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(Revision of ANSI/AWWA B703-06)

American Water Works Association

The Authoritative Resource on Safe Water®

AWWA Standard

Fluorosilicic Acid

STANDARD
American Water Works Association
Since 1881

Approved American National Standard
ANSI

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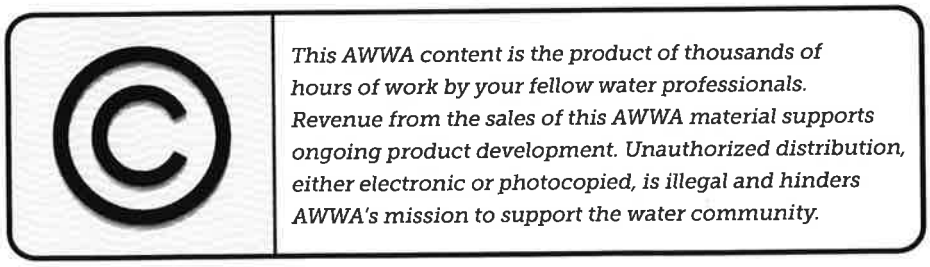

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Foreword

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 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 caries.

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

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

distilled water has no effect on the formation of this precipitate. 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. This edition was prepared by the AWWA Standards Committee on Fluorides and approved on June 12, 2011.

I.C. *Acceptance.* 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 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.

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, Drinking Water Treatment Chemicals—Health Effects (NSF/ANSI 60), and NSF/ANSI 61, Drinking Water System Components—Health Effects (NSF/ANSI 60). NSF, in cooperation with ASDWA, does a biennial

* AWWA Manual M4, *Water Fluoridation Principles and Practices*, AWWA, Denver, Colo.

† Water Research Foundation, 6666 W. Quincy Avenue, Denver, CO 80235.

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

§ NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.

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 for 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.

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 material safety data sheets (MSDS) 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.

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 sunlight. 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. Whether compliance with NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects, is required.

3. Quantity required.

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

5. 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 aggregated acid content.

6. 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 the standard or the absence of, or irregularities in, seals may be sufficient cause to reject a shipment.

7. Form of shipment—bulk or package, package type, and package size (Sec. 6.2.2).

8. 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.

9. 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 a requirement for compliance with the Safe Drinking Water Act and other federal regulations (Section 4).

2. Inclusion of a requirement for tamper-evident packaging (Sec. 6.2.5 and 6.2.6).

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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ANSI/AWWA B703-11
(Revision of ANSI/AWWA B703-06)

American Water Works Association

AWWA Standard

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.

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.

NSF*/ANSI† 60, Drinking Water Treatment Chemicals—Health Effects.

Standard Methods for the Examination of Water and Wastewater. APHA,‡ AWWA, and WEF.§

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Day:* A day is defined as a 24-hr period.

2. *Manufacturer:* The party that manufactures, fabricates, or produces materials or products.

3. *Potable water:* Water that is safe and satisfactory for drinking and cooking.

4. *Purchaser:* The person, company, or organization that purchases any materials or work to be performed.

5. *Supplier:* The party that supplies material or services. A supplier may or may not be the manufacturer.

6. *Tamper-evident packaging:* Packaging having one or more indicators or barriers to entry which, if breached or missing, can reasonably be expected to provide visible evidence to the purchaser that tampering has occurred. The tamper-evident features of the packaging shall be designed to and shall remain intact when handled in a reasonable manner during manufacture, storage, shipment, and delivery to the purchaser. Properly constructed, labeled, and closed drums or nonbulk containers constitute two forms of tamper-evident packaging.

SECTION 4: REQUIREMENTS

Materials shall comply with the requirements of the Safe Drinking Water Act and other federal regulations for potable water systems as applicable.

Sec. 4.1 Physical Requirements

4.1.1 *Suspended matter.* The fluorosilicic acid supplied according to this standard shall be clean and free of visible suspended matter.

* NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.
† American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
‡ American Public Health Association, 800 I Street NW, Washington, DC 20001.
§ Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314.

4.1.2 *Color.* The fluorosilicic acid supplied according to this standard shall be white to straw yellow. Straw yellow shall be determined as material with a maximum of 200 color units in accordance with Method 2120B, visual comparison method.*

Sec. 4.2 Chemical Requirements

The fluorosilicic acid shall contain between 20 and 30 percent fluorosilicic acid by weight unless specified otherwise by the purchaser.

Sec. 4.3 Impurities†

4.3.1 *General.* The material supplied according to this standard shall contain no mineral or organic substances in quantities capable of producing deleterious or injurious effects on the health of those consuming water that has been properly treated with the material.

4.3.2 *Free acid content.* The fluorosilicic acid supplied according to this standard shall contain a maximum of 1 percent free acids (other than fluorosilicic acid), expressed as HF (hydrofluoric acid).

4.3.3 *Product certifications.* Fluorosilicic acid is a direct additive used in the treatment of potable water. This material should be certified in accordance with the requirements of NSF/ANSI 60. Appendix B lists the impurities typically checked under NSF/ANSI 60 for fluorosilicic acid, the US and Canadian drinking water standards for those impurities, and the single product allowable concentration (SPAC) for each impurity. The SPAC is the allowable concentration of the impurity in the treated water when the material is added to give a fluoride concentration of 1.2 mg/L.

4.3.4 *Additional impurity limits.* Additional impurity limits may be specified by the purchaser to ensure the material supplied is suitable for water treatment. If additional impurity limits are specified, the purchaser must state the test methodology to be used to determine compliance with the additional limits.

SECTION 5: VERIFICATION

Sec. 5.1 Sampling and Laboratory Examination

Sampling shall be conducted in accordance with this section of the standard. The laboratory examination of the samples shall be completed within the following time limitations:

* *Standard Methods for the Examination of Water and Wastewater.*
† See Sec. I.C of the foreword.

1. Bulk shipments: before unloading, unless the shipment is accompanied by a certified analysis from the manufacturer or supplier.

2. Drum shipments: within five days after receipt of the shipment.

5.1.1 *Sampling point.* Samples shall be taken at the point of destination.

5.1.2 *Amount of shipment to be sampled.* If the acid is supplied in drums, the number of drums sampled will be left to the discretion of the purchaser. In the case of bulk shipments, a composite sample should be taken from the tank truck or tank car.

5.1.3 *Sampling container.* Samples shall be collected in a clean, plastic or rubber container. Containers lined with acid-resistant plastic, wax, or rubber may also be used.

5.1.4 *Sampling method for drums.* When sampling from drums, the fluorosilicic acid in the containers to be sampled shall first be mixed by rolling or other suitable means. A portion shall be taken from each container to be sampled so that the total gross sample consists of at least 2 L.

5.1.5 *Sampling method for bulk material.* When sampling from a tank truck or tank car, at least five different 500-mL portions shall be taken from different places in the container (top, middle, and bottom) and combined to form a composite sample that is representative of the entire container.

5.1.6 *Sample handling.* After mixing of the gross sample, three 500-mL samples shall be sealed in airtight, moisture-proof, plastic or rubber containers. Each sample container shall be labeled to identify it, and the label shall be signed by the sampler.

5.1.7 *Sample retention.* Samples shall be held for 30 days before disposal.

Sec. 5.2 Test Procedures

Testing of fluorosilicic acid shall be conducted in accordance with the procedures presented in the following sections. Alternate procedures can be used only on the written approval of the purchaser. In any case of conflict, the methods of this standard shall prevail.

5.2.1 *Test samples.* Test samples shall be obtained from the sealed material samples (Sec. 5.1.6) delivered to the laboratory. Material samples shall be unsealed only when it is necessary to remove quantities of the material for testing. Removal of material shall be performed quickly, and the material samples shall then be resealed for future reference.

5.2.2 *Determining fluorosilicic acid content.* Two methods are presented for determining the percentage of fluorosilicic acid content. The specific-gravity method will provide only a very rough approximation and should not be used for

determining the exact amount of acid. If facilities are available, the hydrogen titration method is the preferred method for determining fluorosilicic acid content.

5.2.2.1 Hydrogen titration method.

1. Principle. Titration of ionizable hydrogen in a chilled solution from which the fluorosilicate ions have been precipitated as potassium fluorosilicate.

2. Reagents.

a. Deionized ice.

b. Potassium nitrate-saturated solution.

c. Standard sodium hydroxide solution, 0.5*N*.

d. Bromothymol blue, 0.2 percent solution.

3. Procedure.

a. Using a pipette bulb, slowly pipette 25 mL of sample into a 500-mL volumetric flask that already contains 100 mL of deionized water. Dilute with additional deionized water to the mark and mix. If this suggested dilution produces a precipitate (Sec. I.A of the foreword), pipette a smaller sample volume (in 5-mL increments) until no precipitate forms.

b. Place 100 to 150 mL of clean deionized ice into a 400-mL beaker, add 25 mL of potassium nitrate solution, and using a pipette bulb, pipette a 25-mL aliquot of the diluted sample solution into the beaker. Wash down the sides of the beaker with deionized water.

c. Stirring constantly, add 6–10 drops of bromothymol blue for use as the end-point indicator, and promptly titrate with standard sodium hydroxide. The end point has been reached when the blue color persists for at least 30 sec. On standing longer, the indicator will turn yellow.

4. Calculation.*

$$\text{volume of sample taken, in milliliters } (D) = C \times \frac{A}{B} \qquad \text{(Eq 1)}$$

$$\text{weight of sample taken, in grams} = D \times \text{specific gravity (at room temperature)} \qquad \text{(Eq 2)}$$

$$\text{percent } H_2SiF_6 = \frac{\text{mL NaOH} \times N \times 0.072 \times 100}{\text{weight of sample, in grams}} \qquad \text{(Eq 3)}$$

Where:

A = original sample volume, in milliliters (step 1)

B = diluted sample volume, in milliliters (generally 500 mL)

C = aliquot volume, in milliliters (step 2)

* Based on the following chemical equations:

$H_2Si_6 + 2KNO_3 \rightarrow K_2SiF_6 + 2HNO_3$

$HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$

5.2.3 *Determining free acid.*

5.2.3.1 Procedure. The preceding method will include any free acid other than fluorosilicic acid that may be present. If it is necessary to distinguish between fluorosilicic acid and other acids, place the beaker, the contents of which have been titrated as above, on a hot plate and bring to a boil. Titrate the hot solution with standard sodium hydroxide to the neutral point of the bromothymol blue. This titration breaks down the fluorosilicate radical of the potassium fluorosilicate:

$$K_2SiF_6 + 4NaOH \rightarrow 2KF + 4NaF + SiO_2 + 2H_2O \qquad \text{(Eq 4)}$$

If the fluorosilicic acid is 100 percent pure, the milliliters of NaOH used in the cold titration will equal exactly half the milliliters of NaOH used in the hot titration. If free acid other than fluorosilicic is present, the cold titer will exceed half the hot titer. If the fluorosilicate salts are present, half the hot titer will exceed the cold titer.

5.2.3.2 Calculation.

$$\frac{\left(\text{mL NaOH}^{*} - \frac{\text{mL NaOH}^{\dagger}}{2}\right) \times N \times 0.02 \times 100}{\text{weight of sample, in grams}} = \text{percent free acid other than } H_2SiF_6\text{, expressed as HF} \qquad \text{(Eq 5)}$$

$$\frac{\frac{\text{mL NaOH}^{\dagger}}{2} \times N \times 0.072 \times 100}{\text{weight of sample, in grams}} = \text{percent } H_2SiF_6 \qquad \text{(Eq 6)}$$

5.2.4 *Specific-gravity method.*

5.2.4.1 Apparatus.

1. Acid-resistant plastic or glass cylinder or dish with sufficient depth to float a hydrometer.

2. Glass hydrometer (long stem) capable of being read to three significant figures. (If the density of the solution varies over a wide range, a set of three or more hydrometers should be available to cover the range.)

5.2.4.2 Procedure.

1. Carefully transfer the fluorosilicic acid from the sample container to the cylinder and adjust the temperature to 17.5°C (63.5°F). Insert the hydrometer and measure the specific gravity.

2. Do not keep the hydrometer and other glassware in contact with the fluorosilicic acid solution longer than is necessary. Thoroughly rinse the hydrometer and other glassware in clear, cool, running water immediately after using.

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* Cold titer.

† Hot titer.

3. Determine the approximate percentage of fluorosilicic acid from a table* or graph that has been prepared from the analyses of a number of shipments from which both specific gravity and actual fluoride content have been determined.

5.2.5 *Test procedure for impurities.* When testing for impurities, the analytic methods provided for in *Standard Methods for the Examination of Water and Wastewater* shall be employed. Impurity-specific methods and additional methodologies that provide for automation and for multiple analyses to be determined at the same time are provided in Table 1. The aggregate methodologies are often more economical when the full spectrum of impurities are to be determined and are recommended. Producers are encouraged to maintain a database of impurity concentrations based on quarterly analysis of normal production product.

Sec. 5.3 Notice of Nonconformance

5.3.1 *Notice of Nonconformance.* If the material delivered to the purchaser does not meet the chemical, physical, safety, or security requirements of this standard, the purchaser shall provide a notice of nonconformance to the supplier within 10 days after receipt of the shipment at the point of destination. The results of the purchaser's test shall prevail, unless the supplier notifies the purchaser within five days after receipt of the notice of nonconformance that a retest is desired. On receipt of the request for a retest, the purchaser shall forward to the supplier one of the sealed samples taken in accordance with Sec. 5.1. In the event the results obtained by the supplier do not agree with the results obtained by the purchaser, the other sealed sample shall be forwarded, unopened, for analysis to a referee laboratory agreed on by both parties. The results of the referee analysis shall be accepted as final.

The supplier shall provide to the purchaser an adjustment that is agreed on between the supplier and the purchaser reflecting the diminished quality of the product.

5.3.2 *Material originating outside of North America.* On request of the purchaser, the supplier shall inform the purchaser of the origin of the fluorosilicic acid to be provided. The purchaser may request from the supplier a written statement presenting the steps the supplier will take to ensure the material to be supplied conforms to the requirements of this standard and NSF/ANSI 60.

* The use of a standard table from a handbook is not recommended. Because these tables are prepared from dilutions of cp-grade acid, distilled water may introduce errors of more than 10 percent. Experience in the field has shown that the specific gravity of commercial grades of fluorosilicic acid in concentrations from 20 to 30 percent varies considerably between different manufacturers (5 to 14 percent less than that given in the standard table).

Table 1 Impurity analytic methods

Impurity	*Standard Methods** Section	Aggregate Methodologies†
Regulated Metals		
Antimony	3500-Sb	AAS, ICP, ICP/MS
Arsenic	3500-As	AAS, ICP, ICP/MS
Barium	3500-Ba	AAS, ICP, ICP/MS
Beryllium	3500-Be	AAS, ICP, ICP/MS
Cadmium	3500-Cd	AAS, ICP, ICP/MS
Chromium (total)	3500-Cr	AAS, ICP, ICP/MS
Copper	3500-Cu	AAS, ICP, ICP/MS
Lead	3500-Pb	AAS, ICP, ICP/MS
Mercury (inorganic)	3500-Hg	AAS
Selenium	3500-Se	AAS, ICP, ICP/MS
Thallium	3500-T1	AAS, ICP, ICP/MS
Radionuclides		
Beta particle and photon activity	7110	—
Gross alpha particle activity	7110	—
Radium 226 and 228 (combined)	7500-Ra	—
Uranium	3500-U	ICP/MS

**Standard Methods for the Examination of Water and Wastewater.*

†Aggregate Methodologies
AAS—Atomic Absorption Spectrometry
ICP—Inductively Coupled Plasma (with spectrometer)
ICP/MS—Inductively Coupled Plasma/Mass Spectrometer

SECTION 6: DELIVERY

Sec. 6.1 Marking*

6.1.1 *Required.*

6.1.1.1 Drum shipment labels. Each shipment shall contain clear identification of the material and a warning of potential danger in handling. Each drum shall have marked legibly on it the name of the acid, the grade, the net weight or

* Governmental marking, packaging, and shipping references reflect US requirements. Users of ANSI/AWWA B703 outside the United States should verify applicable local, provincial, and national regulatory requirements. Because of frequent changes in these regulations, all parties should remain informed of possible revisions. Provisions of the purchaser's documents should not preclude compliance with applicable regulations.

volume of the contents, the percent strength of the acid, the name and address of the supplier or manufacturer, the lot number, and the brand name if any. All markings on packaged, containerized, or bulk shipments shall conform to applicable laws and regulations, including requirements established by the US Occupational Safety and Health Administration (OSHA). The warning label should include suggestions for immediately rinsing away all acid coming in contact with the skin and the thorough dilution of acid accidentally spilled, including neutralization of the acid with lime.

6.1.1.2 Bulk shipment labels. On rail tank cars and tank truck shipments, the information listed under Sec. 6.1.1.1 shall accompany the bill of lading.

6.1.2 *Optional.* Packages may also bear the statement, "Guaranteed by (name of manufacturer) to meet the requirements of ANSI/AWWA B703, Fluorosilicic Acid," provided that the requirements of this standard are met.

Sec. 6.2 Packaging and Shipping

6.2.1 *Packaging.* Drums and any other nonbulk container used to package fluorosilicic acid shall comply with all applicable paragraphs of HM-181, part 178 of CFR 49.*

6.2.2 *Containers.*

6.2.2.1 General. Containers shall be rubber-lined steel, cross-linked polyethylene, or other structures suitably lined to prevent corrosion by the fluorosilicic acid. US Department of Transportation (USDOT) regulations should be consulted for additional options.

6.2.2.2 Structure. The container must be structurally sound and designed to withstand all hydrostatic pressures and other forces encountered. The specific gravity of fluorosilicic acid at 30 percent solution is 1.27.

6.2.3 *Net weight.*

6.2.3.1 Net weight of containers. The net weight of each container of material shall be within 2.5 percent of the marked weight. If the purchaser objects to the weight of material received, a minimum of 10 percent of the containers, selected at random from the containers received, shall be weighed on a certified scale. The shipment shall be deemed satisfactory if none of the containers in the sample have a weight less than 97.5 percent of the marked weight or if the sample weight meets criteria agreed to by the purchaser and the supplier.

* *Code of Federal Regulations*, Title 49, part 178 (Transportation). Superintendent of Documents, US Government Printing Office, Washington, DC 20402.

6.2.3.2 Net weight of bulk shipments. Tank truck shipments shall be accompanied by certified weight tickets. Delivered weight can be determined by the use of load cells on storage tanks, if present. Alternatively, initial and final volumes can be determined by the use of level indicators on storage tanks. Delivered weight can be computed using the specific weight of the chemical. The purchase documents between purchaser and supplier should address differences in delivered weight and/or specific weight of the chemical.

6.2.4 *Shipping regulations.* Packaging and shipping of all fluorosilicic acid solutions shall conform to all applicable local, state or provincial, and federal regulations (including USDOT regulations and applicable interstate regulations).

6.2.5 *Security requirements for nonbulk shipments.* Packaged product shall be stored, shipped, and delivered in tamper-evident packaging as defined in Section 3, or an alternative method or methods may be agreed on by the manufacturer and purchaser that provide a reasonable assurance of protection against tampering.

6.2.6 *Security requirements for bulk shipments.* Bulk quantities of product shall be secured by employing one of the following security measures or a combination of measures:

6.2.6.1 Seals. Bulk quantities of product may be sealed with a uniquely numbered tamper-evident seal(s). The seal numbers shall be recorded and disclosed on shipping documents such as the Bill of Lading. Seals shall be inspected upon receipt of product by the purchaser, and evidence of tampering or removal should be reported to the carrier and supplier.

6.2.6.2 Chain of custody. A continuous chain of custody may be maintained between the manufacturer and the purchaser during storage and shipment if so specified by the purchaser.

6.2.6.3 Alternative method. An alternative method or methods may be agreed on by the manufacturer and purchaser that provide reasonable assurance of protection against tampering.

Sec. 6.3 Affidavit of Compliance or Certified Analyses

The purchaser may require (1) an affidavit from the manufacturer or supplier that the material provided complies with applicable requirements of this standard; or (2) a certified analysis of the material at the time of delivery detailing the desired items.

APPENDIX A

Materials Compatibility

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

All tanks and containers must be manufactured from or lined with materials that are highly resistant to fluorosilicic acid. General materials in use include the following:

1. Fiberglass-reinforced plastic (FRP) 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).
2. Polyethylene manufactured from high-density, cross-linked material that contains a minimum of 0.25 percent ultraviolet stabilizer.
3. Steel tanks lined with a minimum 2.4-mm (3/32-in.) thickness of natural rubber, butyl rubber, or neoprene and secured to the metal surface with proper adhesive.

References to specific materials commonly in use include, but are not limited to, the following: polyvinyl chloride (PVC), type 1, grade 1; polyvinylidene fluoride (PVDF); ethylene propylene dienemonomer (EPDM); ethylene chlorotrifluoroethylene (E-CTFE); Saran; Vinyl; Hypalon; Carpenter 20; and Hastelloy C.

When purchasing storage tanks or other appurtenances used to handle fluorosilicic acid, the purchaser may request certification from the materials manufacturer verifying the tested resistance of the particular material for use in contact with fluorosilicic acid. Bulk storage tanks should be provided with a certification plate containing (at minimum) the following:

1. Name of tank manufacturer.
2. Date of manufacture.
3. Chemical (chemicals) to be stored.
4. Mechanical properties of the structure.*
5. Mechanical properties of the lining.†

* For example, high-density, cross-linked polyethylene.

† For example, 2.4-mm (3/32-in.) thick butyl rubber.

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APPENDIX B

Fluorosilicic Acid—Contaminants

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

Table B.1 Fluorosilicic acid—contaminants

Contaminant*	Regulation	Drinking Water Maximum Contaminant Level/Total Allowable Concentration (MCL/TAC) *mg/L*	Single Product Allowable Concentration (SPAC) *mg/L*
Regulated Metals			
Antimony	(40 CFR § 141.60, § 141.62)	0.006	0.0006
Arsenic	(40 CFR § 141.60) (issue date 10/01)	0.010	0.001
Barium	(40 CFR § 141.60, § 141.62)	2	0.2
Beryllium	(40 CFR § 141.60, § 141.62)	0.004	0.0004
Cadmium	(40 CFR § 141.60, § 141.62)	0.005	0.0005
Chromium (total)	(40 CFR § 141.60, § 141.62)	0.1	0.01
Copper (at tap)	(40 CFR § 141.80, 65 FR 1950)	TT† (action level 1.3 mg/L)	0.13
Lead (at tap)	(40 CFR § 141.80, 65 FR 1950)	TT† (action level 0.015 mg/L)	0.0015
Mercury (inorganic)	(40 CFR § 141.60, § 141.62)	0.002	0.0002
Selenium	(40 CFR § 141.60, § 141.62)	0.05	0.005
Thallium	(40 CFR § 141.60, § 141.62)	0.002	0.0002
Radionuclides			
Beta particle and photon activity	(40 CFR § 141.16)	4 mrem/y	0.4 mrem/y
Gross alpha particle activity	(40 CFR § 141.15)	15 pCi/L	1.5 pCi/L
Radium 226 and 228 (combined)	(40 CFR § 141.15)	5 pCi/L	0.5 pCi/L
Uranium	(40 CFR § 141.66) (issue date 10/99)	0.02 mg/L 13 pCi/L	0.002 mg/L 1.3 pCi/L

*The references for criteria based on US primary drinking water regulations are from the US Code of Federal Regulations, Title 40 (Protection of Environment), revised as of July 1, 1999. This document is available online at www.access.gpo.gov/cgi-bin/cfrassemble.cgi. Issue dates are given for criteria based on Health Canada guidelines. Additional information on the guidelines for these chemicals is available at www.hc-sc.gc.ca/water quality.
†TT—Treatment technique

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