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(Revision of ANSI/AWWA C652-11)

AWWA Standard

Disinfection of Water-Storage Facilities

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American Water Works
Association



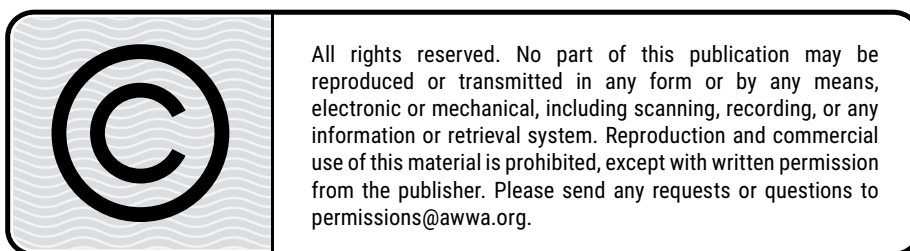
AWWA Standard

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA C652.*

I. Introduction.

I.A. *Background.* This standard describes methods of disinfecting water-storage tanks. The disinfecting agents discussed in this standard are chlorine solutions, and several combinations of free chlorine residual and contact time (CT) are provided. The chlorine solutions may be derived from liquid chlorine (Cl_2), calcium hypochlorite ($\text{Ca}(\text{OCl})_2$), or sodium hypochlorite (NaOCl).

I.B. *History.* This standard was first approved on June 15, 1980, under the designation ANSI/AWWA D105, Standard for Disinfection of Water-Storage Facilities. The 1980 edition was developed from information originally contained in AWWA D102-64, modified to include disinfection of water-storage facilities constructed of steel or other materials. The standard was redesignated ANSI/AWWA C652 with the 1986 edition. It was later revised in 1992 and again in 2002. The 2011 edition was approved by the AWWA Board of Directors on June 12, 2011. This edition was approved on Oct. 28, 2019.

I.C. *Acceptance.* In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF[†] International (NSF) to develop voluntary third-party consensus standards and a certification program for direct and indirect drinking water additives. Other members of the original consortium included the Water Research Foundation (formerly AwwaRF) and the Conference of State Health and Environmental Managers (COSHEM). AWWA and the Association of State Drinking Water Administrators (ASDWA) joined later.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.[‡] Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including

1. Specific policies of the state or local agency.

* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

[†] NSF International, 789 North Dixboro Road, Ann Arbor, MI 48105.

[‡] Persons outside the United States should contact the appropriate authority having jurisdiction.

2. Two standards developed under the direction of NSF, NSF/ANSI/CAN* 60, Drinking Water Treatment Chemicals—Health Effects, and NSF/ANSI/CAN 61, Drinking Water System Components—Health Effects.

3. Other references, including AWWA standards, *Food Chemicals Codex*, *Water Chemicals Codex*,[†] and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with NSF/ANSI/CAN 61. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdiction. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Annex A, “Toxicology Review and Evaluation Procedures,” to NSF/ANSI/CAN 61 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of “unregulated contaminants” are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

ANSI/AWWA C652 does not address additives requirements. Thus, users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.
2. Determine the status of certifications by parties offering to certify products for contact with, or treatment of, drinking water.
3. Determine current information on product certification.

II. Special Issues.

II.A. *Information on Application of This Standard.* Utilities are increasingly focusing on water-storage reservoir management and maintenance as part of preserving distribution system water quality. Disinfection of water-storage tanks presents special challenges because of the quantity of water that must be dealt with, the conditions of the water supplied to the tank, and the ability to collect representative samples of the water in the tank.

Disinfection of tanks and other facilities used for drinking water relies on high levels of free chlorine to ensure bacteria and other potential pathogens are inactivated. It should be noted that pH and temperature are two important factors affecting

* Standards Council of Canada, 55 Metcalfe Street, Suite 600, Ottawa, ON K1P 6L5 Canada.

[†] Both publications available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001.

the disinfection process. Hypochlorous acid and hypochlorite are the two forms of chlorine present in water at pH greater than 3. Hypochlorous acid has been shown to be significantly more effective than hypochlorite for disinfection. Above pH 9, there is essentially no hypochlorous acid, only hypochlorite. Temperature also affects the effectiveness of disinfection; low temperatures are not as effective as high temperatures for chlorine disinfection. The high chlorine dosages required in this standard are necessary to provide effective disinfection under varying conditions of pH, temperature, and other factors.

In addition, systems using chloramines in their water supply will need to consider the impacts of chloramines and free chlorine mixing within the tank to be disinfected. Higher chlorine doses will be required to achieve the specified free chlorine residuals listed in this standard (to pass through breakpoint chlorination). Depending on the method selected, if a free chlorine residual is present in the tank to be activated into the water system, it could result in depressed residuals in the service area it supplies.

Following disinfection and before activating the tank for use, water in the storage tank should be tested to determine that it meets expected parameters typical in the system. Consider especially the work done in the tank and appropriate parameters to measure. Test results should confirm that the water quality is appropriate for distribution. Although this assessment is unique for each system, suggested test parameters include pH, alkalinity, turbidity, odor, and specific conductance. If the tank was painted or if epoxy was applied, measuring levels of volatile organic compounds (VOCs) or other components of the coating material (such as zinc) may be necessary, noting that the trihalomethanes (THMs) chloroform, bromodichloromethane, dibromochloromethane, and bromoform, which are part of the VOC test, are a result of disinfection, not coating materials, and would be expected to be present. Satisfactory chlorine residual and coliform results are also required.

When collecting samples for analysis of coliform or other parameters, it is important that the sample represent the water quality in the tank. Sample taps need to be clean and sanitary. In some cases, samples may need to be collected from the top of the tank or hatch. When sampling from the top of the tank or hatch, use of a depth sampler may be beneficial to best represent the quality of water that will enter the system.

For bacteriological tests, the results of testing must show no coliform. Given the different test procedures available for coliform analysis, results should be expressed as "confirmed coliform" and should be <1 cfu/100 mL, < 1 MPN/100 mL, or "Absent."

While bacteriological testing in accordance with Section 5 is used to verify the absence of coliform organisms and is generally accepted as verification that acceptable

disinfection has been accomplished, following sanitary procedures during the course of all work is necessary to ensure the disinfected tank will be ready for activation.

Disinfectants other than chlorine may be appropriate to use. While this standard describes only the use of liquid chlorine (gas), sodium hypochlorite solutions, and calcium hypochlorite, the applicability of other disinfectants should be evaluated. Ozone, chlorine dioxide, and chemical cleaners have been used, and these warrant further investigation. Whichever disinfectant or method is selected, approval from the local regulatory agency may be required.

Depending upon the nature of the work in the water-storage facility, disinfection may or may not be required. Storage facilities dewatered for purposes of entering the tank and performing painting, repairs, or other highly invasive activities shall be disinfected and sampled. In some cases, the tank may remain in service, or isolated, for minimally intrusive activities such as remotely operated vehicle (ROV) or diver inspections. Where rigorous sanitary procedures have been followed, only sampling may be required.

As more frequent inspections and cleaning of reservoirs are required, utilities are turning to methods that minimize downtime and wasted water. Utilities may use methods employing divers or ROVs for both inspection and sediment removal. Section 4.4 of this standard describes the disinfection procedures and operational considerations for conducting inspection and cleaning in potable-water-storage facilities. Any underwater retrieval of ROVs with divers must be performed in accordance with all aspects of this standard. When selecting a contractor to perform this type of work, it is essential to evaluate their experience, safety procedures, and methods. Each bidder should be willing to meet the minimum requirements set by this standard for safe performance of the work. This standard includes references to pertinent OSHA regulations. There are specific technical skills a purchaser should look for when considering a firm for this type of work, such as the following:

- Qualifications for conducting in-service operations in compliance with OSHA.
- Qualifications for inspecting and evaluating steel/concrete/wood or membrane-covered reservoirs.
- Résumés for the specific personnel who will perform underwater inspection and/or cleaning.

Section 4.4 does not address the following items, each of which must be specified by the purchaser:

1. The type of inspection to be performed (structural, coating, bottom sediment, cathodic protection, bacteriological, etc.).

2. The technical requirements of the inspection and/or cleaning.

For additional guidance, refer to AWWA Manual M42, *Steel Water-Storage Tanks*.

Section 4.4 does not attempt to rewrite existing safety standards and relies on the existing applicable OSHA Standards, including but not limited to

- OSHA, 29 CFR, Subpart T, Commercial Diving Operations, 1910.401 through 1910.440.
- OSHA, 29 CFR, Permit-Required Confined Spaces, 1910.146.

III. Use of This Standard. This standard describes methods of disinfecting water-storage facilities that are newly constructed, have been entered for construction or inspection purposes, or continue to show the presence of coliform bacteria during normal operation. In addition, the standard defines disinfection procedures for underwater inspections because water utilities increasingly are employing divers and ROVs to conduct underwater inspections and/or cleaning of in-service potable-water-storage facilities to minimize water loss and downtime normally associated with necessary maintenance. The standard does not describe the type and technical requirements of underwater inspection and/or cleaning or the required skill level of the diving inspector. This standard is meant to be used for tanks within public water systems and is not intended for storage tanks within premise plumbing systems in buildings. Premise plumbing components in buildings use a wide variety of materials, including some that may not be compatible with the chlorine concentrations in this standard.

A storage facility is defined as a reservoir from which water, without further treatment other than booster disinfection, is supplied directly to the distribution piping system for domestic use. From a practical standpoint, this standard applies to the disinfection of covered storage facilities constructed of steel, concrete, or materials that would provide a similar structure from a water quality standpoint. Because wood may support the growth of coliform bacteria, it is recommended that any submerged wood surface (columns, baffles, etc.) be coated with epoxy or other durable, effectively impermeable paint or coating approved for domestic water use.

Parts of this standard may be applicable to the disinfection of large, finished-water, open storage reservoirs, such as reservoirs formed by concrete or earth dams, but these

applications are incidental, and this standard is not intended to cover those kinds of storage facilities.

Three methods of chlorinating storage facilities are described in this standard. Each purchaser should decide which method is most suitable for a given situation. In selecting the method to be used, personnel should consider the availability of materials and equipment for disinfection, the training of personnel who will perform the disinfection, chlorinated water disposal options, and safety. For example, gas chlorination should be used only when properly designed and constructed equipment is available; makeshift equipment is not acceptable when liquid-chlorine cylinders are used. Spray equipment should be used inside the storage facility only when thorough ventilation is ensured or when appropriate protection is provided using canister-type gas masks or self-contained breathing units. If a chlorination method is selected that requires the storage facility to be drained in order to dispose of highly chlorinated water, thorough consideration should be given to the effect on the receiving environment. If there is any question as to whether a chlorinated-waste discharge may cause damage to fish life, plant life, physical installations, or other downstream water uses of any type, an adequate amount of a reducing agent should be applied to the discharged water to thoroughly neutralize the chlorine residual. The effects of chloramines in the potable supply should also be evaluated in terms of dosing and ability to meet specified free chlorine residual requirements.

It is the responsibility of the user of an AWWA standard to determine that the products and procedures described in that standard are suitable for use in the particular application being considered.

III.A. Purchaser Options and Alternatives. This standard is written as though the work will be done by the purchaser's personnel. If the purchaser is contracting for the work to be done, appropriate provisions should be included in the contract agreement to ensure the contractor is specifically instructed as to his or her responsibilities. At a minimum, the purchaser should specify the following:

1. Standard used—that is, ANSI/AWWA C652, Disinfection of Water-Storage Facilities, of latest revision.
2. Details of federal, state, and local requirements (Sec. 4.1.1).
3. Whether compliance with NSF/ANSI/CAN 60, Drinking Water Treatment Chemicals—Health Effects, is required.
4. Method of disinfection to be used.

5. Any required disposal and precautions to be taken in disposing of chlorinated water in the storage facility.

6. Bacteriological testing and method to be used.

7. Redisinfection procedure if required.

III.B. *Modification to Standard.* Any modification of the provisions, definitions, or terminology in this standard must be provided by the purchaser.

IV. Major Revisions. Major changes made in this revision of ANSI/AWWA C652 are as follows:

1. Additions were made to address concerns in achieving chlorine levels in chloraminated systems throughout the standard.

2. Clarification was added regarding the use of this standard with public water system tanks and not for tanks used within premise plumbing systems (Sec. III and Sec. 1.1)

3. Provides clarification on when disinfection, sampling, or both may be required (Sec. II.A. and Sec. 1.1).

4. Acknowledges ROVs may be used for tank inspections.

5. Appendix C – Disposal of Highly Chlorinated Water has been deleted. For dechlorination procedures, the standard now refers to ANSI/AWWA C655, Field Dechlorination.

6. Definitions for chloramine, inspection firm, liquid chlorine (gas), reclaimed water, and wastewater have been added.

V. Comments. If you have any comments or questions about this standard, please call AWWA Engineering and Technical Services at 303.794.7711, FAX at 303.795.7603, write to the department at 6666 West Quincy Avenue, Denver, CO 80235-3098, or e-mail at standards@awwa.org.

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(Revision of ANSI/AWWA C652-11)

AWWA Standard

Disinfection of Water-Storage Facilities

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard for disinfection of water-storage facilities describes materials, facility preparation, application of disinfectant to interior surfaces of facilities, and sampling and testing for the presence of coliform bacteria, chlorine residual, and acceptable aesthetic water quality. The standard also includes disinfection procedures for underwater inspection and/or cleaning of potable-water-storage facilities but does not describe the technical aspects of underwater inspection and/or cleaning. All new storage facilities shall be disinfected before they are placed in service. Depending upon the nature of work performed on an existing tank and the potential for contamination, disinfection and/or sampling only may be appropriate. Storage facilities dewatered for purposes of entering the tank and performing painting, repairs, or other highly invasive activities shall be disinfected and sampled. In some cases, the tank may remain in service, or isolated, for minimally intrusive activities such as ROV or diver inspections. Where rigorous sanitary procedures have been followed, only sampling may be required. This standard is meant to be used for tanks within public water systems and is not intended for storage tanks within premise plumbing systems in buildings. Premise plumbing components in buildings use a wide variety of materials, including some that may not be compatible with the chlorine concentrations in this standard.