

The following standard specification is intended to be edited according to the specifics of the project. Brackets [ ] and areas shaded in gray [e.g. format] indicate requirements that are optional depending upon the type of system being provided or per instructions associated with the [ ] and project requirements. Consult with University's Representative and campus stakeholders.

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## SECTION 33 13 00 DISINFECTION OF DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. This specification applies to the installation of all new and repaired potable (domestic) water lines. All new domestic water lines shall be disinfected before they are connected to existing piping and placed in service. All domestic water lines taken out of service for inspection, repair, or other activities that might lead to contamination of water shall be disinfected before they are returned to service.
- B. Except as specifically noted, Contractor shall furnish all labor, equipment, and materials to prepare, disinfect and test domestic water lines in conformity with the procedures and standards described in this section.

#### 1.2 RELATED SECTIONS

- A. Section 01 33 23 Shop Drawings, Product Data and Samples
- B. Section 33 11 00 Water Distribution Piping

#### 1.3 REFERENCES

- A. American Water Works Association (AWWA) C651- AWWA Standard for Disinfecting Water Mains and applicable local and government regulations.
- B. AWWA B300 – Hypochlorites
- C. AWWA M12 - Simplified Procedures for Water Examination – Fifth Edition
- D. Standard Methods for the Examination of Water and Wastewater

#### 1.4 SUBMITTALS

- A. Submit a Disinfection Plan describing flushing procedures; type, form, and dose of disinfectant to be used; proposed locations for adding disinfectants and collecting disinfection verification samples; final flushing procedures; and location for disposal of flushing water.
- B. Following completion of disinfection, provide a Disinfection Certification Report confirming compliance with specification to the University's Representative. This report, together with acceptable disinfection verification sample results collected and analyzed by the University's Representative will form the basis for approval of disinfection.
- C. Submit in accordance with Section 01 33 23 Shop Drawings, Product Data and Samples.

#### 1.5 UPERVISION AND TESTING

- A. Disinfection shall not commence until the University's Representative has accepted the Disinfection Plan. The University's Representative shall supervise the start of disinfection and the conclusion of the disinfection retention period.
- B. Unless otherwise approved by the University's Representative the final disinfection verification water samples will be collected by the University's Representative with analysis performed by a California Department of Health Services laboratory selected and paid for by the University. Contractor shall assist the University's Representative in completing this task.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. The following forms of chlorine are approved for use as disinfecting agents:
  - 1. Sodium hypochlorite in liquid form, conforming to American National Standards Institute/American Water Works Association (ANSI/AWWA) B300.
- B. Contractor shall comply with all applicable local, state and federal regulations concerning transport, handling and reporting of the materials used for disinfection.

## PART 3 - EXECUTION

### 3.1 PREVENTIVE AND CORRECTIVE MEASURES DURING CONSTRUCTION

- A. General. The procedures of this section must be observed to assure that water pipelines and appurtenances have been thoroughly cleaned for the final disinfection by chlorination. New pipelines must be isolated until bacteriological tests described in this section, are satisfactorily completed and disinfection is approved by the University's Representative.
- B. Keeping pipe clean and dry. The interiors of pipes, fitting, and valves shall be protected from contamination. Pipe delivered for construction shall be strung to minimize the entrance of foreign material. All opening in the pipelines shall be closed with water tight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Rodent-proof plugs may be used when watertight plugs are not practicable and when thorough cleaning will be performed by flushing or other means.
- C. Packing materials. Yarning or packing material shall consist of molded or tubular rubber rings, rope of treated paper, or other approved materials. Materials such as jute or hemp shall not be used. Packing material shall be handled in a manner that avoids contamination. Packing materials are only acceptable if specified as part of the piping system and provided in accordance with piping requirement specified in other sections of specification. Refer to piping specification [Section 33 11 00 Water Utility Distribution Piping](#),
- D. Sealing materials. No contaminated material or any material capable of supporting prolific growth of microorganisms shall be used for sealing joints. Sealing material or gaskets shall be handled in a manner that avoids contamination. Sealing materials are only acceptable if specified as part of the piping system and provided in accordance with piping requirement specified in other sections of specification. Refer to [Section 33 11 00 Water Utility Distribution Piping](#),
- E. Cleaning and swabbing. If dirt enters the pipe, it shall be removed and the interior pipe surface swabbed with a 1 to 5 percent hypochlorite disinfecting solution. If, in the opinion of the University's Representative, the dirt remaining in the pipe will not be removed using the flushing operation, then the interior of the pipe shall be cleaned using mechanical means, such as a hydraulically propelled foam pig (or other suitable device acceptable to the University's Representative in conjunction with the application of a 1 percent hypochlorite disinfecting solution. The cleaning method used shall not force mud or debris into the interior pipe-joint spaces and shall be acceptable to the University's Representative.
- F. Flooding by storm or accident during construction. If the pipeline is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water until the main is clean. The section exposed to the floodwater shall then be filled with chlorinated potable water that, at the end of a 24-hour holding period, will have a free chlorine residual of not less than 25 mg/L. The chlorinated water may then be drained or flushed from the pipeline. After construction is completed, the pipeline shall be disinfected using the continuous-feed method.

### 3.2 METHODS OF CHLORINATION

- A. General. The continuous feed method shall be used for disinfection. AWWA's "tablet method" and "slug method" are not allowed. All valves, faucets, and fixtures shall be installed and piping installation shall be completed before chlorination is initiated.
- B. Notification and Scheduling. Contractor shall notify the University's Representative of their intent to begin the disinfection process. Prior to scheduling this work, the disinfection submittal must have been approved by the University. The Contractor will coordinate the disinfection, final flushing, and disinfection verification sampling with the University's Representative at least 72 hours prior to commencing chlorination. Disinfection verification sampling must be scheduled only on Mondays, Tuesdays, Wednesdays or Thursdays and be completed prior to 3:30 P.M.
- C. Preflushing of source water. The source water (typically a University fire hydrant) used for disinfection and pressure testing shall be flushed prior to its use to ensure that contaminants or debris are not introduced into the new pipe. Flushed water shall not be discharged, either directly or indirectly, into campus storm drainage systems. Flushed water shall either be discharged into the campus sanitary sewer system, or managed in a manner to retain the water on site. The University's Representative will provide the Contractor a location to discharge flushing water during formation of the Disinfection Plan.
- D. Preliminary flushing. Before the pipeline is chlorinated, it shall be filled to eliminate air pockets and flushed to remove particulates. The flushing velocity in the pipeline shall not be less than 2.5 ft/s unless the University's Representative determines that conditions do not permit the required flow to be discharged to waste. As practical, as determined by the University's Representative, all fixtures shall be flushed in the full-open position until the water is clear. The University's Representative will provide the Contractor the duration of flushing at 2.5 ft/s during formation of the Disinfection Plan.
- E. Critical service disruptions. When emergency eyewashes and/or emergency showers for in-use laboratories are removed from service due to disinfection procedures, alternative emergency eyewashes and showers shall be provided.
- F. Procedure for chlorinating the pipeline.
  1. Water supplied from a temporary, backflow-protected connection to the existing domestic water system shall flow at a measured rate into the newly installed water pipeline. In the absence of a meter, the rate may be approximated using a Pitot gauge in the discharge, measuring the time to fill a container of known volume, or other approved method.
  2. A service cock shall be installed on piping intended for disinfection for the introduction of hypochlorite solution and for use as a sample bib for testing purposes. Service cock shall be located no more than 10 feet downstream of the supply point for disinfection water.
  3. For disinfection of hot water systems, the temperature of the hot water system shall be reduced to that of the cold water system before initiating chlorination.
  4. Prior to initiating chlorination, each outlet and valve shall be posted with signs indicating water may not be used; e.g., "Do Not Use", "Chlorinated Water – Do Not Drink". Postings must be made in English and Spanish. Water lines must remain isolated from use, and faucets and valves must remain posted until conditional or final approval for use has been given by University's Representative.
  5. At a point not more than 10 feet downstream from the beginning of the new pipeline, water entering the new pipeline shall receive a dose of hypochlorite fed at a constant rate such that the water will have not less than 25 mg/L and not more than 35 mg/L free chlorine. To ensure that this concentration is provided, measure chlorine concentration at regular intervals in accordance with the procedures described in the current edition of Standard Methods for the Examination of Water and Wastewater or AWWA Manual M12, or using approved chlorine test kits. The hypochlorite solution may be applied to the water pipeline with a gasoline or electrically powered chemical-feed pump designed for feed chlorine solutions. Feed lines shall be made of material capable of withstanding the corrosion caused by the concentrated

chlorine solutions and the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the solution is applied to the pipeline.

6. All fixtures shall be partially opened to allow for a simultaneous trickle of flow. Chlorine application shall not cease until the entire pipeline is filled with heavily chlorinated water, as verified by measurements at the fixtures. The University's Representative will witness the initial concentrations measured by the Contractor and may take disinfection verification samples to confirm compliance. Following verification of chlorination, each outlet and valve shall be closed.
7. The chlorinated water shall be retained in the pipeline for at least 24 hours, but not more than 48 hours, unless approved by the University's Representative. At the end of the retention period, the treated water in all portions of the pipelines shall have residual of not less than 10 mg/L of free chlorine.

G. Final Flushing.

1. Clearing the pipeline of heavily chlorinated water. After the application retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or to prevent corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main fittings, valves, and branches until chlorine measurements show that the concentration of the water leaving the pipeline is no higher than that generally prevailing in the distribution system or 0.5 ppm. The University's Representative shall take samples and determine the chlorine concentration of the flush water.
2. Disposing of heavily chlorinated water. Flushed water shall not be discharged, either directly or indirectly, into campus storm drainage systems. Flushed water may be discharged into the campus sanitary sewer system if approved by the University Representative, otherwise Contractor is responsible to retain the water on site, remove and dispose off-site in accordance with applicable regulations.

3.3 DISINFECTION VERIFICATION

- A. Sampling. After final flushing and before the new water pipeline is connected to the distribution system, 2 consecutive sets of samples, taken at least 24-hours apart, shall be collected from the new pipeline. Under normal circumstances, the first set of samples will be collected immediately following final flushing. At a minimum, the University's Representative will take samples every 1,000 feet of pipeline, plus 1 set from the end of the pipeline, and at least 1 set from each branch. The Contractor shall provide dedicated and clean sampling taps at these locations. A corporation cock may be installed in the pipeline with a copper-tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use. The number and location of samples from fixtures is at the discretion of the University's Representative and shall be determined on a project specific basis. The source water will also be sampled. The University will test the samples for bacteriological quality, turbidity, and pH in accordance with Standard Methods for the Examination of Water and Wastewater. For approval by the University's Representative, 2 consecutive sets of samples from each location shall show the absence of coliform organisms and turbidity and pH consistent with that of the source water.
- B. Special conditions. Under certain circumstances, such as when excessive quantities of dirt or debris are known to have entered the pipeline, the University's Representative may elect to collect bacteriological samples after allowing the water to stand in the new pipeline for at least 16 hours after final flushing has been completed.

3.4 REDISINFECTION

- A. If the initial disinfection fails to produce satisfactory bacteriological results, the new pipeline may be reflushed and resampled. If the check samples also fail to produce acceptable results, the pipeline shall be rechlorinated by the continuous-feed method until satisfactory results are obtained. Reflushing, resampling, and rechlorination shall be at no expense to the University.

PROJECT TITLE  
CONTRACT TITLE  
UNIVERSITY OF CALIFORNIA, DAVIS  
CITY, CALIFORNIA

PROJECT NO: 000000  
GRANT NO: 000000

### 3.5 APPROVAL

- A. Conditional Approval. After satisfactory completion of the disinfection procedure, the University's Representative may issue a conditional approval for immediate use of the water distribution system pending results of bacteriological analysis of water samples.
- B. Final Approval. Upon receipt of laboratory confirmation that all samples are negative for coliform bacteria, the system will be approved for immediate use.

END OF SECTION 33 13 00