

## **SECTION 15020**

### **DISINFECTING PIPELINES**

#### **PART 1: GENERAL**

##### **1.01 SCOPE OF WORK**

Flush and disinfect all pipelines installed under this Contract if indicated in the summary of work. This would include furnishing the necessary labor, tools, transportation, and other equipment for the operation of valves, hydrants, and blowoffs during the chlorination. Install, and if directed remove, all chlorination taps required for disinfection. The cost of this work shall be included in the bid item for pipe installation. The disinfection will be performed under the supervision of Owner.

##### **1.02 WORK BY OWNER**

The Owner reserves the option to provide/furnish the chlorine and chlorination equipment. The Owner will furnish water for testing, flushing and disinfecting pipelines. The Owner will also perform bacteriological testing.

##### **1.03 PROTECTION**

Chlorine disinfection and dechlorination shall be under the direct supervision of someone familiar with the physiological, chemical, and physical properties of the form of chlorine used. They shall be trained and equipped to handle any emergency that may arise. All personnel involved shall observe appropriate safety practices to protect working personnel and the public.

The forwards of AWWA Standards B300 and B301 contain information and additional reference material regarding the safe handling of hypochlorites and liquid chlorine. The Contractor shall familiarize himself with this information prior to performing any disinfection work.

##### **1.04 RELATED WORK**

Observe the precautions described in Specification Section 15000 to avoid contamination during installation of the pipeline.

#### **PART 2: PRODUCTS**

##### **2.01 MATERIALS AND EQUIPMENT**

- A. Furnish aqueous chlorine, sample corporations, injection equipment, chlorine residual testing equipment, chlorine residual neutralizing equipment, chlorine neutralizing chemical, sodium hypochlorite (bleach) and calcium hypochlorite (HTH) as needed to disinfect, neutralize the chlorine residual, and sample all pipelines and appurtenances.

- B. Liquid chlorine contains 100% available chlorine and is packaged in steel containers, usually of 100 lb, 150 lb, or 1 ton net chlorine weight. Liquid chlorine is to be furnished in accordance with AWWA B301.
- C. Calcium hypochlorite is available in granular form or in approximately 5-g tablets, and contains approximately 65% available chlorine by weight. The material should be stored in a cool, dry, and dark environment to minimize its deterioration. Do not use calcium hypochlorite intended for swimming pool disinfection, as this material (containing trichloroisocyanuric acid) has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time had been achieved.
- D. Calcium hypochlorite must conform to AWWA B300.

## **PART 3: EXECUTION**

### **3.01 PREPARATION**

All pipelines shall be pressure and leak tested, flushed, and cleaned of debris and dirt prior to application of the disinfectant. Flushing shall continue until the volume in the newly installed main has turned over at least one time unless the Engineer determines that conditions do not permit the required volume to be safely discharged to waste.

### **3.02 APPLICATION OF DISINFECTANT**

Methods to be used for disinfection are those detailed in ANSI/AWWA C651 Disinfecting Water Mains.

### **3.03 WATER MAINS**

Two (2) methods of chlorination are described below. Disinfection shall be done in accordance with AWWA Standard C651-14 with the exception of the 16 hour holding period for sample collections is **not permitted**. Samples shall be collected with a 24 hour holding period between each sample set. The tablet method cited in the AWWA standard is not approved for use.

#### **A. Continuous Feed Method**

##### **1. Set up**

The continuous feed method consists of completely filling the main to remove all air pockets, flushing the completed main to remove particulates, and then refilling the main with chlorinated potable water. The potable water shall be 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 in collected samples.

Chlorine can be applied in advance of preliminary flushing by swabbing joints with bleach. In any such case, the contractor shall make sure and take appropriate action to make sure that the flushed water is dechlorinated.

Preliminary flushing. Prior to being chlorinated, fill the main to eliminate air pockets and flush to remove particulates. Neutralize the chlorine residual of the water being disposed of in accordance with Section 15020.3.04. B, C, D, and E. The flushing velocity in the main shall be not less than 3.0 fps unless the Engineer determines that conditions do not permit the required flow to be discharged to waste. Flushing shall continue until the volume in the newly installed main has turned over at least one time. Table 1 shows the rates of flow required to produce a velocity of 3.0 fps in pipes of various sizes.

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

**TABLE 1**  
Required Flow and Openings to Flush Pipelines  
(40 psi Residual Pressure in Water Main)\*

Pipe Diameter (inches)	Flow Required to Produce 3.0 fps Velocity in Main (gpm)	Size of Tap (inches)			Number of 2-1/2 in. Hydrant Outlets to Use
		1	1-1/2	2	
		Number of Taps on Pipe <sup>†</sup>			
4	120	1	-	-	1
6	260	-	1	-	1
8	470	-	2	1	1
10	730	-	3	2	1
12	1060	-	-	2	2
16	1880	-	-	4	2

\*With a 40 psi pressure in the main with the hydrant flowing to atmosphere, a 2½-inch hydrant outlet will discharge approximately 1,000 gpm and a 4½-inch hydrant outlet will discharge approximately 2,500 gpm.

† Number of taps on pipe based on discharging through 5 feet of galvanized iron pipe with one 90 degree elbow.

In mains of 24-inches or larger diameter, an acceptable alternative to flushing is to broom-sweep the main, carefully removing all sweepings prior to chlorinating the main.

## 2. Chlorinating the Main.

- a. Flow water from the existing distribution system or other approved source of supply at a constant, measured rate into the newly laid water main. In the absence of a meter, approximate the rate by placing a pitot gauge in the discharge or measuring the time to fill a container of known volume.
- b. At a point not more than 10 feet downstream from the beginning of the new main, dose the water entering the new main with chlorine

fed injection at a constant rate such that the water will have not less than 25 mg/L free chlorine. Provide an injection quill that distributes the concentrated solution to the center of the flow in the main. Provide and install corporations to measure the chlorine concentration at not more than 1200ft intervals including one within 10ft of the point of initial injection to ensure that this concentration is provided. Measure chlorine in accordance with the procedures described in the current edition of the AWWA Manual M12 or of *Standard Methods for the Examination of Water and Wastewater*.

- c. Table 2 gives the amount of chlorine required for each 100 feet of pipe of various diameters. Solutions of 1 percent chlorine may be prepared with calcium hypochlorite and the table indicates the appropriate amount of the 65% calcium hypochlorite. If using other concentrations of calcium hypochlorite, a properly adjusted weight must be used. A 1 percent chlorine solution requires 1 pound of calcium hypochlorite in 8 gallons of water.

**TABLE 2**

Chlorine and Hypochlorite Required to Produce 25 mg/L  
Concentration in 100 feet of Pipe by Diameter

Pipe Diameter inches	100 Percent Chlorine lbs	65 Percent Hypochlorite lbs	1 Percent Chlorine Solutions gallons
4	0.013	0.020	0.16
6	0.030	0.046	0.36
8	0.054	0.083	0.65
10	0.085	0.131	1.02
12	0.120	0.185	1.44
16	0.217	0.334	2.60

- d. During the application of chlorine, position valves so that the strong chlorine solution in the main being treated will not flow into water mains in active service. Do not stop the chlorine application until the entire main is filled with heavily chlorinated water. Keep the chlorinated water in the main for at least 24 hours. During this time, operate all valves and hydrants in the section treated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine.
- e. Hypochlorite solution may be injected to the water main with a gasoline or electrically powered chemical feed pump designed for feeding chlorine solutions. The pump, feed lines, injector corporations, and injector quills, shall be of such material and strength as to safely withstand the corrosion caused by the concentrated chlorine solutions and the maximum pressures that may be created by the pumps. Check all connections for tightness before the solution is applied to the main.

B. Slug Method

1. Setup

- a. The slug method consists of; completely filling the main to eliminate all air pockets, flushing the main to remove particulates, and slowly flowing a slug of water containing 100 mg/L of free chlorine through the main so that all parts of the main and its appurtenances will be exposed to the highly chlorinated water for a period of not less than 3 hours. Neutralize the chlorine residual of the water being disposed of in accordance with Section 15020.3.04. B, C, D, and E.

2. Chlorinating the main.

- a. At a point not more than 10 feet downstream from the beginning of the new main, dose the water entering the new main with chlorine fed injection at a constant rate such that the water will have not less than 100 mg/L free chlorine. Provide an injection quill that distributes the concentrated solution to the center of the flow in the main. Provide and install corporations to measure the chlorine concentration at not more than 1200ft intervals including one within 10ft of the point of initial injection to ensure that this concentration is provided. Measure chlorine in accordance with the procedures described in the current edition of the AWWA Manual M12 or of *Standard Methods for the Examination of Water and Wastewater*. The chlorine shall be applied continuously and for a 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.
- b. The free chlorine residual shall be measured in the slug as it moves through the main. If at any time the slug drops below 50 mg/L, stop the flow, relocate the chlorination equipment to the head of the slug, and as flow is resumed, apply chlorine to restore the free chlorine in the slug to not less than 100 mg/L.
- c. As the chlorinated water flows past fittings and valves, operate related valves and hydrants so as to disinfect appurtenances and pipe branches.

**3.04 DISPOSAL OF CHLORINATED WATER**

- A. Field dechlorination shall be done in accordance with AWWA C655-09. Do not keep heavily chlorinated water in contact with pipe for more than 48 hours after the applicable retention period. In order to prevent damage to

the pipe lining or corrosion damage to the pipe itself, flush the heavily chlorinated water from the main fittings, valves, and branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use. Take all steps necessary to dechlorinate water where required per section 3.04B and 3.04C below. Contact the local sewer department to arrange for disposal of the heavily chlorinated water to the sanitary sewer if applicable.

- B. Neutralize the chlorine residual of the water being disposed of by treating with one of the chemicals listed in Table 3. Select an alternative disposal site if a sanitary sewer system is unavailable for disposal of the chlorinated water. Chlorine residual shall be zero (0) prior to entering any storm water structure or a body of water that has the potential for aquatic life.
- C. The proposed alternative disposal site shall be inspected and approved of by the Engineer. Apply a reducing agent to the chlorinated water to be wasted to completely neutralize the chlorine residual remaining in the water. (See Table 3 for neutralizing chemicals). Do not overdose neutralizing chemicals as this may result in adverse environmental impacts. Only dose the amount required to neutralize the amount of chlorine present. Contact federal, state and local regulatory agencies, where necessary, to determine special provisions for the disposal of heavily chlorinated water.

**TABLE 3**  
Pounds of chemicals required to neutralize various  
residual chlorine concentrations in 100,000 gallons of water.

Residual Chlorine Concentration	Sulfur Dioxide	Sodium Bisulfite	Sodium Sulfite	Sodium Thiosulfate	Ascorbic Acid
<u>mg/L</u>	<u>(SO<sub>2</sub>)</u>	<u>(NaHSO<sub>3</sub>)</u>	<u>(Na<sub>2</sub>SO<sub>3</sub>)</u>	<u>(Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> · 5H<sub>2</sub>O)</u>	<u>(C<sub>6</sub>O<sub>8</sub>H<sub>6</sub>)</u>
1	0.8	1.2	1.4	1.2	2.1
2	1.7	2.5	2.9	2.4	4.2
10	8.3	12.5	14.6	12.0	20.9
50	41.7	62.6	73.0	60.0	104.0

- D. Test for chlorine residual throughout the disposal process to be sure that the chlorine is neutralized
- E. Submit a plan of disposal of flushed water to the Engineer for approval

### **3.05 BACTERIOLOGICAL TESTING**

- A. Bacteriological testing shall be done in accordance with AWWA Standard C651. After final flushing and before the water main is placed in service, the first of two consecutive sets of acceptable samples can be collected from

the new main. The second set of samples must be taken at least 24 hours after the first set of samples. The main shall not be flushed between final flushing and collection of the first and second collection set of samples. It is permitted to run minimal water flow for one minute through the sample port to clear the sample site for the collection of the first and second sample sets. At least one set of samples shall be collected from every 1,200 feet, of the new water main, plus one set from the end of the line and at least one set from each branch when possible or as required by regulatory requirements.

- B. Samples shall be collected by a person knowledgeable in collecting samples for bacteriological sampling or arrange for the Owner to collect the sample. Coordinate with Owner and submit samples to the Owner for testing of bacteriological (chemical and physical) quality. Testing will be in accordance with Standard Methods of the Examination of Water and Wastewater. Currently, both the Membrane Filtration and Absence/Presence testing are approved methods for identification of coliform bacteria.
- C. Samples shall show the absence of coliform organisms; and the presence of chlorine residual. Turbidity must be below 0.5 NTU and chlorine residual consistent with levels normally found in the distribution system before Bac-T and chemical samples can be taken. At arrival, the laboratory will double check the turbidity, chlorine and pH. The water quality record sheet and field data must accompany the samples.
- D. If tests shows the presence of coliform or laboratory analysis are outside operating limit additional flushing and disinfection of the pipeline must be performed, at no additional cost to the Owner. The Contractor will be charged for the additional testing performed by the Owner.

### **3.06 REMOVE CORPS STOPS**

- A. Remove the corporation stops and plug the taps after successfully passing all bacteriological testing, as approved by the Engineer.

### **3.07 RETESTING AND TESTING SOURCE WATER**

- A. At the time of initial flushing the main to remove material and test for air pockets, Contractor may request the Owner to continue flushing until the normal chlorine residual is met at the discharge point. Notification must be provided in advance and the Contractor shall be prepared to test for chlorine at intervals of no more than five minutes as the water clears. This will provide the Contractor with some assurance that the source water is chlorinated.
- B. If subsequent tests for bacteriological contamination conducted by the Contractor fail, the Contractor may request the Owner to continue flush from the source water into the new pipe system until chlorine residual is found at

the discharge point. Notification must be provided in advance and the Contractor shall be prepared to test for chlorine at intervals of no more than five minutes as the water clears. The operation of all existing system valves shall be by the Owner at the Contractor expense and the discharge point must be opened prior to opening existing valves to avoid contamination. This will provide the Contractor with some assurance that the source water is chlorinated for subsequent tests.

**END OF SECTION**