

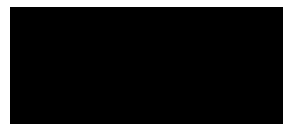
American Water Works Association

ANSI/AWWA D104-97

(Revision of ANSI/AWWA D104-91)



AWWA STANDARD
FOR
**AUTOMATICALLY CONTROLLED,
IMPRESSED-CURRENT CATHODIC
PROTECTION FOR THE INTERIOR OF
STEEL WATER TANKS**



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AMERICAN WATER WORKS ASSOCIATION

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Foreword

This foreword is for information only and is not a part of AWWA D104.

I. Introduction.

I.A. *Background.* This standard covers automatically controlled, impressed-current cathodic protection systems for the interior submerged surfaces of water storage tanks. This standard does not cover sacrificial (galvanic) anode-type cathodic protection systems or manually controlled rectifiers.

I.B. *History.* Cathodic protection equipment, which was previously included in Sec. 4 of AWWA D102-64, Painting and Repainting Steel Tanks, Standpipes, Reservoirs, and Elevated Tanks for Water Storage, was not included in AWWA D102-78, Painting Steel Water Storage Tanks. Therefore, AWWA D104 was developed by the Standards Committee on Steel Elevated Tanks, Standpipes, and Reservoirs to include this information. The first edition of ANSI/AWWA D104 was approved by the AWWA Board of Directors on Jan. 27, 1991. This edition was approved on Feb. 2, 1997.

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 all direct and indirect drinking water additives. Other members of the original consortium included the American Water Works Association Research Foundation (AWWARF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (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. 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 61. Individual states or local agencies have authority to accept or

* 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.

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 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 Appendix A procedures may not always be identical, depending on the certifier.

AWWA D104-96 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.
3. Determine current information on product certification.

II. Special Issues.

II.A. Protective Coatings. Protective coatings are commonly used in water storage tanks. They are an effective method of corrosion control except where flaws exist in the coating due to application, coating deterioration, or ice damage. When properly designed and maintained, cathodic protection systems will arrest corrosion at flaws in the submerged coated surface. Properly applied coatings reduce the bare surface area requiring protection and reduce the amount of current required to protect the surface. Use of protective coatings extends the life of the cathodic protection system and reduces operating costs. For submerged areas of a tank, cathodic protection can also reduce the frequency of coating maintenance. Cathodic protection or coatings alone can reduce corrosion on the interior submerged surfaces; however, the combination of coatings and cathodic protection may be more economical and effective than using coatings or cathodic protection alone.

II.B. Cathodic Protection. The two major components of an automatically controlled, impressed-current cathodic protection system are the DC power supply controller (rectifier) and the anode system. The range of output current capacity required for an automatically controlled rectifier in a specific application is determined by assuming the area of submerged, bare steel to be protected when the interior tank coating is new and when the interior coating has deteriorated to the point where recoating is necessary. In potable water, current density requirements can range from 0.05 to 5.0 mA/ft² (0.54 to 53.8 mA/m²). Some applications involving turbulence or high temperature, or both, may require higher current densities. For newly coated tanks, the total current requirement may be as little as 1 percent of the current required to protect an uncoated surface. As a rule, rectifiers for newly coated tanks should have sufficient current capacity to protect at least 20 percent of the submerged surface area if it were bare. The required operating voltage of a rectifier for a specific tank depends on the current required to provide adequate protection and the total circuit resistance of the system.

There are two types of automatically controlled rectifier systems: the Type A, IR drop-free system, and the Type B, current-applied system. The principal difference between the two systems is the method of measuring the tank-to-water potentials. IR drop must be eliminated or minimized to accurately determine the voltage between the tank and the reference electrode that is submerged in the tank. The Type A rectifier accomplishes this by creating an instant-off measurement (interrupts the current instantaneously), which provides an IR drop-free measurement. The Type B rectifier does not interrupt the flow of current to eliminate IR drop, but requires that the reference

electrode be located within 1 cm of the tank surface to approximate an error-free measurement.

Automatically controlled, impressed-current cathodic protection systems use one or more long-life reference electrodes, which constantly monitor the protection levels maintained on the submerged surfaces. The reference electrode is used to continuously determine the tank-to-water potential. The controller compares the actual tank-to-water potential to a preset value and automatically adjusts the current output of the rectifier. Automatic units include a tank-to-water potential monitoring meter, which can be easily checked by the purchaser.

NOTE: Manually controlled rectifiers are not recommended for use in water storage tanks and are not covered by this standard because they require frequent monitoring, testing, and manual adjustment of the rectifier current output whenever the current requirements change due to changes in water level, coating condition, temperature, water chemistry, water turbulence, or accumulation of polarization films. Failure to adjust rectifier current output can result in corrosion due to underprotection or coating damage due to overprotection.

The second major component of an automatically controlled system is the anode system. The anode system includes the anode material and the method of suspending the anode within the tank. The type of anode material and suspension system specified is typically based on the tank's susceptibility to icing conditions.

For tanks subject to icing conditions, a seasonal or a long-life anode system may be used. A seasonal (or temporary) anode arrangement consists of aluminum rods installed and serviced through hand holes in the tank roof. This type of suspension system is susceptible to ice damage. Ice will adhere to some portion of the anode string and tear the anodes loose, causing the system to fail. Since it is anticipated that the anodes will be damaged annually, low-cost aluminum rods are used. While the anode system is intact, the system will operate properly during the more corrosive summer season. In locations subject to freezing temperatures, there is usually a two- to five-month period during the winter when the system may not operate properly due to ice damage. This type of anode system will usually require annual replacement of the anodes and vertical anode suspension system. Anode remnants should be removed from the tank whenever the interior is accessible.

A long-life anode system includes suspension systems that are designed to be more resistant to ice damage and permit the use of long-life anode materials that have a design life of at least 10 years. The potential for ice damage is reduced by attaching the anode material to a buoyant or horizontally submerged spider-type rope system, which is attached to the walls of the tank and prevents the anode system from coming in contact with ice formations. Another type of system compensates for ice damage by attaching the anode material to an extendable element suspended from the tank roof and accessible through hand holes. The extendable element stretches with the movement of ice and allows the anode to eventually return to its original position. Long-life anode systems are typically used for tanks subject to freezing.

For tanks not subject to icing conditions, anodes may be suspended from the tank roof without an extendable element or may be horizontally supported from a buoyant, submerged, spider-type rope system.

III. Use of This Standard. AWWA has no responsibility for the suitability or compatibility of the provisions of this standard to any intended application by any user. Accordingly, each user of this standard is responsible for determining that the standard's provisions are suitable for and compatible with that user's intended application.