

## SECTION 33 13 01

## DISINFECTION OF WATER SYSTEMS

10/06

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2004) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA B303	(2005) Sodium Chlorite
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C652	(2002) Disinfection of Water-Storage Facilities
AWWA C653	(2003) Disinfection of Water Treatment Plants

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

## SD-05 Design Data

Sequencing and Scheduling of Disinfection Activities; G

Action plan for:

Disinfection of Piping and Pipelines; G  
 Disinfection of Pumps; G  
 Disinfection of Clearwell; G  
 Disinfection of RO Trains and Process Components; G

Method of Disposal of disinfecting wastewater; G

Testing Procedures and Results; G

Qualifications: Independent testing agency. Indicating chlorine concentration and bacteriological tests will be performed in accordance with applicable standards.

### 1.3 QUALIFICATIONS

Independent Testing Agency: Certified in the State of California, with 10 years of experience in the field of water sampling and testing required for this Project. Calibrated testing instruments and equipment, and documented standard procedures for performing specified testing.

### 1.4 SEQUENCING AND SCHEDULING

- a. Commence Disinfection After Completion of Following:
  1. Hydrostatic and pneumatic testing, pressure testing, functional and performance testing and acceptance of pipelines, pumping systems, structures, and equipment.
  2. Cleaning and flushing.

## PART 2 PRODUCTS

### 2.1 Water For Disinfection and Testing

- a. Clean, uncontaminated, and potable.
- b. Obtain potable water from the water distribution system at the site. Contractor shall convey in disinfected pipelines or containers.

### 2.2 CONTRACTOR'S EQUIPMENT

Furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.

### 2.3 MIXING DISINFECTANT

- a. Prepare "stock" solution by mixing any of following as described below. The purpose of the stock solution is to facilitate mixing and dilution to ensure a uniform disinfecting solution. The Contractor shall not be required to mix a stock solution if a liquid chlorine gas feed system that can accurately feed a desired amount of chlorine to mix a final (dilute) disinfecting solution is used.
  1. Liquid chlorine gas conforming to [AWWA B301](#) and water mixture.
  2. Dry chlorine gas conforming to [AWWA B301](#).
  3. Calcium hypochlorite conforming to [AWWA B300](#) or sodium hypochlorite conforming to [AWWA B303](#) powder or liquid and water mixture.
- b. Feed dry chlorine gas through devices to regulate the rate of flow and ensure uniform diffusion of gas into water within the pipe or vessel being treated. Chlorinating devices for feeding chlorine gas solution or the gas itself shall prevent backflow of water into chlorine cylinder.
- c. Use Following Proportions of Hypochlorite or Chlorine to Water:
  1. Chlorine Gas or Liquid (100 Percent Cl): 1 pound per 11.75 gallons water.

(a) Apply liquid chlorine gas-water solution by means of a solution feed chlorinating device.

2. Calcium Hypochlorite (65 to 70 Percent Cl): 1 pound per 7.5 gallons water.

(a) If calcium hypochlorite is used, first mix dry powder with water to make a thick paste, then thin to a 1 percent solution (10,000 ppm chlorine).

3. Sodium Hypochlorite (5.25 Percent Cl): 1 gallon per 4.25 gallons water.

(a) If sodium hypochlorite procedure is used, dilute the liquid with water to obtain a 1 percent solution.

### PART 3 EXECUTION

#### 3.1 GENERAL

a. Disinfect raw water piping, cartridge filters, pumps, water storage tanks, and pipelines, installed under this Project, intended to hold, transport, or otherwise contact potable water:

1. Disinfect all new process pipelines except the RO pump station concentrate header and pipeline to the concentrate.

2. Disinfect surfaces of materials that will contact partially - treated and finished water, both during and following construction using spray method described below. Disinfect prior to contact with finished water.

b. Prior to application of disinfectants, clean the water storage tank, pumps, and piping of loose and suspended material. Flush piping until clear of suspended solids and color. Use water suitable for flushing and disinfecting.

c. Conform to [AWWA C651](#) for pipes and pipelines, [AWWA C652](#) for tanks and reservoirs, and [AWWA C653](#) to water treatment plants and filters, except as modified in these Specifications.

d. Allow freshwater and stock disinfectant solution to flow into the pipe or vessel at a measured rate so that the chlorine-water solution is at the specified strength. Do not place concentrated commercial disinfectant in the pipeline or vessel before it is filled with water.

e. While disinfection of piping and pumps around RO membrane trains, Contractor shall ensure the existence of an air gap between the piping and the RO membrane train, if membranes are installed.

f. Disinfect the RO trains with no membranes installed, as specified herein.

g. Contractor shall be responsible for replacing any piece of equipment, installed or existing, that is damaged during the activities related to the disinfection of the water systems specified in this Contract.

### 3.2 SEQUENCING AND SCHEDULING OF DISINFECTION ACTIVITIES

- a. Commence Disinfection After Completion of Following:
  1. Completion and acceptance of internal painting of system(s).
  2. Hydrostatic and pneumatic testing, pressure testing, functional and performance testing and acceptance of pipelines, pumping systems, structures, and equipment.
  3. Disinfection of:
    - (a) Pumps and associated system piping.
    - (b) Treatment plant basins and processes used to supply water to system.
- b. All disinfection activities shall commence with approval of the Owner and Owner's Representative.
- c. All structures, pipelines, pumps, and mechanical equipment disinfected, excluding finished water transfer pumps, finished water piping, and finished water ground storage tank, can not be put in service in less than 3 days after complete flushing of disinfected water is finished.

### 3.3 DISINFECTION OF PIPING AND PIPELINES

- a. Flushing:
  1. Before disinfecting, flush all foreign matter from pipeline. Provide hoses, temporary pipes, ditches, and other conduits as needed to dispose of flushing water without damage to adjacent properties. Flushing velocities shall be at least 2.5 fps. For large diameter pipe, where it is impractical or impossible to flush the pipe at specified velocity, clean the pipeline in-place from the inside by brushing and sweeping, then flush the line.
  2. Flush pipelines through flushing branches and remove branches after flushing is completed. Operate valves during flushing process at least twice during each flush.
  3. Flush service connections and hydrants. Flush distribution lines prior to flushing hydrants and service connections.
- b. Disinfecting Solution: Chlorine-water solution having a free chlorine concentration of not less than 50 ppm.
- c. Disinfecting Procedure: In accordance with [AWWA C651](#), unless herein modified.
- d. Point of Application:
  1. Inject chlorine mixture into pipeline to be treated at beginning of line through corporation stop or suitable tap in top of pipeline.
  2. Control water to flow slowly into pipeline during application of chlorine.

3. Control rate of chlorine solution flow in proportion to rate of water entering pipe so that combined mixture shall contain not less than 50 ppm of free available chlorine.

4. Prevent backflow of chlorine solution into line supplying water.

e. Retention Period:

1. Retain treated water in pipeline for at least 24 hours to destroy all nonspore-forming bacteria. At end of 24-hour period, disinfecting solution shall contain at least 10 ppm of free chlorine or the pipeline shall be recleaned, disinfecting solution shall be reapplied, and specified procedure repeated.

2. Operate valves, hydrants, and appurtenances during disinfection to ensure that disinfecting solution is dispersed into all parts of pipeline, including dead-ends and areas that otherwise may not be treated.

3. After disinfection, flush water from the permanent source until water through the pipeline is equal chemically and bacteriologically to permanent source of supply.

### 3.4 DISINFECTION OF PUMPS

a. Disinfecting Solutions: Minimum free chlorine concentration of 200 ppm.

b. Disinfecting Procedure: In accordance with [AWWA C653](#), unless herein modified.

c. Application:

1. Inject the disinfecting solution into the pump and associated piping and circulate for a minimum 2 hour period of time. At the end of the 2 hour period, the solution shall have a strength of at least 100 ppm free chlorine.

2. Operate valves and/or pump appurtenances during disinfection to ensure that the disinfecting solution is dispersed into all parts of the pumps and lines.

3. If the disinfecting solution contained in the pumps has a residual free chlorine concentration less than 100 ppm after the 2 hour retention period, reclean the pump, reapply disinfecting solution, and retest until a satisfactory test result is obtained.

4. After chlorination, flush the water from the pumps until the water through the units is chemically and bacteriologically equal to the permanent source of supply.

5. Where circulating the disinfection solution is not practical, spray chlorine or pump interior, rinse thoroughly with water.

### 3.5 DISINFECTION OF CLEARWELL

a. Cleaning:

1. Clean interior surfaces using water under pressure before sterilizing. Isolate tank from system to prevent contaminating materials from entering the distribution system. Cleaning shall:

- (a) Remove all deposits of foreign nature.
- (b) Remove all biological growths.
- (c) Clean the slopes, walls, top, and bottom.
- (d) Avoid damage to the structure.
- (e) Avoid pollution or oil deposits by workers and equipment.

2. Dispose of water used in cleaning in accordance with applicable regulations before adding disinfecting solution to the reservoir.

b. Alternatively, the tank may be cleaned by scrubbing the walls and floor with solution containing at least 200 ppm of free chlorine, rinsing the walls and floor with a stream of water, and disposing of the rinse water. The structures shall then be filled with water containing at least 2 ppm of chlorine until 1 ppm of free chlorine remains after 24 hours' contact.

c. Disinfecting Procedure: In accordance with [AWWA C652](#), unless herein modified.

1. Disinfect interior surfaces of tank and inlet and outlet pipelines by the application of chlorine. Wash and disinfect surfaces even though there may be no visible evidence of contamination.

2. Disinfect in Accordance with One of the Following Methods:

(a) Spray or brush a solution containing 200 ppm of free chlorine onto the interior surfaces of tank. Apply solution from the bottom up and to the entire structure. Allow to remain 3 hours or until dry before being rinsed off.

(b) Fill tank with water containing at least 50 ppm of free chlorine. Hold solution for at least 3 hours, drain the structure, and fill with potable water.

(c) Parts of structures, such as ceilings or overflows, that cannot be immersed by the second method above shall be spray or brush disinfected.

3. Drain previous chlorine solution and fill tank with chlorinated water to produce a free chlorine residual of 5 ppm after a retention period of 24 hours. After holding for 24 hours, drain the reservoir and fill with potable water.

### 3.6 [DISINFECTION OF RO TRAINS AND PROCESS COMPONENTS](#)

a. All RO trains, including piping and pressure vessels, shall be disinfected using chlorine as specified herein before installation of

the new reverse osmosis RO membrane elements.

b. Care must be taken to ensure that the RO membranes are not exposed to any chlorine or any other strong oxidants.

c. "Passing" bacteriological testing in this Article shall mean collecting samples, coliform testing using methods specified herein, and having test results where there are no (zero) coliform counts on 2 consecutive day samples.

d. The process piping upstream of the RO trains (raw and feed water piping), the cartridge filters, and the membrane feed bypass line shall be disinfected and "pass" bacteriological testing before the RO trains are disinfected. The W2 water may be used for chlorine solution makeup.

e. Each RO train (with no membranes installed) shall be disinfected using W2 water for chlorine solution makeup using the membrane cleaning system. The permeate flowstream from each RO train must "pass" bacteriological testing.

f. After each RO train has passed bacteriological testing, the permeate piping to the decarbonator, the decarbonator and piping from the decarbonator to the chlorine contact basin shall be disinfected and "pass" bacteriological testing.

g. After all piping to the chlorine contact basin has passed bacteriological testing (Items d through f above), the high service pumps, and finished water piping (up to the point of final connection to the existing finished water piping) shall be disinfected and "pass" bacteriological testing.

### 3.7 DISPOSAL OF DISINFECTING WASTEWATER

a. Do not allow flow into a waterway without neutralizing disinfectant residual.

1. See [AWWA C652](#) for acceptable neutralization methods.

### 3.8 TESTING PROCEDURES AND RESULTS

a. Test Equipment:

1. Clean containers and equipment used in sampling and assure they are free of contamination.
2. Obtain sampling bottles with instructions for handling from an independent testing laboratory.

b. Chlorine Concentration Sampling and Analysis:

1. Sampling Frequency: As required to demonstrate conformance to these specifications.
2. Sampling Locations: As approved by Owner.
3. Analysis to be performed by an independent test laboratory. Samples will be analyzed using the amperometric titration method for free chlorine as described in the latest edition of Standard Methods for Examination of Water and Wastewater.

c. After water storage tanks, pumps, pipelines, and piping have been cleaned, disinfected, and refilled with potable water, Contractor shall take water samples and have them analyzed for conformance to bacterial limitations for public drinking water supplies. Samples shall be analyzed for coliform concentrations in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater.

1. A minimum of two samples on each of 2 consecutive days from each separable structure and every 100 feet of pipeline will be obtained and analyzed by standard procedures outlined by state and local regulatory agencies.

2. Sampling points will be representative as accepted by the Owner.

3. Independent laboratory will be selected and retained by Owner.

d. If the minimum samples required above are not bacterially negative, the disinfecting procedures and bacteriological testing shall be repeated on the respective facilities until bacterial limits are met. The Contractor shall ensure that all system components are free from coliform bacteria contamination.

e. After initial disinfection process has been completed, fill tank with water containing at least 2 ppm of free available chlorine residual; after 24 hours' contact, 1 ppm of free available chlorine must remain.

-- End of Section --