American Water Works Association

ANSI/AWWA C652-92

(Revision of ANSI/AWWA C652-86)

AWWA STANDARD

FOR

DISINFECTION OF WATER-STORAGE FACILITIES

Return to
List of Standards

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AMERICAN WATER WORKS ASSOCIATION

6666 West Quincy Avenue, Denver, Colorado 80235

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Committee Personnel

The AWWA Standards Committee on Disinfection of Facilities, which reviewed and approved this standard, had the following personnel at the time of approval:

Larry A. Hensley, *Chair*

Consumer Members

P.G. Boissonneault, Portland Water District, Portland, Maine	(NEWWA)
J.C. Dice, Denver Water Department, Denver, Colo.	(AWWA)
L.A. Hensley, Gary-Hobart Water Corporation, Gary, Ind.	(AWWA)
W.E. Neuman, American Water Works Service Company Inc., Voorhees, N.J.	(AWWA)
J.P. Reames, Dallas Water Utilities Department, Dallas, Texas	(AWWA)
C.H. Smith, Consumers Illinois Water Company, Kankakee, Ill.	(AWWA)
J.L. Stapf, City of Wyoming, Wyoming, Mich.	(AWWA)

General Interest Members

K.C. Choquette,* Iowa Department of Public Health, Des Moines, Iowa	(AWWA)
B.R. Elms,† Standards Engineer Liaison, AWWA, Denver, Colo.	(AWWA)
J.V. Feuss, Cortland County Health Department, Cortland, N.Y.	(AWWA)
C.A. Froman Jr.,† Gary-Hobart Water Corporation, Gary, Ind.	(AWWA)
C.B. Hagar, Camp Dresser & McKee Inc., Phoenix, Ariz.	(AWWA)
I.M. Markwood, Alvord, Burdick and Howson, Springfield, Ill.	(AWWA)
T.W. Walker, New York State Department of Health, Victor, N.Y.	(AWWA)
M.L. Wentink, Nebraska Department of Health, North Platte, Neb.	(AWWA)

Producer Members

W.B. Huebner, Wallace & Tiernan Inc., Belleville, N.J.	(AWWA)

*Alternate

†Liaison, nonvoting

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Foreword

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

I. History of Standard. This standard was first approved on June 15, 1980, under the designation 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 AWWA C652 with the 1986 edition.

II. Advisory Information on 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 that 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 to conduct underwater inspections of on-line potable-water-storage facilities to minimize water loss and downtime normally associated with necessary maintenance inspections. The standard does not cover the type and technical requirements of underwater inspection, or the required skill level of the diving inspector.

A storage facility is defined as a reservoir from which water, without further treatment, 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. Since wood may support the growth of coliform bacteria, it is recommended that any submerged wood surface (columns, baffles, and so forth) 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 such 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 utility should decide which method is most suitable for a given situation. In selecting the method to be used, the utility should consider the availability of materials and equipment for disinfection, the training of personnel who will perform the disinfection, 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 assured or when appropriate protection is provided by the use of canister-type gas masks or self-contained breathing units. If a chlorination method is selected that requires the draining of a storage facility in order to dispose of highly chlorinated water, then 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, then an adequate amount of a reducing agent should be applied to the discharged water in order to thoroughly neutralize the chlorine residual.

III. 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 all direct and indirect drinking water additives. Other members of the consortium included the American Water Works Association Research Foundation (AWWARF), the Conference of State Health and Environmental Managers (COSHEM), the American Water Works Association (AWWA), and the Association of State Drinking Water Administrators (ASDWA). The consortium is responsible for the cooperative effort of manufacturers, regulators, product users, and other interested parties that develop and maintain the NSF standards.

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. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on Apr. 7, 1990.
2. Specific policies of the state or local agency.
3. Two standards developed under the direction of NSF, ANSI†/NSF‡ 60, Drinking Water Treatment Chemicals—Health Effects, and ANSI/NSF 61, Drinking Water System Components—Health Effects.
4. 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 ANSI/NSF 60. 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.

Appendix A, "Toxicology Review and Evaluation Procedures," to ANSI/NSF 60 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 Appendix A procedures may not always be identical, depending on the certifier.

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 all parties offering to certify products for contact with, or treatment of, drinking water.

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*Persons in Canada, Mexico, and non-North American countries should contact the appropriate authority having jurisdiction.

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

‡NSF International, 3475 Plymouth Rd., Ann Arbor, MI 48106.

§Both publications available from National Academy of Sciences, 2102 Constitution Ave. N.W., Washington, DC 20418.

3. Determine current information on product certification.

IV. Information Required for Use of This Standard. This standard is written as though the work will be done by the purchaser's personnel. If the purchaser is contracting for such work to be done, appropriate provisions should be included in the contract agreement to ensure that the constructor is specifically instructed as to his responsibilities. At the least, the purchaser should specify the following:

1. Standard used—that is, AWWA C652-92, Standard for Disinfection of Water-Storage Facilities.
2. Method of disinfection to be used.
3. Any required disposal and precautions to be taken in disposing of chlorinated water in the storage facility.
4. Bacteriological testing and method to be used.
5. Redisinfection procedure if required.

V. Modification to Standard. Any modification of the provisions, definitions, or terminology in this standard must be provided in the purchaser's specifications.

VI. Major Revisions. Major changes made in this revision of AWWA C652 are as follows:

1. Section II, Advisory Information on Use of This Standard, was added to the foreword.
2. Section III, Acceptance, was added to the foreword.
3. Section V, Modification to Standard, was added to the foreword.
4. Section 5, Disinfection Procedures When Conducting Underwater Inspection of Potable-Water-Storage Facilities, was added.
5. Table A.2, Amounts of Chemicals Required to Give Chlorine Concentrations of 200 mg/L in Various Volumes of Water, was added.

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AWWA STANDARD FOR

DISINFECTION OF WATER-STORAGE FACILITIES

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard for disinfection of water-storage facilities covers materials, facility preparation, application of disinfectant to interior surfaces of facilities, and sampling and testing for the presence of coliform bacteria. The standard also includes disinfection procedures for underwater inspection of on-line, potable-water-storage facilities, but does not cover the technical aspects of underwater inspection. All new storage facilities shall be disinfected before they are placed in service. All storage facilities taken out of service for inspecting, repairing, painting, cleaning, or other activity that might lead to contamination of water shall be disinfected before they are returned to service.

Sec. 1.2 References

This standard references the following documents. The latest current edition of each document forms a part of this standard where and to the extent specified herein. In case of any conflict, the requirements of this standard shall prevail.

ANSI*/AWWA B300—Standard for Hypochlorites.

ANSI/AWWA B301—Standard for Liquid Chlorine.

Standard Methods for the Examination of Water and Wastewater. APHA,† AWWA, and WEF.‡ Washington, D.C. (18th ed., 1992).

*American National Standards Institute Inc., 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.

Additional materials relating to activity under this standard include the following:

Chlorine Manual—Chlorine Institute Inc.*

Introduction to Water Treatment. WSO Series, Vol. 2. AWWA, Denver (1984).

Material safety data sheets for forms of chlorine used (provided by suppliers).

Safety Practice for Water Utilities. AWWA Manual M3. AWWA, Denver (1990).

Water Chlorination Principles and Practices. AWWA Manual M20. AWWA, Denver (1973).

Water Quality and Treatment. AWWA, Denver (4th ed., 1990).

Sec. 1.3 Record of Compliance

The record of compliance shall be the bacteriological test results certifying that the water held in the storage facility is free of coliform bacteria contamination.

SECTION 2: CLEANING

All scaffolding, planks, tools, rags, and other materials not part of the structural or operating facilities of the tank shall be removed. Then the surfaces of the walls, floor, and operating facilities of the storage facility shall be cleaned thoroughly using a high-pressure water jet, sweeping, scrubbing, or equally effective means. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the storage facility or otherwise removed.

Sec. 2.1 Other Materials

Following the cleaning operation, the vent screen, overflow screen, and any other screened openings shall be checked and put in satisfactory condition to prevent birds, insects, and other possible contaminants from entering the facility. Any material required to be in the operating storage facility after the cleaning procedure has been completed shall be clean and sanitary when placed in the facility. In such instances, care shall be taken to minimize the introduction of dirt or other foreign material. (For example, placing a layer of limestone granules on the unpainted bottom of the storage facility to prevent corrosion.)

SECTION 3: FORMS OF CHLORINE FOR DISINFECTION

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

Sec. 3.1 Liquid Chlorine

Liquid chlorine conforming to ANSI/AWWA B301 contains 100 percent available chlorine and is packaged in steel containers usually of 100-lb, 150-lb, or 1-ton (45.4-kg, 68.0-kg, or 907.2-kg) net chlorine weight. Liquid chlorine shall be used only (1) in combination with appropriate gas-flow chlorinators and ejectors to provide a

*Chlorine Institute Inc., 2001 L St. N.W., Washington, DC 20036.

controlled high-concentration solution feed 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.

Sec. 3.2 Sodium Hypochlorite

Sodium hypochlorite conforming to ANSI/AWWA B300 is available in liquid form in glass, rubber-lined, or plastic containers typically ranging in size from 1 qt (0.95 L) to 5 gal (18.92 L). Containers of 30 gal (113.6 L) or larger may be available in some areas. Sodium hypochlorite contains approximately 5 percent to 15 percent available chlorine by volume, and care must be taken to control storage conditions and length of storage to minimize its deterioration.

Sec. 3.3 Calcium Hypochlorite

Calcium hypochlorite conforming to ANSI/AWWA B300 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.

SECTION 4: ALTERNATIVE METHODS OF CHLORINATION

Three methods of chlorination are explained in this standard. Typically, only one method will be used for a given storage-facility disinfection, but combinations of the methods may be used. The three methods are (1) chlorination of the full storage facility such that, at the end of the appropriate retention period, the water will have a free chlorine residual of not less than 10 mg/L; (2) spraying or painting of all storage facility water-contact surfaces with a solution of 200-mg/L available chlorine; and (3) chlorination of full storage facility with water having a free chlorine residual of 2 mg/L after 24 h.*

Sec. 4.1 Chlorination Method 1

The water-storage facility shall be filled to the overflow level with potable water to which enough chlorine is added to provide a free chlorine residual in the full facility of not less than 10 mg/L at the end of the appropriate 6-h or 24-h period, as described in Sec. 4.1.4. The chlorine, either as calcium hypochlorite, sodium hypochlorite, or liquid chlorine, shall be introduced into the water as described hereafter.

4.1.1 *Liquid-chlorine use.* Liquid chlorine shall be introduced into the water filling the storage facility in such a way as to give a uniform chlorine concentration during the entire filling operation. Portable chlorination equipment shall be carefully operated and shall include a liquid-chlorine cylinder, gas-flow chlorinator, chlorine ejector, safety equipment, and an appropriate solution tube to inject the high-concentration chlorine solution into the filling water. The solution tube shall be

*For reference, amounts of chemicals needed for various chlorine concentrations are shown in appendix A, Table A.1.

inserted through an appropriate valve located on the inlet pipe and near the storage facility such that the chlorine solution will mix readily with the inflowing water.

4.1.2 *Sodium hypochlorite use.* Sodium hypochlorite shall be added to the water entering the storage facility by means of a chemical-feed pump, or shall be applied by hand-pouring into the storage facility and allowing the inflowing water to provide the desired mixing.

4.1.2.1 When a chemical-feed pump is used, the concentrated chlorine solution shall be pumped through an appropriate solution tube so as to inject the high-concentration chlorine solution at a rate that will give a uniform chlorine concentration in the filling water. The solution tube shall be inserted through an appropriate valve located on the inlet pipe and near the storage facility, or through an appropriate valve located on the storage facility such that the chlorine solution will mix readily with the filling water.

4.1.2.2 When the sodium hypochlorite is poured into the storage facility, the filling of the storage facility shall begin immediately thereafter or as soon as any removed manhole covers can be closed. The sodium hypochlorite may be poured through the cleanout or inspection manhole in the lower course or level of the storage facility, in the riser pipe of an elevated tank, or through the roof manhole. The sodium hypochlorite shall be poured into water in the storage facility when such water is not more than 3 ft (0.9 m) in depth, nor less than 1 ft (0.3 m) in depth or as close thereto as manhole locations permit.

4.1.3 *Calcium hypochlorite use.* Calcium hypochlorite granules or tablets broken or crushed to sizes not larger than ¼-in. (6.4-mm) maximum dimension may be poured or carried into the storage facility through the cleanout or inspection manhole in the lower course or level of the storage facility, into the riser pipe of an elevated tank, or through the roof manhole. The granules or tablet particles shall be placed in the storage facility before flowing water into it. The granules or tablets shall be located so that the inflowing water will ensure a current of water circulating through the calcium hypochlorite, dissolving it during the filling operation. The calcium hypochlorite shall be placed only on dry surfaces unless adequate precautions are taken to provide ventilation or protective breathing equipment.

4.1.4 *Retention period.* After the storage facility has been filled with the disinfecting water, it shall stand full as follows: (1) for a period of not less than 6 h when the water entering the storage facility has been chlorinated uniformly by gas-feed equipment or chemical pump, or (2) for a period of not less than 24 h when the storage facility has been filled with water that has been mixed with sodium hypochlorite or calcium hypochlorite within the storage facility as described in Sec. 4.1.2 and Sec. 4.1.3.

4.1.5 *Handling of disinfection water.* After the retention period stated in Sec. 4.1.4, the free chlorine residual in the storage facility shall be reduced to a concentration appropriate for distribution (not more than 2 mg/L) by completely draining the storage facility and refilling with potable water, or by a combination of additional holding time and blending with potable water having a low chlorine concentration. When an appropriate chlorine concentration is reached and subject to satisfactory bacteriological testing and acceptable aesthetic quality, such water may be delivered to the distribution system.

4.1.5.1 The environment into which the chlorinated water is to be discharged shall be inspected, and if there is any likelihood that the chlorinated discharge will cause damage, then a reducing agent shall be applied to the water to be wasted to thoroughly neutralize the chlorine residual in the water. Federal, state, or local

environmental regulations may require special provisions or permits prior to disposal of highly chlorinated water. The proper authorities should be contacted prior to disposal of highly chlorinated water.

Sec. 4.2 Chlorination Method 2

A solution of 200-mg/L available chlorine shall be applied directly to the surfaces of all parts of the storage facility that would be in contact with water when the storage facility is full to the overflow elevation.

4.2.1 *Method of application.* The chlorine solution may be applied with suitable brushes or spray equipment. The solution shall thoroughly coat all surfaces to be treated, including the inlet and outlet piping, and shall be applied to any separate drain piping such that it will have available chlorine of not less than 10 mg/L when filled with water. Overflow piping need not be disinfected.

4.2.2 *Retention.* The disinfected surfaces shall remain in contact with the strong chlorine solution for at least 30 min, after which potable water shall be admitted, the drain piping purged of the 10-mg/L chlorinated water, and the storage facility then filled to its overflow level. Following this procedure, and subject to satisfactory bacteriological testing and acceptable aesthetic quality, such water may be delivered to the distribution system.

Sec. 4.3 Chlorination Method 3

Water and chlorine shall be added to the storage facility in amounts such that the solution will initially contain 50 mg/L available chlorine and will fill approximately 5 percent of the total storage volume. This solution shall be held in the storage facility for a period of not less than 6 h. The storage facility shall then be filled to the overflow level by flowing potable water into the highly chlorinated water. It shall be held full for a period of not less than 24 h. All highly chlorinated water shall then be purged from the drain piping. Following this procedure, and subject to satisfactory bacteriological testing and acceptable aesthetic quality, the remaining water may be delivered to the distribution system.

4.3.1 *Adding chlorine.* Chlorine shall be added to the storage facility by the method described in Sec. 4.1.1, Sec. 4.1.2, or Sec. 4.1.3. The actual volume of the 50-mg/L chlorine solution shall be such that, after the solution is mixed with filling water and the storage facility is held full for 24 h, there will be a free-chlorine residual of not less than 2 mg/L.

Sec. 4.4 Bacteriological Sampling and Testing

After the chlorination procedure is completed, and before the storage facility is placed in service, water from the full facility shall be sampled and tested for coliform organisms in accordance with the latest edition of *Standard Methods for the Examination of Water and Wastewater*. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique.

4.4.1 *Test for odor.* The water in the full facility should also be tested to assure that no offensive odor exists due to chlorine reactions or excess chlorine residual.

4.4.2 *Results of testing.* If the test for coliform organisms is negative, then the storage facility may be placed in service. If the test shows the presence of coliform bacteria, then the situation shall be evaluated by a qualified engineer. In any event, repeat samples shall be taken until two consecutive samples are negative, or the storage facility shall again be subjected to disinfection.

4.4.3 *Care in sampling.* The samples shall be taken from a sample tap on the outlet piping from the storage facility or from a sample tap connected directly to the storage facility. In either case, the operation shall be such as to ensure that the sample collected is actually from water that has been in the storage facility.

4.4.4 *Recommended additional samples.* During the disinfection operation and the required sampling of water from the storage facility, it is recommended that samples be taken from water inflowing to the storage facility to determine if coliforms are present in the typical potable water source.

SECTION 5: DISINFECTION PROCEDURES WHEN CONDUCTING UNDERWATER INSPECTION OF POTABLE-WATER-STORAGE FACILITIES

Increasingly, utilities are using divers to conduct underwater inspections of isolated, on-line, potable-water reservoirs to minimize water wastage and downtime associated with necessary storage-facility maintenance. This section sets forth disinfection procedures for conducting underwater inspections of potable-water-storage facilities. These disinfection procedures are required to assure that the potable quality of the reservoir contents is not compromised by underwater inspection work performed by divers.

This section 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, and so forth).
2. The technical requirements of the inspection.
3. Skill levels required of the diving inspector.

Generally, the water-storage facility shall be removed from service prior to the inspection and the free chlorine residual of the contents determined. All diving and inspection equipment and clothing used by the diver(s) shall be disinfected immediately prior to use within the water-storage facility. Debris and other contamination shall be prevented from blowing or falling into the facility at all times during inspection. Following the dive, adequate disinfection and bacteriological testing of the water in the facility shall be successfully completed before placing the facility back in service.

Sec. 5.1 Storage-Facility Isolation

The water-storage facility shall be removed from service and isolated from the system prior to the inspection by closing all inlet and outlet valves. Flowmeters and the tank level should be monitored to verify that the facility has been isolated. The underwater inspection should be made with the water-storage facility as full as possible. If the reservoir inlet/outlet valve(s) must be inspected in the open position, system valves farther upstream (and downstream) should be closed.

On-line inspection of storage facilities without isolation should be avoided. However, if special conditions necessitate underwater inspection without isolation, then the diving work should only be done during periods when flow rates into or out of the water-storage facility are minimal. For underwater inspection of nonisolated

facilities having a common inlet–outlet pipe, it is recommended that a positive flow into the storage facility be maintained during the dive.

Sec. 5.2 Storage-Facility Access

Before the facility access hatch is opened, the hatch and immediate area should be cleaned of all loose dirt and debris. The working area in the immediate vicinity of the access hatch shall be covered with a protective plastic sheet, which, once in place, should be washed with the disinfectant solution (see Sec. 5.6).

Wind screens or other protective devices should be provided to prevent wind-blown or dropped contaminants from entering the storage facility after the hatch is opened.

Sec. 5.3 Initial Water Quality

The first step of any underwater inspection project shall be to establish the free chlorine residual in the reservoir contents before entering the reservoir for any other purpose. Representative water samples shall be taken from several locations and analyzed for free chlorine residual. The results shall be recorded for future reference.

Sec. 5.4 Equipment and Personnel Requirements

5.4.1 *Equipment and clothing.* All diving and inspection equipment and clothing to be used for underwater inspection of potable-water-storage facilities shall be dedicated for that purpose only. Only external-air-supplied equipment shall be used. Certification of equipment and clothing-use history shall be provided to the water utility, and the items shall be available for inspection. All equipment and clothing shall be suitable for disinfection. Diving clothing shall be of the dry-suit type and shall be in good condition, free from tears, scrapes, unrepaired areas, or other imperfections that may impair the integrity of the suit. The diver and the clothing shall be disinfected after the diver is suited up. Between uses, all equipment and clothing dedicated for potable-water, underwater inspection work shall be stored in a manner that prevents both chemical and bacteriological contamination.

5.4.2 *Personnel requirements.* It is recommended that the dive team performing the work should include a minimum of two SCUBA-certified divers (one being a standby diver), each with diving experience in closed, confined spaces, and experience in the use of the underwater inspection equipment. Unless otherwise specified by the purchaser, the standby diver need not be suited up and, in case of emergency, is not required to undergo disinfection procedures before entering the water-storage facility.

All personnel on the dive team shall be free of communicable diseases and shall not have been under a physician's care within the seven-day period prior to entering the facility. No person who knowingly has an abnormal temperature or symptoms of illness shall work in a water-storage facility. The water utility has the right to request a physician's assurance (based on an examination within the 48-h period immediately prior to the time the diver enters the water-storage facility) that all inspection personnel are free of water-transferable communicable diseases.

5.4.3 *Safety.* The team shall comply with all related local, state, and federal safety requirements and provide all necessary safety equipment suitable for the specific access opening, depth to water, and other aspects of the water-storage facility to be inspected.

5.4.4 *Predive meeting.* A predive meeting involving the dive team and water utility representatives shall be held to ensure that the divers understand the configuration of the reservoir and any underwater appurtenances, any time restrictions, diving conditions, and inspection requirements. Any problems associated with dive logistics should be resolved at this time.

Sec. 5.5 Equipment Disinfection

The diving suit and all equipment to be used within the water-storage facility must be disinfected immediately prior to the diver's entrance into the potable-water reservoir. Equipment to be used for nondiving inspection of a water-storage facility, such as a rubber boat used for survey, shall be disinfected in a manner similar to disinfection of the diver's equipment. All equipment to be in contact with the water, such as diving apparatus and clothing, inspection equipment, boats, paddles, ropes, and so forth, shall be disinfected.

The method of equipment disinfection can be submersion in, spraying with, or sponging with disinfectant solution as defined in Sec. 5.6. The preferred methods are

1. Complete immersion of equipment in the disinfectant solution.
2. Thorough and complete sponging of the diver with disinfectant solution after suiting up and again after donning all equipment.
3. Providing a foot bath containing disinfectant solution for the diver to submerge the flippers prior to entry. After the foot bath, the diver should immediately enter the storage facility to avoid contamination.

Care must be taken when applying disinfectant solution to the diver and equipment so that any excess, runoff, or spillage is controlled and disposed of in an environmentally sound manner acceptable to the local regulatory authorities. Care should also be taken when applying the disinfectant solution to the diver to avoid contact with the eyes or prolonged contact with the skin.

Sec. 5.6 Disinfectant Solution

The disinfectant solution shall have a minimum of 200 mg/L free available chlorine. The type and amount of chemical required to produce the required 200-mg/L concentration in various quantities of water are presented in Table A.2 of appendix A. The strength of the disinfectant solution shall be verified with a chlorine test kit before use.

Sec. 5.7 Postinspection Chlorine Residual and Bacteriological Testing

If proper disinfection procedures are followed, there should be no need to increase the chlorine residual in the storage facility after completion of the inspection. However, after all divers and equipment are removed from the water-storage facility, the chlorine residual in the facility shall be retested. If the chlorine residual has dropped from that indicated by the initial test made prior to entry, sufficient chlorine solution or granules shall be added to the storage facility to return the free chlorine residual to preentry levels, but not to exceed a free chlorine concentration of 2 mg/L. Disinfectant shall be added in a manner to achieve maximum distribution over the surface and achieve all possible mixing. Adequate mixing can be promoted by recirculation, if available, or with portable mixers or portable pumps suitably disinfected. (NOTE: The pre- and postdive residuals may not match exactly due to sampling and analytical variability.)

With the chlorine residual at preentry levels, samples for coliform organisms should be taken and analyzed in accordance with Sec. 4.4.

If the chlorine residual in the storage facility did not drop during the inspection, the facility can be returned to service as soon as the bacteriological samples have been confirmed as acceptable. However, if it was necessary to rebuild the chlorine residual in the storage facility after completion of the diver's work, then the storage facility should not be placed in service until after completion of a satisfactory bacteriological analysis.

APPENDIX A
Chlorine Dosages

This appendix is for information only and is not a part of AWWA C652.

Table A.1 Amounts of chemicals required to give various chlorine concentrations in 100,000 gal (378.5 m^3) of water*

Desired Chlorine Concentration in Water	Liquid Chlorine Required		Sodium Hypochlorite Required						Calcium Hypochlorite Required	
			5 Percent Available Chlorine		10 Percent Available Chlorine		15 Percent Available Chlorine		65 Percent Available Chlorine	
mg/L	*lb*	*(kg)*	*gal*	*(L)*	*gal*	*(L)*	*gal*	*(L)*	*lb*	*(kg)*
2	1.7	(.77)	3.9	(14.7)	2.0	(7.6)	1.3	(4.9)	2.6	(1.18)
10	8.3	(3.76)	19.4	(73.4)	9.9	(37.5)	6.7	(25.4)	12.8	(5.81)
50	42.0	(19.05)	97.0	(367.2)	49.6	(187.8)	33.4	(126.4)	64.0	(29.03)

*Amounts of sodium hypochlorite are based on concentrations of available chlorine by volume. For either sodium hypochlorite or calcium hypochlorite, extended or improper storage of chemicals may have caused a loss of available chlorine.

Table A.2 Amounts of chemicals required to give chlorine concentrations of 200 mg/L in various volumes of water*

Volume of Water		Liquid Chlorine Required		Sodium Hypochlorite Required						Calcium Hypochlorite Required	
				5 Percent Available Chlorine		10 Percent Available Chlorine		15 Percent Available Chlorine		65 Percent Available Chlorine	
gal	*(L)*	*lb*	*(g)*	*gal*	*(L)*	*gal*	*(L)*	*gal*	*(L)*	*lb*	*(g)*
10	(37.9)	0.02	(9.1)	0.04	(.15)	0.02	(.08)	0.02	(.08)	0.03	(13.6)
50	(189.3)	0.1	(45.4)	0.2	(.76)	0.1	(.38)	0.07	(.26)	0.15	(68.0)
100	(378.5)	0.2	(90.7)	0.4	(1.51)	0.2	(.76)	0.15	(.57)	0.3	(136.1)
200	(757.1)	0.4	(181.4)	0.8	(3.03)	0.4	(1.51)	0.3	(1.14)	0.6	(272.2)

*Amounts of sodium hypochlorite are based on concentrations of available chlorine by volume. For either sodium hypochlorite or calcium hypochlorite, extended or improper storage of chemicals may have caused a loss of available chlorine.

APPENDIX B

Disposal of Heavily Chlorinated Water

This appendix is for information only and is not a part of AWWA C652.

1. Check with local sewer department for conditions of disposal to sanitary sewer, and with the state regulatory agency for conditions of disposal to natural drainage courses.

2. Chlorine residual of disposed water will be neutralized by treating with one of the chemicals listed in Table B.1.

Table B.1 Amounts of chemicals required to neutralize various residual chlorine concentrations in 100,000 gal (378.5 m^3) of water

	Chemical Required							
Residual Chlorine Concentration	Sulfur Dioxide (SO_2)		Sodium Bisulfite ($NaHSO_3$)		Sodium Sulfite (Na_2SO_3)		Sodium Thiosulfate ($Na_2S_2O_3 \cdot 5H_2O$)	
mg/L	*lb*	*(kg)*	*lb*	*(kg)*	*lb*	*(kg)*	*lb*	*(kg)*
1	0.8	(.36)	1.2	(.54)	1.4	(.64)	1.2	(.54)
2	1.7	(.77)	2.5	(1.13)	2.9	(1.32)	2.4	(1.09)
10	8.3	(3.76)	12.5	(5.67)	14.6	(6.62)	12.0	(5.44)
50	41.7	(18.91)	62.6	(28.39)	73.0	(33.11)	60.0	(27.22)

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