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1. SCOPE

- a. This general specification covers the **minimum technical requirements** for the design, manufacture, testing, and installation of atmospheric fluorosilicic acid bulk storage tanks with stairway, work platform, and handrails suitable for use in a fluorosilicic acid type fluoridation system. For a specific bulk storage tank, this specification shall be used in conjunction with the project specifications, data sheets, and project drawings for that system. The owner/operator of the public water system shall submit, in writing, any requested exceptions to the requirements of this specification for resolution by the Texas Fluoridation Project Engineer.

2. APPLICABLE DOCUMENTS

- a. The public water system owner/operator, contractor, and tank supplier and/or tank manufacturer shall consider and apply the most recent issue of the applicable standards and codes issued by the following associations and approval bodies as part of this specification.
 - Uniform Building Code (UBC)
 - Standard Building Code (SBC)
 - National Fire Protection Association (NFPA), NFPA 70 National Electrical Code
 - United States Department of Labor - Occupational Safety and Health Administration (OSHA) CFR Part 1910
 - American Society for Testing and Materials (ASTM) ASTM D 1998,
- b. The data sheet Bulk Storage Tank applies to this specification.
- c. Applicable General Specifications
 - ES-1 Equipment Specification, Fluorosilicic Acid System

3. REQUIREMENTS

3.1 Item Definition

- a. An atmospheric bulk storage tank is a vessel capable of safely and dependably storing corrosive and non-corrosive liquids with no differential pressure between the interior pressure of the tank due to hydrostatic pressure and atmospheric pressure on the exterior. The tanks have the following features:
 - Vertical shell
 - Cylindrical
 - Fixed dome shaped roof

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The bulk storage tanks are fabricated of high-density cross-linkable polyethylene resin for storage of fluorosilicic acid for injection into potable water systems.

- c. Tank shall be lined with a NSF/ANSI 61 Certified oxidation resistance system.
- d. The bulk storage tank includes the following components and appurtenances:
 - Access manway
 - Bulkhead fittings
 - Manway and cover
 - Atmospheric U-vent
 - Drop pipe/downcomer at tank fill nozzle
 - Lateral wind restraint
 - Lifting lugs or other lifting devices
 - Stairway or Ladder support structure, work platform, and hand rails

3.2 Characteristics

3.2.1 Performance

- a. The bulk storage tank shall be designed for continuous service under the operating conditions specified below.

3.2.1 Physical characteristics.

- a. The tank shall be designed for lifting from the top with spreader bars using suitable lifting lugs attached to the tank, unless otherwise specified.
- b. The tank size and height conforms to the physical size limitations and availability of the acid transfer pump.

3.3.3 Maintainability

- a. The bulk storage tank shall be designed for ease of maintenance.
- b. Unless otherwise specified, vents, gauges, and system components shall be accessible by ladders, cages, stairs, and handrails.

3.3 Design and Construction

3.3.1 General.

- a. The bulk storage tank shall be an ASTM D 1998 Type 1 tank constructed of virgin high-density cross-linkable polyethylene and lined with a NSF/ANSI 61 Certified oxidation resistance system.
- b. The bulk storage tank shall be designed and oriented to facilitate interconnection with other equipment and piping associated with the fluoridation system.

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- c. The bulk storage tank shall be supplied complete with any support structures, piping, tank fittings, safety features, and other features necessary to ensure safe operation.
- d. The tank shall comply with the requirements of OSHA.
- e. Placing the tank in operation shall require only installation of the fluorosilicic acid transfer pump and electrical, piping external of the bulkhead fittings, installation of the lateral wind restraint system, installation of the level indicator and electrical, and attachment or erection of the stairway or ladder access platform.
- f. The bulk storage tank shall be placed on a smooth concrete pad or foundation.
- g. Tank designs shall provide independently for seismic and wind loads.
- h. Tanks shall be capable of withstanding a wind loading calculated at exposure C and a 50-year recurrence level in accordance with ANSI A58.1, Building Code Requirements for Minimum Design Loads in Buildings and Other Structures.
- i. Lateral wind restraint types allowed are as follows: 1) cable type over the dome restraint with foundation mounted anchors, 2) cable type connecting to dome mounted integral or fabricated metal tie down cleats with foundation mounted anchors, or 3) integral side wall mounted hold down lugs with foundation mounted anchors.

3.3.1 Polyethylene Tanks.

- a. Polyethylene tanks for atmospheric pressure shall be constructed in accordance with ASTM D 1998, Standard Specification for Polyethylene Upright Storage tanks.

3.3.2 Materials. Construction materials shall be in accordance with the project specifications and/or data sheets and shall be suitable for the intended chemical service and environmental conditions.

- a. Materials for polyethylene tanks shall conform to applicable ASTM specifications and shall be selected for the most economical design based on the specified service conditions.
- b. The tank's shell, dome, bottom, and manway shall be molded from virgin high-density cross-linkable polyethylene with a minimum of **70** percent gel per ASTM D 1998.
- c. Polyethylene Materials. The tank shell, bottom, dome, and manway molding powder shall be Marlex CL-200 as manufactured by Phillips 66, Paxon 7004 mXL as manufactured by Paxon Polymer Company, or cross-linkable polyethylene powders of equal physical and chemical properties approved by the Texas Fluoridation Project Engineer.
- d. Oxidation Resistance. The inner tank shall be lined internally with a NSF/ANSI 61 Certified Poly Processing Company OR-1000 oxidation resistance system.
- e. Fillers and Pigments. The polyethylene plastic shall not contain any filler. All plastic shall contain a minimum of 0.25 % to a maximum of 0.50 % U.V. stabilizer by weight. Pigments, if added, shall not exceed 0.5 % of the weight of the tank.

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- f. All mechanical fittings and piping supplied with the tank shall be of PVC, CPVC, Polypropylene, Hastelloy-C 276, Carpenter 400, or Monel 400 Series material. All wetted metals shall be of Hastelloy-C 276, Carpenter 400, or Monel 400 Series material. Fasteners and other metallic components inside of the tank that are exposed to the fluorosilicic acid shall be encapsulated in polyethylene or other suitable plastic material. Non-wetted metallic components such as lifting lugs shall be fabricated of Type 304SS or Type 316 SS.
- g. All gaskets and/or seal materials shall be of VITON, Cross-linked Polyethylene, or Teflon construction.

3.3.3 Tank Shell.

3.3.3.1 General.

- a. The design of the inner liquid storage tank shell thickness shall be computed for a full tank (maximum straight side wall capacity) with a design liquid specific gravity of 1.90.
- b. The design of the outer double containment storage tank shell thickness shall be computed for a full tank (maximum straight side wall capacity) with a design liquid specific gravity of 1.90.
- c. The hydrostatic test shell thickness shall be computed for a water-filled tank if the specific gravity of the stored liquid is less than 1.0.
- d. The materials of construction, construction method, workmanship, physical properties, and methods of testing shall be in accordance with ASTM D 1998.
- e. The inner tank shall be lined internally with Poly Processing Company OR-1000 oxidation resistance system.
- f. The tank shall be of double containment construction with an inner tank with domed closed type top for storage of the fluorosilicic acid and an outer open top tank that shall contain, at a minimum, 110% of the straight shell contents of the inner tank. The outer tank provides secondary containment of the inner tank contents. The design of the outer secondary containment tank shall be such that no fluids are allowed to enter the annular space between the inner storage tank and the outer containment tank during tank operation.
- g. The inner and outer tank shall be flat bottomed. All appurtenances and fittings installed in the inner tank shall be through the closed dome top only. The outer containment shell shall contain only one bulkhead fitting with drain valve located as low as possible to the knuckle radius of the outer tank.
- h. The tank shall be of rotationally molded construction.

3.3.3.2 Polyethylene Tank Shell.

- a. The minimum wall thickness of the inner tank at the point of maximum stress shall be calculated in accordance with ASTM D 1998 for tanks with a design hoop stress of

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600 PSI at 100 degrees Fahrenheit for a tank containing a liquid with a specific gravity of **1.90**.

- b. The minimum wall thickness of the outer (secondary containment) tank at the point of maximum stress shall be calculated in accordance with ASTM D 1998 for tanks with a design hoop stress of 600 PSI at 100 degrees Fahrenheit for a tank containing a liquid with a specific gravity of **1.90**.
- c. The design factor of safety for both the inner and outer (secondary containment) tank shall be 2.0.

3.3.3.3 Tank Roof.

- a. The roof shall be dome shaped in accordance with ASTM D 1998.
- b. Tank roofs shall be furnished with lifting lugs or other lifting device attachments for installation, plant operation, or maintenance.

3.3.3.4 Tank Bottom.

- a. The tank bottom shall be flat and of the same construction and materials as the tank shell.
- b. The tank manufacturer shall specify the requirements for support of the tank bottom in installation specifications and recommended installation practices.
- c. The knuckle radius at the tank bottom to shell connection shall have a minimum radius of 1-1/2 inch.

3.3.4 Venting.

- a. The bulk storage tank shall be equipped with vents to allow for normal in-breathing and out-breathing as a result of temperature changes and liquid movement into and out of the tank.
- b. Open ends of atmospheric vents not equipped with a flame arrester shall be cut square across the end and equipped with a bird screen of polypropylene mesh material suitable for fluorosilicic acid exposure.

3.3.5 Nozzles.

- a. All nozzle connections shall be either straight or universal/self aligning through bulkhead tank fittings. All bulkhead tank fittings installed through the tank dome shall be self-aligning unless the fitting is installed at the center of the dome or in a flat area such as a dome top tank runway.
- b. All bulkhead tank fittings shall have an equivalent pipe size pressure rating as SCH 80 pipe in the same material.
- c. All bulkhead connections shall have female NPT threads.
- d. All gaskets shall be VITON or Teflon.
- e. All cut edges for tank fitting installation shall be trimmed to have smooth edges.

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3.3.6 Manway

3.3.6.1 General.

- a. Manways shall be provided in tanks for inspection, cleaning and maintenance.
- b. Openings for manways requiring operator attention or periodic maintenance shall be located for easy accessibility.
- c. The minimum size of manways shall be 24-inch Nominal Pipe Size (NPS).
- d. The manway, manway gasket, and bolting shall provide a liquid-tight seal during an over flow condition with a minimum of 3 feet of hydrostatic head of the process fluid above the overall height of the tank.

3.3.7 Bolting.

- a. Bolting shall conform to ASTM standards.
- b. Bolting shall consist of stud bolts and hexagon nuts.
- c. Bolting materials wetted by the fluorosilicic acid shall be of Hastelloy-C 276, Carpenter 400, or Monel Series 400 material except at the manway where high-density polyethylene is allowed. Bolting materials not in wetted service or located in the vapor space of the tank shall be of Type 316 SS material.
- d. Suitable thread lubricant shall be used for thread make-up.

3.3.8 Ladders, Cages, Stairs, and Handrails.

3.3.8.1 General

- a. Design, fabrication, and erection of ladders, cages, stairs, and handrails for bulk storage tanks shall be in accordance with applicable OSHA and ASTM requirements, project specifications, and the following additional requirements.
- b. Stairways or ladders shall be self-supporting.
- c. The top of the stairway or ladder landing shall be 30 inches below the elevation of the top of the outer containment tank shell if no runway or manway exists; else the top of the landing shall be 30 inches below the tank runway elevation with man way.
- d. Treads: All steel and fiberglass stairs shall have treads made of grating. All treads shall have an even distinctive leading edge with nosing of a non-slip design. Nosing shall extend 1/2 to 1 inch over the leading edge of a tread.
- e. The greatest rise height within any flight of stairs shall not exceed the smallest by more than 3/8-inch, (provide uniform rise height between treads). This requirement includes rise height between top or bottom tread and platform, floor, or landing.
- f. Clear Pathway: A 2 ft. - 6 in. minimum width is required for egress stairway and ladder stiles.
- g. Bottom Landing: A 2 ft. – 6 in. X 2ft. – 6 in. minimum landing area is required at the base of a stairway or ladder.

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- h. Top Landing/Tank Platform: A 3 ft. – 6 in. X 3 ft. – 6 in. minimum landing/tank platform is required at the top of a stairway or ladder where access to the top of a tank is required for maintenance operations. The platform profile adjacent to the tank shall conform to the radius of the tank.
- i. Unless otherwise specified, the rise/run combination shall be 7-3/4 in. rise height/9-3/4 in. tread run (38 degrees – 29 minutes).
- j. Ladders, cages, stairs, and handrails shall be fabricated from either hot-dipped galvanized steel in accordance with ASM A123, Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip or fabricated from hot-dipped galvanized steel with fiberglass grating components, or fabricated using structural members and grating of fiberglass construction, or fabricated from steel that is sandblasted to near white and painted with an acid resistant two part epoxy coating system.

3.3.1 Critical Dimensions and Tolerances

- a. The manufacturer shall fabricate the bulk storage tank within the dimensions and tolerances established by this specification, the project drawings, and ASTM D 1998.
- b. All measurements taken to verify fabrication accuracy, fitting locations and fitting type shall be in agreement with the approved drawings. Tank dimensions will be obtained on the exterior.
- c. Measurements shall be taken in the vertical position, unfilled.
- d. The tolerance for the outside diameter, including out of roundness, shall be +/- 3%.
- e. The tolerance for the shell and head thickness shall be –20% of the design thickness to unlimited on the high side. The total amount of surface area on the low side of the tolerance shall not exceed 10% of the total surface and no individual area shall exceed 1 sq. ft. in size.
- f. The tolerance for fittings shall be +/- 0.5 inches in elevation and +/- 2 degrees radial.

3.3.10 Identification and marking.

- a. The bulk storage tank shall be furnished with a stainless steel nameplate with the following information.
 - Name of fabricator
 - ASTM D 1998 Type
 - Date of manufacture (month/year)
 - Inner tank manufacturer's serial number
 - Outer tank manufacturer's serial number
 - Tank number assigned by municipality
 - Inner tank outside diameter and height in feet and inches
 - Outer tank outside diameter and height in feet and inches
 - Design liquid level of the inner tank in feet and inches

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- Maximum specific gravity of the tank design
- Design pressure
- Maximum operating temperature
- Inner tank capacity (gallons) based on fluid level used to determine minimum wall thickness.

b. The nameplate shall be permanently attached to the tank. No markings shall be stamped or etched directly on the tank wall except for the tank serial number embossed by the tank manufacturer at the time of the molding process

3.3.11 Workmanship. Workmanship for Type 1 tanks shall be shall be in accordance with ASTM D 1998.

a. The inside finished surface walls shall be free, as commercially practical, of visual defects such as air bubbles, pin holes, pimples, cracking, crazing, foreign inclusions, and de-laminations. The exterior surfaces shall have a relatively smooth texture that is similar to the interior surface.

3.3.12 Manufacturer's standards. The tank and its usage shall comply with the applicable provisions and recommendations of the following except as otherwise specified.

- a. Manufacturer's standard provisions for warranties, including tank base or foundation, design of auxiliary supports or appurtenances, and requirements for tank attachments, as found in the manufacturer's warranty.
- b. Manufacturer's tank installation and use instructions/recommendations.
- c. Standards of manufacture of ASTM D 1998 Type 1 tanks by the manufacturer.

3.4 Documentation Requirements. The tank manufacturer and/or supplier shall provide the following documentation. One copy of the shop fabrication drawings shall be submitted to the tank purchaser for approval prior to fabrication. One copy each of the as-built documentation listed below shall be submitted at the time of tank installation or final inspection to the Texas Drinking Water Fluoridation Project Engineer and to the tank purchaser.

- a. Elevation and plan layout drawing showing all critical dimensions.
- b. Calculations performed to determine the thickness of the tank wall per ASTM D 1998.
- c. Certified test report of the each tanks hydrotest and material performance test reports detailing the results of the low-temperature impact test and percent gel level on the material used in the construction of the tank per ASTM D 1998.
- d. Material test reports detailing the tank material type, polyethylene supplier, polyethylene product name, and part number, and raw material mechanical properties base on molded parts listed as follows.

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<u>PROPERTY</u>	<u>ASTM TEST</u>	<u>NOMINAL VALUE</u>
Density	ASTM D 1505	0.940 – 0.944 gm/cc ³
Environmental stress cracking	ASTM D 1693	>1000 hours
Tensile strength, at yield	ASTM D 638	2,600 PSI
Vicat softening point	ASTM D 1525	248 ⁰ F
Brittleness temperature	ASTM D 746	-180 ⁰ F
Flexural modulus	ASTM D 790	100,000 – 110,000 PSI
Low temperature impact test	ASTM D 1998	Pass dart drop impact test

- e. Bill of Material detailing all installed fittings and other components required for installation. The Bill of Material shall reference material of construction, pipe size and type, and any other descriptive information required to reference a component.
- f. Detail drawings for the lateral wind restraint and attachment hardware and any other supporting structures for piping, ladders, handrails, or stairs.
- g. Manufacturer's literature, illustration, specifications, engineering data, and installation and maintenance instructions.

3.5 Precedence of specifications, standards, and codes.

- a. Texas Department of State Health Services (DSHS) and grantee project specifications and drawings (in combination with applicable detail specifications and data sheets) take precedence over all other specifications, standards, and codes.
- b. Texas Department of State Health Services and grantee general specifications take precedence over all other specifications, standards, and codes except DSHS and grantee project specifications and drawings.
- c. Appropriate standards, codes, and practices of the associations and approval bodies listed in section 2 of the DSHS general specifications shall apply in cases not covered by the DSHS general specifications or DSHS drawings.
- d. DSHS specifications take precedence over grantee specifications unless reviewed and approved in writing by the Texas Fluoridation Project Engineer.
- e. Any conflicts or discrepancies among the documents listed in a, b, c, or d above shall be called to the attention of the Texas Fluoridation Project Engineer for resolution prior to purchase, design, fabrication, or construction.

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4. QUALITY ASSURANCE PROVISIONS

4.1 Tank tests and Inspections.

- a. The tank manufacturer shall hydrotest each tank used in the assembly of the double containment tank. The minimum holding time for the water test shall be 12 hours after the filling height is reached.
- b. The manufacturer shall perform the Low-temperature Impact Test and Percent Gel Test per ASTM D 1998 specifications. A **minimum of 70% gel** is required.

4.2 Warranty.

- a. The tank SUPPLIER shall offer a limited two- (2) year warranty concurrent with the Manufacturer's standard limited two- (2) year warranty that warrants all products manufactured shall be free from defects in material and workmanship.
- b. The tank manufacturer shall provide an additional pro-rated limited warranty period of four (4) years after expiration of the standard two (2) year warranty period.

5.0 PREPARATION FOR SHIPPING AND STORAGE

The manufacturer and/or supplier shall be responsible for the design and provision of any load out features such as lifting eyes, spreader bars, reinforcements, or any other requirement necessary to safely ship and set the tank.