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(Revision of ANSI/AWWA B703-11)

American Water Works Association

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AWWA Standard

Fluorosilicic Acid

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AWWA Standard

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA B703.*

I. Introduction.

I.A. *Background.* Community water fluoridation is an effective, safe, and relatively inexpensive way to prevent tooth decay. Since the first fluoridation installation during 1945, studies have shown that this method of fluoride delivery benefits Americans of all ages and socioeconomic status. Dental decay can be reduced by 20 to 40 percent among children who have consumed fluoridated water since birth. Fluorosilicic acid (H_2SiF_6) is one of several fluoride compounds presently being added to drinking water to reduce the incidence of dental cavities.

Fluorosilicic acid is an aqueous solution of H_2SiF_6—water white to amber in color. It is a corrosive acid, irritating to the skin, and has a pungent odor. It is not known to exist in any anhydrous form. The boiling point increases with increasing acid content. At a typical commercial strength of 25 percent acid content, the boiling point is 105.8°C (222.5°F), and the freezing point is approximately –15.5°C (4°F). A 25 percent solution has a pH of 1.2 and weighs 10.1 lb/gal (1.20 kg/L). The molecular weight of H_2SiF_6 is 144.08.

Fluorosilicic acid is produced as a co-product in the manufacture of wet-process phosphoric acid and other phosphate fertilizers. The raw material, phosphate rock, contains fluoride and silica and is treated with sulfuric acid, which evolves the gases silicon tetrafluoride (SiF_4) and hydrogen fluoride (HF). These gases are passed through scrubbers and react with water to form fluorosilicic acid. This acid is the principal raw material in the production of all silicofluoride salts. It is also used in the ceramic, brewing, paint, and metallurgical industries.

Fluorosilicic acid is added to water using various liquid-feeding devices and metering pumps. It is normally fed directly into the water to produce the optimal fluoride concentration. Dilution of the acid before feeding is not recommended. If the acid is too concentrated for the solution feeder to control, solutions of other compounds are generally indicated; for example, solutions of sodium fluoride or sodium fluorosilicate. If the acid must be diluted, dilutions in the range of 10 to 1 and 20 to 1 (parts water to parts acid) should be avoided because they often result in the formation of an insoluble silica precipitate that can clog feeders, orifices, and other equipment. The use of softened or distilled water has no effect on the formation of this precipitate.

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

However, the precipitate can be avoided by using dilutions outside the critical range (dilutions in the range of 200:1 to 100:1 are known to work well), or by using acid that has been fortified with hydrogen fluoride (HF). Refer to AWWA Manual M4, *Water Fluoridation Principles and Practices,*[*] for additional technical information concerning the application and use of fluorosilicic acid.

I.B. *History.* This standard was first published in the November 1954 issue of *Journal AWWA* as tentative, having been approved on July 30, 1954, by the AWWA Board of Directors. Subsequent revisions to ANSI/AWWA B703 were approved on May 15, 1960; June 18, 1971; Jan. 30, 1984; Jan. 29, 1989; Jan. 30, 1994; Jan. 23, 2000; and Feb. 12, 2006. The last edition was prepared by the AWWA Standard Committee on Fluorides and approved on June 12, 2011. This edition was approved on April 19, 2019.

I.C. *Acceptance.* Products that are covered by this Standard should have certification in accordance with NSF[†]/ANSI 60, Drinking Water Treatment Chemicals—Health Effects and documentation on conformational testing to ANSI/AWWA B703 criteria.

Conformational testing to ANSI/AWWA B703 should be provided by the supplier to the consumer with each lot delivered. It is recommended that the consumer also conduct independent validation testing to confirm the conformational testing by the producer.

Certification of product quality in accordance with NSF/ANSI 60 should be indicated for each lot delivered and provided to the consumer by the supplier in accordance to NSF/ANSI 60 requirements.

In September 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 American Water Works Association Water Research Foundation,[‡] (AwwaRF, now Water Research Foundation), 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 April 1990, USEPA formally withdrew its list of acceptable drinking water additives, and regulatory oversight of direct and indirect drinking water additives passed to the process developed by the consortium under the leadership of NSF.

[*] AWWA Manual M4, *Water Fluoridation Principles and Practices*, AWWA, Denver, Colo.
[†] NSF International, P.O. Box 130140, 789 North Dixboro Road, Ann Arbor, MI 48105.
[‡] Water Research Foundation, 6666 W. Quincy Avenue, Denver, CO 80235.

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 two standards developed under the direction of NSF, NSF/ANSI 60, and NSF/ANSI 61, Drinking Water System Components—Health Effects. NSF, in cooperation with ASDWA, does a biennial survey of the US state and Canadian provinces/territories to determine which states and provinces/territories require, by legislation, regulations or policies that products and drinking water additives be evaluated by NSF/ANSI 60 and 61. Survey results from 2009 show adoption of NSF/ANSI 60 by 47 states and 9 provinces/territories, and adoption of NSF/ANSI 61 by 46 states and 11 provinces/territories.

Several organizations are accredited by national or international third-party agencies to certify products in accordance with NSF/ANSI 60. States, provinces/territories, local agencies, and water utilities can determine which certification organizations are acceptable within their individual jurisdictions.

Annex A, "Toxicology Review and Evaluation Procedures," to NSF/ANSI 60 does not stipulate a total allowable concentration (TAC) or a single product allowable concentration (SPAC) value of a contaminant or substances not regulated by a USEPA final maximum contaminant level (MCL). The TACs and SPACs 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 B703 addresses additives requirements in Sec. 4.3 of the standard. The transfer of contaminants from chemicals to processed water or to residual solids is becoming a problem of greater concern. Sec. 4.3.3 recommends that material covered by this standard be certified by an accredited agency for compliance with NSF/ANSI 60. As noted above, most states and provinces/territories require that direct additives be certified to NSF/ANSI 60. A user of this standard should consult with the state, province/territory, or local agency having jurisdiction for certification requirements, but the user may require certification even in the absence of such a requirement by the agency having jurisdiction.

* Persons outside the United States should contact the appropriate authority having jurisdiction.

II. Special Issues.

II.A. *Storage, Handling, and Safety Precautions.* Fluorosilicic acid must be handled carefully because it is corrosive. If the acid comes in contact with skin, the affected parts should be immediately rinsed thoroughly for at least 15 min with water. Then apply 2.5 percent calcium gluconate gel liberally to areas suspected of fluorosilicic acid contact, paying particular attention to areas under the fingernails. It is recommended that a supply of the gel be kept on-site wherever fluorosilicic acid is handled or stored. Prompt medical attention should follow. For information on safety, refer to the safety data sheets (SDSs) available from the chemical supplier or manufacturer. Protective safety gear should be worn when handling fluorosilicic acid. The following protective clothing and equipment should be the minimum available.

1. Gauntlet neoprene gloves (12-in. [300-mm] minimum glove length).
2. Full 8-in. (200-mm) face shield and chemical splash-proof safety goggles.
3. Heavy-duty, acid-proof-type neoprene aprons.
4. Safety shower and eyewash in an easily accessible location.

Bulk storage tanks and other containers can be made of polyethylene, rubber-lined steel, fiberglass-reinforced plastic (FRP), or other appropriate materials. Storage tanks for fluorosilicic acid shall also be placed in proper secondary containment made with appropriate lined materials.

FRP for fluorosilicic acid applications should be composed of an epoxy vinyl ester resin. The acid contact surfaces of the FRP should be provided with a single or double synthetic veil/liner. After an FRP tank is constructed, it should be cured using methyl ethyl ketone peroxide (MEKP).

Materials such as glass, ceramics, steel, concrete, and wood are not suitable for fluorosilicic acid containers and other equipment because they are attacked by the hydrofluoric acid (HF) and silicon tetrafluoride (SiF_4) formed at the surface of the fluorosilicic acid. Bulk storage tanks and other containers can be made of polyethylene, rubber-lined steel, fiberglass, or other appropriate materials. The polyethylene should be manufactured from high-density, cross-linked material (cross-linking provides strength). The polyethylene should contain a minimum of 0.25 percent ultraviolet stabilizer to protect against sun light. Steel tanks must always be lined. The linings are commonly made of natural rubber, neoprene, butyl rubber, or equivalent, and should be at least 2.4-mm (3⁄32-in.) thick. Fiberglass for fluorosilicic acid applications must be composed of a vinyl ester resin and a synthetic veil/liner. Structural carbon, Hastelloy C, Durimet 20, or equivalent materials can be used for hardware. The rooms where the acid is stored and used should be thoroughly ventilated with a vent

located near the ceiling because acid fumes are lighter than air. Closed tanks should be vented to the outside, and such tank venting systems should be pressure-tested for leaks before being placed into service. When cross-linked polyethylene tank venting systems are pressure-tested, extreme care must be exercised, as maximum allowed tank overpressures are typically ~5 psig. Additional information on materials compatibility appears in appendix A.

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

III.A. *Purchaser Options and Alternatives.* The following information should be provided by the purchaser:

1. Standard used—that is, ANSI/AWWA B703, Fluorosilicic Acid, of latest revision.

2. Details of other federal, state or provincial, and local requirements (Section 4).

3. Concentration (strength of acid desired) (Sec. 4.2). The acid shall contain between 20 and 30 percent H_2SiF_6 by weight. Where variations in acid strength are acceptable, arrangements should be made between the purchaser and the supplier as to the method of payment, based on the aggregate acid content.

4. Whether the purchaser will reject product from containers or packaging with missing or damaged seals. The purchaser may reject product from bulk containers or packages with missing or damaged seals unless the purchaser's tests of representative samples, conducted in accordance with Sec. 5.2, demonstrate that the product meets the standard. Failure to meet this standard or the absence of, or irregularities in, seals may be sufficient cause to reject a shipment.

5. Form of shipment—bulk or package, package type, and package size (Sec. 6.2).

6. Whether alternative security measures have been adopted to replace or augment the security measures set out in Sec. 6.2.5 and 6.2.6.

7. Affidavit of compliance or certified analyses, or both, if required (Sec. 6.3).

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

IV. Major Revisions. Major changes made in this revision of the standard include the following:

1. Inclusion of maximum allowed concentrations of impurities calculations (Sec. 4.3.3 and Table 1).

2. Revisions to Notice of Nonconformance (Sec. 5.3).
3. Revisions to Marking (Sec. 6.1).

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 group at 6666 West Quincy Avenue, Denver, CO 80235-3098, or e-mail at standards@awwa.org.

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Fluorosilicic Acid

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes fluorosilicic acid (H_2SiF_6) for use in the treatment of potable water.

Sec. 1.2 Purpose

The purpose of this standard is to provide the minimum requirements for fluorosilicic acid, including physical, chemical, sampling, packaging, shipping, and testing requirements.

Sec. 1.3 Application

This standard can be referenced in documents for purchasing and receiving fluorosilicic acid and can be used as a guide for testing the physical and chemical properties of fluorosilicic acid samples. The stipulations of this standard apply when this document has been referenced and only to fluorosilicic acid used in the treatment of potable water.