



## Public Input No. 38-NFPA 22-2015 [ Global Input ]

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**Proposal:** Delete the term “Standpipe” as it is not consistently used throughout the standard and is redundant with the term suction or gravity tank.

**14.2.5.1.1** The base elbow of tanks with steel-plate tank risers, of suction tanks, or of standpipes gravity tanks shall have bell ends.

**14.2.8.2.3** A rigid flanged connection or welded joint shall be permitted to be used between the discharge pipe and the bottom of a suction tank, a standpipe gravity tank , or the base of a steel-plate tank riser of a tank that is located on an independent tower where special approval is obtained from the authority having jurisdiction.

**16.2.1.1** A steam-heated vertical radiator system shall be used for elevated tanks with unprotected tank risers of 3 ft (0.91 m) or more in diameter that have tower heights under 100 ft (30.5 m) (see 13.1.2), standpipes gravity tanks, and on-grade suction tanks.

Already proposed to be deleted see Chapter 16 proposal.

**16.2.1.3** Immersed steam coils shall be used for suction tanks and standpipes gravity tanks that have flat bottoms supported near ground level in situations where the tank is kept filled so that the steam coils are continuously submerged.

Already proposed to be deleted see Chapter 16 proposal.

**16.2.2.1** Suction tanks, standpipes, and elevated gravity tanks that have tank risers of 3 ft (0.91 m) or more in diameter shall not be required to have provision for heat.

Already proposed to be deleted see Chapter 16 proposal.

**16.3.6.2** An accurate angle socket thermometer that has at least a 6 in. (152 mm) stem and that is calibrated as low as 30°F(-1.1°C) shall be permanently inserted through the plate ~~or standpipe~~ and as far from the heating unit as possible.

**16.3.8.9** The surface water temperatures for elevated gravity tanks, standpipes, and suction tanks shall be ascertained by means of a listed temperature-detecting device.

**A.16.1.3 Choice of Circulating Heaters.** To select a suitable circulating heater, first obtain from Figure 16.1.4 the lowest mean atmospheric temperature for one day that may occur at the locality in question; then determine the total heat loss from the

tank equipment in British thermal units (kilowatts) per hour from Table 16.1.4(a) for an elevated gravity steel tank, from Table 16.1.4(b) for an elevated wood tank, from Table 16.1.4(c) for a steel suction tank ~~or standpipe~~, or from Table 16.1.4(d) for an embankment-supported coated fabric suction tank. The heater installed should have sufficient capacity to deliver, under actual field conditions, an amount of heat that is equivalent to that lost from the tank equipment. A steam water heater should be planned with due consideration of the steam pressure available. Other heaters should be planned for the particular kind of fuel to be used.

**A.16.1.4 Heat Losses.** Table 16.1.4(a) through Table 16.1.4(h) specify the heat losses from uninsulated elevated gravity steel tanks, elevated wood tanks, steel suction tanks and standpipes, embankment-supported coated fabric suction tanks, insulated steel gravity tanks, and insulated steel suction tanks, respectively, for common sizes exposed to various atmospheric temperatures of 35°F to -60°F (1.7°C to -51.1°C). The losses are indicated in the British thermal units per hour (kilowatts) that are lost from the entire tank equipment when the temperature of the coldest water is safely above the freezing point, and represent the British thermal units per hour that the heating system should supply when the atmospheric temperature is within the range provided by the tables.

**A.16.2 Recommendations for Gravity Circulation Heating.** Gravity circulation allows convenient observation of the coldest water temperatures at a thermometer in the cold-water return pipe and is dependable and economical when correctly planned. Cold water received through a

connection from the discharge pipe or from near the bottom of a suction tank or standpipe is heated and rises through a separate hot-water pipe into the tank. Water has its maximum density at 39.2°F (4°C). When the temperature of the water falls below 39.2°F (4°C), a water inversion occurs and the warmer water settles to the bottom of the tank while the colder water rises. Therefore, if the circulation heater is to be fully effective, sufficient heat should be provided so that the temperature of the coldest water is maintained above 42°F (5.6°C) to prevent inversion. (See *Table A.16.2.*)

**A.16.3.6.1** A vertical steam radiator, as shown in Figure B.1(u), but without the open-ended pipe sleeve around the radiator heater, is reasonably well adapted to heating elevated gravity tanks with larger tank risers for tower heights under 100 ft (30.5 m) (see 13.1.2), suction tanks, and standpipes.

## Statement of Problem and Substantiation for Public Input

The term standpipe is not used consistently throughout the standard and should be deleted as it can be used to refer to either a suction or gravity tank.

## Submitter Information Verification

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## Committee Statement

**Resolution:** [FR-39-NFPA 22-2016](#)

**Statement:** The term standpipe is not used consistently throughout the standard and should be deleted as it can be used to refer to either a suction or gravity tank.



## Public Input No. 1-NFPA 22-2015 [ Chapter 2 ]

### Chapter 2 Referenced Publications

#### 2.1 General.

The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

#### 2.2 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2010 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2013 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2013 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2012 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 2011 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2013 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2013 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2011 edition.

NFPA 70<sup>®</sup>, *National Electrical Code*<sup>®</sup>, 2011 edition.

NFPA 72<sup>®</sup>, *National Fire Alarm and Signaling Code*, 2013 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, 2013 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2011 edition.

#### 2.3 Other Publications.

##### 2.3.1 ACI Publications.

American Concrete Institute, P.O. Box 9094, **38800 Country Club Drive**, Farmington Hills, MI 48333 **48331** - 9094 **3439**.

ACI 318M, *Building Code Requirements for Structural Concrete and Commentary*, 2008, **2014**.

ACI 350R 350, **Code Requirements For Environmental Engineering Concrete Structures And Commentary**, 2006, **Errata, 2015**. (**Supersedes ACI 350R**)

##### 2.3.2 ANSI- **IEEE** Publications.

American National Standards Institute, Inc., 25 West 43rd Street, 4th **IEEE**, **3 Park Avenue**, **17th** Floor, New York, NY 10036 **10016-5997**.

ANSI-SI- **IEEE** SI 10, **American National Standard for Use of the International System of Units (SI): The Modern Metric System**, 2010 **Metric Practice**, 2010, **Errata, 2013**.

##### 2.3.3 API Publications.

American Petroleum Institute, 1220 L Street N.W., Washington, DC 20005-4070.

API- 5LC **SPEC 5LC**, *Specification for CRA Line Pipe*, 3rd ed., 1998, **reaffirmed 2015**.

##### 2.3.4 ASHRAE Publications.

American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta, GA 30329-2305.

ASHRAE *Handbook- of - Fundamentals*, 2009 **2013**.

### 2.3.5 ASME Publications.

American Society of Mechanical Engineers, Three ASME International , Two Park Avenue, New York, NY 10016-5990.

ASME *Boiler and Pressure Vessel Code*, "Rules for the Section VIII, Division 1, "Rules for Construction of Unfired Pressure Vessels", "2010 2015 .

2.3.6 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM A-6 A6 /A-6M A6M , *Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling*, 2011 - **2014** .

ASTM A-27 A27 /A-27M A27M , *Standard Specification for Steel Castings, Carbon, for General Application*, 2010 - **2013** .

ASTM A-36 A36 /A-36M A36M , *Standard Specification for Carbon Structural Steel*, 2008 - **2014** .

ASTM A-53 A53 / **A53M** , *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, 2010 - **2012** .

ASTM A-105 A105 /A-105M A105M , *Standard Specification for Carbon Steel Forgings for Piping Applications*, 2011 - **2014** .

ASTM A-106 A106 /**A106M** , *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service*, Rev. **2014** - A, 2010.

ASTM A-108 A108 , *Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality*, 2007 - **2013** .

ASTM A-134 A131 /A-131M A131M , *Standard Specification for Structural Steel for Ships*, 2004 - **2014** .

ASTM A-139 A139 /**A139M** , *Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and over)*, **2004, reapproved 2010** .

ASTM A-184 A181 /A-181M A181M , *Standard Specification for Carbon Steel Forgings, for General-Purpose Piping*, 2006 - **2014** .

ASTM A-193 A193 /**193M** , *Standard Specification for Alloy-Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications*, 2012 - **2014A** .

ASTM A-283 A283 /A-283M A283M , *Standard Specification for Low- and Intermediate-Tensile Strength Carbon Steel Plates*, Rev. **2013** - A, 2007.

ASTM A-285 A285 /A-285M A285M , *Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength*, 2007 - **2012** .

ASTM A-307 A307 , *Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength*, 2010 - **2014** .

ASTM A-502 A502 , *Standard Specification for Steel Structural Rivets*, 2009 - **2003, reapproved 2015** .

ASTM A-516 A516 /A-516M A516M , *Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service*, 2010.

ASTM A-572 A572 /A-572M A572M , *Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel*, 2007 - **2015** .

ASTM A-615 A615 /A-615M A615M , *Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement*, 2009 - **2015** .

ASTM A-668 A668 /A-668M A668M , *Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use*, 2009 - **2015** .

ASTM A-675 A675 /A-675M A675M , *Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties*, Rev. **2014** - A, 2009.

ASTM A-992 A992 /A-992M A992M , *Standard Specification for Steel for Structural Shapes for Use in Building Framing*, 2011.

ASTM A-1011 A1011 /**A1011M** , *Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability*, 2010 - **2014** .

ASTM C-578 C578 , *Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation*, 2011 - **2014A** .

ASTM D-754 D751 , *Standard Test Methods for Coated Fabrics*, 2006, **reapproved 2011** .

ASTM D-1174 D1171 , *Standard Test Method for Rubber Deterioration — Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)*, 2007.

ASTM D-1183 D1183 , *Standard Test Methods for Resistance of Adhesives to Cyclic Laboratory Aging Conditions*, 2011.

ASTM D 1754 D1751 , *Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)*, 2008 . **2004, (2013 e1)** .

ASTM D 2264 D2261 , *Standard Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine)*, 2007 . **2013** .

ASTM F 1554 F1554 , *Standard Specification for Anchor Bolts Steel 36, 55 and 105-KSI Yield Strength, 2007A, ( 2011 E1)* .

#### 2.3.7 AWPA Publications.

American Wood Preservers- Wood Protection Association, 7735 Old Georgetown Avenue N.W., Suite 500, Washington, DC 20036 . **P.O. Box 361784, Birmingham, AL 35236-1784** .

*Standard Specifications of the American Wood Preservers Association by the Empty-Cell Process*, July 1, 2011.

#### 2.3.8 AWS Publications.

American Welding Society, 550 N.W. LeJeune Road, **8869 NW 36 Street, Suite #130** , Miami, FL 33126 **33166-6672** .

AWS A5.1/**A5.1M** , *Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding*, 1994 . **2012** .

AWS D1.1/**D1.1M** , *Structural Welding Code — Steel*, 2010 . **2015** .

#### 2.3.9 AWWA Publications.

American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235.

AWWA C652, *Disinfection of Water-Storage Facilities*, 2002 . **2011** .

AWWA D100, *Welded Steel Tanks for Water Storage*, 2011.

AWWA D102, *Coating Steel Water-Storage Tanks*, 2014 . **2014** .

AWWA D103, *Factory-Coated Bolted Steel Tanks for Water Storage*, 2009, **Addenda, 2014** .

AWWA D110, *Wire- and Strand-Wound, Circular-Prestressed Concrete Water Tanks*, 2004 . **2013** .

AWWA D115, *Circular-Prestressed Concrete Water Tanks with Circumferential Tendons*, 2006.

AWWA D120, *Standard for Thermosetting Fiberglass-Reinforced Plastic Tanks*, 2009.

#### 2.3.10 NWTI Publications.

National Wood Tank Institute, **Hall-Woolford Tank Company, Inc.** , 5500 N. Water St., P.O. Box 2755, Philadelphia, PA 19120.

NWTI Bulletin S82, *Specifications for Tanks and Pipes*, 1982.

#### 2.3.11 SSPC Publications.

Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh, PA 15222-4656.

*SSPC Systems and Specifications Steel Structures Painting Manual*, Volume 2, Chapter 5, 2011.

SSPC SP 6, *Joint Surface Preparation Standard Commercial Blast Cleaning*, 2007.

SSPC SP 8, *Pickling*, 2004.

SSPC SP 10, *Joint Surface Preparation Standard Near-White Blast Cleaning*, 2007.

#### 2.3.12 U.S. Government Publications.

U.S. Government Printing- Government Publishing Office, **732 North Capitol Street, NW, Washington DC 20402 20401-0001** .

Title 29, Code of Federal Regulations, Part 1910 (OSHA).

Federal Standard 191 Method. Textile Test Methods, 1978.

Federal Test Method Standard 601. Rubber: Sampling and Testing, 1955.

#### 2.3.13 Other Publications.

*Merriam-Webster's Collegiate Dictionary*, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

#### 2.4 References for Extracts in Mandatory Sections. (Reserved)

## Statement of Problem and Substantiation for Public Input

Referenced current SDO names, addresses, standard names, numbers, and editions.

## Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
<u>Public Input No. 2-NFPA 22-2015 [Chapter C]</u>	

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## Committee Statement

**Resolution:** FR-40-NFPA 22-2016

**Statement:** Updated references as required by NFPA Manual of Style.





## Public Input No. 42-NFPA 22-2015 [ Section No. 2.3.4 ]

### 2.3.4 ASHRAE Publications.

American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta, GA 30329-2305.

ASHRAE *Handbook of - Fundamentals*, 2009 2013 .

### Statement of Problem and Substantiation for Public Input

A superseded version of the Handbook of Fundamentals is referenced, and this comment seeks to update the reference to the most recent published version of the Handbook.

All references to the Handbook should be editorially corrected from the ASHRAE Handbook of Fundamentals to the formal reference (the ASHRAE Handbook - Fundamentals) throughout the document.

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### Committee Statement

**Resolution:** [FR-40-NFPA 22-2016](#)

**Statement:** Updated references as required by NFPA Manual of Style.



## Public Input No. 3-NFPA 22-2015 [ Section No. 3.3.1 ]

### 3.3.1 2.2 Break Tank.

A tank providing suction to a fire pump whose capacity is less than the fire protection demand (flow rate times flow duration).

### Additional Proposed Changes

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
NFPA_22_Chapter_3.docx	Reorganized section and added definitions of terms commonly used in the document.	

### Statement of Problem and Substantiation for Public Input

Reorganized section and added definitions of terms used in the document such as bladder, gravity and pressure tank, standpipe and tank riser. These are terms not generally defined in Miriam Websters Dictionary and need clarification.

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### Committee Statement

**Resolution:** [FR-41-NFPA 22-2016](#)

**Statement:** Reorganized General Definition section by adding definitions for bladder, gravity and pressure tank, and modified the definitions of suction tank and tank riser. Also added new annex content for bladder, gravity, and tank riser. These are terms not generally defined in Miriam Websters Dictionary and need clarification. The submitter of PI#3 proposed a definition for the term standpipe, however, the term standard has been removed from the standard and therefore a definition is no longer required.

### 3.3 General Definitions

~~3.3.1 Break Tank. A tank providing suction to a fire pump whose capacity is less than the fire protection demand (flow rate times flow duration).~~

**3.3.1 Holiday.** A discontinuity in the coating system that includes, but is not limited to, voids, cracks, pinholes, or scratches.

~~3.3.3 Suction Tank. Any tank that provides water to a fire pump~~

~~3.3.4 Tank Riser. A large diameter shaft that surrounds and encloses the piping below an elevated gravity tank to provide a measure of insulation and protection~~

#### 3.3.2 Tank

3.3.2.1 Bladder Tank. A type of pressure tank containing air and water separated by a flexible membrane (bladder).

**3.3.2.2 Break Tank.** A tank providing suction to a fire pump whose capacity is less than the fire protection demand (flow rate times flow duration).

3.3.2.3 Gravity Tank. An elevated storage tank (on a tower or hill) that utilizes elevation (head) as a source of pressure.

A.3.3.2.3 A gravity tank might be capable of providing the necessary head pressure to operate a fire suppression system or used to provide water to a fire pump.

3.3.2.4 Pressure Tank. A tank that utilizes air or some other gas under pressure as a means of expelling its contents.

**3.3.2.5 Suction Tank.** A tank, located in close proximity to a fire pump into which a minimal amount of head pressure is provided. ~~Any type of tank that provides water to a fire pump.~~

3.3.3 Standpipe. A ground-supported, flat-bottom, cylindrical tank having a shell height greater than its diameter.

A.3.3.3 A standpipe can be used either as a suction tank or as a gravity tank if elevated in some form (such as on a hill or building roof).

**3.3.4\* Tank Riser.** A large diameter shaft that surrounds and encloses the piping below an elevated gravity tank to provide a measure of insulation and protection. A tank riser can also serve as the discharge pipe for the tank.

**A.3.3.4** See Figure B.1(j) .

**Substantiation:** Reorganized section and added definitions of terms used in the document such as bladder, gravity and pressure tank, standpipe and tank riser. These are terms not generally defined in Miriam Websters Dictionary and need clarification.



## Public Input No. 4-NFPA 22-2015 [ Section No. 4.1 ]

### 4.1 Capacity and Elevation.

#### 4.1.1 \* \_

The size and elevation of ~~the tank~~ tanks shall be determined by conditions at each individual property after due consideration of all factors involved the required flow and duration of the attached fire protection system(s) and the pressures required .

#### 4.1.2

~~Whenever possible, standard~~ Standard sizes of tanks shall be as specified in 5.1.3, 6.1.2, 8.1.3, and Sections 9.2 and 10.3.

#### 4.1.3 \*

For suction tanks, the net capacity shall be the number of U.S. gallons (cubic meters) between the inlet of the overflow and the level of the vortex plate.

#### 4.1.4

A tank shall be sized so that the stored supply plus reliable automatic refill shall ~~be sufficient to~~ meet the system demand ~~placed upon it~~ for the design duration.

#### 4.1.5

A break tank shall be sized for a minimum duration of 15 minutes with the fire pump operating at 150 percent of rated capacity.

### Statement of Problem and Substantiation for Public Input

Removes unenforceable language and provides clarification of the capacity requirements for all tanks.

### Submitter Information Verification

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### Committee Statement

**Resolution:** FR-42-NFPA 22-2016

**Statement:** Removes unenforceable language and provides clarification of the capacity requirements for all tanks. New annex language has been added to A.4.1.3 however, the proposed figure A.4.1.3 was not accepted as the standard already contains a figure of a vortex plate and piping, an additional figure may add confusion.



## Public Input No. 5-NFPA 22-2015 [ New Section after 4.1.2 ]

### TITLE OF NEW CONTENT

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4.1.2.1 Tanks other than standard size shall be approved.

### Additional Proposed Changes

<u>File Name</u>	<u>Description Approved</u>
NFPA_22_Section_4.1_Capacity_Elevation.docx	

### Statement of Problem and Substantiation for Public Input

Removes unenforceable language and provides clarification of the capacity requirements for all tanks.

### Submitter Information Verification

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### Committee Statement

**Resolution:** [FR-42-NFPA 22-2016](#)

**Statement:** Removes unenforceable language and provides clarification of the capacity requirements for all tanks. New annex language has been added to A.4.1.3 however, the proposed figure A.4.1.3 was not accepted as the standard already contains a figure of a vortex plate and piping, an additional figure may add confusion.

## 4.1 Capacity and Elevation.

4.1.1\* The size and elevation of tanks shall be determined by the required fire flow and duration for the attached fire protection system(s) and the pressures required. of the tank shall be determined by conditions at each individual property after due consideration of all factors involved.

A.4.1.1 Where tanks are to supply fire protection systems, sprinklers, see separately published NFPA water based standards; such as NFPA 11, 13, 14, 15, 16, 20 and 24. also see NFPA 13.

4.1.2 Wherever possible, standard sizes of tanks shall be as specified in 5.1.3, 6.1.2, 8.1.3, and Sections 9.2 and 10.3.

4.1.2.1 Tanks other than standard size shall be approved.

4.1.3\* For suction tanks, the net capacity shall be the number of U.S. gallons (cubic meters) between the inlet of the over-flow and the level of the vortex plate.

A.4.1.3 Careful consideration should be given to the determination of tank capacity. In addition to the required fire flow and duration requirements of water based system standards, the permitted fluctuations of the water level sensors (See Section 14.9) 12 in. (300 mm) below normal for evaporation and closure time for the fill valve and maintaining a reasonable amount of water in the bottom of suction tanks to prevent cavitation of fire pumps should be factored into the overall tank size.

For example, assuming a suction tank supplying a standpipe system via a 1000gpm fire pump:

Standpipe system design = 1000gpm x 30 minutes = 30,000 gallons required.

Assuming a 20ft diameter suction tank, the tank would hold approximately 2349 gallons per foot of tank height ( $v=3.1416 r^2h$ )  $314 = 3.1416(10)^2(1) \times 7.48 = 2349$  gal.

Given a 1ft variation between the fill sensor and overflow connection 2349 gallons would have to be added to the tank capacity. Further assuming that the minimum water level should be approximately equal to the center line of the suction pipe (to prevent fire pump cavitation – see Figure A.4.1.3) then another 3948 gal should be added to the needed capacity.

Volume =  $3.1416 (10)^2 ( 1.68) \times 7.48$  gal/cu.ft = 3948 gallons.

$3948 + 2349 = 6297$  gallons

Adding these considerations brings the total needed capacity to 36,297 gallons or a 40,000 gallon tank (based on standard tank sizes)

The dimensions in Figure A.4.1.3 are based on a 1000 gpm fire pump which requires an 8" suction line. Dimensions for other sizes of pumps and suction lines will vary slightly.

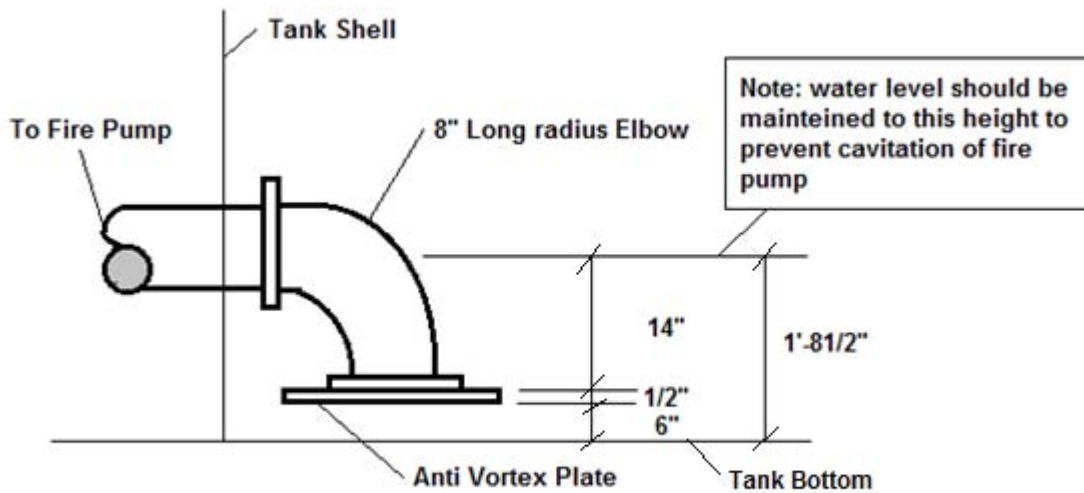
4.1.3.1 For all other tanks, the net capacity shall be the numbers of U.S. gallons

(cubic meters) between the inlet of the overflow and the discharge outlet.

**4.1.4** A tank shall be sized so that the stored supply plus reliable automatic refill shall be sufficient to meet the system demand placed upon it for the design duration.

**4.1.5** A break tank shall be sized for a minimum duration of 15 minutes with the fire pump operating at 150 percent of rated capacity.

**Substantiation:** Removes unenforceable language and provides clarification of the capacity requirements for all tanks.



**Figure A.4.1.3**





## Public Input No. 6-NFPA 22-2015 [ Chapter 5 ]

### Chapter 5 Welded-Steel Gravity Tanks and Suction Tanks

#### 5.1 General.

##### 5.1.1

This chapter shall apply to the design, fabrication, and erection of welded-steel gravity water tanks, including pump suction tanks.

##### 5.1.2 Capacity.

###### 5.1.2.1

The capacity of the tank shall be the number of U.S. gallons (cubic meters) available above the outlet opening.

###### 5.1.2.2

The net capacity between the outlet opening of the discharge pipe and the inlet of the overflow shall be equal to at least the rated capacity.

###### 5.1.2.3

The net capacity for gravity tanks with large plate tank risers shall be the number of U.S. gallons (cubic meters) between the inlet of the overflow and the designated low-water level line.

#### 5.1.3 Standard Sizes.

##### 5.1.3.1

The standard net capacity sizes of steel tanks shall be as follows:

- (1) 5000 gal (18.93 m<sup>3</sup>)
- (2) 10,000 gal (37.85 m<sup>3</sup>)
- (3) 15,000 gal (56.78 m<sup>3</sup>)
- (4) 20,000 gal (75.70 m<sup>3</sup>)
- (5) 25,000 gal (94.63 m<sup>3</sup>)
- (6) 30,000 gal (113.55 m<sup>3</sup>)
- (7) 40,000 gal (151.40 m<sup>3</sup>)
- (8) 50,000 gal (189.25 m<sup>3</sup>)
- (9) 60,000 gal (227.10 m<sup>3</sup>)
- (10) 75,000 gal (283.88 m<sup>3</sup>)
- (11) 100,000 gal (378.50 m<sup>3</sup>)
- (12) 150,000 gal (567.75 m<sup>3</sup>)
- (13) 200,000 gal (757.00 m<sup>3</sup>)
- (14) 300,000 gal (1135.50 m<sup>3</sup>)
- (15) 500,000 gal (1892.50 m<sup>3</sup>)

##### 5.1.3.2

Tanks of other sizes shall be permitted.

**5.1.4 Form.**

Steel tanks shall be permitted to be of any form desired, provided they conform to all requirements of this standard.

**5.2 Materials.****5.2.1 Plates, Shapes, and Tubular Columns.****5.2.1.1 Plates.**

Plate materials shall be of open-hearth, electric furnace, or basic oxygen process steel that conforms to AWWA D100 and one of the following ASTM specifications:

- (1) ASTM A 36/A 36M
- (2) ASTM A 283/A 283M, Grades A, B, C, and D

**5.2.1.2**

Where plates of thicknesses greater than  $\frac{3}{4}$  in. (19.1 mm) are used, ASTM A 283, Grade D, shall not be used. ASTM A 131, Grades A, B, and C; or ASTM A 516, Grades 55 and 60, shall be used as alternatives.

**5.2.1.3 Basis of Furnishing Plates.**

Plates shall be furnished, based on weight, with permissible underrun and overrun in accordance with the tolerance table for plates ordered to weight in ASTM A 20.

**5.2.1.4 Shapes.**

Structural materials shall be open-hearth, electric furnace, or basic oxygen process steel that conforms to ASTM A 36, or ASTM A 131, Grades A, B, and D, or ASTM A 992/A 992M.

**5.2.1.5**

Copper-bearing steel that contains approximately 0.20 percent copper shall be permitted to be used. In all other respects, steel shall conform to the specifications of [5.2.1.1](#), [5.2.1.3](#), and [5.2.1.4](#).

**5.2.2 Bolts, Anchor Bolts, and Rods.****5.2.2.1**

Bolts and anchor bolts shall conform to AWWA D100.

**5.2.2.2**

ASTM A 36 shall be considered an acceptable alternative material for anchor bolts. Rods shall be open-hearth, electric furnace, or basic oxygen process steel that conforms to ASTM A 36.

**5.2.3\* Forgings.****5.2.3.1**

Steel used for forgings shall be made only by the open-hearth process.

**5.2.3.2**

Forgings shall conform to the following ASTM specifications:

- (1) ASTM A 105
- (2) ASTM A 668 Class D
- (3) ASTM A 181, Class 70

**5.2.4 Castings.**

Castings shall conform to ASTM A 27, Grade 60-30 full annealed.

**5.2.5 Reinforcing Steel.**

Reinforcing steel shall comply with ASTM A 615, Grade 40 or Grade 60.

**5.2.6 Filler Metal Electrodes.****5.2.6.1**

Manual, shielded metal arc welding electrodes shall conform to the requirements of AWS A5.1.

**5.2.6.2**

Electrodes shall be of any E60XX or E70XX classification that is suitable for the electric current characteristics, the position of welding, and other conditions of intended use.

**5.2.6.3**

Electrodes for other welding processes shall be in accordance with applicable AWS specifications for filler metal.

**5.3 Earthquake Load.****5.3.1**

Tanks shall meet the requirements for resistance to earthquake damage in accordance with the earthquake design provisions of AWWA D100.

**5.3.2**

For seismic anchor-bolt loading, the following formula shall be used:

$$T_s = \frac{4M_s}{ND} - \frac{W'}{N}$$

where:

$T_s$  = seismic bolt tension (lb)

$M_s$  = seismic overturning moment (ft lb)

$W'$  = weight of tank shell and portion of roof carried by shell (lb)

$N$  = number of anchor bolts

$D$  = tank diameter (ft)

## 5.4 Unit Stresses.

The maximum stresses in pounds per square inch (megapascals) that are produced by the loads specified in Sections 4.12 and 5.3, or any combination of them, shall not exceed the values in Table 5.4.

Table 5.4 Maximum Stresses

	<u>psi</u>	<u>MPa</u>
Tension: On net section, rolled steel	15,000	103.43
Tension:		
Anchor Bolts†		
Mild steel		
ASTM A 36 or ASTM F 1554–36	15,000	103.43
ASTM F 1554–55 (weldable)	18,750	129.29
High-strength steel		
ASTM A 193–B7		
1 ¼ in. ≤ diameter ≤ 2 ½ in.	31,250	215.48
2 ½ in. ≤ diameter ≤ 4 in.	28,750	198.24
ASTM F 1554–105		
1 ¼ in. ≤ diameter ≤ 3 in.	31,250	215.48
Tension: Cast steel		
Bending:		
Tension on extreme fibers, except column base plates	15,000*	103.43
Column base plates	20,000	137.90
Compression on extreme fibers of rolled sections, and plate girders and built-up members for values as follows:		
$\frac{ld}{bt}$ not in excess of 600	15,000	103.43
$\frac{ld}{bt}$ in excess of 600	9,000,000	62,055
	$\frac{ld}{bt}$	$\frac{ld}{bt}$
where <i>l</i> is the unsupported length; <i>d</i> is the depth of the member; <i>b</i> is the width; and <i>t</i> is the thickness of its compression flange; all in in. (mm); except that <i>l</i> shall be assumed to be twice the length of the compression flange of a cantilever beam not fully stayed at its outer end against translation or rotation.		
Pins, extreme fiber	22,500	155.15
Cast steel	11,250	77.57

\*For materials with  $F_y = 36,000$  psi, the allowable stress may be taken as 18,000 psi.

†On area based on diameter at root of threads.

## 5.5 Design Details.

### 5.5.1 Minimum Thickness.

#### 5.5.1.1

Except for cylindrical shell plates in contact with water in accordance with 5.5.1.6, the minimum thickness of any part of the structure shall be ⅜ in. (4.8 mm) for parts not in contact with water contents and ¼ in. (6.4 mm) for parts in contact with water contents.

#### 5.5.1.2

The controlling thickness of rolled shapes for the purposes of the foregoing stipulations shall be taken as the mean thickness of the flanges, regardless of web thickness.

**5.5.1.3**

The minimum thickness of tubular columns and struts shall be  $\frac{1}{4}$  in. (6.4 mm).

**5.5.1.4**

Round or square bars used for wind bracing shall have a minimum diameter or width of  $\frac{3}{4}$  in. (19.1 mm).

**5.5.1.5**

Bars of other shapes, if used, shall have a total area at least equal to a  $\frac{3}{4}$  in. (19.1 mm) round bar.

**5.5.1.5.1**

Roof plates for suction tanks with cone roofs shall be permitted to be 0.1792 in. (7 gauge) sheet.

**5.5.1.6**

Cylindrical shell plates in contact with water shall have minimum thicknesses as specified in accordance with [Table 5.5.1.6](#).

Table 5.5.1.6 Minimum Thickness of Cylindrical Shell Plates

	<b>Diameter</b>							
	<b>&lt;50 ft</b>	<b>&lt;15.2 m</b>	<b>50 ft– 120 ft</b>	<b>15.2 m– 35.6 m</b>	<b>120 ft– 200 ft</b>	<b>35.6 m– 61 m</b>	<b>&gt;200 ft</b>	<b>&gt;61 m</b>
Bottom rings	$\frac{1}{4}$ in.	6.4 mm	$\frac{1}{4}$ in.	6.4 mm	$\frac{5}{16}$ in.	7.9 mm	$\frac{3}{8}$ in.	9.5 mm
Upper rings	$\frac{3}{16}$ in.	4.8 mm	$\frac{1}{4}$ in.	6.4 mm	$\frac{5}{16}$ in.	7.9 mm	$\frac{3}{8}$ in.	9.5 mm

**5.5.2 Thickness for Corrosion.****5.5.2.1**

If interior bracing is required to support the water content,  $\frac{1}{16}$  in. (1.6 mm) additional thickness shall be added to the calculated sections.

**5.5.2.2**

Except for hermetically sealed tubular sections, the sections shall be open to facilitate cleaning and painting.

**5.5.2.2.1**

Tubular sections used for columns on elevated legged tanks shall be hermetically sealed to prevent internal corrosion.

**5.5.2.3**

The plates of tanks that are to contain salt or alkaline water shall be  $\frac{1}{16}$  in. (1.6 mm) thicker than calculated.

**5.5.3 Thickness of Tank Plates.****5.5.3.1**

Tank plates shall be designed on the basis of the following maximum membrane tensile stresses, which shall be reduced for the joint efficiencies set forth in AWWA D100.

**5.5.3.2\***

Plate surfaces that are susceptible to complete stress analysis shall be designed on the basis of a maximum membrane tensile stress of 15,000 psi (103.43 MPa).

**5.5.3.3**

Plate surfaces that are not susceptible to complete stress analysis shall also be designed on the basis of a maximum membrane tensile stress of 15,000 psi (103.43 MPa) after making reasonable allowances for such loads and stresses that cannot be accurately determined.

**5.5.3.3.1**

The maximum membrane tensile stress shall in no case exceed 11,000 psi (75.85 MPa) when calculated, assuming that the concentrated reactions of supporting members are uniformly distributed between such reactions.

**5.5.3.3.2**

Therefore, the lowest cylindrical courses of tanks with suspended bottoms and the suspended bottoms themselves shall be designed for a maximum membrane tensile stress of 11,000 psi (75.85 MPa), reduced for the joint efficiencies.

**5.5.3.4**

As an alternative to 5.5.3.1 and 5.5.3.2, tank shell plates for suction tanks shall be permitted to be designed on the basis of the stresses, material selection, and inspection set forth in Section 14 of AWWA D100, provided all requirements of Section 14 of the standard are met.

**5.5.3.5**

Where compressive stresses exist, the selected plate thickness shall comply with the allowable local buckling stresses in accordance with AWWA D100.

**5.5.4 Thickness of Flat Bottoms.****5.5.4.1**

The thickness of plates in flat bottoms shall be not less than those given in Table 5.5.4.1(a) and Table 5.5.4.1(b).

Table 5.5.4.1(a) Thickness of Bottom Plates for Flat-Bottom Tanks (in inches)

<u>Type of Support</u>	<u>Length</u> (ft)	<u>Depth of Water</u>												
		<u>10 ft</u>	<u>12 ft</u>	<u>14 ft</u>	<u>16 ft</u>	<u>18 ft</u>	<u>20 ft</u>	<u>22 ft</u>	<u>24 ft</u>	<u>26 ft</u>	<u>28 ft</u>	<u>30 ft</u>	<u>40 ft</u>	
Steel or concrete beams	12	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{3}{8}$
	14	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$
	16	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$
	18	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{1}{2}$
	20	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{9}{16}$
24	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{9}{16}$	$\frac{9}{16}$	$\frac{9}{16}$	$\frac{11}{16}$	
Concrete slab or earth grade		$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	

Table 5.5.4.1(b) Thickness of Bottom Plates for Flat-Bottom Tanks (in millimeters)

<u>Type of Support</u>	<u>Length</u> (m)	<u>Depth of Water</u>											
		<u>3.1 m</u>	<u>3.7 m</u>	<u>4.3 m</u>	<u>4.9 m</u>	<u>5.5 m</u>	<u>6.1 m</u>	<u>6.8 m</u>	<u>7.3 m</u>	<u>7.9 m</u>	<u>8.5 m</u>	<u>9.1 m</u>	<u>12.2 m</u>
Steel or concrete beams	3.7	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	9.5
	4.3	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	9.5	9.5	11.1
	4.9	7.9	7.9	7.9	7.9	7.9	7.9	9.5	9.5	9.5	9.5	9.5	11.1
	5.5	7.9	7.9	7.9	7.9	9.5	9.5	9.5	9.5	11.1	11.1	11.1	12.7
	6.1	7.9	7.9	9.5	9.5	9.5	11.1	11.1	11.1	11.1	12.7	12.7	14.3
7.3	9.5	9.5	11.1	11.1	11.1	12.7	12.7	12.7	14.3	14.3	14.3	17.5	
Concrete slab or earth grade		6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4

**5.5.4.2**

Any corrosion allowance specified shall be added to the value from the table.

**5.5.5 Accessibility of Bottoms.**

Grillages shall be designed so that the tank bottom and beams are accessible for inspection and painting.

**5.5.6 Net Sections.**

Net sections shall be used in calculating the tensile stress in plates and members.

**5.5.7 Load Location.**

**5.5.7.1**

When calculating the thickness of plates that are stressed by the weight or pressure of the tank contents, the pressure at the lower edge of each ring shall be assumed to act undiminished on the entire area of the ring.

**5.5.8 Opening Reinforcement.****5.5.8.1**

All openings of more than 4 in. (102 mm) in diameter that are located in the shell, suspended bottom, larger steel plate tank riser, or tubular support shall be reinforced.

**5.5.8.2**

The reinforcement shall be either the flange of a fitting, an additional ring of metal, excess plate metal above that actually required, or a combination of these methods.

**5.5.8.3**

The opening diameter shall be considered to be the maximum dimension of the hole cut in the plate perpendicular to the direction of maximum stress.

**5.5.8.3.1**

Excess plate metal used for joint efficiency shall not meet the requirements for opening reinforcement if the center of the opening is within one opening diameter of any plate seam or point of support attachment.

**5.5.8.4**

Welding shall be provided to transmit the full net strength of the reinforcing ring or flange to the plate.

**5.5.8.4.1**

In computing the net reinforcing area of a fitting, such as a boilermaker's flange or a manhole saddle that has a neck, the material in the neck shall be considered as part of the reinforcement for a distance, measured from the surface of the parent plate or from the surface of an intervening reinforcement plate, that is equal to four times the thickness of the material in the neck.

**5.5.9 Roof Supports.**

The supports for tank roofs that do not contain water shall be designed in accordance with the steel construction specifications of the American Institute of Steel Construction.

**5.5.9.1**

Rafters that are in contact with a steel roof, have a slope of less than 2 in. in 12 in. (51 mm in 305 mm), and consist of beam or channel shapes less than 15 in. (381 mm) deep shall be considered to be adequately braced in the lateral position by friction between the roof plate and the top flange.

**5.5.9.2**

The maximum slenderness ratio,  $L/r$ , for columns that support the roof shall be 175. The spacing between rafters, as measured along the tank circumference, shall not exceed  $2\pi$  ft (0.61 $\pi$  m).

**5.5.10 Welded Joints.**

The types of joints used and their design shall conform to AWWA D100.

**5.6 Workmanship.****5.6.1 Plate Edges.**

The plate edges to be welded shall be universal mill edges or shall be prepared by shearing, machining, chipping, or mechanically guided oxygen cutting. Where the edges of plates are oxygen cut, the surface obtained shall be uniform and smooth and shall be cleaned of slag accumulations before welding.

**5.6.1.1**

Edges of irregular contour shall be permitted to be prepared by manually guided oxygen cutting.

**5.6.2 Rolling.**

For elevated tanks plates shall be cold-rolled to suit the curvature of the tank and the erection procedure in accordance with [Table 5.6.2](#).

Table 5.6.2 Plate Dimensions

<b>Plate Thickness</b>	<b>Minimum Diameter for Plates Not Rolled</b>
< $\frac{3}{8}$ in. (9.5 mm)	40 ft (12.2 m)
$\frac{3}{8}$ in. to < $\frac{1}{2}$ in. (9.5 mm to < 12.7 mm)	60 ft (18.3 m)
$\frac{1}{2}$ in. to < $\frac{5}{8}$ in. (12.7 mm to < 15.9 mm)	120 ft (36.6 m)
$\frac{5}{8}$ in. (15.9 mm) and heavier	Must be rolled for all diameters

**5.6.3 Double-Curved Plates.**

Plates that are curved in two directions shall be pressed cold or hot or shall be dished with a mortar and pestle die by repeated applications.

**5.6.4 Milling Columns.**

The ends of columns shall be milled to provide a satisfactory bearing unless the design provides sufficient welding to resist the total calculated loads.

**5.6.5 Fitting Roofs.****5.6.5.1**

The roof shall fit tightly to the top of the shell to eliminate any gap between the roof and the shell.

**5.6.5.2**

Where a spider is used, it shall not obstruct the flow of water into the overflow inlet.

**5.6.6 Preventing Ice Damage.**

During the construction, the contractor shall keep the tank, structure, and building roofs free of ice caused by leakage until the tank equipment is made watertight.

**5.6.7 Coating for Bottom Plates on Soil or Concrete.****5.6.7.1\***

The underside of all bottom plates shall be protected against corrosion by one of the methods required by [5.6.7.1.1](#) through [5.6.7.1.3](#).

**5.6.7.1.1**

Two coats of paint shall be applied after the bottom has been completely welded. When the underside of the tank bottom surface is painted and lime (optional) is added to the base material on the tank underside, the compatibility of the paint and the lime shall be checked with the paint supplier.

**5.6.7.1.2**

The sand pad, including pH range of the lime sand mix, sulfate content, and chloride content, shall meet the requirements of AWWA D100.

**5.6.7.1.3**

Where permitted by environmental authorities, an oiled sand cushion shall be permitted to be used. The sand shall be coated but shall not be running with excess oil.

**5.6.7.2\***

Where the tank bottom is placed on oiled sand, the sand shall be saturated to a depth of 4 in. (102 mm) with a suitable petroleum-base oil.

**5.6.8**

Tanks shall meet the erection tolerance requirements of AWWA D100.



## **5.7 Accessories.**

### **5.7.1 Connections.**

Connections shall be provided on the tank for the necessary pipes, braces, frost-casting, and walkway supports.

### **5.7.2 Roof Anchorage.**

Each roof plate shall be securely fastened to the top of the tank.

### **5.7.3 Roof Hatch.**

#### **5.7.3.1**

An easily accessible roof hatch or roof door having a minimum opening dimension of 24 in. (610 mm) shall be provided in the roof.

#### **5.7.3.2**

The hatch cover shall be built of steel plate with a minimum thickness of  $\frac{3}{16}$  in. (4.8 mm).

#### **5.7.3.3**

The hatch opening shall have a curb that is a minimum of 4 in. (102 mm) high, and the cover shall have a minimum downward overlap of 2 in. (51 mm).

#### **5.7.3.4**

A catch shall be provided to keep the cover closed.

#### **5.7.3.5**

A second roof hatch shall be placed 180 degrees from the primary roof hatch.

### **5.7.4 Ladders — General.**

#### **5.7.4.1**

Outside and inside steel ladders that are arranged for convenient passage from one to the other and through the primary roof hatch shall be provided.

#### **5.7.4.2**

Ladders shall not interfere with the opening of the hatch cover and shall not incline outward from the vertical at any point.

#### **5.7.4.3**

For pedestal-supported tanks, the ladder shall be placed inside an access tube that extends through the center of the tank.

### **5.7.5 Outside Fixed Shell and Roof Ladder.**

#### **5.7.5.1**

The outside tank ladder of suction tanks and multiple-column-supported gravity tanks shall be fixed a minimum of 7 in. (178 mm) between the tank side and the centerline of rungs and shall be rigidly bolted or welded to brackets that are spaced a maximum of 12 ft (3.7 m) apart and that are welded to the tank plates.

#### **5.7.5.2**

The bottom bracket shall be located a maximum of 6 ft (1.8 m) above the base of the tank cylinder, and the ladder shall extend up the tank shell and radially along the roof, with the top bracket located within approximately 2 ft (0.61 m) of the roof hatch.

#### **5.7.5.3**

There shall be a minimum 1 ft (0.3 m) clearance at the sides and front of the ladder at the balcony.

#### **5.7.5.4**

All ladders shall be equipped with a cage, a rigid notched rail, or other listed ladder safety device.

### **5.7.6 Inside Ladder.**

**5.7.6.1**

The inside fixed ladder provided for passage between the roof hatch and tank bottom shall not be rigidly connected to the bottom plates.

**5.7.6.2**

A ladder shall extend from the top to the bottom of the inside of the large steel tank riser pipes and shall be secured to the shell plates by brackets that are spaced a maximum of 12 ft (3.7 m) apart.

**5.7.6.2.1**

The upper bracket shall be located at the top of the tank riser.

**5.7.6.3**

All ladders over 20 ft (6.1 m) high shall be equipped with a cage, a rigid notched rail, or other listed ladder safety device.

**5.7.7 Ladder Bars and Rungs.****5.7.7.1**

Ladder side bars shall be not less than 2 in. × ½ in. (51 mm × 12.7 mm) or 2 ½ in. × ⅜ in. (64 mm × 9.5 mm).

**5.7.7.2**

Side bars shall be spaced at least 16 in. (406 mm) apart. Rungs shall be of at least ¾ in. (19.1 mm) round or square steel and shall be spaced 12 in. (305 mm) on their centers.

**5.7.7.3**

The rungs shall be firmly welded to the side bars.

**5.7.7.4**

Ladders and connections shall be designed to support a concentrated load of 350 lb (159 kg).

**5.7.8 Painting Inaccessible Parts.****5.7.8.1**

Except for the underside of the floor on ground-supported flat-bottom tanks, faying surfaces of bolted connections that prohibit coatings, and contact surfaces of unsealed roof lap joints, parts that are inaccessible after fabrication, but that are subject to corrosion, shall be protected by paint before assembly.

**5.7.8.1.1**

This requirement shall not apply to the overlapping surfaces of single-welded lap joints above the high waterline.

**5.7.9 Painting.****5.7.9.1**

All interior surfaces of steel tanks that are exposed to water immersion or the vapor phase zone above the high water level shall be cleaned by near-white blasting in accordance with SSPC SP 10 and shall be primed in accordance with the requirements for "Inside Paint System No. 1" in AWWA D102.

**5.7.9.2**

All exterior surfaces and inside dry surfaces (pedestal tanks) shall be cleaned by commercial blasting in accordance with SSPC SP 6 and shall be coated in accordance with the requirements of AWWA D102.

**5.7.9.3**

The appropriate primers for other interior and exterior paint systems shall be permitted to be used, provided permission is first obtained from the authority having jurisdiction.

**5.7.9.4**

After construction, all weld seams, unprimed surfaces, or any areas where the primer (if preprimed) has been damaged shall be blast-cleaned and patch-primed with the coating system primer.

**5.7.9.5**

All finish coat painting for interior surfaces shall be in accordance with the requirements of AWWA D102.

**5.7.9.5.1\***

Wax coating systems shall not be permitted.

**5.7.9.6**

Finish coat painting for all exterior surfaces shall be in accordance with the requirements of AWWA D102.

**5.7.10\*** Painting Application.

All painting shall be applied in accordance with the appropriate requirements of *SSPC Systems and Specifications Steel Structures Painting Manual*, Chapter 5.

**5.7.11**

The painting and priming systems described in 5.7.9 through 5.7.10 shall be lead free.

## Additional Proposed Changes

<u>File Name</u>	<u>Description Approved</u>
NFPA_22_Chapter_5.docx	

## Statement of Problem and Substantiation for Public Input

Deleted requirements that are redundant to AWWA D-100 and referenced AWWA D-100 as the construction document. Items particular to fire water storage tanks remains in this chapter. Clarifies construction requirements for tanks in one document.

## Submitter Information Verification

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## Committee Statement

**Resolution:** The Technical Committee will establish a Task Group to review Chapter 5 in its entirety to compare current requirements align with AWWA standards and review the removal of language that directly references the AWWA standards. The task group will submit a public comment based on their work.

## Chapter 5 Welded-Steel Gravity Tanks and Suction Tanks

### 5.1 General.

**5.1.1** This chapter shall apply to the design, fabrication, and erection of welded-steel gravity water tanks, including pump suction tanks.

### 5.1.2 Capacity.

**5.1.2.1** The capacity of the tank shall be the number of U.S. gallons (cubic meters) available above the outlet opening.

**5.1.2.2** The net capacity between the outlet opening of the discharge pipe and the inlet of the overflow shall be equal to at least the rated capacity.

**5.1.2.3** The net capacity for gravity tanks with large plate tank risers shall be the number of U.S. gallons (cubic meters) between the inlet of the overflow and the designated low-water level line.

### 5.1.3 Standard Sizes.

**5.1.3.1** The standard net capacity sizes of steel tanks shall be as follows:

- (1) 5000 gal (18.93 m<sup>3</sup>)
- (2) 10,000 gal (37.85 m<sup>3</sup>)
- (3) 15,000 gal (56.78 m<sup>3</sup>)
- (4) 20,000 gal (75.70 m<sup>3</sup>)
- (5) 25,000 gal (94.63 m<sup>3</sup>)
- (6) 30,000 gal (113.55 m<sup>3</sup>)
- (7) 40,000 gal (151.40 m<sup>3</sup>)
- (8) 50,000 gal (189.25 m<sup>3</sup>)
- (9) 60,000 gal (227.10 m<sup>3</sup>)
- (10) 75,000 gal (283.88 m<sup>3</sup>)
- (11) 100,000 gal (378.50 m<sup>3</sup>)
- (12) 150,000 gal (567.75 m<sup>3</sup>)
- (13) 200,000 gal (757.00 m<sup>3</sup>)
- (14) 300,000 gal (1135.50 m<sup>3</sup>)
- (15) 500,000 gal (1892.50 m<sup>3</sup>)

**5.1.3.2** Tanks of other sizes shall be permitted.

**5.1.4 Form.** Steel tanks shall be permitted to be of any form desired, provided they conform to all requirements of this standard.

## **5.2 Materials.**

### ~~5.2.1 Plates, Shapes, and Tubular Columns.~~

~~5.2.1 All tank materials, fabrication, construction and welding shall be in accordance with AWWA D-100.~~

~~5.2.2 All tank and tower foundations, steel tank towers, pipe connections and fittings, valve enclosures and frost protection, tank heating and acceptance test requirements shall be in accordance with this standard.~~

~~**Plates.** Plate materials shall be of open hearth, electric furnace, or basic oxygen process steel that conforms to AWWA D100 and one of the following ASTM specifications:~~

- ~~(1) ASTM A 36/A 36M~~
- ~~(2) ASTM A 283/A 283M, Grades A, B, C, and D~~

~~5.2.1.2 Where plates of thicknesses greater than  $\frac{3}{4}$  in. (19.1 mm) are used, ASTM A 283, Grade D, shall not be used. ASTM A 131, Grades A, B, and C; or ASTM A 516, Grades 55 and 60, shall be used as alternatives.~~

~~5.2.1.3 **Basis of Furnishing Plates.** Plates shall be furnished, based on weight, with permissible underrun and overrun in accordance with the tolerance table for plates ordered to weight~~

~~**5.2.1.4 Shapes.** Structural materials shall be open hearth, electric furnace, or basic oxygen process steel that conforms to ASTM A 36, or ASTM A 131, Grades A, B, and D, or ASTM A992/A 992M.~~

~~**5.2.1.5** Copper bearing steel that contains approximately 0.20 percent copper shall be permitted to be used. In all other respects, steel shall conform to the specifications of 5.2.1.1, 5.2.1.3, and 5.2.1.4.~~

## ~~**5.2.2 Bolts, Anchor Bolts, and Rods.**~~

~~**5.2.2.1** Bolts and anchor bolts shall conform to AWWA D100.~~

~~**5.2.2.2** ASTM A 36 shall be considered an acceptable alternative material for anchor bolts. Rods shall be open hearth, electric furnace, or basic oxygen process steel that conforms to ASTM A 36.~~

## ~~**5.2.3\* Forgings.**~~

~~**5.2.3.1** Steel used for forgings shall be made only by the open hearth process.~~

~~**5.2.3.2** Forgings shall conform to the following ASTM specifications:~~

~~(1) ASTM A 105~~

~~(2) ASTM A 668 Class D (3) ASTM A 181, Class 70~~

~~**5.2.4 Castings.** Castings shall conform to ASTM A 27, Grade 60 30 full annealed.~~

~~**5.2.5 Reinforcing Steel.** Reinforcing steel shall comply with ASTM A 615, Grade 40 or Grade 60.~~

## ~~**5.2.6 Filler Metal Electrodes.**~~

~~**5.2.6.1** Manual, shielded metal arc welding electrodes shall conform to the requirements of AWS A5.1.~~

~~**5.2.6.2** Electrodes shall be of any E60XX or E70XX classification that is suitable for the electric current characteristics, the position of welding, and other conditions of intended use.~~

~~**5.2.6.3** Electrodes for other welding processes shall be in accordance with applicable AWS specifications for filler metal.~~

## ~~**5.3 Earthquake Load.**~~

~~5.3.1 Tanks shall meet the requirements for resistance to earthquake damage in accordance with the earthquake design provisions of AWWA D100.~~

~~5.3.2 For seismic anchor bolt loading, the following formula shall be used:~~

$$\text{---} \quad \text{---} \quad T = 4M_s = W'$$

~~specified in Sections 4.12 and 5.3, or any combination of them, shall not exceed the values in Table 5.4.~~

## ~~5.5 Design Details.~~

### ~~5.5.1 Minimum Thickness.~~

~~5.5.1.1 Except for cylindrical shell plates in contact with water in accordance with 5.5.1.6, the minimum thickness of any part of the structure shall be  $\frac{3}{16}$  in. (4.8 mm) for parts not in contact with water contents and  $\frac{1}{4}$  in. (6.4 mm) for parts in contact with water contents.~~

~~5.5.1.2 The controlling thickness of rolled shapes for the purposes of the foregoing stipulations shall be taken as the mean thickness of the flanges, regardless of web thickness.~~

~~5.5.1.3 The minimum thickness of tubular columns and struts shall be  $\frac{1}{4}$  in. (6.4 mm).~~

~~5.5.1.4 Round or square bars used for wind bracing shall have a minimum diameter or width of  $\frac{3}{4}$  in. (19.1 mm).~~

~~5.5.1.5 Bars of other shapes, if used, shall have a total area at least equal to a  $\frac{3}{4}$  in. (19.1 mm) round bar.~~

~~5.5.1.5.1 Roof plates for suction tanks with cone roofs shall be permitted to be 0.1792 in. (7 gauge) sheet.~~

~~5.5.1.6 Cylindrical shell plates in contact with water shall have minimum thicknesses as specified in accordance with Table 5.5.1.6.~~

### ~~5.5.2 Thickness for Corrosion.~~

~~5.5.2.1 If interior bracing is required to support the water content,  $\frac{1}{16}$  in. (1.6 mm) additional thickness shall be added to the calculated sections.~~

~~5.5.2.2 Except for hermetically sealed tubular sections, the sections shall be open to facilitate cleaning and painting.~~

~~5.5.2.2.1~~ Tubular sections used for columns on elevated legged tanks shall be hermetically sealed to prevent internal corrosion.

~~5.5.2.3~~ The plates of tanks that are to contain salt or alkaline water shall be  $\frac{1}{16}$  in. (1.6 mm) thicker than calculated.

### ~~5.5.3 Thickness of Tank Plates.~~

~~5.5.3.1~~ Tank plates shall be designed on the basis of the following maximum membrane tensile stresses, which shall be reduced for the joint efficiencies set forth in AWWA D100.

~~5.5.3.2\*~~ Plate surfaces that are susceptible to complete stress analysis shall be designed on the basis of a maximum membrane tensile stress of 15,000 psi (103.43 MPa).

~~5.5.3.3~~ Plate surfaces that are not susceptible to complete stress analysis shall also be designed on the basis of a maximum membrane tensile stress of 15,000 psi (103.43 MPa) after making reasonable allowances for such loads and stresses that cannot be accurately determined.

~~$T_s$  = seismic bolt tension (lb)~~

~~$M_s$  = seismic overturning moment (ft lb)~~

~~$W'$  = weight of tank shell and portion of roof carried  
by shell (lb)~~

~~$N$  = number of anchor bolts~~

~~$D$  = tank diameter (ft)~~

~~5.4 Unit Stresses.~~ The maximum stresses in pounds per square inch (megapascals) that are produced by the loads

~~5.5.3.3.1~~ The maximum membrane tensile stress shall in no case exceed 11,000 psi (75.85 MPa) when calculated, assuming that the concentrated reactions of supporting members are uniformly distributed between such reactions.

~~5.5.3.3.2~~ Therefore, the lowest cylindrical courses of tanks with suspended bottoms and the suspended bottoms themselves shall be designed for a maximum membrane tensile stress of 11,000 psi (75.85 MPa), reduced for the joint efficiencies.

**Table 5.4 Maximum Stresses**



~~5.5.3.4~~ As an alternative to 5.5.3.1 and 5.5.3.2, tank shell plates for suction tanks shall be permitted to be designed on the basis of the stresses, material selection, and inspection set forth in Section 14 of AWWA D100, provided all requirements of Section 14 of the standard are met.

~~5.5.3.5~~ Where compressive stresses exist, the selected plate thickness shall comply with the allowable local buckling stresses in accordance with AWWA D100.

#### ~~5.5.4 Thickness of Flat Bottoms.~~

~~5.5.4.1~~ The thickness of plates in flat bottoms shall be not less than those given in Table 5.5.4.1(a) and Table 5.5.4.1(b).

~~5.5.4.2~~ Any corrosion allowance specified shall be added to the value from the table.

~~5.5.5 Accessibility of Bottoms.~~ Grillages shall be designed so that the tank bottom and beams are accessible for inspection and painting.

~~5.5.6 Net Sections.~~ Net sections shall be used in calculating the tensile stress in plates and members.

#### ~~5.5.7 Load Location.~~

~~5.5.7.1~~ When calculating the thickness of plates that are stressed by the weight or pressure of the tank contents, the pressure at the lower edge of each ring shall be assumed to act undiminished on the entire area of the ring.

#### ~~5.5.8 Opening Reinforcement.~~

~~5.5.8.1~~ All openings of more than 4 in. (102 mm) in diameter that are located in the shell, suspended bottom, larger steel plate tank riser, or tubular support shall be reinforced.

~~5.5.8.2~~ The reinforcement shall be either the flange of a fitting, an additional ring of metal, excess plate metal above that actually required, or a combination of these methods.

~~5.5.8.3~~ The opening diameter shall be considered to be the maximum dimension of the hole cut in the plate perpendicular to the direction of maximum stress.

~~5.5.8.3.1~~ Excess plate metal used for joint efficiency shall not meet the requirements for opening reinforcement if the center of the opening is within one opening diameter of any plate seam or point of support attachment.

~~5.5.8.4~~ Welding shall be provided to transmit the full net strength of the reinforcing ring or flange to the plate.

~~5.5.8.4.1~~ In computing the net reinforcing area of a fitting, such as a boilermaker's flange or a manhole saddle that has a neck, the material in the neck shall be considered as part of the reinforcement for a distance, measured from the surface of the parent plate or from the surface of an intervening reinforcement plate, that is equal to four times the thickness of the material in the neck.

~~5.5.9 Roof Supports.~~ The supports for tank roofs that do not contain water shall be designed in accordance with the steel construction specifications of the American Institute of Steel Construction.

~~5.5.9.1~~ Rafters that are in contact with a steel roof, have a slope of less than 2 in. in 12 in. (51 mm in 305 mm), and consist of beam or channel shapes less than 15 in. (381 mm) deep shall be considered to be adequately braced in the lateral position by friction between the roof plate and the top flange.

~~Table 5.5.4.1(a) Thickness of Bottom Plates for Flat-Bottom Tanks (in inches)~~

~~5.5.9.2~~ The maximum slenderness ratio,  $L/r$ , for columns that support the roof shall be 175. The spacing between rafters, as measured along the tank circumference, shall not exceed  $2\pi$  ft ( $0.61\pi$  m).

~~5.5.10 Welded Joints.~~ The types of joints used and their design shall conform to AWWA D100.

## ~~5.6 Workmanship.~~

~~5.6.1 Plate Edges.~~ The plate edges to be welded shall be universal mill edges or shall be prepared by shearing, machining, chipping, or mechanically guided oxygen cutting. Where the edges of plates are oxygen cut, the surface obtained shall be uniform and smooth and shall be cleaned of slag accumulations before welding.

~~5.6.1.1~~ Edges of irregular contour shall be permitted to be prepared by manually guided oxygen cutting.

~~5.6.2 Rolling.~~ For elevated tanks plates shall be cold rolled to suit the curvature of the tank and the erection procedure in accordance with Table 5.6.2.

### ~~Table 5.6.2 Plate Dimensions~~

~~5.6.7.1.2~~ The sand pad, including pH range of the lime sand mix, sulfate content, and chloride content, shall meet the requirements of AWWA D100.

~~5.6.7.1.3~~ Where permitted by environmental authorities, an oiled sand cushion shall be permitted to be used. The sand shall be coated but shall not be running with excess oil.

~~5.6.7.2\*~~ Where the tank bottom is placed on oiled sand, the sand shall be saturated to a depth of 4 in. (102 mm) with a suitable petroleum-base oil.

~~5.6.8~~ Tanks shall meet the erection tolerance requirements of AWWA D100.

## ~~5.7 Accessories.~~

~~5.7.1 Connections.~~ Connections shall be provided on the tank for the necessary pipes, braces, frost casting, and walkway supports.

~~5.7.2 Roof Anchorage.~~ Each roof plate shall be securely fastened to the top of the tank.

### ~~5.7.3 Roof Hatch.~~

~~5.7.3.1~~ An easily accessible roof hatch or roof door having a minimum

~~opening dimension of 24 in. (610 mm) shall be provided in the roof.~~

~~5.7.3.2 The hatch cover shall be built of steel plate with a minimum thickness of  $\frac{3}{16}$  in. (4.8 mm).~~

~~5.7.3.3 The hatch opening shall have a curb that is a minimum of 4 in. (102 mm) high, and the cover shall have a minimum downward overlap of 2 in. (51 mm).~~

~~5.6.3 Double-Curved Plates. Plates that are curved in two directions shall be pressed cold or hot or shall be dished with a mortar and pestle die by repeated applications.~~

~~5.6.4 Milling Columns. The ends of columns shall be milled to provide a satisfactory bearing unless the design provides sufficient welding to resist the total calculated loads.~~

#### ~~5.6.5 Fitting Roofs.~~

~~5.6.5.1 The roof shall fit tightly to the top of the shell to eliminate any gap between the roof and the shell.~~

~~5.6.5.2 Where a spider is used, it shall not obstruct the flow of water into the overflow inlet.~~

~~5.3-6.6 Preventing Ice Damage. During the construction, the contractor shall keep the tank, structure, and building roofs free of ice caused by leakage until the tank equipment is made watertight.~~

#### ~~5.4 6.7 Coating for Bottom Plates on Soil or Concrete.~~

~~5.4 6.7.1\* The underside of all bottom plates shall be protected against corrosion by one of the methods required by 5.6.7.1.1 through 5.6.7.1.3.~~

~~5.46.7.1.1 Two coats of paint shall be applied after the bottom has been completely welded. When the underside of the tank bottom surface is painted and lime (optional) is added to the base material on the tank underside, the compatibility of the paint and the lime shall be checked with the paint supplier.~~

~~5.46.7.1.2 The sand pad, including pH range of the lime sand mix, sulfate content, and chloride content, shall meet the requirements of AWWA D100.~~

~~5.46.7.1.3 Where permitted by environmental authorities, an oiled sand cushion shall be permitted to be used. The sand shall be coated but shall not be running with excess oil.~~

~~5.46.7.2\* Where the tank bottom is placed on oiled sand, the sand shall be saturated to a depth of 4 in. (102 mm) with a suitable petroleum-base oil.~~

~~5.6.8 Tanks shall meet the erection tolerance requirements of AWWA~~

D100.

## **5.7 Accessories.**

**5.7.1 Connections.** Connections shall be provided on the tank for the necessary pipes, braces, frost casting, and walkway supports.

**5.7.2 Roof Anchorage.** Each roof plate shall be securely fastened to the top of the tank.

### **5.7.3 Roof Hatch.**

**5.7.3.1** An easily accessible roof hatch or roof door having a minimum opening dimension of 24 in. (610 mm) shall be provided in the roof.

**5.7.3.2** The hatch cover shall be built of steel plate with a minimum thickness of  $\frac{3}{16}$  in. (4.8 mm).

**5.7.3.3** The hatch opening shall have a curb that is a minimum of 4 in. (102 mm) high, and the cover shall have a minimum downward overlap of 2 in. (51 mm).

**5.7.3.4** A catch shall be provided to keep the cover closed.

**5.7.3.5** A second roof hatch shall be placed 180 degrees from the primary roof hatch.

### **5.7.4 Ladders — General.**

**5.7.4.1** Outside and inside steel ladders that are arranged for convenient passage from one to the other and through the primary roof hatch shall be provided.

**5.7.4.2** Ladders shall not interfere with the opening of the hatch cover and shall not incline outward from the vertical at any point.

**5.7.4.3** For pedestal supported tanks, the ladder shall be placed inside an access tube that extends through the center of the tank.

### **5.7.5 Outside Fixed Shell and Roof Ladder.**

**5.7.5.1** The outside tank ladder of suction tanks and multiple column-supported gravity tanks shall be fixed a minimum of 7 in. (178 mm) between the tank side and the centerline of rungs and shall be rigidly bolted or welded to brackets that are spaced a maximum of 12 ft (3.7 m) apart and that are welded to the tank plates.

~~5.7.5.2~~ The bottom bracket shall be located a maximum of 6 ft (1.8 m) above the base of the tank cylinder, and the ladder shall extend up the tank shell and radially along the roof, with the top bracket located within approximately 2 ft (0.61 m) of the roof hatch.

~~5.7.5.3~~ There shall be a minimum 1 ft (0.3 m) clearance at the sides and front of the ladder at the balcony

~~5.7.5.4~~ All ladders shall be equipped with a cage, a rigid notched rail, or other listed ladder safety device.

#### **5.7.6 Inside Ladder.**

~~5.7.6.1~~ The inside fixed ladder provided for passage between the roof hatch and tank bottom shall not be rigidly connected to the bottom plates.

~~5.7.6.2~~ A ladder shall extend from the top to the bottom of the inside of the large steel tank riser pipes and shall be secured to the shell plates by brackets that are spaced a maximum of 12 ft (3.7 m) apart.

~~5.7.6.2.1~~ The upper bracket shall be located at the top of the tank riser.

~~5.7.6.3~~ All ladders over 20 ft (6.1 m) high shall be equipped with a cage, a rigid notched rail, or other listed ladder safety device.

#### **5.7.7 Ladder Bars and Rungs.**

~~5.7.7.1~~ Ladder side bars shall be not less than 2 in.  $\times$  1/2 in. (51 mm  $\times$  12.7 mm) or 2 1/2 in.  $\times$  3/8 in. (64 mm  $\times$  9.5 mm).

~~5.7.7.2~~ Side bars shall be spaced at least 16 in. (406 mm) apart. Rungs shall be of at least 3/4 in. (19.1 mm) round or square steel and shall be spaced 12 in. (305 mm) on their centers.

~~5.7.7.3~~ The rungs shall be firmly welded to the side bars.

~~5.7.7.4~~ Ladders and connections shall be designed to support a concentrated load of 350 lb (159 kg).

#### **5.57.8 Painting Inaccessible Parts.**

~~5.57.8.1~~ Except for the underside of the floor on ground-supported flat-bottom tanks, faying surfaces of bolted connections that prohibit coatings, and contact surfaces of unsealed roof lap joints, parts that are inaccessible after fabrication, but

that are subject to corrosion, shall be protected by paint before assembly.

**5.57.8.1.1** This requirement shall not apply to the overlapping surfaces of single-welded lap joints above the high waterline.

### **5.67.9 Painting.**

**5.67.9.1** All interior surfaces of steel tanks that are exposed to water immersion or the vapor phase zone above the high water level shall be cleaned by near-white blasting in accordance with SSPC SP 10 and shall be primed in accordance with the requirements for "Inside Paint System No. 1" in AWWA D102.

**5.67.9.2** All exterior surfaces and inside dry surfaces (pedestal tanks) shall be cleaned by commercial blasting in accordance with SSPC SP 6 and shall be coated in accordance with the requirements of AWWA D102.

**5.67.9.3** The appropriate primers for other interior and exterior paint systems shall be permitted to be used, provided permission is first obtained from the authority having jurisdiction.

**5.67.9.4** After construction, all weld seams, unprimed surfaces, or any areas where the primer (if preprimed) has been damaged shall be blast-cleaned and patch-primed with the coating system primer.

**5.67.9.5** All finish coat painting for interior surfaces shall be in accordance with the requirements of AWWA D102.

**5.67.9.5.1\*** Wax coating systems shall not be permitted.

**5.67.9.6** Finish coat painting for all exterior surfaces shall be in accordance with the requirements of AWWA D102.

**5.7.10\* Painting Application.** All painting shall be applied in accordance with the appropriate requirements of *SSPC Systems and Specifications Steel Structures Painting Manual*, Chapter 5.

**5.7.11** The painting and priming systems described in ~~5.7.9 through 5.7.10~~ this section shall be lead free.

**Substantiation:** Deleted requirements that are redundant to AWWA D-100 and referenced AWWA D-100 as the construction document. Items particular to fire water storage tanks remains in this chapter. Clarifies construction requirements for tanks in one document.









## Public Input No. 7-NFPA 22-2015 [ Chapter 6 ]

### **Chapter 6** Factory-Coated, Bolted Steel Tanks

#### **6.1** General.

##### **6.1.1\***

This chapter shall apply to the design, fabrication, and erection of bolted steel water tanks, including pump suction tanks with factory-applied coatings.

##### **6.1.2** Standard Capacity.

The standard capacity of bolted tanks varies with the number of panels added to the diameter and ranges from 4000 gal to approximately 500,000 gal (15.1 m<sup>3</sup> to approximately 1900 m<sup>3</sup>) net capacity.

##### **6.1.2.1**

Tanks of other capacities shall be permitted.

##### **6.1.3** Form.

##### **6.1.3.1**

Bolted tanks shall be cylindrical.

##### **6.1.3.2**

All joints, including vertical, horizontal, shell-to-roof, and shell-to-bottom plates or sheets, shall be field bolted.

##### **6.1.3.3**

Coatings shall be factory applied.

##### **6.1.3.4**

Bolt holes shall be shop-punched or drilled for field assembly.

##### **6.1.3.5**

Joints that are in contact with water and weather-tight joints shall be sealed.

#### **6.2** Plate and Sheet Materials.

##### **6.2.1**

Plate and sheet materials shall be of open-hearth, electric furnace, or basic oxygen process steel that conforms to any of the following:

- (1) ASTM A 36
- (2) ASTM A 283, Grade C or Grade D
- (3) ASTM A 1011
- (4) ASTM A 572, Grade 42 or Grade 50

##### **6.2.2**

Plates and sheets shall be furnished on the basis of weight, with permissible underrun and overrun in accordance with the tolerance table for plates ordered to weight in ASTM A 6.

##### **6.2.3** Structural Shapes.

##### **6.2.3.1**

Hot-rolled structural shapes shall conform to ASTM A 36 or ASTM A 992/A 992M.

##### **6.2.3.2**

Aluminum shapes shall be permitted to be used for portions of the tank that are not in contact with water and shall follow the design criteria in Appendix A of AWWA D103.

## **6.2.4 Tubular Columns.**

### **6.2.4.1**

Steel pipe shall be permitted to be used for tubular columns or other structural members, provided it complies with ASTM A 53, Type E or Type S, Grade B; ASTM A 139, Grade B; and API 5LC, Grade B; and provided the minimum wall thickness of any such material complies with the design requirements and the minimum thickness requirement of this standard.

### **6.2.4.2**

The allowable underrun shall be subtracted from the nominal wall thickness when calculating the minimum pipe wall thickness.

### **6.2.4.3**

Tubular sections shall not be flattened to form end connections.

## **6.2.5 Bolts, Anchor Bolts, and Nuts.**

Bolts, anchor bolts, and nuts shall conform to AWWA D103 and Section [12.4](#).

## **6.2.6\* Forgings.**

Steel used for forging shall be made only by the open-hearth process. Forgings shall conform to the following ASTM specifications:

- (1) ASTM A 105
- (2) ASTM A 668

## **6.2.7 Filler Metal Electrodes.**

### **6.2.7.1**

Manual, shielded metal arc welding electrodes shall conform to the requirements of AWS A5.1.

### **6.2.7.2**

Electrodes shall be of any E60XX or E70XX classification suitable for the electric current characteristics, the position of welding, and other conditions of intended use.

### **6.2.7.3**

Electrodes for other welding processes shall be in accordance with applicable AWS specifications for filler metal.

## **6.2.8 Gasket.**

### **6.2.8.1**

Gasket material shall be of adequate tensile strength and resilience to obtain a leakproof seal at all seams and joints.

### **6.2.8.2**

Gasket material shall be resistant to weather and ozone exposure and shall be in accordance with ASTM D 1171. Physical requirements shall conform to AWWA D103.

### **6.2.8.3**

Gasket material shall be capable of resisting chlorination exposure in accordance with AWWA C652.

## **6.2.9 Sealant.**

### **6.2.9.1**

Sealants shall be supplied by the tank manufacturer. Sealants shall remain flexible over a temperature range of -40°F to 170°F (-40°C to 76.7°C).

### **6.2.9.2**

Resistance to hardening and cracking shall be required. The sealant shall be solid with no plasticizers or extenders to cause shrinkage.

### 6.2.9.3

The sealant shall resist ozone and ultraviolet light and shall not swell or degrade under normal water storage conditions. In addition, the sealant shall be capable of resisting chlorination exposure in accordance with AWWA C652.

## 6.3 Earthquake Load.

### 6.3.1

Tanks shall meet requirements for resistance to earthquake damage in accordance with the earthquake design provisions of AWWA D103. For seismic anchor-bolt loading,

$$T_s = \frac{4M_s}{ND} - \frac{W'}{N}$$

where:

$T_s$  = seismic bolt tension (lb)

$M_s$  = seismic overturning moment (ft lb)

$W'$  = weight of tank shell and portion of roof carried by shell (lb)

$N$  = number of anchor bolts

$D$  = tank diameter (ft)

### 6.3.2 Unit Stress of Shell Plates.

The maximum stresses in pounds per square inch (megapascals) that are produced by the design loads in Section 4.13 shall not exceed the requirements of AWWA D103.

## 6.4 Design Details.

### 6.4.1 Minimum Steel Thickness.

Steel plates or sheets shall meet the minimum design criteria in accordance with AWWA D103, as well as any additional requirements outlined in 6.4.1.1 through 6.4.1.4.

#### 6.4.1.1

Roof sheets shall have a minimum thickness of 0.094 in. (2.4 mm).

##### 6.4.1.1.1

Sheets on roofs having a slope of 1 in 2.75 or greater for which the tank diameter does not exceed 35 ft (10.7 m) shall be permitted to utilize a minimum thickness of 0.070 in. (1.8 mm), provided a suitable walkway is provided from the ladder to all appurtenances including, but not limited to, the roof hatch(es), roof vent(s), and controls for the water level and temperature.

##### 6.4.1.2

Floor sheets shall have a minimum thickness of 0.105 in. (2.7 mm), provided the tank floor is supported on a granular base, on crushed stone, or on a concrete slab.

##### 6.4.1.3

The minimum thickness of the first full height shell plate and starter ring (if applicable) shall be 0.1875 in. (4.8 mm).

**6.4.1.3.1**

This minimum thickness shall be permitted to be reduced, provided the design meets the following criteria:

- (1) *Tension on the Net Section.* The tensile stress on the net section of a bolted connection shall not exceed the lesser of the values determined by the following formulas:

$$f_t = 0.5F_y \left( 1.0 - 0.9r + \frac{3rd}{s} \right) \leq 0.5F_y$$

$$f_t = \frac{1}{3}F_u$$

where:

$f_t$  = allowable tensile stress (psi)

$F_y$  = published yield strength of the sheet material (psi)

$r$  = force transmitted by the bolt or bolts at the section considered, divided by the tensile force in the member at that section; if  $r$  is less than 0.2, it can be taken equal to zero.

$d$  = diameter of the bolt (in.)

$s$  = spacing of the bolts perpendicular to the line of stress (in.)

$F_u$  = ultimate strength of the sheet material (psi)

- (2) *Shell Thickness.* The thickness of cylindrical shell plates stressed by the pressure of the tank contents shall be calculated by the following formula:

$$t = \frac{2.6 HDSG}{f_t(S - d)}$$

where:

$t$  = shell plate thickness (in.)

$H$  = height of liquid from the top capacity line to the point of overflow to the bottom of the shell course being designed (ft)

$D$  = tank diameter (ft)

$S$  = bolt spacing in line perpendicular to line of stress (in.)

$G$  = specific gravity of liquid (1.0 for water)

$f_t$  = allowable tensile stress (psi)

$d$  = bolt-hole diameter (in.)

**6.4.1.4**

The minimum thickness of the upper rings of shell plates shall be 0.105 in. (2.7 mm).

**6.4.1.4.1**

This minimum thickness shall be permitted to be reduced to no less than 0.094 in. (2.4 mm), provided that the design meets the criteria of [6.4.1.3.1](#).

**6.5 Fabrication.****6.5.1**

Parts shall be fabricated in accordance with AWWA D103 practices and tolerances.

**6.5.2**

Welding shall be limited to the shop installation of nozzles, vents, manway connections, and subassemblies. Field welding shall not be permitted.

**6.5.3**

Coatings shall be applied in accordance with AWWA D103.

**6.5.4**

All tank components shall be given a mark number for ease of assembly.

**6.5.5\***

All coated parts shall be protected from damage during shipment.

**6.6** Erection.**6.6.1**

Bolted tanks shall be erected in accordance with the manufacturers' drawings, instructions, and AWWA D103 procedures to facilitate inspection for leaks.

**6.6.1.1**

Bolted steel floor plates shall be positioned directly on a minimum 4 mil (102 µm) polyethylene base that is arranged to allow waterflow from the center of the tank to the perimeter of the tank.

**6.6.1.2**

The polyethylene sheets shall be placed over the sloped base and shall be lapped a minimum of 18 in. (457 mm) on top of one another (the higher sheet overlapping the adjacent sheet) to allow drainage from the underside of the tank.

**6.6.1.3**

Polyethylene sheeting shall not be required for tanks with concrete slabs that also serve as the tank floor, provided the provisions of Section 17.1 have been met.

**6.6.2**

The erector shall exercise care to properly install all parts of the tank including, but not limited to, gaskets and sealants.

**6.6.3**

Care in handling coated parts shall be exercised.

**6.6.3.1**

Any sections that experience damage to the factory-applied coatings shall be repaired or replaced in accordance with the manufacturers' instructions.

**6.6.3.2**

Damaged parts shall be replaced.

**Additional Proposed Changes**

<u>File Name</u>	<u>Description Approved</u>
NFPA_22_Chapter_6.docx	

**Statement of Problem and Substantiation for Public Input**

Deleted requirements that are redundant to AWWA D-103 and referenced AWWA D-103 as the construction document. Items particular to fire water storage tanks remains in this chapter. Clarifies construction requirements for tanks in one document.

**Submitter Information Verification**

**Submitter Full Name:** DAVID HAGUE  
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**Submittal Date:** Fri Jun 19 12:50:49 EDT 2015

**Committee Statement**

**Resolution:** The Technical Committee will establish a Task Group to review Chapter 6 in its entirety to compare current requirements align with AWWA standards and review the removal of language that directly references the AWWA standards. The task group will submit a public comment based on their work.

## Chapter 6 Factory-Coated, Bolted Steel Tanks

### 6.1 General.

**6.1.1\*** This chapter shall apply to the design, fabrication, and erection of bolted steel water tanks, including pump suction tanks with factory-applied coatings.

**6.1.2 Standard Capacity.** The standard capacity of bolted tanks varies with the number of panels added to the diameter and ranges from 4000 gal to approximately 500,000 gal (15.1 m<sup>3</sup> to approximately 1900 m<sup>3</sup>) net capacity.

**6.1.2.1** Tanks of other capacities shall be permitted.

### 6.1.3 Form.

**6.1.3.1** Bolted tanks shall be cylindrical.

**6.1.3.2** All joints, including vertical, horizontal, shell-to-roof, and shell-to-bottom plates or sheets, shall be field bolted.

**6.1.3.3** Coatings shall be factory applied.

**6.1.3.4** Bolt holes shall be shop-punched or drilled for field assembly.

**6.1.3.5** Joints that are in contact with water and weather-tight joints shall be sealed.

### **6.2 Materials, Fabrication and Installation.** ~~Plate and Sheet Materials.~~

**6.2.1** All design, materials, fabrication and installation shall be in accordance with AWWA D-103.

**6.2.2** All tank and tower foundations, steel tank towers, pipe connections and fittings, valve enclosures and frost protection, tank heating and acceptance test requirements shall be in accordance with this standard.

~~Plate and sheet materials shall be of open hearth, electric furnace, or basic oxygen process steel that conforms to any of the following:~~

- ~~(1) ASTM A 36~~
- ~~(2) ASTM A 283, Grade C or Grade D (3) ASTM A 1011~~
- ~~(4) ASTM A 572, Grade 42 or Grade 50~~



~~6.2.2~~ Plates and sheets shall be furnished on the basis of weight, with permissible underrun and overrun in accordance with the tolerance table for plates ordered to weight in ASTM A 6.

### ~~6.2.3 Structural Shapes.~~

~~6.2.3.1~~ Hot rolled structural shapes shall conform to ASTM A 36 or ASTM A 992/A 992M.

~~6.2.3.2~~ Aluminum shapes shall be permitted to be used for portions of the tank that are not in contact with water and shall follow the design criteria in Appendix A of AWWA D103.

### ~~6.2.4 Tubular Columns.~~

~~6.2.4.1~~ Steel pipe shall be permitted to be used for tubular columns or other structural members, provided it complies with ASTM A 53, Type E or Type S, Grade B; ASTM A 139, Grade B; and API 5LC, Grade B; and provided the minimum wall thickness of any such material complies with the design requirements and the minimum thickness requirement of this standard

~~6.2.4.2~~ The allowable underrun shall be subtracted from the nominal wall thickness when calculating the minimum pipe wall thickness.

~~6.2.4.3~~ Tubular sections shall not be flattened to form end connections.

~~6.2.5 Bolts, Anchor Bolts, and Nuts.~~ Bolts, anchor bolts, and nuts shall conform to AWWA D103 and Section 12.4.

~~6.2.6\* Forgings.~~ Steel used for forging shall be made only by the open hearth process. Forgings shall conform to the following ASTM specifications:

- ~~(1) ASTM A 105~~
- ~~(2) ASTM A 668~~

### ~~6.2.7 Filler Metal Electrodes.~~

~~6.2.7.1~~ Manual, shielded metal arc welding electrodes shall conform to the requirements of AWS A5.1.

~~6.2.7.2~~ Electrodes shall be of any E60XX or E70XX classification suitable for the electric current characteristics, the position of welding, and other conditions of intended use.

~~6.2.7.3~~ Electrodes for other welding processes shall be in accordance with applicable AWS specifications for filler metal.

### ~~6.2.8 Gasket.~~

~~6.2.8.1~~ Gasket material shall be of adequate tensile strength and resilience to obtain a leakproof seal at all seams and joints.

~~6.2.8.2~~ Gasket material shall be resistant to weather and ozone exposure and shall be in accordance with ASTM D1171. Physical requirements shall

conform to AWWA D103.

### **6.2.9 Sealant.**

**6.2.9.1** Sealants shall be supplied by the tank manufacturer.

Sealants shall remain flexible over a temperature range =40°F to 170°F (-40°C to 76.7°C).

**6.2.9.2** Resistance to hardening and cracking shall be required. The sealant shall be solid with no plasticizers or extenders to cause shrinkage.

**6.2.9.3** The sealant shall resist ozone and ultraviolet light and shall not swell or degrade under normal water storage conditions. In addition, the sealant shall be capable of resisting chlorination exposure in accordance with AWWA C652.

### **6.3 Earthquake Load.**

**6.3.1** Tanks shall meet requirements for resistance to earthquake damage in accordance with the earthquake design provisions of AWWA D103. For seismic anchor bolt loading

**6.3.2 Unit Stress of Shell Plates.** The maximum stresses in pounds per square inch (megapascals) that are produced by the design loads in Section 4.13 shall not exceed the requirements of AWWA D103.

### **6.4 Design Details.**

**6.4.1 Minimum Steel Thickness.** Steel plates or sheets shall meet the minimum design criteria in accordance with AWWA D103, as well as any additional requirements outlined in

6.4.1.1 through 6.4.1.4.

**6.4.1.1** Roof sheets shall have a minimum thickness of 0.094 in. (2.4 mm).

**6.4.1.1.1** Sheets on roofs having a slope of 1 in 2.75 or greater for which the tank diameter does not exceed 35 ft (10.7 m) shall be permitted to utilize a minimum thickness of 0.070 in. (1.8 mm), provided a suitable walkway is provided from the ladder to all appurtenances including, but not limited to, the roof hatch(es), roof vent(s), and controls for the water level and temperature.

**6.4.1.2** Floor sheets shall have a minimum thickness of 0.105 in. (2.7 mm), provided the tank floor is supported on a granular base, on crushed stone, or on a concrete slab.

**6.4.1.3** The minimum thickness of the first full height shell plate and starter ring (if applicable) shall be 0.1875 in. (4.8 mm).

**6.4.1.3.1** This minimum thickness shall be permitted to be reduced,

provided the design meets the following criteria:

~~(1) *Tension on the Net Section.* The tensile stress on the net section of a bolted connection shall not exceed the lesser of the values determined by the following formulas~~

~~6.4.1.4 The minimum thickness of the upper rings of shell plates shall be 0.105 in. (2.7 mm).~~

~~6.4.1.4.1 This minimum thickness shall be permitted to be reduced to no less than 0.094 in. (2.4 mm), provided that the design meets the criteria of 6.4.1.3.1.~~

## ~~6.5 Fabrication.~~

~~6.5.1 Parts shall be fabricated in accordance with AWWA D103 practices and tolerances.~~

~~6.5.2 Welding shall be limited to the shop installation of nozzles, vents, manway connections, and subassemblies. Field welding shall not be permitted.~~

~~6.5.3 Coatings shall be applied in accordance with AWWA D103.~~

~~6.5.4 All tank components shall be given a mark number for ease of assembly.~~

~~6.5.5\* All coated parts shall be protected from damage during shipment.~~

## ~~6.6 Erection.~~

~~6.6.1 Bolted tanks shall be erected in accordance with the manufacturers' drawings, instructions, and AWWA D103 procedures to facilitate inspection for leaks.~~

~~6.6.1.1 Bolted steel floor plates shall be positioned directly on a minimum 4 mil (102 µm) polyethylene base that is arranged to allow waterflow from the center of the tank to the perimeter of the tank.~~

~~6.6.1.2 The polyethylene sheets shall be placed over the sloped base and shall be lapped a minimum of 18 in. (457 mm) on top of one another (the higher sheet overlapping the adjacent sheet) to allow drainage from the underside of the tank.~~

~~6.6.1.3 Polyethylene sheeting shall not be required for tanks with concrete slabs that also serve as the tank floor, provided the provisions of Section 17.1 have been met.~~

~~6.6.2 The erector shall exercise care to properly install all parts of the tank including, but not limited to, gaskets and sealants.~~

~~6.6.3 Care in handling coated parts shall be exercised.~~

~~6.6.3.1 Any sections that experience damage to the factory applied coatings shall be repaired or replaced in accordance with the manufacturers' instructions.~~

~~6.6.3.2 Damaged parts shall be replaced.~~

**Substantiation:** Deleted requirements that are redundant to AWWA D-103 and referenced AWWA D-103 as the construction document. Items particular to fire water

storage tanks remains in this chapter. Clarifies construction requirements for tanks in one document.





## Public Input No. 8-NFPA 22-2015 [ Section No. 14.1.5 ]

### 14.1.5 Precautions During Repairs.

The authority having jurisdiction shall be notified well in advance when the tank is to be drained. The precautions required by [14.1.5.1](#) through [14.1.5.5](#) shall be observed.

#### 14.1.5.1

Work shall be planned carefully to enable its completion in the shortest possible time.

#### 14.1.5.2

Where available, a second, reasonably reliable water supply with constant suitable pressure and volume, usually public water, shall be connected to the system.

#### 14.1.5.3

Where such a supply is not available, the fire pump shall be started and kept running to maintain suitable pressure in the system.

#### 14.1.5.4

Additional portable fire extinguishers shall be placed in buildings where protection is impaired, and extra, well-instructed watch personnel shall be continuously on duty.

#### 14.1.5.5

The members of the private fire brigade, as well as the public fire department, shall be familiar with conditions that affect repairs.

## Additional Proposed Changes

<u>File Name</u>	<u>Description Approved</u>
NFPA_22_Section_14.1.5.docx	

## Statement of Problem and Substantiation for Public Input

Removes unenforceable language and references a formal impairment procedure for situations where a tank is impaired.

## Submitter Information Verification

**Submitter Full Name:** DAVID HAGUE  
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**Submission Date:** Fri Jun 19 12:53:29 EDT 2015

## Committee Statement

**Resolution:** [FR-43-NFPA 22-2016](#)  
**Statement:** Removes unenforceable language and references a formal impairment procedure for situations where a tank is impaired.

**14.1.5 Precautions During Repairs.** The authority having jurisdiction shall be notified well in advance when the tank is to be drained for repairs. ~~The precautions required by 14.1.5.1 through 14.1.5.5 shall be observed.~~

**14.1.5.1** Whenever an in-service tank is drained for repairs, the impairment procedures in NFPA 25 shall be followed. ~~Work shall be planned carefully to enable its completion in the shortest possible time.~~

**14.1.5.2** ~~Where available, a second, reasonably reliable water supply with constant suitable pressure and volume, usually public water, shall be connected to the system.~~

**14.1.5.3** ~~Where such a supply is not available, the fire pump shall be started and kept running to maintain suitable pressure in the system.~~

**14.1.5.4** ~~Additional portable fire extinguishers shall be placed in buildings where protection is impaired, and extra, well instructed watch personnel shall be continuously on duty.~~

**14.1.5.5** ~~The members of the private fire brigade, as well as the public fire department, shall be familiar with conditions that affect repairs.~~

**Substantiation:** Removes unenforceable language and references a formal impairment procedure for situations where a tank is impaired.



## Public Input No. 9-NFPA 22-2015 [ New Section after 14.1.7 ]

**14.1.7\* Connections for Use Other Than for Fire Protection.** The authority having jurisdiction shall be consulted before the tank is designed where water for other than fire protection purposes is to be drawn from the tank.

### **14.1.7\* 3.8 Connections for Use Other Than for Fire Protection.**

**A.14.1.7 8.1** The use of an elevated tank, in part, for purposes other than fire protection, is not advised. Frequent circulation of the water results in an accumulation of sediment that can obstruct the piping of sprinklers, and a fluctuating water level hastens decaying of wood and corrosion of steel.

**14.1.7 3.8.1** Connections for a use other than fire protection shall not be made.

**14.1.7 3.8.2** Where acceptable to the authority having jurisdiction, unavoidable connections for other than fire protection shall be permitted.

**14.1.7\* 8.2.1** Pipe used for other than fire protection purposes shall be entirely separate from fire-service pipes and shall extend to an elevation inside the tank below above that required which an adequate quantity of water is constantly available for fire protection.

**A.14.1.7.2.1** See Figure A.14.1.7.2.1.



**Figure A.14.1.7.2.1 Dual Purpose Tank**

**14.1.7.3** Connections shall be rigidly made to the tank bottom, and a standard expansion joint, where needed, shall be provided in each such pipe that is located below, and entirely independent of, the tank.

**14.1.7.4 8.2.3** Pipe inside the tank shall be braced near the top and at points not over 25 ft (7.6 m) apart.

**14.1.7.5 8.2.4 \*** Where an expansion joint exists, it shall be of the standard type, shall be located below the tank, and shall be without connection to the tank plates.

**14.1.7.6 8.3\* At Roofs and Floors.** Where a pipe used for other than fire protection purposes intersects with a building roof or a water-proof or concrete floor, the intersection shall be watertight.

**TITLE OF NEW CONTENT**

Type your content here ...

## Additional Proposed Changes

<u>File Name</u>	<u>Description Approved</u>
NFPA_22_Section_14.1.7.docx	

## Statement of Problem and Substantiation for Public Input

Consolidates requirements for connections for use other than fire protection which were conflicting and removes unenforceable language.

## Submitter Information Verification

**Submitter Full Name:** DAVID HAGUE  
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**Submittal Date:** Fri Jun 19 12:57:40 EDT 2015

### **Committee Statement**

**Resolution:** [FR-49-NFPA 22-2016](#)

**Statement:** Consolidates requirements for connections for use other than fire protection which were conflicting and removes unenforceable language. Renumber section 14.8.2.2 as 14.8.2.1 and 14.8.2.2.1 as 14.8.2.2.

~~14.1.7\* Connections for Use Other Than for Fire Protection. The authority having jurisdiction shall be consulted before the tank is designed where water for other than fire protection purposes is to be drawn from the tank.~~

**14.1.7\*3.8 Connections for Use Other Than for Fire Protection.**

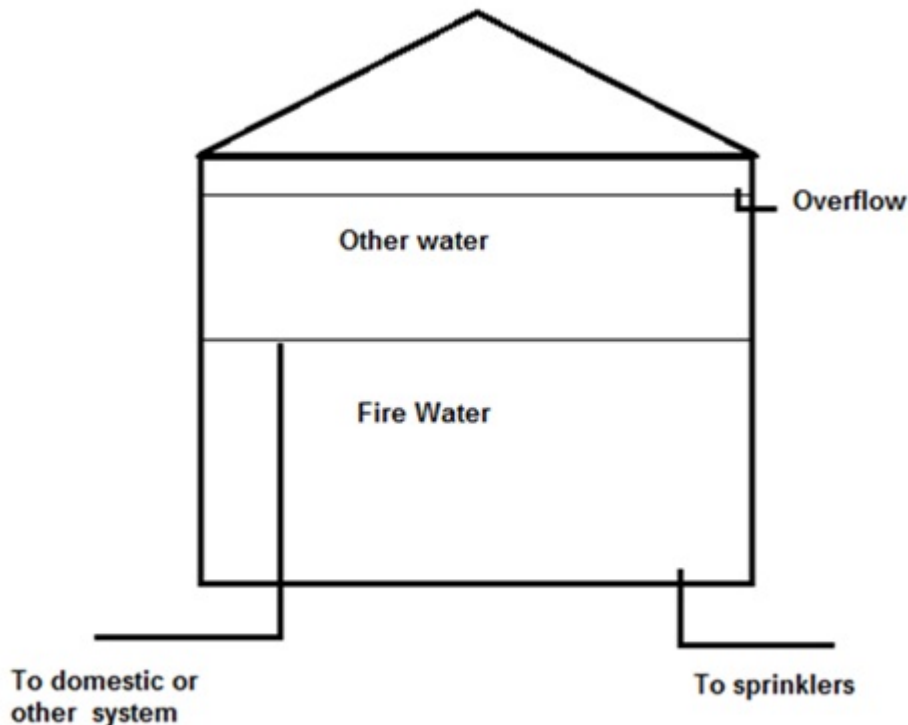
**A.14.1.7 8.4** The use of an elevated tank, in part, for purposes other than fire protection, is not advised. Frequent circulation of the water results in an accumulation of sediment that can obstruct the piping of sprinklers, and a fluctuating water level hastens decaying of wood and corrosion of steel.

**14.1.7 3.8.1** Connections for a use other than fire protection shall not be made.

**14.1.7 3.8.2** Where acceptable to the authority having jurisdiction, ~~unavoidable~~ connections for other than fire protection shall be permitted.

**14.1.7\* 8.2.1** Pipe used for other than fire protection purposes shall be entirely separate from fire-service pipes and shall extend to an elevation inside the tank ~~below~~ above that required ~~which an adequate quantity of water is constantly available~~ for fire protection.

**A.14.1.7.2.1** See Figure A.14.1.7.2.1.



**Figure A.14.1.7.2.1 Dual Purpose Tank**

**14.1.7.3** Connections shall be rigidly made to the tank bottom, and a standard expansion joint, where needed, shall be provided in each such pipe that is located below, and entirely independent of, the tank.

**14.1.7.4 ~~8.2.3~~** Pipe inside the tank shall be braced near the top and at points not over 25 ft (7.6 m) apart.

**14.1.7.5 ~~8.2.4~~\*** Where an expansion joint exists, it shall be of the standard type, shall be located below the tank, and shall be without connection to the tank plates.

**14.1.7.6 ~~8.3~~\*** **At Roofs and Floors.** Where a pipe used for other than fire protection purposes intersects with a building roof or a water-proof or concrete floor, the intersection shall be watertight.

**Substantiation:** Consolidates requirements for connections for use other than fire protection which were conflicting and removes unenforceable language.



## Public Input No. 10-NFPA 22-2015 [ Section No. 14.1.12 ]

[14.1.12](#) Steel Pipe.

[14.1.12.1](#)

Steel pipe shall conform to ASTM A 53, Type E, Type F, Type S, Grade A, or Grade B, manufactured by the open-hearth, electric furnace, or basic oxygen process, or it shall conform to ASTM A 106, Grade A or Grade B.

[14.1.12.2](#)

Paragraphs [14.1.12.2.1](#) through [14.1.12.2.3](#) shall apply to steel pipe that is in contact with storage water.

[14.1.12.2.1](#)

Steel pipe smaller than 2 in. (50 mm) shall not be used.

[14.1.12.2.2](#)

Steel pipe of 2 in. to 5 in. (50 mm to 125 mm) ~~to 5 in. (125 mm)~~ shall be ~~extra-strong weight~~ schedule 80.

[14.1.12.2.3](#)

All steel pipe 6 in. (150 mm) and larger shall be ~~standard weight~~ schedule 40.

### Statement of Problem and Substantiation for Public Input

Editorial

### Submitter Information Verification

**Submitter Full Name:** DAVID HAGUE

**Organization:** LIBERTY MUTUAL INSURANCE

**Street Address:**

**City:**

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**Submission Date:** Fri Jun 19 13:00:59 EDT 2015

### Committee Statement

**Resolution:** [FR-6-NFPA 22-2016](#)

**Statement:** Clarifies that extra strong weight pipe is "Sch 80" and that standard weight pipe is "Sch 40."



## Public Input No. 11-NFPA 22-2015 [ Section No. 14.2.2 ]

### 14.2.2 Size.

#### 14.2.2.1

The conditions at each plant shall determine the size of the discharge pipe that is needed.

#### 14.2.2.2

The size shall not be less than 6 in. (150 mm) for tanks up to and including a 25,000 gal (94.63 m<sup>3</sup>) capacity and shall not be less than 8 in. (200 mm) for capacities of 30,000 gal to 100,000 gal (113.55 m<sup>3</sup> to 378.50 m<sup>3</sup>) inclusive, or 10 in. (250 mm) for greater capacities.

#### 14.2.2.3

Pipe that is smaller than specified in 14.2.2.2 [not less than 6 in. (150 mm)] shall be permitted in some cases where conditions are favorable and large flows of water are not needed.

##### 14.2.2.3.1

Larger pipe shall be required where deemed necessary because of the location and arrangement of piping, height of buildings, or other conditions.

##### 14.2.2.3.2

In all cases, approval of the pipe sizes shall be obtained from the authority having jurisdiction.

### Statement of Problem and Substantiation for Public Input

Editorial, not all water tanks are located at a plant and clarifies that Section 14.2.2.2 is referring to the discharge pipe.

### Submitter Information Verification

**Submitter Full Name:** DAVID HAGUE  
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**Submission Date:** Fri Jun 19 13:05:06 EDT 2015

### Committee Statement

**Resolution:** [FR-7-NFPA 22-2016](#)  
**Statement:** All systems are required to be hydraulically designed back to the source establishing pipe size based on system demand not on tank capacity.



## Public Input No. 12-NFPA 22-2015 [ New Section after 14.2.11 ]

### TITLE OF NEW CONTENT

Type your content here ...

14.2.11.4\* For suction tanks where the discharge pipe is not used as a fill connection, a check valve is not required.

A.14.2.11.4 See Section 14.4.1.1.

### Statement of Problem and Substantiation for Public Input

For suction tanks, the fire pump discharge pipe always has a check valve installed. Another check valve serves no purpose in such an arrangement unless the discharge pipe serves as a fill connection.

### Submitter Information Verification

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**Submittal Date:** Fri Jun 19 13:08:02 EDT 2015

### Committee Statement

**Resolution:** [FR-8-NFPA 22-2016](#)

**Statement:** For suction tanks, the fire pump discharge pipe always has a check valve installed. Another check valve serves no purpose in such an arrangement unless the discharge pipe serves as a fill connection.



## Public Input No. 13-NFPA 22-2015 [ Section No. 14.2.12 ]

### 14.2.12 Controlling Valves.

#### 14.2.12.1

A listed gate valve shall be placed in the discharge pipe ~~on the yard~~ each side of the check valve and on the discharge side of the check valve, shall be located between the check valve and any connection of the tank discharge to other piping.

#### 14.2.12.1.1

The listed gate valve shall be permitted to be equipped with an indicating post.

#### 14.2.12.2

Where yard room for an indicator post is not available, a listed outside screw and yoke (OS&Y) gate valve that is of similar arrangement, but that is located inside the valve pit or room, shall be used.

#### 14.2.12.3

~~A listed indicating control valve shall be placed in the discharge pipe on the tank side of the check valve.~~

#### ~~14.2.12.3.1~~

Where the tank is on an independent tower, the valve shall be placed in the pit with the check valve, preferably on the yard side of the base elbow.

#### ~~14.2.12.3.2~~

Where a tank is used as a suction source for a fire pump, the listed indicating control valve shall be of the OS&Y type.

#### ~~14.2.12.3.3~~

Where the tank is located over a building, the valve shall be placed under the roof near the point where the discharge pipe enters the building.

#### ~~14.2.12.3.4~~

For suction tanks, the valve shall ~~be as close to the tank as possible~~ not be located within 10 pipe diameters of the fire pump suction flange .

## Statement of Problem and Substantiation for Public Input

Consolidates the location requirements for a gate valve in the discharge pipe and removes unenforceable language.

## Submitter Information Verification

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**Submittal Date:** Fri Jun 19 13:09:47 EDT 2015

## Committee Statement

**Resolution:** [FR-9-NFPA 22-2016](#)

**Statement:** Consolidates the location requirements for a control valve in the discharge pipe and removes unenforceable language.





## Public Input No. 14-NFPA 22-2015 [ Section No. 14.3.2 ]

14.3.2 General Design.

14.3.2.1

The expansion joint design shall be selected such that the joint operates reliably over years without attention and shall be of adequate strength to resist the it resists the stresses and corrosion to which it is subjected.

14.3.2.2

One or both of the two parts that slide, one on the other, shall be of brass or other ~~noncorrodible~~ noncorrosive metal of ample strength and resistance to resist wear.

### Statement of Problem and Substantiation for Public Input

clarifies intent and removes unenforceable language.

### Submitter Information Verification

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**Submission Date:** Fri Jun 19 13:16:46 EDT 2015

### Committee Statement

**Resolution:** [FR-10-NFPA 22-2016](#)

**Statement:** Clarifies intent and removes unenforceable language.



## Public Input No. 15-NFPA 22-2015 [ Section No. 14.3.4.2 ]

### 14.3.4.2

Provisions shall be made for a packing space of adequate size .

### Statement of Problem and Substantiation for Public Input

removes unenforceable language

### Submitter Information Verification

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**Submittal Date:** Fri Jun 19 13:20:54 EDT 2015

### Committee Statement

**Resolution:** [FR-11-NFPA 22-2016](#)

**Statement:** Removes unenforceable language.



## Public Input No. 16-NFPA 22-2015 [ Section No. 14.3.5 ]

### 14.3.5 Gland.

The adjustable gland shall be of brass or iron and shall be connected to the body casting, preferably with four standard bolts of at least  $\frac{5}{8}$  in. (15.9 mm) ~~and diameter and of sufficient a~~ length to allow full adjustment.

### Statement of Problem and Substantiation for Public Input

removes unenforceable language

### Submitter Information Verification

**Submitter Full Name:** DAVID HAGUE

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**Submittal Date:** Fri Jun 19 13:21:44 EDT 2015

### Committee Statement

**Resolution:** [FR-12-NFPA 22-2016](#)

**Statement:** Removes unenforceable language.



## Public Input No. 17-NFPA 22-2015 [ Section No. 14.3.7 ]

14.3.7 Packing.

14.3.7.1

The packing shall consist of ~~asbestos wicking~~ of approved wicking material that is saturated with ~~rape rapeseed~~ oil and graphite or ~~an equally suitable~~ other approved material.

14.3.7.2

Packing at least 2 in. (51 mm) deep and ½ in. (12.7 mm) thick shall be provided in the packing space.

### Statement of Problem and Substantiation for Public Input

Removes requirement for the installation of asbestos wicking material and removes unenforceable language.

### Submitter Information Verification

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**Zip:**

**Submittal Date:** Fri Jun 19 13:22:44 EDT 2015

### Committee Statement

**Resolution:** [FR-13-NFPA 22-2016](#)

**Statement:** Removes requirement for the installation of asbestos wicking material and removes unenforceable language.



## Public Input No. 18-NFPA 22-2015 [ Section No. 14.3.8 ]

~~Moved to section 14.3.8– Connections for Use Other Than for Fire Protection. 14.3.8.~~

~~1~~

~~–~~

~~Connections for a use other than fire protection shall not be made.~~

~~14.3.8.2 –~~

~~Where unavoidable connections for other than fire protection shall be permitted, connections shall be rigidly made to the tank bottom, and a standard expansion joint, where needed, shall be provided in each such pipe that is located below, and entirely independent of, the tank.~~

~~.7~~

### Statement of Problem and Substantiation for Public Input

Consolidated with Section 14.1.7. There is no need for multiple sections dealing with connections for use other than fire protection.

### Submitter Information Verification

**Submitter Full Name:** DAVID HAGUE

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**Submission Date:** Fri Jun 19 13:25:15 EDT 2015

### Committee Statement

**Resolution:** [FR-49-NFPA 22-2016](#)

**Statement:** Consolidates requirements for connections for use other than fire protection which were conflicting and removes unenforceable language. Renumber section 14.8.2.2 as 14.8.2.1 and 14.8.2.2.1 as 14.8.2.2.



## Public Input No. 40-NFPA 22-2015 [ Section No. 14.5.1 ]

### 14.5.1 – Application.

Break tanks shall be used for one or more of the following reasons:

- (1) - ~~As a backflow prevention device between the city water supply and the fire pump suction~~
- (2) - ~~To eliminate pressure fluctuations in the city water supply and provide a steady suction pressure to the fire pump~~
- (3) - ~~To augment the city water supply when the volume of water available from the city is inadequate for the fire protection demand~~

### Statement of Problem and Substantiation for Public Input

The purpose for the break tank does not belong in the requirements of NFPA 22. Many people want to use break tanks, but for purposes not mentioned here. For example, a building owner might not have the room for a full-size tank and a break tank might fit better. Another example is a situation where a change of use in the building requires more water, but an existing tank can be turned into a break tank rather than installation of a whole new tank.

Rather than create an exhaustive list, the committee should just move this into the annex for examples of why people use break tanks. See our related Public Input that puts this information in the annex.

### Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
<a href="#">Public Input No. 41-NFPA 22-2015 [New Section after A.14.2.13.2]</a>	

### Submitter Information Verification

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**Submittal Date:** Fri Jul 10 12:38:58 EDT 2015

### Committee Statement

**Resolution:** [FR-44-NFPA 22-2016](#)

**Statement:** The purpose for the break tank does not belong in the requirements of NFPA 22. Many people want to use break tanks, but for purposes not mentioned here. For example, a building owner might not have the room for a full-size tank and a break tank might fit better. Another example is a situation where a change of use in the building requires more water, but an existing tank can be turned into a break tank rather than installation of a whole new tank.

Relocate section 14.5.1 with the attached modifications from the body of the standard to the annex as A.14.5. Renumber remaining sections accordingly.



## Public Input No. 19-NFPA 22-2015 [ Section No. 14.6.1 ]

### 14.6.1 Size.

The overflow pipe shall be of adequate capacity for the operating conditions and shall be of not have a capacity greater than the fill connection but not less than 3 in. (75 mm) throughout.

### Statement of Problem and Substantiation for Public Input

Clarifies intent and removes unenforceable language.

### Submitter Information Verification

**Submitter Full Name:** DAVID HAGUE

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**Submittal Date:** Fri Jun 19 13:27:26 EDT 2015

### Committee Statement

**Resolution:** [FR-16-NFPA 22-2016](#)

**Statement:** Clarifies intent and removes unenforceable language.



## Public Input No. 20-NFPA 22-2015 [ Section No. 14.6.4.2.1 ]

### 14.6.4.2.1

Inside overflow pipes shall be braced ~~by substantial~~ with clamps to tank and tank riser plates at points not over 25 ft (7.6 m) apart.

### Statement of Problem and Substantiation for Public Input

Clarifies intent and removes unenforceable language.

### Submitter Information Verification

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**Submittal Date:** Fri Jun 19 13:29:37 EDT 2015

### Committee Statement

**Resolution:** [FR-17-NFPA 22-2016](#)

**Statement:** Clarifies intent and removes unenforceable language.





## Public Input No. 21-NFPA 22-2015 [ Section No. 14.7.4.1 ]

### 14.7.4.1

A drain pipe of at least 2 in. (50 mm) that is fitted with a controlling valve and a ½ in. (13 mm) drip valve shall be connected into the tank discharge pipe near its base and ~~where possible,~~ on the tank side of all valves.

### Statement of Problem and Substantiation for Public Input

Removes unenforceable language

### Submitter Information Verification

**Submitter Full Name:** DAVID HAGUE

**Organization:** LIBERTY MUTUAL INSURANCE

**Street Address:**

**City:**

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**Submittal Date:** Fri Jun 19 13:30:54 EDT 2015

### Committee Statement

**Resolution:** [FR-18-NFPA 22-2016](#)

**Statement:** Removes unenforceable language.



## Public Input No. 22-NFPA 22-2015 [ Section No. 14.7.4.5 ]

### 14.7.4.5 \*

Where a circulation-tank heater is located near the base of the tank riser, the drain pipe shall, if possible, be connected from the cold-water return pipe between the cold-water valve and the heater in order to permit flushing water from the tank through the hot-water pipe heater and drain for clean-out purposes.

### Statement of Problem and Substantiation for Public Input

removes unenforceable language

### Submitter Information Verification

**Submitter Full Name:** DAVID HAGUE

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**Street Address:**

**City:**

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**Submittal Date:** Fri Jun 19 13:31:47 EDT 2015

### Committee Statement

**Resolution:** [FR-19-NFPA 22-2016](#)

**Statement:** Removes unenforceable language.



## Public Input No. 23-NFPA 22-2015 [ Section No. 14.9.1 ]

### 14.9.1

Provisions shall be made for the installation of sensors in accordance with *NFPA 72* for two critical water temperatures- ~~and~~ two critical water levels and two critical air pressure readings (for pressure tanks only) .

### Statement of Problem and Substantiation for Public Input

Clarifies intent

### Submitter Information Verification

**Submitter Full Name:** DAVID HAGUE

**Organization:** LIBERTY MUTUAL INSURANCE

**Street Address:**

**City:**

**State:**

**Zip:**

**Submittal Date:** Fri Jun 19 13:35:19 EDT 2015

### Committee Statement

**Resolution:** [FR-45-NFPA 22-2016](#)

**Statement:** The modification to 14.9.1 clarifies that critical pressure readings are for pressure tanks only. Relocate annex A.14.9 replacing section 14.9.2 from to the body of the standard with the following modifications, providing requirements where supervision of tanks is provided.