

American Water Works Association

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AWWA STANDARD
FOR
DISINFECTION OF
WATER TREATMENT PLANTS



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AMERICAN WATER WORKS ASSOCIATION

6666 West Quincy Avenue, Denver, Colorado 80235



AWWA STANDARD FOR DISINFECTION OF WATER TREATMENT PLANTS

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard covers chlorination materials, procedures, and requirements for disinfection of new treatment facilities and existing water treatment facilities temporarily taken out of service for cleaning, inspection, maintenance, painting, repair, or any other activity that might lead to contamination of water. Typically, these units include filter basins, filter media, clearwells, pump suction wells, and all associated piping and appurtenances located downstream from the filter influent or from the first point of application of disinfectant in the treatment process if process disinfection is initiated upstream of the filters. The disinfection method employed is surface contact with a high-strength chlorine solution for a specific time period. Proof that disinfection has been accomplished is provided by the results of bacteriological sampling and testing that show the absence of coliform organisms.

Sec. 1.2 Purpose

The purpose of this standard is to define the minimum requirements for the disinfection of water treatment plants, including facility preparation, application of chlorine to the interior surfaces of water treatment units, and sampling and testing for the presence of coliform bacteria.

Sec. 1.3 Application

This standard can be referenced in specifications for the disinfection of water treatment plants and can be used as a guide for facility preparation, application of chlorine, and sampling and testing for the presence of coliform bacteria. The stipulations of this standard apply when this document has been referenced and then only to the disinfection of water treatment plants.

SECTION 2: REFERENCES

This standard references the following documents. In their latest editions, they form a part of this standard to the extent specified within the standard. In any case of conflict, the requirements of this standard shall prevail.

- ANSI* /AWWA B100—Standard for Filtering Material.
 ANSI/AWWA B604—Standard for Granular Activated Carbon.
 ANSI/AWWA C651—Standard for Disinfecting Water Mains.
 ANSI/AWWA C652—Standard for Disinfection of Water-Storage Facilities.
Standard Methods for the Examination of Water and Wastewater. APHA,[†]
 AWWA, and WEF,[‡] Washington, D.C. (19th ed., 1995).
 Chlorine Institute[§]—*Chlorine Manual*.
Introduction to Water Treatment. AWWA, Denver, Colo. (1983).
 Material Safety Data Sheets for forms of chlorine used (provided by suppliers).
 AWWA Manual M3—*Safety Practices for Water Utilities* (1990).
 AWWA Manual M20—*Water Chlorination Principles and Practices* (1973).
Water Quality and Treatment. 4th. ed. Prepared by AWWA. McGraw-Hill Book
 Co., New York, N.Y. (1990).

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Disinfectant*: Any oxidant, including, but not limited to, chlorine, chlorine dioxide, chloramine, and ozone, that is added to water in any part of the treatment or distribution process and is intended to kill or inactivate pathogenic microorganisms. For the purposes of this standard, the disinfectants to be used are chlorine solutions derived from liquid chlorine, sodium hypochlorite, or calcium hypochlorite.
2. *Disinfection*: A process that inactivates pathogenic organisms in water by chemical oxidants or equivalent agents.

SECTION 4: REQUIREMENTS

Sec. 4.1 Cleaning

The entire newly constructed treatment facility (including treatment units and piping not requiring disinfection under the provisions of this standard) shall be thoroughly cleaned before the new facility is disinfected and placed in service. All existing treatment units and piping temporarily taken out of service for inspection,

* American National Standards Institute, 11 W. 42nd St., New York, NY 10036.

† American Public Health Association, 1015 15th St. N.W., Washington, DC 20005.

‡ Water Environment Federation, 601 Wythe St., Alexandria, VA 22314-1994.

§ Chlorine Institute, 20001 L St. N.W., Washington, DC 20036.

maintenance, repair, or any other activity that might lead to contamination of the process water shall be thoroughly cleaned before being disinfected and returned to service. Cleaning agents used shall not contain hazardous substances or deleterious compounds that would cause a violation of water quality health-effects standards if subsequently introduced into the water supply during disinfection and filling operations.

All scaffolding, planks, tools, rags, and any other material not part of the structural or operating facilities of the treatment unit shall be removed. Once the materials are removed, the surfaces of the walls, floors, and attached structures shall be thoroughly cleaned with a high-pressure water jet, or by sweeping, scrubbing, or other equally effective means. All water, paint flakes, sediment, dirt, and foreign material accumulated during this cleaning operation shall be discharged, vacuumed, or otherwise removed from the unit.

Sec. 4.2 Units Requiring Disinfection

Disinfection is required for all elements of the treatment plant that are in contact with disinfected water under normal plant operations. All treatment units and piping located downstream from the filter influent including, but not limited to, filter basins, filter media, clearwells, pump-suction wells, and all associated piping and appurtenances shall be disinfected as described in this standard before being placed in service. If process disinfection is initiated upstream of the filters, then all treatment units and piping below the first point of application of process disinfection shall be disinfected before being placed in service. It is recommended that equipment and storage facilities of chemical feed systems that input below the first point of application of process disinfection be cleaned and rinsed with disinfectant prior to being placed in service.

Sec. 4.3 Materials for Disinfectant Chlorine Solutions

The forms of chlorine that may be used in the disinfecting operations are liquid chlorine, sodium hypochlorite solution, and calcium hypochlorite granules or tablets.

4.3.1 *Liquid chlorine.* Liquid chlorine contains 100 percent available chlorine and is packaged in steel containers, usually of 100-lb, 150-lb, or 1-ton net chlorine weight. Liquid chlorine shall be used only (1) in combination with appropriate gas-flow chlorinators and injectors to provide a solution feed of controlled concentration to the water to be chlorinated; (2) under the direct supervision of a person who is familiar with chlorine's physiological, chemical, and physical properties, and who is trained and equipped to handle any emergency that may arise; and (3) when appropriate safety practices are observed to protect working personnel and the public.

4.3.2 *Sodium hypochlorite.* Sodium hypochlorite is available in liquid form in glass, rubber-lined, or plastic containers typically ranging in size from 1 pt to 5 gal; containers of 30-gal or larger size may be available in some areas. Sodium hypochlorite contains approximately 5 percent to 15 percent available chlorine, but care must be used in control of conditions and length of storage to minimize its deterioration and the creation of chlorate.

4.3.3 *Calcium hypochlorite.* Calcium hypochlorite is available in granular form or in small tablets and contains approximately 65 percent available chlorine by weight. The material should be stored in a cool, dry, dark environment to minimize its deterioration. The precautions listed on the container should be carefully noted.

Sec. 4.4 Plant Disinfection Procedures

4.4.1 *Plant piping.* All plant piping shall be disinfected using one of three alternative methods described in ANSI/AWWA C651, including application methods, chlorine solution strengths, retention times, disposal of highly chlorinated water, and bacteriological sampling and testing.

4.4.2 *Tanks and clearwells.* All storage tanks, clearwells, and similar receptacles shall be disinfected using one of the methods described in ANSI/AWWA C652, including application methods, chlorine solution strengths, retention times, disposal of highly chlorinated water, and bacteriological sampling and testing.

4.4.3 *Filters.* This section covers disinfection of filter basins and gravel, silica sand, anthracite, and other mixed media materials except granular activated carbon (GAC). GAC cannot feasibly be disinfected in the field. Therefore, when GAC is to be part of the filter media, special care shall be used to protect the GAC from contamination; all other media shall be placed in the filter basin and disinfected prior to placement of the GAC.

4.4.3.1 *Preparation.* Before any filter material is placed, the filter basin itself shall be thoroughly cleaned as described in Sec. 4.1.

4.4.3.2 *Media placement.* After the filter basin has been cleaned, the filter media shall be placed in the basin in accordance with ANSI/AWWA B100, using all reasonable precautions to maintain cleanliness. Following placement, the filter media shall be backwashed and prepared for service in accordance with ANSI/AWWA B100, Sec. 4.5, Preparing Filter for Service.

4.4.4 *Filter disinfection.*

4.4.4.1 *Disinfection procedure.* After all other work is completed, and before the filter is placed in service, the entire filter basin up to the maximum water level shall be disinfected by chlorination. This can be accomplished preferably by injecting sufficient chlorine into the backwash water to produce a free chlorine residual of at least 25 mg/L throughout the filter. After this has been accomplished, the chlorinated water shall be allowed to stand in the filter for at least 12 h. At the end of the 12-h contact time, the chlorinated water shall be tested to determine the amount of free chlorine residual. If the free residual is less than 15 mg/L, the chlorination process should be repeated. Sufficient tests should be made both from the top and bottom of the unit (and at intermediate points if feasible) to ensure that the residual readings measure the lowest chlorine level existing in the unit at the end of the 12-h period. If satisfactory chlorine residuals are obtained after the chlorine retention period, the filter shall be run to waste or backwashed thoroughly to remove the highly chlorinated water.

4.4.4.2 *Alternative procedure.* As an alternative to the procedure described in Sec. 4.4.4.1, chlorine may be continuously introduced into the filter influent water while filtering to waste to produce a free residual of not less than 25 mg/L. When water with at least a 25 mg/L free residual chlorine concentration reaches the filter-to-waste, the flow of water shall be stopped and the filter shall be held full of the chlorinated water for a period of not less than 12 h. At the end of the 12-h contact time, the chlorinated water shall be tested to determine the free residual. If the free residual is less than 15 mg/L, the chlorination process shall be repeated. Sufficient tests should be made both from the top and bottom of the unit (and at intermediate points if feasible) to ensure that the residual readings measure the lowest chlorine level existing in the unit at the end of the 12-h period. After the chlorine retention period, if satisfactory chlorine residuals are obtained, the filter shall be run to waste or backwashed thoroughly to remove the highly chlorinated water.

4.4.4.3 GAC filters. Disinfection of granular activated carbon (GAC) (see ANSI/AWWA B604) filters shall be similar to Sec. 4.4.3.1, 4.4.3.2, 4.4.4.1, and 4.4.4.2 except that in Sec. 4.4.3.2, all media and support gravel (see ANSI/AWWA B100) except GAC shall be placed in the filter prior to disinfection. Following disinfection according to Sec. 4.4.4.1 or 4.4.4.2, the GAC may be placed in the filter. The GAC must be stored and handled to keep it as clean as possible. Any equipment used in placing the GAC in the filter must be cleaned and disinfected with a 200 mg/L solution of chlorine immediately before use. This includes shovels, spreading devices, or other equipment that comes in contact with the GAC. In addition, all workers shall wear rubber boots and gloves that have been previously disinfected with a 200-mg/L chlorine solution.

4.4.4.4 Chlorinated discharge. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to neutralize the residual chlorine. (See appendix A for neutralizing chemicals.) Federal, state, or local environmental regulations may require special provisions or permits prior to disposal of highly chlorinated water.

SECTION 5: VERIFICATION

Sec. 5.1 Bacteriological Sampling

After the chlorination procedure is completed, and before the treatment unit or facility is placed in service, at least duplicate samples shall be taken from the unit or facility not less than 30 min apart and shall be tested for the presence of coliform in accordance with the latest edition of *Standard Methods for the Examination of Water and Wastewater*. If none of the samples show the presence of coliform, the unit or facility may be placed in service.

If any of the samples shows the presence of coliform, one of the following procedures shall be followed before placing the unit or facility in service.

1. Take repeat samples at least 24 h apart until consecutive samples do not show the presence of coliform.
2. Again, subject the unit or facility to chlorination and sampling as described in this standard.

Sec. 5.2 Record of Compliance

The report of bacteriological test results certifying that the water discharged from the treatment facility is free of coliform bacteria shall serve as the record of compliance.

SECTION 6: DELIVERY

This standard has no applicable information for this section.

APPENDIX A

Disposal of Heavily Chlorinated Water

This appendix is for information only and is not a part of AWWA C653.

1. Check with the local sewer department or authority for conditions of disposal of heavily chlorinated water to any sanitary sewer.
2. Chlorine residual of water being disposed will be neutralized by treating with one of the chemicals in Table A.1.

Table A.1 Pounds of chemicals required to neutralize various residual chlorine concentrations in 100,000 gal of water*

Residual Chlorine Concentration <i>mg/L</i>	Sulfur Dioxide (SO ₂) <i>lb</i>	Sodium Bisulfate (NaHSO ₃) <i>lb</i>	Sodium Metabisulfite (Na ₂ S ₂ O ₅) <i>lb</i>	Sodium Sulfite (Na ₂ SO ₃) <i>lb</i>
1	0.8	1.2	1.1	1.5
2	1.5	2.4	2.2	3.0
10	7.5	12.2	11.2	14.8
50	38	61	56	74

*CAUTION: A substantial excess of dechlorinating chemical also may be harmful to the environment. Care should be exercised to balance the amount of dechlorinating chemical against the chlorine present.

NOTE: Sodium thiosulfate (Na₂S₂O₅•5H₂O) can also be used as a dechlorinating agent. However, dosages are pH dependent, and must be calculated for each water.