

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

SECTION 33 1300– DISINFECTION OF WATERLINES

Maintain Section format, including the UH master spec designation and version date in bold in the center columns of the header and footer. Complete the header and footer with Project information

Edit and finalize this Section, where prompted by Editor's notes, to suit Project specific requirements. Make selections for the Project at text identified in bold.

This Section uses the term "Engineer." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

Delete hidden text after this Section has been edited for the Project.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
 - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
 - 2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

1.2 SUMMARY

- A. This Section specifies the requirements for labor, materials, tools, and equipment to perform all operations in connection with disinfection for completed water lines, fire hydrants, and appurtenances.

1.3 APPLICABLE PUBLICATIONS

- A. The following publications of the latest issues listed below, but referred to thereafter by basic designation only, form a part of these Specifications to the extent indicated by reference thereto:
 - 1. American Water Works Association (AWWA)
 - a. C 651 - AWWA Standard for Disinfecting Water Mains

<Insert A/E Name>

AE Project #: <Insert Project Number>

Disinfection of Waterlines
UH Master:10.2020

33 1300 - 1

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

1.4 PROJECT/SITE CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Follow the University of Houston's Plant Operations Planned and Emergency Utility Outage Guidelines. See "COORDINATION" Article in this Section.
- B. Do not proceed with interruption of water-distribution service without prior approval and coordination with the Owner and local municipal water supplier.

1.5 COORDINATION

- A. Complete the Outage Planning Form in the University of Houston's Planned and Emergency Utility Outage Guidelines available in Section 00 6000 of these Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chlorine - Calcium hypochlorite, or equal, which contains sixty-five percent chlorine by weight.
- B. Water for Testing:
 - 1. Water for testing will be furnished by the University; or
 - 2. Obtain transient water meter from City for use when water for testing will be taken from City system. Conform to City requirements for water meter use.
 - 3. All connections of new pipeline must be isolated from existing potable water lines by a physical air gap until the original copy of a negative coliform test report has been received by the Owner from the County Health Department or a TCEQ approved lab.

2.2 TESTING REQUIREMENTS

- A. Chlorine Residual Drop Dilution Method
 - 1. The drop dilution method of approximating total residual chlorine is suitable for concentrations above 10 mg/L, such as are applied in the disinfection of water mains or tanks.
 - 2. Apparatus:
 - a. A graduated cylinder for measuring distilled water.
 - b. An automatic or safety pipet.
 - c. A dropping pipet that delivers a one-milliliter (1 ml) sample in twenty (20) drops. This pipet is for measuring the water sample and should not be used for any other purpose.
 - d. A comparator kit containing a suitable range of standards.

<Insert A/E Name>

AE Project #: <Insert Project Number>

Disinfection of Waterlines

UH Master:10.2020

33 1300 - 2

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

3. Procedure

- a. Ascertain the volume of the comparator cell and using an automatic or safety pipet, add 0.5 ml of orthotolidine for each 9.5 ml of distilled water to be added.
- b. Using a graduated cylinder, add a measured volume of distilled water.
- c. With the dropping pipet, add the water sample a drop at a time, allowing mixing, until a yellow color is formed that matches one of the color standards.
- d. Record the total number of drops used and the final chlorine value obtained.
- e. Calculate the milligrams per liter residual chlorine as follows:
 - 1) Multiply by twenty the number of milliliters of distilled water used in Step b above.
 - 2) Multiply product in Step e.1 by the final chlorine value in milligrams per liter recorded in Step d.
 - 3) Divide the product found in Step e.2 by the total number of drops of water sample recorded in Step d.

PART 3 - EXECUTION

3.1 GENERAL

- A. During the construction operations, workmen shall be required to use utmost care to see that the inside of pipes, fittings, jointing materials, valves, etc., that will come into contact with potable water be maintained in a sanitary condition.
- B. Every effort must be made to keep the inside of the pipe, fittings, and valves free of all foreign matter, sticks, dirt, rocks, etc. As each joint of pipe is being laid, it must be effectively swabbed so that all foreign matter is removed. Placing dry powdered chlorine in the pipeline will be permitted in conjunction with certain methods of sterilization as specified by the Engineer. All fittings and exposed open ends of pipe must be blocked with a plug or capped until the line is completed.
- C. Sterilization of the line, or any section thereof, shall not be commenced until the Engineer has approved the method, apparatus, sterilizing agent, and the section of the line.
- D. When the entire pipeline, or certain section thereof, has been completed, tested, and made ready for use, the line or section of line shall be thoroughly sterilized according to the following procedure:
 1. The Contractor shall provide all necessary taps to complete this Work of this Section.
 2. The water main shall be flushed prior to disinfection.
 3. The flushing velocity shall be greater than 2.5 feet per second. The rate of flow required to produce this velocity in various diameters is shown in Table 1. No site for flushing shall be chosen unless it has been determined by the Engineer or Inspector that drainage is adequate at that site. Flushing is not a substitute for preventive measures taken before and during pipe laying. Certain contaminants, especially in caked deposits, resist flushing at any velocity.

<Insert A/E Name>

AE Project #: <Insert Project Number>

Disinfection of Waterlines
UH Master:10.2020

33 1300 - 3

University of Houston Master Specification

<Insert Project Name>
<Insert U of H Proj #>

<Insert Issue Name>
<Insert Issue Date>

TABLE 1 – REQUIRED OPENINGS TO FLUSH PIPELINES (40 PSI RESIDUAL PRESSURE)

PIPE SIZE	FLOW (gpm) REQUIRED TO PRODUCE 2.5 FPS VELOCITY	ORIFICE SIZE (IN)	NUMBER OF HYDRANT OUTLET NOZZELS	SIZE (IN) OF HYDRANT OUTLET NOZZELS
4	10	15/16	1	2-1/2
6	220	1-3/8	1	2-1/2
8	390	1-7/8	1	2-1/2
10	610	2-5/16	1	2-1/2
12	880	2-13/16	1	2-1/2
14	1200	3-1/4	2	2-1/2
16	1565	3-5/8	2	2-1/2
18	1980	4-3/16	2	2-1/2

NOTE: A 2-1/2-inch hydrant outlet nozzle will discharge approximately 1,000 gpm and a 4-1/2-inch hydrant outlet nozzle will discharge approximately 2,500 gpm with 40 psi residual pressure.

E. Methods of Chlorine Application

1. Continuous Feed Method

- a. This method is suitable for general applications.
- b. Water from the existing distribution system, or other pre-approved sources of supply, shall be made to flow at a constant, measured rate into the newly laid pipeline. The water shall receive a dose of chlorine concentration until the water in the pipe maintains a minimum of fifty milligrams per liter (50 mg/l) available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described herein.
- c. In the absence of a meter, the rate may be determined either by placing a pitot gauge at the discharge, or by measuring the time to fill a container of known volume.
- d. Table 2 gives the amount of chlorine residual required for each 100 feet of pipe of various diameters. Solutions of one percent chlorine may be prepared with approximately one pound (1 lb.) of calcium hypochlorite (65 percent strength) in 8.5 gallons of water.

University of Houston Master Specification

<Insert Project Name>
<Insert U of H Proj #>

<Insert Issue Name>
<Insert Issue Date>

TABLE 2 – CHLORINE REQUIRED TO PRODUCE 50 MG/L CONCENTRATION IN 100 FEET OF PIPE BY DIAMETER

PIPE SIZE	100% CHLORINE (LB/100FT)	1% CHLORINE SOLUTION (GAL/100FT)
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88
16	0.427	5.12
18	0.540	6.48
24	0.960	11.50

- e. During the application of chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least twenty-four (24) 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 twenty-four (24) hour period, the treated water shall contain no less than fifty (50) milligrams per liter and no more than one hundred (100) milligrams per liter chlorine throughout the length of the main. A dosage of more than the maximum allowable chlorine will require the Contractor to dilute the flush water with a TCEQ-approved dilution chemical. The chemical and description of procedure shall be submitted in writing to the Engineer and Owner for approval.
2. Slug Method
- a. This method is suitable for use with mains of large diameter for which, because of the volume of water involved, the continuous feed method is not practical.
 - b. Water from the existing distribution system shall be made to flow at a constant, measured rate (see C.1.a. Note) into the newly laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two (2) rates shall be proportioned so that the concentration of the water entering the pipeline is maintained at no less than 300 milligrams per liter. As the chlorinated water passes along the line, it shall expose all interior surfaces to a concentration of at least 300 mg/L for at least three (3) hours. The application shall be checked at a tap near the upstream and downstream ends of the line by chlorine residual measurements made according to the procedures described herein.
 - c. As the chlorinated water flows past tees and crosses, related valves and hydrants shall be operated so as to disinfect appurtenances.
3. Dry Treatment during Installation
- a. The dosage and application of sodium hypochlorite will be determined by the following:
 - 1) Calculate weight of sodium hypochlorite required for water to be treated using Table 2.

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- 2) Add required amount of solution at the bell of each pipe as it is installed.

F. FINAL FLUSHING

1. After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is less than three milligrams per liter (3 mg/l). Chlorine residual determination shall be made by the Inspector to ascertain that the heavily chlorinated water has been removed from the pipeline.

G. BACTERIOLOGIC TESTS

1. Before the water main is placed in service, a sample or samples shall be collected from points designated by the Inspector and tested for bacteriologic quality. This sample shall be collected 24 hours after final flushing. The test shall show the absence of coliform organisms before the water main may be placed in service. At least one (1) sample per one thousand (1000) feet of new line or portion thereof shall be taken. Sampling shall be supervised by the Inspector. Samples shall be submitted by the Contractor to a TCEQ approved laboratory and/or County Health Department for analysis.
2. Samples of bacteriologic analysis shall be collected in sterile bottles obtained from the Harris County Health Department. Samples shall be collected at points specified by the Engineer.
3. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

H. REPETITION OF PROCEDURE

1. If the initial disinfection fails to produce samples with no coliform present, the Contractor shall re-disinfect the line following the procedures stated in 3.1.D, E, and F of this Specification until samples indicating no coliform present have been obtained. When the samples indicate no coliform present and the Owner has received original copies of the test report, the main may be placed in service.

3.2 PROCEDURE AFTER CUTTING INTO OR REPAIRING EXISTING MAINS

- A. The procedure outlined in this section applies primarily when mains are wholly or partially dewatered. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure require no disinfection.

1. Trench "Treatment"

- a. When an old line is opened, either by accident or by design, apply liberal quantities of hypochlorite to open trench areas to lessen the danger of contamination. Use slow dissolving tablets.

2. Main Disinfection

- a. Swabbing and Flushing. The following procedure is considered as a minimum that may be used:

<Insert A/E Name>

Disinfection of Waterlines

33 1300 - 6

AE Project #: <Insert Project Number>

UH Master:10.2020

University of Houston Master Specification

<Insert Project Name>
<Insert U of H Proj #>

<Insert Issue Name>
<Insert Issue Date>

- 1) Swabbing with hypochlorite solution: The interior of all pipe and fittings used to make the repair (particularly couplings and tapping sleeves) shall be swabbed with a 5 percent hypochlorite solution before they are installed. If valving and hydrant locations permit, flushing from both directions is recommended. Flushing shall be started as soon as the repairs are completed and continued until discolored water is eliminated.
- b. Slug Method: In addition to the swabbing and flushing procedures above, the section of main in which the break is located shall be flushed and chlorinated using the slug method where practical, as determined by the Engineer or Inspector.
 - 1) Isolate the section of main, shutting off all service connections, flushing the main, and chlorinating the main as described in the Slug Method in Paragraph 3.1.E.2. except that the dose may be increased to as much as 500 mg/1, and the contact time reduced to as little as 1/2 hour. After chlorination, resume flushing and continue until discolored water is eliminated.
- c. Sampling: Bacteriologic samples shall be taken after repairs to provide a record by which the effectiveness of the procedures used can be determined by the Inspector. If the direction of flow is unknown, samples shall be taken on each side of the main break.
- d. Acceptance shall be determined on the basis of allowable pressure loss. If any test of pipe discloses a pressure loss greater than that specified, the Contractor shall, at his own expense, locate and repair the defective material until the pressure loss is within the specified allowance.
- e. Repair all visible leaks, regardless of the amount of pressure loss.

END OF SECTION 33 1300