 - c. Chlorine residual testing
 - d. Final flushing
 - e. Bacteriologic tests
- B. During construction, place calcium hypochlorite granules at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500 ft. intervals:

Table 02653-1

Ounces of Calcium Hypochlorite Granules to be Placed at Beginning of Main and at Each 500-ft. Interval

Pipe Diameter (in.)	Calcium Hypochlorite Granules (oz.)
4	1.7
6	3.8
8	6.7
12	15.1
14 and larger	D ² x 15.1 Where D is pipe diameter in feet

- C. Preliminary Flushing:
 - 1. Prior to disinfection, except when the tablet method is used, fill the line to eliminate air pockets and flush the line at a rate of flow of 2.5 feet per second to remove particulates:

Table 02653-2

Flow Required to Produce 2.5 fps (Approx.) Velocity in Main

Pipe Diameter (in.)	Required Flow (gpm)	Size of Tap (in.)			Number of 2½-inch Hydrant Outlets
		1	1½	2	
4	100	1	-	-	1
6	200	-	1	-	1
8	400	-	2	1	1
10	600	-	3	2	1
12	900	-	-	2	2
16	1600	-	-	4	2

2. Dispose of flushing water. Conform with Federal, State, and local laws when discharging the chlorinated solution.
- D. Chlorine Form:
1. The chlorine form to be applied to the system shall be either chlorine gas solution, calcium hypochlorite or sodium hypochlorite.
- E. Chlorine Application:
1. Continuous Feed Method:
 - a. The continuous feed method consists of placing calcium hypochlorite granules in the main during construction, completely filling the main to remove air pockets, flushing to remove particulates, and filling the main with potable water chlorinated so that after a 24-hour holding period in the main, there will be a free chlorine residual of not less than 10 mg/L.
 - b. Feed water and chlorine to the line at a constant rate such that the water will have not less than 25 mg/L free chlorine. Chlorine application shall not cease until the entire line is filled with heavily chlorinated water.

Table 02653-3

Chlorine Required to produce 25-mg/L Concentration in 100 feet of Pipe-by Diameter

Pipe Diameter (in.)	100-percent Chlorine (lb.)	1-percent Chlorine Solution (gal.)
4	.013	.16
6	.030	.36
8	.054	.65
10	.085	1.02
12	.120	1.44
16	.217	2.60

- a. during chlorine application, take precautionary measures to prevent the concentrated treatment solution from flowing back into the existing distribution system and/or supply source.
- 2. Tablet Method:
 - a. The tablet method consists of placing calcium hypochlorite granules and tablets in the water main as it is being installed and then filling the main with potable water when installation is completed.

NOTE: Since the preliminary flushing step must be eliminated, this method may be used only when scrupulous cleanliness has been exercised and only with approval of the ENGINEER. It shall not be used if trench water or foreign material has entered the main, or if the water temperature is below 41° F.

- b. During construction, place sufficient number of 5 gram calcium hypochlorite tablets in each section of pipe, in hydrants, hydrant branches, and other appurtenances to obtain a minimum of 25 mg/L available chlorine. Attach tablets to the invert of pipe sections with adhesive. Apply adhesive only to the broad side of the tablet next to the pipe surface.

Table 02653-4

Number of 5-gram Calcium Hypochlorite Tablets Required for Dose of 25 mg/L

Pipe Diame- ter (in.)	<u>Length of Pipe Selection (ft.)</u>				
	13 or less	18	20	30	40
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7
16	4	6	7	10	13

- c. When pipeline installation is completed, fill the main with water at a maximum velocity of one foot per second. This water shall remain in the pipe for at least 24-hours. Manipulate valves so that the chlorine solution does not flow back into the line supplying the water.
- 3. During the 24-hour treatment, operate all valves, curb stops, and hydrants in the section treated.
- 4. At the completion of the 24-hour treatment, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine.
- 5. Repeat the disinfection process until the minimum free chlorine is present at the end of the treatment sequence. The tablet method cannot be used in these subsequent disinfections. No additional compensation will be provided the CONTRACTOR for repeat treatment or testing.

- F. Final Flushing:
1. After completion of the required disinfection, flush the line at a minimum rate of 2.5 fps until the free chlorine residual reduces to the level of the existing water supply or 1 mg/L, whichever is lower. Dispose of flushing water in conformance with Federal, State, and local laws. A neutralizing chemical shall be applied to the water to be wasted to neutralize residual chlorine. Wasted water may be discharged to the public sewer system, if approved by the ENGINEER.
 2. No flushing or bacteriological tests permitted until receipt of passed chlorine residue test results.
- G. Bacteriological Testing:
1. After final flushing is completed and before the water main is placed in service, test the line for bacteriologic quality. Perform two tests, 24-hours between tests in the presence of the OWNER or ENGINEER.
 2. In the presence of the OWNER or ENGINEER, collect a minimum of one sample at the end of each line for each test, and one sample of the incoming water from the existing water system for comparison.
 3. Collect samples in sterile bottles treated with sodium thiosulphate.
 4. Sampling tap shall consist of corporation stop installed in the main with copper tube gooseneck assembly. Fire hydrants may be used if approved by ENGINEER.
 5. Provide bacteriological test reports to the OWNER and the ENGINEER. The presence of bacteriological contamination will be cause to require the CONTRACTOR to rechlorinate and retest the system, at no additional cost to the OWNER.

END OF SECTION