

Standard Pressurized Water Storage Tank

**American National Standard/
Water Systems Council Standard**

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Water Systems Council Standard**

Pressurized Water Storage Tank

Standard Developer
NSF International

Designated as an ANSI standard

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Sponsor
NSF International

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The NSF Joint Committee on Water Systems Council

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Foreword¹

It is the purpose of this Standard to prescribe minimum performance and construction requirements for pressurized storage tanks for service in water well systems with a maximum factory pre-charge pressure of 40 psig (280 kPa) or with exception as stated in DOT issued allowance, to be operated in ambient air temperatures up to 120 °F (49 °C), with maximum working pressures not less than 75 psig (520 kPa) and not greater than 150 psig (1000 kPa) and tank volumes not exceeding 120 gallons (450 L).

Most private water systems are powered by an electric motor and incorporate a closed pressure tank. The three essential components of such a system are pump, tank and control. The functions of a water pressure storage tank are threefold: (1) to protect and prolong the life of the pump by preventing rapid cycling of the pump motor (most motor manufacturers recommend pump cycle rates of under 300 for each 24-hour period and not more than 15 starts per hour for up to 3/4 hp, and not more than 7-1/2 starts per hour for greater than 3/4 hp motors); (2) to provide water under pressure for delivery between cycles; and (3) to provide additional water storage under pressure to assist the pump in meeting the total demands of a system if the pump or well is incapable of supplying the required capacity.

ANSI/WSC PST-2000 Pressurized Water Storage Tank Standard can be used by regulatory agencies when developing codes for pressurized storage tanks

In 1999, a group of Water System Council members comprised of leading U.S. manufacturers of pressurized water storage tanks for water wells met to define and promote, through voluntary written standards, minimum performance and construction requirements for pressurized water storage tanks for service in water well systems. The Water Systems Council Board of Directors approved this voluntary standard in November 2000.

This American National Standard was originally developed in 2005 by the NSF Canvass Committee on Pressurized Storage Tanks using the consensus process described by the American National Standards Institute (ANSI). Subsequently, the standard was approved through the ANSI process by the NSF Joint Committee on Water Systems Council made up of industry, consultant/user, and public agency members.

This version of the Standard includes:

Issue 4

This revision updates sections 5.2.5.3, 6.1.3 and adds section 6.1.4 regarding pressure testing.

Suggestions for improvement of this Standard are welcome. Comments should be sent to Secretariat, NSF Joint Committee on Water Systems Council, c/o NSF International, Standards Department, PO Box 130140, Ann Arbor, Michigan 48113-0140, USA or via email: standards@nsf.org

The National Programs Office of the Water Systems Council can be contacted toll-free at 202-625-4387 or at www.watersystemscouncil.org. Water Well Standards.

¹ The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. As such, this Foreword may contain material that has not been subjected to public review of a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.

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Collaborating organizations

Water Systems Council

The Water Systems Council (WSC) is a national non-profit organization, dedicated to promoting the wider use of wells as modern and affordable safe drinking water systems and to protect ground water resources. WSC members include major manufacturers of the integral components of wells and other small drinking water systems, leading distributors of those components, and other drinking water professionals.

Founded in 1932, WSC is dedicated to protecting the public health and ground water resources through product excellence and informational services. WSC represents the manufacturing and engineering skill and water well knowledge of the nation's water tank, accessory and well supply manufacturers. WSC endeavors to work closely with industry and public health groups.

WSC is the only national organization solely focused on individual water wells and other private well-based water systems.

NSF International

NSF International, The Public Health and Safety Company™, a not-for-profit, non-governmental organization, is the world leader in standards development, product certification, education, and risk-management for public health and safety. For 70 years, NSF has been committed to public health, safety, and protection of the environment. While focusing on food, water, indoor air, and the environment, NSF develops national standards, provides learning opportunities through its Center for Public Health Education, and provides third-party conformity assessment services while representing the interests of all stakeholders. The primary stakeholder groups include industry, the regulatory community, and the public at large.

NSF is widely recognized for its scientific and technical expertise in the health and environmental sciences. Its professional staff includes engineers, microbiologists, chemists, toxicologists, and public health professionals with broad experience both in public and private organizations.

NSF International is a Pan American Health Organization/World Health Organization Collaborating Center on Food Safety, Water Quality and Indoor Environment.

Serving manufacturers operating in more than 150 countries, NSF was founded in 1944 and is headquartered in Ann Arbor, MI USA. The NSF Mark is recognized for its value in international trade around the world and is respected by regulatory agencies at the local, state, and federal levels.

www.nsf.org

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ANSI/WSC Standard – Pressurized Water Storage Tank Standard (PST-2000)

1 Scope

This standard prescribes minimum performance and construction requirements for pressurized storage tanks for service in water well systems with a maximum factory pre-charge pressure of 40 psig (280 kPa), or with exception as stated in Dot issued allowance to be operated in ambient air temperatures up to 120 °F (49 °C), with maximum working pressures not less than 75 psig (520 kPa) and not greater than 150 psig (1000 kPa) and tank volumes not exceeding 120 gallons (450 L).

2 Reference documents

The following documents contain provisions that, through reference, constitute provisions of this ANSI/WSC Standard. All documents are subject to revision, and parties are encouraged to investigate the recent editions of the documents indicated below. The most recent published edition of the document shall be used for undated references.

ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability²

ASTM A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability²

Code of Federal Regulations, Title 49, Part 173.306(g), *Transportation*³

NSF/ANSI 61. Drinking Water System Components – Health Effects⁴

NSF/ANSI 372. Drinking Water System Components – Lead Content⁴

3 Definitions and symbols

3.1 Definitions

3.1.1 circumferential: Perpendicular to the centerline axis of the tank.

3.1.2 composite materials: Composite materials are material structures that include, but are not solely fiber, laminates and particulate composites.

3.1.3 concave: The curved portion of the head that is outward in respect to the inside of the tank.

3.1.4 dome: The curved portion of the head.

² ASTM International, 100 Barr Harbor Dr., West Conshohocken, PA 19428 <www.astm.org>

³ National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA <www.ntis.gov>

⁴ NSF International, P.O. Box 130140, Ann Arbor, Mi 48113-0140 <www.nsf.org>

- 3.1.5 **head:** The end of the tank that integrally includes the dome, knuckle radius and flange.
- 3.1.6 **head flange:** The cylindrical portion of the head.
- 3.1.7 **hydrostatic leak test:** A test when pressure is maintained over a defined period of time without leak.
- 3.1.8 **hydrostatic pressure:** The pressure in the tank when it is completely filled with water, in psig.
- 3.1.9 **knuckle radius:** The section of the head between the dome and the flange.
- 3.1.10 **longitudinal:** Parallel to the centerline axis of the tank.
- 3.1.11 **particulate composite:** A composite material composed of particles embedded in a matrix.
- 3.1.12 **package:** The outer wrapping for the tank used for shipping purposes.
- 3.1.13 **pre-charge pressure:** The pressure of air or gas applied at the factory in psig.
- 3.1.14 **psi:** Pounds per square inch gauge (kPa) or (psig).
- 3.1.15 **shell:** A separate cylindrical section of the tank.
- 3.1.16 **residual fluid seepage:** The formation of bubbles or droplets of water on the outside of a fiber glass tank during the initial phase of a pressure test due to the expression of water that was trapped between the tank liner and the fiber glass wrap during the tank manufacturer's testing.

3.2 Symbols

- 3.2.1 E: Weld Efficiency for longitudinal welds (0.85).

NOTE – E = 1 if 100% of production is tested at maximum working pressure

- 3.2.2 P: Manufacturer's rated maximum working pressure or 3 times pre-charge pressure at 70 °F (21°C), whichever is greater.
- 3.2.3 R: Inside radius of head flange or shell in inches.
- 3.2.4 S: Allowable yield stress of steel material in psi.
- 3.2.5 Th: Thickness of head flange portion of a head in inches.
- 3.2.6 Ts: Thickness of a shell or head flange in inches.

4 Materials

4.1 General

- 4.1.1 The tank manufacturer shall specify the material requirements to the material supplier in the form of chemical and mechanical requirements or by ASTM specification number.
- 4.1.2 The tank manufacturer shall verify that the materials are in compliance with their design specifications.

4.1.3 Materials in contact with potable water shall be in compliance with the latest applicable provisions of NSF/ANSI 61 and NSF/ANSI 372.

4.2 Types of materials

4.2.1 Carbon steel

4.2.1.1 Deep drawn and stamped steel head

The steel shall meet the latest minimum requirements of ASTM A 1011/A 1011M and A 1008/A 1008M.

4.2.1.2 Rolled steel shell

Material shall be suitable for rolling and welding and meet the latest minimum requirements of ASTM A 1011/A 1011M and A 1008/A 1008M.

4.2.1.3 Nonconforming steel

Steel irregularities, such as seams, cracks or laminations, shall not be used in tank construction.

4.2.2 Composite materials

Composite materials shall be material structures that include, but are not solely fiber, laminates and particulate composites. Composite materials shall meet the applicable requirements of the criteria in section 5 of this Standard.

4.2.3. Additional materials

Materials not covered under 4.2.1 and 4.2.2 shall be acceptable if the requirements of the criteria in section 5 of this Standard are met.

5 Design acceptance criteria

5.1 General requirements

A technical specification of each new tank design, including design drawings, calculations, material specifications, and required tests, shall be submitted with test sample(s) by the manufacturer to a nationally recognized testing laboratory. A tank that has received approval under this Standard shall be considered to be of a new design when compared to an existing approved design when:

- a) It is manufactured in a different manufacturing facility; or
- b) It is manufactured by a different process (major process change, i.e., rolling to stamping); or
- c) It is manufactured from material of a different specification; or
- d) The tank profile has changed; or
- e) The thickness has been reduced by 10% or more; or
- f) The overall length of the tank has increased by more than 50%; or
- g) The outside diameter of the cylinder has been increased by more than 1% of the original design diameter; or

- h) The amount of fittings has increased; or
- i) The size of the openings has increased.

5.2 Prototype testing

5.2.1 General

The representative(s) of the prototype design shall be tested as described in sub-sections 5.2.2 to 5.2.5, inclusive. Prior to subjecting the tanks to prototype testing, the testing lab shall verify the product specifications.

5.2.2 Material tests

A certified physical and chemical analysis of the material shall be obtained from the material manufacturer.

5.2.3 Volume test

One tank from each design shall have the volume verified. The calculated tank volume shall be within 10% of the stated literature volume.

Each tank shall be placed on a scale to determine the tare weight of the tank. Each tank shall then be filled with fluid to the maximum volume (void of air).

5.2.4 Hydrostatic leak test

5.2.4.1 Hydrostatic leak tests shall be carried out on a minimum of three (3) representative prototype tanks of the same design.

5.2.4.2 Tests shall be carried out at room temperature. The pressure gauge shall be accurate to within 1%.

5.2.4.3 The pressure in the tank shall be increased at a rate not exceeding 20 psig per second (140 kPa/sec) until the minimum hydrostatic leak pressure is reached.

5.2.4.4 The acceptance criteria for this test shall be no external leakage during 15 minutes at 3 times the maximum working pressure or 6 times the pre-charge pressure, whichever is greater.

Residual fluid seepage in composite tanks shall not constitute external leakage.

5.2.5 Cyclical test

5.2.5.1 The cyclical test shall be conducted on 3 representative prototype tanks of the same design.

5.2.5.2 Each tank shall be completely filled with water at room temperature and pressure cycled between the lowest expected pre-charge pressure and the maximum working pressure. The cycle time is to be a minimum of 5 seconds with an additional dwell time at the maximum working pressure of 5 seconds.

5.2.5.3 The acceptance criteria shall be 10,000 cycles without leaks for steel tanks and 33,000 cycles without leaks for composite tanks.

5.2.6 Test report

5.2.6.1 A test report on the prototype design shall be made. In addition, the mechanical (physical) and chemical properties of the material and the thickness of the cylindrical section of the tank shall be included in the report.

5.2.6.2 The tank manufacturer shall maintain copies of the test report(s) for the entire period that the tanks are being manufactured and five (5) years after manufacturing ceases.

6 Minimum construction performance design method criteria

Tanks shall meet either 6.1 or 6.2 design method below, as applicable:

6.1 Design method by hydrostatic test

6.1.1 The maximum working pressure shall be determined by subjecting 3 tanks made of the same design and from the same production run to a hydrostatic leak test. The minimum value of the leak test shall determine the maximum working pressure. The manufacturing process shall ensure repeatability of the results.

6.1.2 For steel tanks the minimum hydrostatic leak test value shall be at least 3 times the maximum working pressure (MWP) or 6 times the pre-charge pressure, whichever is greater. For composite tanks the minimum hydrostatic leak test value shall be at least 5 times the MWP.

6.1.3 For steel tanks, the hydrostatic pressure shall gradually be increased until the required test pressure is achieved. The test vessel shall be located between the pressure source and the pressure measurement device. It shall be held for 15 minutes. There shall be no sign of external leakage.

6.1.4 For composite tanks, a cyclic pressure test shall be performed in accordance with 5.2.5. The acceptance criteria shall be 33,000 cycles without leakage. After the cyclic pressure test, a hydrostatic pressure test shall be performed. The hydrostatic test pressure in the test vessel shall be increased at a rate not exceeding 20 psig/sec (140 kPa/sec) until the required hydrostatic test pressure is achieved. The test vessel shall be located between the pressure source and the pressure measurement device, and the test pressure shall be held at the required hydrostatic test pressure for 5 seconds. There shall be no sign of external leakage.

6.2 Design method by calculation for low carbon steel tanks

6.2.1 Head thickness: The cylindrical (head flange) thickness portion of a head shall be determined using the following equation:

$$T_h = PR / S$$

The allowable yield stress (S) is 20,000 psi (140,000 kPa) or greater or with exception as stated in DOT issued allowances.

6.2.2 Shell thickness: The minimum thickness of a shell shall be determined using the following equation:

$$T_s = PR / ES$$

E = Weld efficiency for longitudinal welds (0.85)

NOTE – 1 if 100% of production is tested at the maximum working pressure.

S = Yield strength 20,000 psi (140,000 kPa) or greater or with exception as stated in DOT issued allowances.

7 Production testing

Prior to shipment, the manufacturer shall subject each tank to a pneumatic pressure equal to 3 times the pre-charge pressure or the MWP, whichever is greater.

8 Markings

8.1 Tank markings

Each tank shall be marked, at a minimum, with the following:

- a) the manufacturer's name and address;
- b) model identification;
- c) serial number which will identify the date of manufacture;
- d) maximum working pressure; and
- e) maximum operating temperature.

8.2 Package markings

Each package shall be marked at a minimum with the model identification of the tank.

9 Instructions

Each tank shall be accompanied by printed instructions for the proper installation, maintenance and safe use of the tank.

Annex A⁵
(informative)

Water systems council listing program

A.1 Listings

A.1.1 Eligibility

In order to be eligible for listing by the Water Systems Council (WSC), Pressurized Water Storage Tanks are certified as meeting PST-2000 by an independent laboratory. Applicants for such listing identify the original equipment manufacturer of the product in their certification applications. At least one size of the same model series of these products is tested and certified as meeting PST-2000 in order for the entire model series to be listed.

A.1.2 Symbol authorization

Manufacturers or re-distributors of products eligible for listing may be licensed or authorized by the Water Systems Council to use its symbol of compliance with this Standard.

A.1.3 Fees for listing

Fees for listing are set from time to time by the Water Systems Council.

A.1.4 Annual renewal of product listing

The Water Systems Council publishes a list of products certified by independent testing laboratories to PST-2000 once a year. This list is available on the WSC website. Listed manufacturers and re-distributors have the annual opportunity to add newly certified products to the list and incur the obligation to inform the certifying laboratory of any changes in their listed products' design or function that could necessitate a retest and re-certification.

A.2 Enforcement

WSC reserves the right to require a retest of any product on the PST-2000 list.

Any challenge by a member or non-member to the veracity of a product's compliance with PST-2000 requirements is to be submitted to WSC in writing. The letter has to include the basis for the challenge as well as the name of the person and/or company submitting the information. The WSC board is responsible for determining what action, if any, will be taken.

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Annex B⁶
(informative)

Process for PST-2000 listing

WSC maintains and updates the PST-2000 published listing annually. WSC publishes the annual update of the PST-2000 List in January of each year. This list will be available on the WSC website. To be included on the updated PST-2000 list, all the below-mentioned materials shall be submitted to WSC before December 15th each year, along with the payment of all fees (if applicable).

Each year in September, manufacturers with products on the current list are sent letters requesting a notarized letter signed by an officer of the company that lists all products to be listed for the current year. For products on the current list, this letter has to certify that no design, materials or function changes have been made to any of these products since the current approval of the PST-2000 listing. If any changes in the listed product have been made, the revised product shall be re-tested and approved separately for PST-2000 listing.

To obtain PST-2000 approval for any products made by you that have never been tested or that are not currently listed, you need to have those products tested by an independent laboratory for PST-2000 compliance before they can be approved for listing. The independent laboratory conducting the test will also be required to ship directly to WSC the tested product along with a letter verifying that the product complies with PST-2000. Once approved and all fees have been paid, a product is immediately listed. Upon request, the Water Systems Council shall make proof of the listing available to the product manufacturer until the product appears on the published listing.

For any products that are manufactured by someone else for you and that are currently PST-2000 listed, you need to obtain a letter from the manufacturer certifying that the product model (include product number) that you want PST-2000 listed is a product manufactured by that manufacturer for you and is a product currently PST-2000 listed by that manufacturer. This letter should include all product numbers for both your product and the manufacturer's product and clearly show the relationship between each.

WATER SYSTEMS COUNCIL
NATIONAL PROGRAMS OFFICE
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www.watersystemscouncil.org

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